US Department of the Interior
National Park Service

Cooperating Agencies:

New York State, Department of Environmental Conservation

US Army Corps of Engineers, New York District

Fire Island National Seashore

Draft Fire Island Wilderness Breach Management Plan / Environmental Impact Statement

October 2016

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UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
FIRE ISLAND NATIONAL SEASHORE
FIRE ISLAND WILDERNESS BREACH MANAGEMENT PLAN / ENVIRONMENTAL IMPACT STATEMENT

Lead Agency: National Park Service, US Department of the Interior

Cooperating Agencies: US Army Corps of Engineers and New York State Department of Environmental Conservation

This draft Fire Island Wilderness Breach Management Plan / Environmental Impact Statement (draft Breach Plan/EIS) for Fire Island National Seashore (the Seashore) presents three alternatives for the management of the wilderness breach that was created in the Otis Pike Fire Island High Dune Wilderness Area in Fire Island, New York during Hurricane Sandy on October 29, 2012. When finalized, this plan will provide direction to the National Park Service for the management of the wilderness breach. The National Park Service will use the management framework established by the Breach Plan to ensure the continued integrity of the wilderness character; protect the natural and cultural features of the Seashore and its surrounding ecosystems; protect human life; and manage the risk of economic and physical damage to the surrounding areas.

This draft Breach Plan/EIS evaluates three alternatives. Alternative 1 (Closure Using Mechanical Processes) would mechanically close the breach as soon as possible. Alternative 2 (Status Determined Entirely by Natural Processes) is the no-action alternative; this alternative would allow the management of the breach under natural processes, to include evolution and potential growth and/or natural closure. Alternative 3 (No Human Intervention unless Established Criteria are Exceeded), the proposed action, is identified as the Seashore's preferred alternative. Under alternative 3, the evolution, growth, and/or closure of the breach would be determined by natural barrier island processes, and human intervention to close the breach would occur only "to prevent loss of life, flooding, and other severe economic and physical damage to the Great South Bay and surrounding areas," as allowed by the *Otis Pike Fire Island High Dune Wilderness Act*. If the breach were to close by natural processes, no human intervention would be taken to reopen it. The breach would be closed mechanically if evaluation of annual monitoring data indicate that changes in the conditions of the breach could elevate the risk of severe storm damage. The draft Breach Plan/EIS analyzes the potential consequences of these three alternatives on the following resources: wilderness character, sediment transport and geomorphology, water quality, ecosystem structure and processes, benthic communities, finfish and decapod crustaceans, public health and safety, flood conditions, and socioeconomics.

The draft Breach Plan/EIS is available for public and agency review and comment for 45 days beginning with the publication of the US Environmental Protection Agency Notice of Availability in the Federal Register; comments must be received within 45 days following the publication of the US Environmental Protection Agency Notice of Availability in the Federal Register. You are encouraged to review this document carefully and provide the Seashore with your comments. Your engagement in this process is critical to the management of the wilderness breach and the protection of the Seashore resources.

A public meeting will be held at the Patchogue-Watch Hill Ferry Terminal in Patchogue, New York. To find out more about the public meeting schedule, and to submit comments electronically, visit the NPS Planning, Environment and Public Comment website at http://parkplanning.nps.gov/FireIslandBreachManagementPlan. You can also submit comments via mail or hand delivery to the address below or by fax to the number listed below. The date and time of the public meeting will also be listed on the Seashore's website (https://www.nps.gov/fiis/index.htm).

Please submit comments online to http://parkplanning.nps.gov/FireIslandBreachManagementPlan or via mail to:

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National Park Service
US Department of the Interior

Fire Island National Seashore
New York

FIRE ISLAND NATIONAL SEASHORE

FIRE ISLAND WILDERNESS BREACH MANAGEMENT PLAN / ENVIRONMENTAL IMPACT STATEMENT

October 2016

EXECUTIVE SUMMARY

PURPOSE OF AND NEED FOR ACTION

The National Park Service is preparing this draft *Fire Island Wilderness Breach Management Plan and Environmental Impact Statement* (draft Breach Plan/EIS) for Fire Island National Seashore (Seashore). On October 29, 2012, Hurricane Sandy created three breaches in the barrier island system off the south shore of Long Island, New York, including one within the Otis Pike Fire Island High Dune Wilderness Area (Fire Island Wilderness). Two other breaches, one in the area of Smith Point and the other near Moriches Inlet, also formed during Hurricane Sandy. The purpose of taking action at this time is to determine how to manage the breach that formed within the Fire Island Wilderness. The draft Breach Plan/EIS has several goals: ensuring the continued integrity of the wilderness character; protecting the natural and cultural features of the Seashore and its surrounding ecosystems; protecting human life; and managing the risk of economic and physical damage to the surrounding areas.

The existing Breach Contingency Plan is the only guidance currently in effect to address breaches along coastal Long Island from Fire Island Inlet east to Montauk Point. Action is needed at this time because the Breach Contingency Plan is outdated and does not adequately address management of breaches in the Fire Island Wilderness. Managing a breach in designated wilderness is different from managing breaches outside wilderness areas, as the National Park Service must manage federal wilderness to preserve wilderness character. Management of the Fire Island Wilderness must comply with the *Wilderness Act of 1964* (Public Law 88-577); the *Otis Pike Fire Island High Dune Wilderness Act* (Public Law 96-585), the legislation that established the Fire Island Wilderness; and the *Wilderness Management Plan, Fire Island National Seashore*, which governs National Park Service (NPS) actions taken in the Fire Island Wilderness.

Although the wilderness breach must be managed to protect wilderness character, a special provision in the *Otis Pike Fire Island High Dune Wilderness Act* states that "wilderness designation shall not preclude the repair of breaches that occur in the wilderness area, in order to prevent loss of life, flooding, and other severe economic and physical damage to the Great South Bay and surrounding areas."

This draft Breach Plan/EIS has been prepared in accordance with the requirements of the *National Environmental Policy Act of 1969* (NEPA) and its implementing regulations (40 CFR 1500–1508); the Department of the Interior NEPA regulations (43 CFR Part 46); NPS Director's Order 12, *Conservation Planning, Environmental Impact Analysis, and Decision-Making*, and the *National Park Service NEPA Handbook*.

HISTORY OF REGIONAL BREACH MANAGEMENT PLANNING

The barrier island system along the south shore of Long Island has developed over thousands of years in response to changes in sea level and the complex and dynamic interaction of waves, tides, storms, and sediment. Breaching and overwash are natural processes that transport sediment, which increases the elevation of the barrier system and provides for barrier island migration and the development of estuarine salt marsh and mud flats. Over the past century, human development of the barrier system has altered these natural processes and provided an additional driver of change.

The *Rivers and Harbors Act of 1960* authorized the US Army Corps of Engineers, New York District, to develop the Fire Island Inlet to Montauk Point, New York Project, to protect against beach erosion and hurricane effects. After a long history of funding issues, reformulation study efforts resumed in 1994 and are ongoing to evaluate and develop long-term solutions to reduce storm damage risk along the south shore of Long Island. The US Army Corps of Engineers distributed the Draft Re-evaluation Report and the Draft Environmental Impact Statement for the proposed Fire Island Inlet to Montauk Point Reformulation Study in July 2016. The enabling legislation for the Seashore (Public Law 88-587) requires that any US Army Corps of Engineers (USACE) erosion control or beach protection projects within the Seashore boundaries are consistent with that legislation and mutually acceptable to the Secretary of the Interior and the Secretary of the Army.

In response to breaching at West Hampton in 1992, a Breach Contingency Plan was developed by the US Army Corps of Engineers in coordination with National Park Service and New York State. The Breach Contingency Plan was developed as an interim project of the Fire Island Inlet to Montauk Point Reformulation Study to provide rapid response to close barrier island breaches along approximately 57 miles of beach from Fire Island to Southampton, including beaches within the Seashore. Prompt closure was recommended as a cost effective measure to reduce changes in storm damage risk as well as the hydrology, biology, and geomorphology of the barrier-estuarine system that could be caused by an open breach. The Breach Contingency Plan specifically excludes breaches in the Fire Island Wilderness from the automatic closure that is applied to all other breaches. The Breach Contingency Plan provides for monitoring of breaches in the Fire Island Wilderness and determination by qualified scientists whether a breach is tending toward natural closure or whether action is needed to close a breach.

In response to storm damage caused by Hurricane Sandy, the Fire Island Inlet to Moriches Inlet stabilization project was formulated by US Army Corps of Engineers to provide a one-time, stand-alone project to expedite recovery of the protective dunes and beach berms along the state, county, town, and community beaches and federal lighthouse tract of Fire Island.

NATIONAL PARK SERVICE WILDERNESS MANAGEMENT

The Fire Island Wilderness is the only federally designated wilderness area in New York State. Federal wilderness areas are wild, undeveloped federal lands that have been designated and protected by Congress. The Fire Island Wilderness is managed such that “the earth and its community of life are untrammeled by man,” and “to preserve its natural conditions,” as directed by the *Wilderness Act of 1964*. The preservation of wilderness character and values includes providing “outstanding opportunities for solitude or a primitive and unconfined type of recreation,” with “the imprint of man’s work substantially unnoticeable” (*Wilderness Act of 1964*). The *Otis Pike Fire Island High Dune Wilderness Act* directs the National Park Service to manage this area to preserve the wilderness character and to refrain from interfering with natural processes that would typically occur within a barrier island. However, this legislation also states that a wilderness breach may be closed if the action is taken “to prevent loss of life, flooding, and other severe economic and physical damage to the Great South Bay and surrounding areas.”

This directive is reinforced both by NPS *Management Policies 2006* (section 4.8.1.1, Shorelines and Barrier Islands), which states that “natural shoreline processes (such as erosion, deposition, dune formation, overwash, inlet formation, and shoreline migration) will be allowed to continue without interference” and by the overarching *Wilderness Act*, which calls for federal wilderness to be both wild (untrammeled or un-manipulated) and natural, thus allowing natural phenomena or processes to proceed unimpeded. Neither NPS *Management Policies 2006* nor the *Otis Pike Fire Island High Dune Wilderness Act* precludes closing a breach in the Fire Island Wilderness if there is a need to do so; however, the *Wilderness Management Plan* stipulates that an environmental impact statement must be prepared and public review and comment on alternatives must be conducted before such a decision would be made. Although the *Wilderness Management Plan* pre-dates the Breach Contingency Plan, the Breach Contingency Plan does not amend, supersede, or otherwise integrate with the *Wilderness Management Plan*. Thus, the National Park Service would adhere to the direction in the *Wilderness Management Plan* when making a decision about closing a breach in the Fire Island Wilderness.

The National Park Service has prepared the *Wilderness Stewardship Plan and Backcountry Camping Policy, Otis Pike Fire Island High Dune Wilderness*, which is an appendix to the *Fire Island National Seashore General Management Plan Environmental Impact Statement*. At the time of this draft Breach Plan/EIS, the *General Management Plan* and the *Wilderness Stewardship Plan* are in the process of being approved. The new *Wilderness Stewardship Plan* is more detailed and when approved and adopted, will supersede the 1983 *Wilderness Management Plan*.

COOPERATING AGENCIES

The National Park Service is the lead agency on the wilderness Breach Plan/EIS. The US Army Corps of Engineers, New York District, accepted cooperating agency status in a letter dated November 10, 2015. A cooperating agency relationship was established between the National Park Service, Northeast Region, and the State of New York, Department of Environmental Conservation in September 2015.

ISSUES AND RESOURCE TOPICS RETAINED FOR DETAILED ANALYSIS

Through the scoping process, the Seashore identified several issues related to the proposed action that were retained for detailed analysis:

- The wilderness breach is geologically bound by erosion-resistant clay to the east and west of the breach, limiting its migration along the coast. However, there is uncertainty regarding how the breach will evolve in the future (narrow or widen from existing conditions), how far it might migrate along the coast, and how it affects sediment transport. The changes in the cross-sectional area, size, position, and orientation of the breach could affect coastal processes, namely sediment transport and geomorphology.

- There is concern that the presence of the wilderness breach increases the potential for flooding on the mainland of Long Island during storm events, increasing the potential risk to life and property. The potential for the presence of the breach to increase flooding on the mainland would affect public health and safety, flood conditions, and socioeconomics.

- The wilderness breach has altered the physical characteristics of the Fire Island Wilderness and Great South Bay, which has led to changes in the ecological communities. The shift of the estuarine environment to one that is more marine has an effect on water quality in the vicinity of the breach, which in turn, influences the aquatic ecosystem, including benthic communities, decapod crustaceans, and finfish.

- The wilderness breach resulted in the creation of a marine wilderness area that did not previously exist. The mechanical closure of the breach would alter the existing wilderness character qualities of the area.

- Driving access has changed since formation of the wilderness breach. There is concern that changes in driving access for emergency response could increase risks to public health and safety in several Fire Island communities (Cherry Grove, Fire Island Pines, Talisman, Spatangaville, Water Island, Davis Park, and Watch Hill). Changes to access and circulation from the presence of the breach have the potential to affect public health and safety, flood conditions, and socioeconomics.

ALTERNATIVES CONSIDERED

This plan/EIS considers three alternatives for managing the wilderness breach.

Alternative 1: Closure Using Mechanical Processes

Under alternative 1, the wilderness breach would be mechanically filled and closed as soon as possible.

Construction Overview. Although the details of the closure process may change according to the exact shape, size, and location of the breach at the time of closure, this section describes the major actions that would occur during construction activities.

Sand to fill the wilderness breach would be dredged from the Westhampton Borrow Area, transported from the borrow area to the breach area using a dredge, and systematically placed into the breach using bulldozers and other large earth moving construction vehicles to create the island cross-section. Details on dredging activities can be found in the Fire Island Inlet to Moriches Inlet environmental assessment.

Structural support would be required during placement of the sand to stabilize the fill material as the breach is filled. Sheet piling or sand filled geotextile tubes would be placed on either the bay side or ocean side of the breach to diminish tidal flow and sand would be filled in behind it. If required, a hydraulic sheet pile driver deployed by a crane would be used to vibrate steel sheet piling sections into the breach to form a continuous wall. The sheet pile wall would span the entirety of the breach and tie into the sand on either side of the breach. This method would essentially stop water flow through the breach and prevent the exchange of water between the Great South Bay and the Atlantic Ocean during the sand placement process. The structural supports (sheet piling or geotextile tubes) would be removed after the breach is filled. The sand would be placed to a maximum elevation of +9.5 feet NGVD29 or +8.5 feet NAVD88 with side slopes contoured to match adjacent bay and ocean shorelines. This design will allow for the beneficial effects of overwash to continue, but protect the immediate area from another breach forming in conditions up to the regional 25-year storm event. It should be noted that these elevations may need to be reevaluated due to sea level rise. Because this Breach Plan/EIS is a long-term management strategy, sea level rise may alter the conditions at the breach. If closure becomes necessary, the maximum elevation and profile of the breach closure and construction procedures should be based on the best available data at the time of closure to make certain that the maximum elevation achieves the stated goals of allowing overwash while protecting the area from breach formation.

Breach closure construction activities are expected to be less than three months in duration. A crane and other heavy earth moving vehicles (e.g., bulldozers, front-end loaders) would be needed for the construction effort. Access to the breach for the construction equipment would be from the east via the William Floyd Parkway, to the Fire Island Wilderness Visitor Center, and then along the beach to the project site. Staging for the project would be at the Smith Point County Park parking lot. The Seashore would work with the contractor to identify proper fueling locations during the detailed planning phase. Large crane or construction mats composed of timbers or composite material may be deployed on the beach, if needed, to facilitate mobilization of the necessary equipment from the staging area and project site and to protect the beach habitat. Upon completion of the breach closure, the equipment would leave the project site, the mats would be recovered and transported to the Smith Point County Park staging area for demobilization from the project.

It is important to note that due to the variability in the morphology of this breach, detailed design for the mechanical closure of the breach has not yet occurred; therefore, there may be adjustments to the construction activities. However, the limits of disturbance area for the project is not expected to change during the detailed design.

Alternative 2: Status Determined Entirely by Natural Processes (No-Action Alternative)

Alternative 2 is the no-action alternative. Under alternative 2, the evolution, growth, and/or closure of the breach would be determined by natural barrier island processes and no human intervention would occur to close the breach or to reopen the breach if it were to close by natural processes.

Alternative 3: No Human Intervention Unless Established Criteria are Exceeded (Proposed Action and NPS Preferred Alternative)

Under alternative 3, the evolution, growth, and/or closure of the breach would be determined by natural barrier island processes, and human intervention to close the breach would occur only "to prevent loss of life, flooding, and other severe economic and physical damage to the Great South Bay and surrounding areas."

The National Park Service would establish criteria that indicate the breach poses a threat to life and/or property (see Breach Monitoring below). As long as monitoring data show that the established criteria have not been exceeded, the National Park Service would allow the breach to be shaped entirely by natural processes with no human intervention. The breach may remain open or it may close naturally.

If monitoring data indicate that the open breach could elevate the risk of severe storm damage, the Seashore would expand the monitoring program and work with other agencies and scientists to evaluate available information to determine the effects of a growing breach and appropriate next steps, including further study or possible closure. If a decision were made to close the breach, the closure would be done as described under alternative 1.

Breach Monitoring. Monitoring has been ongoing since 2012 to evaluate how the open breach has changed the geomorphology, hydrology, and ecology of the barrier island and estuarine systems. Monitoring data and the professional judgment of physical scientists studying the breach have been used to determine that the two criteria described below are the most logical indicators to alert Seashore staff to changes in the breach that could elevate the risk of severe storm damage, which could lead to a decision to close the breach.

- **Criterion 1: Geologic Controls.** As previously described, erosion-resistant clay to the east and west of the breach serve as geologic controls for the breach. The monitoring that has been done to date provides a foundation for understanding the evolution of the breach within that zone. There are no known erosion-resistant materials to control breach migration beyond those identified to the east and west of the breach. If the breach migrates beyond these geologic controls, growth of the breach would be less predictable.

- **Criterion 2: Cross-Sectional Area.** The cross-sectional area of the breach has also been monitored periodically since it opened. Initially the cross-sectional area increased rapidly; however, the breach has reached a dynamic equilibrium in which the cross-sectional area has fluctuated between 300 and 600 square meters. A cross-sectional area range within or below this range represents a condition in which the response of the breach is understood. An increase in cross-sectional area above this range would indicate breach growth and a condition in which the evolution of the breach is less predictable.

Annual Breach Condition Evaluation. Alternative 3 requires long-term monitoring to evaluate if the changes in breach conditions alter potential flooding risks. Monitoring methods to determine the cross-sectional area of the breach include bathymetric surveys, monitoring tide gage data, and monitoring the breach shoreline. The location of the breach and the cross-sectional area would be monitored at least once a year and the monitoring data would be used to prepare an annual breach monitoring report.

These monitoring efforts would document the locations of the eastern and western shores of the breach, as well as the width and the depth of the breach. Additionally, selected tide gages would be monitored weekly to identify changes in the tidal prism, which could indicate a change in the breach conditions. Changes identified in tidal data could be caused by other factors, such as storm-generated winds, and thus would not, by themselves, document a change in the cross-sectional area. They would serve as an indicator that something in the system was changing, alerting the National Park Service to a potential change in the conditions of the breach.

The criteria described above would be refined with an improved understanding of the duration of change, rate of change, and the size of the breach. An increase in cross-sectional area or migration of the breach beyond the erosion-resistant clay would indicate the need to expand the monitoring program and consider additional information about the conditions of Great South Bay and surrounding areas. The Seashore, working with other agencies and scientists, as appropriate, would evaluate available information to determine the effects of a growing breach and appropriate next steps, including further study or possible closure. In addition to this monitoring data, Seashore staff, agencies, and physical scientists would also incorporate results from flooding models that are being used to evaluate changes to storm damage risks associated with open and closed breach scenarios. Under alternative 3, if the breach must be mechanically closed, the construction activities would be the same as those described for alternative 1.

ENVIRONMENTAL CONSEQUENCES

The summary of environmental consequences considers the actions being proposed and the cumulative impacts on resources from occurrences inside and outside the park. The potential environmental consequences of implementing any of the alternatives are addressed for wilderness character, sediment transport and geomorphology, water quality, ecosystem structure and processes, benthic communities, finfish and decapod crustaceans, public health and safety, flood conditions, and socioeconomics.

Impacts from Alternative 1, Closure Using Mechanical Processes

Under alternative 1, the wilderness breach would be mechanically closed. Mechanical closure would have adverse impacts on wilderness character during construction and in perpetuity. The construction noise and presence of construction equipment would degrade visitors' *opportunities for solitude and primitive and unconfined recreation* and the *other features of value*. The sand used to fill the breach would be considered a man-made creation; therefore, the *untrammeled, natural, and undeveloped* qualities of wilderness would be diminished. Although the closure area would regain a more natural appearance over time, the presence of the man-made fill area would result in a permanent and significant adverse impact to the *untrammeled*, *natural*, and *undeveloped* wilderness qualities, as the marine/submerged wilderness environment that had been created through natural processes would be changed to an artificially created barrier island setting.

For physical and natural resources, processes and conditions would return to pre-breach conditions. Sediment transport would continue to be dominated by longshore westward transport, but it would no longer be influenced by the breach. Water quality in Great South Bay would be degraded through increased residence time, decreased circulation, decreased water clarity, and increased intensities of brown tides east of the wilderness breach. Closure of the breach would have temporary and permanent impacts on biological resources. Construction activities could adversely affect organisms through burial and increased turbidity during sand placement. Once the breach is closed, shifts in submerged aquatic vegetation, benthic communities, decapod crustaceans, and finfish could occur due to changes in water quality, specifically water temperature, salinity, and clarity. Overall, closure of the breach could result in a loss of ecosystem maturity in the vicinity of the breach in Great South Bay, resulting in decreased biomass, decreased species diversity, lower connectivity to the ocean, decreased water quality, decreased eelgrass, and lower potential for marsh habitat expansion.

Closing the breach under alternative 1 would create a lower-energy environment. Peak water levels and shoreline flooding would return to conditions similar to those existing prior to the breach. Once the breach closed, growth of the extensive flood delta established by the wilderness breach would likely cease and would be redistributed due to reduced water velocities. Additionally, storm surge and wind-induced flooding and subsequent peak water levels would return to conditions similar to those existing prior to breach opening. The resulting economic impact of breach closure would be a potential reduction in flood damage costs of $23,083,000 per year. However, although the model-projected costs associated with the flooding from increased water levels appear fairly large, the portion of flooding attributed to differences between the breach open and breach closed conditions are within natural water level fluctuations previously observed in the study area. The flood risks associated with predicted changes in flood extent, under all storm return frequency scenarios, are consistent with the extent of the 2015 **Federal Emergency Management Agency** 100-year Flood Hazard Zone, despite the presence of the breach.

During closure, visitors would be excluded from the construction area and the construction activities would be conducted in compliance with a health and safety plan specific to closure of this wilderness breach. Following construction, the resulting connectivity of the east and west sides of the breach would have a slight benefit on public health and safety due to restored connectivity, but would not have a significant beneficial impact on patient care or response times.

Impacts from Alternative 2, Status Determined Entirely by Natural Processes (No-Action Alternative)

The Seashore would manage the wilderness breach under natural processes under alternative 2. The breach could close naturally under this alternative. In this scenario, the conditions would eventually be the same as those for a mechanically closed breach; however, the natural processes would close the breach gradually. The resulting effects would not be considered adverse, as they would be the result of natural barrier island processes. As an open breach, the dynamic conditions are expected to be similar to what has been observed since the breach formed, and the effects on the resources are expected to remain consistent with those under current conditions.

Under this alternative, wilderness qualities would remain unchanged from current conditions. If the breach were to close naturally under these alternatives, there would be no changes to the *untrammeled, natural, undeveloped,* and *other features of value* qualities of wilderness. There would be a slight change in the *opportunities for solitude and primitive and unconfined recreation* quality, as the connectivity would decrease solitude in the area west of the breach and increase solitude for visitors east of the breach.

The breach has changed sediment transport and geomorphology in the vicinity near the breach, although it is not acting as a sediment sink and is therefore not interrupting longshore processes on the ocean side. On the bay side of the breach, the width of the breach and shallow nature of the flood tidal delta are primary factors that dampen energy and therefore have reduced possible erosion that could occur in Great South Bay. The connectivity between the bay and the ocean is creating environmental conditions consistent with a more mature, ecologically and functionally diverse ecosystem, resulting in a long-term significant beneficial effect. There has been an increase in total fish abundance and species diversity and ecosystem processes by increased connectivity with the ocean, improved water quality, reduced intensity of brown tides in areas east of the breach, increased salinity, and moderated water temperatures. There has been a shift in species since the breach formed. Improvements in water quality and more moderate summer water temperatures have favored the establishment of eelgrass, a high quality habitat type for fish and invertebrates, east of the wilderness breach. The formation of the breach has created the potential for marsh habitat expansion on the flood tide deltas, which in turn could provide new habitat for marine and terrestrial species.

Based on model predictions of peak water levels resulting from storm surge events and subsequent shoreline flooding, there is a slight possibility for increased shoreline impacts under alternative 2. Breach migration is not likely to result in additional impacts to hydrology or flood conditions; however, breach expansion could result in even greater water exchange and potentially increase the flood risk zone (extent) along the surrounding shorelines. Under alternative 2, the expanded flood risk zone and the increased risk of flooding in the study area from the breach remaining open are predicted to double economic costs, but the predicted changes represent a significant overestimate of the total economic costs based on the assumptions and modeling limitations.

The wilderness breach has had an effect on how law enforcement responds to Davis Park and Water Island by altering the route emergency response units use to access the eastern communities. This process would continue under alternative 2; however, since patients suffering severe, life-threatening emergencies would be transported via helicopter or vessel, there would not be a significant impact on emergency response time.

Impacts from Alternative 3, No Human Intervention Unless Established Criteria are Exceeded (Proposed Action and NPS Preferred Alternative)

Under alternative 3, the Seashore would manage the breach under natural conditions unless criteria protective of human life and property are exceeded. While the breach remains open, the impacts on resources would be the same as described for alternative 2. Wilderness character would not be impacted, and the natural processes for physical and biological resources would remain unchanged. Sediment transport and geomorphology patterns would continue with some influence from the wilderness breach. The conditions of Great South Bay would continue to be influenced by the exchange of the bay and ocean water, which seems to be contributing to the recovery of system maturity, a benefit for the ecosystem. If the breach were to close naturally, the impacts would also be the same as described for alternative 2. This would eventually lead to pre-breach conditions, but would be expected to happen slowly as part of natural coastal processes.

If the open breach is determined to exceed established criteria, the breach would be closed using mechanical processes. The impacts of this closure would be the same as those described for alternative 1. The adverse impacts from construction would be temporary and localized to the area of sand placement. Permanent adverse impacts would occur from placement of an anthropomorphic creation in the Fire Island Wilderness and elimination of ocean mixing directly with bay water.

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Acronyms and Abbreviations

Breach Plan/EIS	Fire Island Wilderness Breach Management Plan/Environmental Impact Statement
Fire Island Wilderness	Otis Pike Fire Island High Dune Wilderness Area
NEPA	*National Environmental Policy Act*
NPS	National Park Service
Seashore	Fire Island National Seashore
USACE	US Army Corp of Engineers
USFWS	US Fish and Wildlife Service

Purpose and Need

1

Wilderness Breach - November 20, 2012

CHAPTER 1: PURPOSE OF AND NEED FOR ACTION

PURPOSE AND NEED

The National Park Service is preparing this draft *Fire Island Wilderness Breach Management Plan and Environmental Impact Statement* (draft Breach Plan/EIS) for Fire Island National Seashore (Seashore). On October 29, 2012, Hurricane Sandy created three breaches in the barrier island system off the south shore of Long Island, New York, including one within the Otis Pike Fire Island High Dune Wilderness Area (Fire Island Wilderness). Two other breaches, one in the area of Smith Point and the other near Moriches Inlet, also formed during Hurricane Sandy. The purpose of taking action at this time is to determine how to manage the breach that formed within the Fire Island Wilderness. Figure 1 presents the locations of the Seashore, the Fire Island Wilderness, and the wilderness breach. Appendix A presents detailed figures with locations of Fire Island and the surrounding area that are discussed in this draft Breach Plan/EIS. The draft Breach Plan/EIS has several goals: ensuring the continued integrity of the wilderness character; protecting the natural and cultural features of the Seashore and its surrounding ecosystems; protecting human life; and managing the risk of economic and physical damage to the surrounding areas.

The existing Breach Contingency Plan (USACE 1996) is the only guidance currently in effect to address breaches along coastal Long Island from Fire Island Inlet east to Montauk Point. Action is needed at this time because the Breach Contingency Plan is outdated and does not adequately address management of breaches in the Fire Island Wilderness. Managing a breach in designated wilderness is different from managing breaches outside wilderness areas, as the National Park Service must manage federal wilderness to preserve wilderness character. Management of the Fire Island Wilderness must comply with the *Wilderness Act of 1964* (Public Law 88-577); the *Otis Pike Fire Island High Dune Wilderness Act* (Public Law 96-585), the legislation that established the Fire Island Wilderness; and the *Wilderness Management Plan, Fire Island National Seashore* (NPS 1983), which governs the National Park Service (NPS) actions taken in the Fire Island Wilderness.

Although the wilderness breach must be managed to protect wilderness character, a special provision in the *Otis Pike Fire Island High Dune Wilderness Act* states that "wilderness designation shall not preclude the repair of breaches that occur in the wilderness area, in order to prevent loss of life, flooding, and other severe economic and physical damage to the Great South Bay and surrounding areas."

This draft Breach Plan/EIS has been prepared in accordance with the requirements of the *National Environmental Policy Act of 1969* (NEPA) and its implementing regulations (40 CFR 1500–1508); the Department of the Interior NEPA regulations (43 CFR Part 46); NPS Director's Order 12, *Conservation Planning, Environmental Impact Analysis, and Decision-Making* (NPS 2011), and the *National Park Service NEPA Handbook* (NPS 2015a).

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Inset photograph copyright C. Flagg

Figure 1
Location Map

HISTORY OF REGIONAL BREACH MANAGEMENT PLANNING

The barrier island system along the south shore of Long Island has developed over thousands of years in response to changes in sea level and the complex and dynamic interaction of waves, tides, storms, and sediment (Leatherman and Allen 1985; Williams and Meisburger 1987; Williams, Dodd, and Gohn 1995). Breaching and overwash are natural processes that transport sediment, which increases the elevation of the barrier system and provides for barrier island migration and the development of estuarine salt marsh and mud flats. Over the past century, human development of the barrier system has altered these natural processes and provided an additional driver of change (Williams and Foley 2007).

The *Rivers and Harbors Act of 1960* authorized the US Army Corps of Engineers, New York District, to develop the Fire Island Inlet to Montauk Point, New York Project, to protect against beach erosion and hurricane effects. After a long history of funding issues, reformulation study efforts resumed in 1994 and are ongoing to evaluate and develop long-term solutions to reduce storm damage risk along the south shore of Long Island. The US Army Corps of Engineers distributed the Draft Re-evaluation Report and the Draft Environmental Impact Statement for the proposed Fire Island Inlet to Montauk Point Reformulation Study in July 2016. The enabling legislation for the Seashore (Public Law 88-587) requires that any US Army Corps of Engineers (USACE) erosion control or beach protection projects within the Seashore boundaries are consistent with that legislation and mutually acceptable to the Secretary of the Interior and the Secretary of the Army (USACE 2014a).

In response to breaching at West Hampton in 1992, a Breach Contingency Plan was developed by the US Army Corps of Engineers in coordination with the National Park Service and New York State (USACE 1996; USACE 2015; USACE n.d.). The Breach Contingency Plan was developed as an interim project of the Fire Island Inlet to Montauk Point Reformulation Study to provide rapid response to close barrier island breaches along approximately 57 miles of beach from Fire Island to Southampton, including beaches within the Seashore. Prompt closure was recommended as a cost effective measure to reduce changes in storm damage risk as well as the hydrology, biology, and geomorphology of the barrier-estuarine system that could be caused by an open breach. The Breach Contingency Plan specifically excludes breaches in the Fire Island Wilderness from the automatic closure that is applied to all other breaches. The Breach Contingency Plan provides for monitoring of breaches in the Fire Island Wilderness and determination by qualified scientists whether a breach is tending towards natural closure or whether action is needed to close a breach.

In response to storm damage caused by Hurricane Sandy, the Fire Island Inlet to Moriches Inlet stabilization project was formulated by the US Army Corps of Engineers to provide a one-time, stand-alone project to expedite recovery of the protective dunes and beach berms along the state, county, town, and community beaches and federal lighthouse tract of Fire Island.

NATIONAL PARK SERVICE WILDERNESS MANAGEMENT

The Fire Island Wilderness is the only federally designated wilderness area in New York State. Federal wilderness areas are wild, undeveloped federal lands that have been designated and protected by Congress. The Fire Island Wilderness is managed such that “the earth and its community of life are untrammeled by man,” and “to preserve its natural conditions,” as directed by the *Wilderness Act of 1964*. The preservation of wilderness character and values includes providing "outstanding opportunities for solitude or a primitive and unconfined type of recreation," with "the imprint of man's work substantially unnoticeable" (*Wilderness Act of 1964*). The *Otis Pike Fire Island High Dune Wilderness Act* directs the National Park Service to manage this area to preserve the wilderness character and to refrain from interfering with natural processes that would typically occur within a barrier island. However, this legislation also states that a wilderness breach may be closed if the action is taken "to prevent loss of life, flooding, and other severe economic and physical damage to the Great South Bay and surrounding areas."

This directive is reinforced both by NPS *Management Policies 2006* (section 4.8.1.1, Shorelines and Barrier Islands), which states that "natural shoreline processes (such as erosion, deposition, dune formation, overwash, inlet formation, and shoreline migration) will be allowed to continue without interference" and by the overarching *Wilderness Act*, which calls for federal wilderness to be both wild (untrammeled or un-manipulated) and natural, thus allowing natural phenomena or processes to proceed unimpeded. Neither NPS *Management Policies 2006* nor the *Otis Pike Fire Island High Dune Wilderness Act* precludes closing a breach in the Fire Island Wilderness if there is a need to do so; however, the *Wilderness Management Plan* (NPS 1983) stipulates that an environmental impact statement must be prepared and public review and comment on alternatives must be conducted before such a decision would be made. Although the *Wilderness Management Plan* pre-dates the Breach Contingency Plan (USACE 1996), the Breach Contingency Plan does not amend, supersede, or otherwise integrate with the *Wilderness Management Plan*. Thus, the National Park Service would adhere to the direction in the *Wilderness Management Plan* when making a decision about closing a breach in the Fire Island Wilderness.

The National Park Service has prepared the *Wilderness Stewardship Plan and Backcountry Camping Policy, Otis Pike Fire Island High Dune Wilderness*, which is an appendix to the *Fire Island National Seashore General Management Plan Environmental Impact Statement* (NPS 2016b). At the time of this draft Breach Plan/EIS, the *General Management Plan* and the *Wilderness Stewardship Plan* are in the process of being approved. The new *Wilderness Stewardship Plan* is more detailed and when approved and adopted, will supersede the 1983 *Wilderness Management Plan*.

SCOPING AND DEVELOPMENT OF THE ISSUES

Scoping

The National Park Service conducted scoping to confirm the purpose of and need for the project, identify potential management alternatives, and identify the issues relevant to analysis of those alternatives. The National Park Service conducted scoping with federal, state, and local agencies with jurisdiction by law or special expertise, non-governmental entities, other interested and affected parties, and the general public. In addition, two agencies, US Army Corps of Engineers New York District and New York State Department of Environmental Conservation, have entered into an agreement to be cooperating agencies to provide technical expertise for the development of this draft Breach Plan/EIS.

Through scoping, the National Park Service and cooperating agencies developed a list of issues associated with management of the breach. These issues are "problems, concerns, conflicts, obstacles, or benefits that would result if the proposed action or alternatives, including the no-action alternative, are implemented" (NPS 2015a, section 4.2). Issues identified during scoping and retained for detailed analysis are presented in the "Issues and Resource Topics Retained for Detailed Analysis" section.

Technical Synthesis Report

As a result of the wilderness breach, and in accordance with the Breach Contingency Plan, the National Park Service, US Geological Survey, and other agencies and research institutions initiated numerous studies to better understand the dynamics of the breach and the effects of the breach on various elements of the Great South Bay ecosystem. The wilderness breach has offered researchers a rare opportunity to study the dynamics of the breach following its formation and the effects of the open breach on the bay ecosystem. Because the wilderness breach had existed for less than three years at the initiation of this draft Breach Plan/EIS, much of the research relating to the breach was or is still underway. In order to access the most current scientific information and to reach consensus among researchers on resource issues, the National Park Service elected to prepare a technical synthesis report to compile and document the best available data and describe the current state of the science for the physical and natural resource issues, as identified by the National Park Service. The information in the technical synthesis report provided the scientific foundation for this draft Breach Plan/EIS.

To collect the information needed for the technical synthesis report, NPS researchers and consultants developed a process designed to collaborate with subject matter experts and document ongoing research. Subject matter experts consisted of university professors, graduate student scientists, and postdoctoral researchers; federal and state agency researchers and staff; and non-governmental organizations. Appendix B presents the subject matter experts that helped the National Park Service during the technical synthesis report process, whether through consultation and coordination or by providing data and comments. The process consisted of initial data requests, review of available information provided by subject matter experts and obtained from the literature, and a workshop to process and discuss the information obtained.

In January 2016, the National Park Service hosted the workshop, bringing together the subject matter experts and providing an opportunity for the subject matter experts to discuss the current science in the context of the issues that would potentially drive the draft Breach Plan/EIS decision. Results from discussions were used in the development of the draft technical synthesis report. The technical synthesis report is available as a companion to this Breach Plan/EIS and will be published as part of the NPS Natural Resource Technical Report series.

ISSUES AND RESOURCE TOPICS RETAINED FOR DETAILED ANALYSIS

Through the scoping process, the Seashore identified several issues related to the proposed action that were retained for detailed analysis:

- **Issue.** The wilderness breach is geologically bound by erosion-resistant clay to the east and west of the breach, limiting its migration along the coast. However, there is uncertainty regarding how the breach will evolve in the future (narrow or widen from existing conditions), how far it might migrate along the coast, and how it affects sediment transport. It should be noted that as a barrier island, Fire Island is dynamic and susceptible to natural processes, including erosion. Although the clay layers that are present east and west of the breach are resistant to erosion, all materials on the barrier island are vulnerable to erosion; the clay is simply more resistant than most other materials. In this document, these geologic controls will be referred to as *erosion-resistant clay* with the understanding that these controls could be overcome by forces exerted upon them, including wave and wind action and storm surges.

> **Rationale.** The National Park Service has been monitoring the wilderness breach since its formation in October 2012 through tidal data and measurements of the cross-sectional area of the wilderness breach. From this data, it has been determined that there are seasonal oscillations (narrowing and widening) in both average breach width and average ebb and flow discharge. There is a correlation between breach cross-sectional area and the tidal range. Although the tidal range data is informative, it may not be sensitive enough to show trends or to identify when established criteria protective of health and property are exceeded; the cross-sectional area of the breach is the best indicator of this. The oscillating breach has not reached the erosion-resistant clay. While it is difficult to tell a definitive trend after so little time has passed, the breach oscillations seem to be staying within a definable range. It is possible that the breach could grow to a size outside of the current oscillations and migrate westward. The changes in the cross-sectional area, size, position, and orientation of the breach could affect coastal processes, namely sediment transport and geomorphology.

- **Issue.** There is concern that the presence of the wilderness breach increases the potential for flooding on the mainland of Long Island during storm events, increasing the potential risk to life and property.

> **Rationale.** Flooding from storm events can be the result of multiple factors, including the size of the wilderness breach, the presence/size of ebb and flood shoal deltas, tidal activity, storm surge, and wave and wind action. Modeling is helpful in determining the amount of flooding that could be anticipated; however, the models are limited. USACE modeling compares potential flooding from a random variety of storm events from 2-year to 100-year storms for two scenarios – with the breach and without the breach. The current models are not able to analyze the conditions of the breach with different cross-sectional areas. Additionally, the models do not account for the presence of the flood and ebb shoal deltas. Real-time monitoring of water levels in the Great South Bay during storm events contradicts model results. Although the predicted flooding impacts by the models have not been observed, there remains an unknown potential for the breach to increase flooding on the mainland that may affect public health and safety, flood conditions, and socioeconomics.

- **Issue.** The wilderness breach has altered the physical characteristics of the Fire Island Wilderness and Great South Bay, which has led to changes in the ecological communities.

> **Rationale.** The formation of the wilderness breach opened a conduit where marine and estuarine waters are able to mix, flushing daily with tidal action. In addition to the creation of the breach, deposition of sand during Hurricane Sandy changed the elevations in wetlands and the bay itself. Since the breach, coastal processes have created ebb and flood shoal deltas. These changes are altering the physical qualities

of Great South Bay in the general vicinity of the breach, as well as surrounding bays, tributaries, and wetlands and creating habitats that did not exist in the area prior to the breach. Incoming marine water brings with it cooler, more saline waters, and the new open channel, subject to tidal activity, has altered circulation patterns in central and eastern Great South Bay. The exchange and mixing of bay waters with clearer and lower nutrient ocean waters have reduced nutrient levels and improved water clarity. The shift of the estuarine environment to one that is more marine has an effect on water quality in the vicinity of the breach, which in turn, influences the aquatic ecosystem, including benthic communities, decapod crustaceans, and finfish.

- **Issue.** The wilderness breach resulted in the creation of a marine wilderness area that did not previously exist. The mechanical closure of the breach would alter the existing wilderness qualities of the area.

  Rationale. The wilderness breach was formed through natural barrier island processes, and the breach created a marine or submerged wilderness area in the eastern portion of the Fire Island Wilderness. Aspects of the wilderness experience and wilderness qualities were changed with the formation of the breach. This may be a temporary condition as the breach may close under natural conditions. Artificially placing fill sand in the wilderness breach to close it would be considered development and would adversely impact wilderness qualities in perpetuity. The closed breach would impact wilderness experience, as the increased connectivity between the areas east and west of the breach would alter how visitors disperse in the Fire Island Wilderness, including driving on the beach adjacent to wilderness. The changes from terrestrial to submerged wilderness and the potential for development in the Fire Island Wilderness affect wilderness character.

- **Issue.** Driving access has changed since formation of the wilderness breach. There is concern that changes in driving access for emergency response could increase risks to public health and safety in several Fire Island communities (Cherry Grove, Fire Island Pines, Talisman, Spatangaville, Water Island, Davis Park, and Watch Hill).

  Rationale. Prior to the wilderness breach, western Fire Island community residents with driving permits accessed the western communities via Robert Moses Causeway, and eastern Fire Island community residents with driving permits accessed the eastern communities via Smith Point Bridge. Since the breach formed, all Fire Island communities and federal tracts west of the breach can be accessed by boat, ferry, or vehicle from the west by using the Robert Moses Causeway. The eastern communities of Fire Island are located west of the breach and can no longer be accessed using the Smith Point Bridge. This increases the travel time by vehicle from Long Island to the eastern communities. Access to most areas of Fire Island for emergency response has not been changed due to the presence of the wilderness breach. This is because transporting individuals off Fire Island during severe emergencies, such as life-threatening situations, is most effectively and quickly carried out by boat or helicopter transport. However, the breach has had an effect on how law enforcement patrols and responds to minor emergencies in the eastern communities. Prior to the breach, law enforcement access by vehicle to Davis Park and Water Island was from the east at Smith Point County Park and the Wilderness Visitor Center. Since the breach, law enforcement gains access through the western end of Fire Island instead of the east. These changes to access and circulation from the presence of the breach have raised concerns about potential effects on public health and safety.

ISSUES DISMISSED FROM DETAILED ANALYSIS

The following issues were initially considered but were ultimately dismissed from detailed analysis in this draft Breach Plan/EIS. These issues are described below with the reason(s) that further analysis was not warranted.

Borrow Area Resources

The proposal to close the breach mechanically would require a source of sand, and a borrow area would typically have been included in the analysis as a connected action. However, the borrow area that would be used for the wilderness breach closure was previously analyzed by the US Army Corps of Engineers, who prepared an environmental assessment for the Fire Island Inlet to Moriches Inlet stabilization project that would reinforce the existing dune and berm system along Fire Island in response to Hurricane Sandy. The *Fire Island Inlet to Moriches Inlet Stabilization Project Environmental Assessment* documented the impacts associated with implementing the project including impacts to offshore marine habitats that are designated as sand mining areas (borrows) for the stabilization project. These borrow areas evaluated in the 2014 *Fire Island Inlet to Moriches Inlet Stabilization Project Environmental Assessment* would be the same borrow areas that would be used for sand mining to fill the wilderness breach. The US Army Corps of Engineers consulted and coordinated with the National Park Service on this Fire Island Inlet to Moriches Inlet stabilization project. Overall, the *Fire Island Inlet to Moriches Inlet Stabilization Project Environmental Assessment* concluded that impacts to geology/sediments and water quality of the offshore borrow area from dredging activities associated with sand mining would be expected to be adverse, minor to moderate, and short term. The *Fire Island Inlet to Moriches Inlet Stabilization Project Environmental Assessment* also found that impacts to marine invertebrates, shellfish, and fish were adverse but short term; marine mammals are not likely to be affected; and offshore bird species including special-status bird species would not be impacted by the presence of a dredge (USACE 2014a).

An essential fish habitat assessment was prepared, which identified potential impacts to fishery resources and habitat that would result from activities proposed for the Fire Island Inlet to Moriches Inlet stabilization project (USACE 2014b). The essential fish habitat assessment concluded that the overall potential adverse impacts to essential fish habitat-designated species and essential fish habitat in the project area would be minimal. A programmatic agreement was prepared to address potential submerged archaeological resources, primarily shipwrecks, in the borrow area. Section 7 compliance for the Fire Island Inlet to Moriches Inlet stabilization project is being considered as Emergency Exempt, per section 7 of the *Endangered Species Act of 1973*, as amended and implementing regulations for this emergency response (USACE 2014a and NOAA-NMFS 2014).

The National Park Service has been coordinating with the US Army Corps of Engineers on breach issues since the Breach Contingency Plan was prepared in 1995. The National Park Service prepared a Finding of No Significant Impact in 1996 on the Breach Contingency Plan that included a rationale for why the National Park Service supported the proposed action. The National Park Service is currently coordinating with the US Army Corps of Engineers on the Fire Island Inlet to Montauk

Point Reformulation Study to identify storm damage risk reduction and to evaluate alternative methods of providing authorized beach erosion control and hurricane protection.

The issue of dredging activities having an adverse impact on marine offshore resources within the borrow area has been dismissed from further analysis due to the following reasons:

- The National Park Service has been and is actively involved in the USACE projects within Fire Island.
- The borrow area resource impacts have been previously analyzed in a connecting project (*Fire Island Inlet to Moriches Inlet Stabilization Project Environmental Assessment*) resulting in
  - no impacts to short-term, minor to moderate, and adverse impacts to physical resources,
  - minimal impact to natural resources,
  - no adverse effects to essential fish habitat-designated species or essential fish habitat, and
  - special-status species were considered emergency exempt.
- Mitigation measures for physical and natural resources, time of year restrictions, and mitigation for special-status species will be included in the borrow area monitoring plan for this draft Breach Plan/EIS.

Upland Flora and Fauna

The location of the wilderness breach is an example of a relatively undisturbed stretch of barrier island ecosystem characterized by relatively large primary dunes, interdunal swales of grasses and shrubs, freshwater wetlands, tidal marshes, small stretches of scrub forest, and beaches. The formation of the wilderness breach resulted in a conversion of upland habitat to marine and tidal habitat, which represents a loss to some species and a gain for others. The wilderness breach represents a loss of habitat to terrestrial wildlife and plants. Because the breach is part of the natural barrier island process and unique upland habitat was not affected, this loss is not considered an adverse impact. For example, the state-endangered plant annual seepweed (*Suaeda linearis*) was previously documented in the upland area affected by the breach and is not currently present in the area surrounding the breach. Deer that inhabit Fire Island may be able to swim across the breach, and the breach would not significantly affect amphibians or reptiles. Further, waterfowl and shorebirds can move to other areas, as the upland habitat at the breach is not unique. Mechanical closure of the breach would result in a gain of land; however, the gain would not create significant beneficial impacts for upland wildlife and plant species. The changes in habitat types could result from management of the breach; however, these upland habitats are not uncommon on Fire Island and represent a small area when considered against the available habitat at the Seashore. For these reasons, upland flora and fauna have been dismissed from detailed analysis in this draft Breach Plan/EIS.

Special-Status Species

Endangered Species Act

US Fish and Wildlife Service. The wilderness breach formed in an area of the Seashore that is known to support three federally listed species: the federally threatened piping plover (*Charadrius melodus*), the federally threatened red knot (*Calidris canutus rufa*), and the federally threatened seabeach amaranth (*Amaranthus pumilus*). Piping plovers used the area of the breach for foraging, nesting, and rearing chicks both before and after the breach (Ries et al. 2010; Ries, Moore, and Sloop 2011; Ries, Popham, and Sorlien 2012; Ries and Donovan 2013; Ries, Peretz, and Tendick-Matesanz 2014). Red knots do not nest at the Seashore, but they do use the Seashore as a stopover site (De-Rose Wilson et al. 2014; Monk et al. 2015) during their long migration between wintering grounds, which range from the southern United States to Argentina, and breeding grounds in the central Canadian Arctic (USFWS 2014a). Seabeach amaranth grows throughout the Seashore. This low-growing upper-beach annual plant was present within and in close proximity to the area of the breach in 2010, 2011, and 2012, but the plant has been absent from the area since Hurricane Sandy caused the breach in October 2012 (Ries et al. 2010; Ries, Moore, and Sloop 2011; Ries, Popham, and Sorlien 2012; Ries and Donovan 2013; Ries, Peretz, and Tendick-Matesanz 2014). If the breach were to be closed mechanically, construction activities would be restricted during piping plover nesting season (April 1 to September 1), eliminating direct impacts to all three species during that time; however, indirect impacts could occur from closure. For plovers and red knots, the following adverse impacts would occur: the shoreline along the breach from the ocean to the bay would no longer be available to foraging birds; degradation of the ebb and flood shoal deltas created by the breach (considered high-quality foraging habitat); and increased predation from fox being able to move freely along the beach, whereas their movement is currently hindered by the presence of the breach. Conversely, beneficial impacts on these birds include increased foraging area on the bay side due to a reduction in erosion and an increase in plover nesting habitat. Breach closure would provide beneficial impacts on seabeach amaranth in the form of increased available habitat.

The National Park Service is continuing informal consultation with the US Fish and Wildlife Service in accordance with the *Endangered Species Act of 1973*, as amended (87 Stat. 884, as amended; 16 USC 1531 et seq.). Further details of this ongoing informal consultation are presented in chapter 5. The National Park Service has prepared a preliminary draft biological assessment for piping plover, red knot, and seabeach amaranth that fully addresses the impacts that could occur to these species and their habitats if closure was required under the preferred alternative. This preliminary draft biological assessment was prepared to expedite the formal consultation process in the event that a decision to close the wilderness breach is made in the future. It is important to note that due to the variability in the morphology of this natural inlet, detailed design for the mechanical closure of the breach cannot occur at this time. If closure becomes necessary, the preliminary draft biological assessment would be updated with construction details that pertain to the size and location of the breach at that time. The National Park Service will continue to consult with the US Fish and Wildlife Service on an annual basis to obtain the most current information on the piping plover, red knot, and seabeach amaranth and to determine if any new species would require analysis in the biological assessment. At minimum, annual informal consultation meetings would ensure the status of threatened and endangered species are considered in conjunction with data on the evolution of the wilderness breach. Due to this consultation process, these three federally protected species have been dismissed from detailed analysis in this draft Breach Plan/EIS.

National Oceanic and Atmospheric Administration-National Marine Fisheries Service. The activities involved with breach closure have the potential to affect several federally listed marine mammal, reptile, and fish species, as presented in table 1.

TABLE 1. FEDERALLY LISTED MARINE SPECIES THAT MAY BE AFFECTED BY THE PROJECT

Common Name	Scientific Name	Federal Status	New York State Status
Fish			
Atlantic Sturgeon (New York Bight Distinct Population Segment)	*Acipenser oxyrinchus oxyrinchus*	Endangered	Not Listed
Reptiles			
Loggerhead Sea Turtle (Northwest Atlantic Ocean Distinct Population Segment)	*Caretta caretta*	Threatened	Threatened
Kemp's Ridley Sea Turtle	*Lepidochelys kempii*	Endangered	Endangered
Green Sea Turtle	*Chelonia mydas*	Threatened	Threatened
Leatherback Sea Turtle	*Dermochelys coriacea*	Endangered	Endangered
Mammals			
Right Whale	*Eubalaena glacialis*	Endangered	Endangered
Humpback Whale	*Megaptera novaeangliae*	Endangered	Endangered
Finback Whale	*Balaenoptera physalus*	Endangered	Endangered

In consultation with the National Oceanic and Atmospheric Administration-National Marine Fisheries Service, it was determined that due to the dynamic nature of the breach, it was not possible to determine the effects to listed species because there is no way to reasonably predict the extent of the construction or the amount of fill needed. Therefore, the National Park Service determined that consultation could not be completed at this time and would be completed if and when the National Park Service needed to act to close the breach. The National Oceanic and Atmospheric Administration-National Marine Fisheries Service concurred with this determination.

Essential Fish Habitat

Essential fish habitat describes the habitat necessary for fish spawning, breeding, feeding, and growth to maturity. Using tools on the National Oceanic and Atmospheric Administration-National Marine Fisheries Service website, the National Park Service identified essential fish habitat that was present in Great South Bay; based on environmental conditions available in the immediate vicinity of the wilderness breach, the National Park Service identified 13 species of fish and shellfish that could be present.

The National Park Service is consulted with the National Oceanic and Atmospheric Administration-National Marine Fisheries Service in accordance with the 1996 amendments to the Magnuson-Stevens Fishery Conservation and Management Act. Further details of this consultation are presented in chapter 5. The National Park Service prepared an essential fish habitat assessment, which is a review of the potential impacts of a project to essential fish habitat, as required by and set forth in the document *Essential Fish Habitat: New Marine Fish Habitat Conservation Mandate for Federal Agencies* by the National Oceanic and Atmospheric Administration-National Marine Fisheries Service Habitat Conservation Division (revised April 2000). Table 2 presents the species that could be present in the immediate vicinity of the breach, the life stages of the species that could be present, and the potential impacts on the species. The assessment concluded that some essential fish habitat-designated species in the wilderness breach study area would be affected from mechanical closure of the wilderness breach, either through loss of eelgrass habitat or through exceedances of preferred temperature or salinity. Although the eelgrass beds in the immediate vicinity of the breach would likely be lost after breach closure, other submerged aquatic vegetation species that occur in Great South Bay would continue to be available. The majority of essential fish habitat species are mobile and will be able to relocate to areas of preferred salinity or temperature or to areas where submerged aquatic vegetation is present. For these reasons, essential fish habitat-designated species have been dismissed from detailed analysis in the draft Breach Plan/EIS. The essential fish habitat assessment therefore satisfies requirements of the Magnuson-Stevens Fishery Conservation and Management Act and agency consultation between the National Park Service and the National Oceanic and Atmospheric Administration-National Marine Fisheries Service.

TABLE 2. SUMMARY OF POTENTIAL IMPACTS FOR ESSENTIAL FISH HABITAT-DESIGNATED SPECIES AND LIFE HISTORY STAGES

Species	Life Stage	Potential Impacts
Bony Fish Species		
Black Sea Bass (*Centropristis striata*)	L, J, A	Sea bass associate with structures and rough bottoms. Juveniles use eelgrass habitat and would have reduced habitat availability.
Cobia (*Rachycentron canadum)*	E, L, J, A	Would have reduced eelgrass habitat but is pelagic and would likely swim elsewhere if habitat changes.
King Mackerel (*Scomberomorus cavalla*)	E, L, J, A	Epipelagic, would likely swim elsewhere if habitat changes.
Pollock (*Pollachius virens*)	J	Wide range of temperature tolerance. Juveniles use vegetation and would have reduced habitat availability.
Scup (*Stenotomus chrysops*)	J, A	Can thrive in a variety of habitats. Juveniles use eelgrass habitat and would have reduced habitat availability.
Silver Hake (*Merluccius bilinearis*)	J	Affected by increased temperature and salinity, would likely relocate due to habitat change.
Spanish Mackerel (*Scomberomorini*)	E, L, J, A	Epipelagic, would likely swim elsewhere if habitat changes
Summer Flounder (*Paralichthys dentatus*)	J	Wide range of salinity tolerance. Juveniles use eelgrass habitat and would have reduced habitat availability.
Windowpane Flounder (*Scophthalmus aquosus*)	A	As temperature and sediment changes, this species would likely relocate.
Invertebrate Species		
Longfin Inshore Squid (*Loligo pealeii*)	E	Lay eggs in eelgrass habitat and would have reduced habitat availability; would lay eggs elsewhere in response to habitat change.
Surf Clam (*Spisula solidissima*)	J, A	Wide range of temperature and salinity tolerance so unlikely to be affected.
Cartilaginous Species		
Dusky Shark (*Carcharhinus obscurus*)	EJ, LJ	As salinity decreases in the project area, this species would likely spawn elsewhere.
Sandbar Shark (*Carcharhinus plumbeus*)	A	Highly mobile, would migrate to more suitable habitat.

Species	Life Stage	Potential Impacts

Key: E = eggs, L = larvae, J = juveniles, A = adults, EJ = early juveniles, LJ = late juveniles

Wetlands and Floodplains

Section 404 of the *Clean Water Act* regulates activities in wetlands. Executive Order 11990: *Protection of Wetlands*, directs all federal agencies to avoid, to the extent possible, the long- and short-term adverse impacts associated with the destruction or modification of wetlands, and to avoid direct or indirect support of new construction in wetlands wherever there is a practicable alternative. NPS Procedural Manual 77-1: *Wetland Protection* states that for new actions where impacts on wetlands cannot be avoided, proposals must include plans for compensatory mitigation that restores wetlands on NPS lands, where possible, at a minimum acreage ratio of 1:1 (NPS 2016c). Consistent with Executive Order 11990 and Director's Order 77-1, the National Park Service has adopted a goal of "no net loss of wetlands" (NPS 2002).

Executive Order 11988: *Floodplain Management* directs all federal agencies to avoid both long- and short-term adverse impacts associated with occupancy, modification, and development in the 1% annual chance floodplain, when possible. This is the flood risk zone regulated through federal, state, and local land use laws. The National Park Service manages floodplains to preserve floodplain values, minimize potential hazards of flooding, and comply with law (NPS 2006), as directed in Director's Order 77-2: *Floodplain Management* (NPS 2003).

The wilderness breach is located within a floodplain, and wetlands are located within the project site; therefore, the National Park Service must consider the impacts from the alternatives. While the wilderness breach is managed under natural conditions, there would be no adverse impacts on wetlands or floodplains. Changes that result from the barrier island processes would not be considered adverse. If the wilderness breach were to be closed, the floodplain would still function as a floodplain. A discussion of the potential for flooding impacts is presented in the Public Health and Safety sections of chapters 3 and 4. Immediate closure of the wilderness breach would result in the destruction of some wetlands, enhancement of other wetlands, and creation of new wetlands. The impacts that would be expected from future closure would be expected to be similar to those expected under immediate closure of the breach. If it were determined that the breach would require closure (alternative 3), the Seashore would prepare wetlands and floodplains statements of findings at that time. Park staff consulted with the NPS Natural Resource Stewardship and Science Directorate Water Resources Division to reach this decision. Because of the dynamic nature of the breach, the National Park Service cannot determine the future conditions of a breach that would need to be closed, including location and cross-sectional area. The barrier island processes would also have an effect on wetlands over time; therefore, the amount of wetlands that would be impacted is also unknown at this time. For these reasons, wetlands and floodplains have been dismissed from detailed analysis in the draft Breach Plan/EIS. If closure were to be initiated, statements of findings would be prepared after the detailed design has been completed and prior to breach closure, to evaluate the potential for wetland impacts and flood hazards associated with this project in accordance with Director's Orders 77-1 and 77-2 and the accompanying Procedural Manuals. The statements of findings would document the potential impacts on these resources from construction activities and a closed breach scenario. Mitigation measures would also be included in the statements of findings.

Cultural Resources

The National Park Service categorizes cultural resources as archeological resources, cultural landscapes, structures, museum objects, and ethnographic resources. The range of alternatives considered in this draft Breach Plan/EIS includes options to mechanically close the breach, which would have the potential to disturb both terrestrial and submerged archeological resources. Based on the results of previous surveys conducted in the general vicinity of the breach and given the limited nature of potential impacts on cultural resources by mechanical breach closure, the potential impacts to intact cultural resources are expected to be low. However, surveys would be conducted prior to closure of the breach, if it were determined to be needed. Identification of these historic resources and assessment of project effects is required by the provisions contained within the *National Historic Preservation Act of 1966*. The National Park Service is currently consulting with the New York State Historic Preservation Office, the Advisory Council on Historic Preservation, and other consulting parties to prepare a programmatic agreement to allow for a phased identification and evaluation of these resources (36 CFR 800.4(b)(2)).

The programmatic agreement includes stipulations for conducting surveys and identifying and assessing the effects of mechanical breach closure prior to subsequent project-specific actions. The stipulations also serve to outline future project reviews and identify avoidance, minimization, and mitigation measures for potential adverse effects to these resources. Therefore, cultural resources have been dismissed from detailed analysis in this draft Breach Plan/EIS.

Recreational Activities, Visitation, and Opportunities

Visitors to the Seashore engage in a wide range of activities including but not limited to beach combing, boating, swimming, hiking, nature walks, bird watching, touring historic sites, and photography (NPS 2016a). Bicycling is allowed wherever vehicles are permitted and camping is permitted at Watch Hill with a reservation and by permit in the Fire Island Wilderness (NPS 2016a). Hunting and fishing require state permits and are allowed within the Seashore during specific times of the year and recreational driving is allowed by permit at the eastern point of access to the Seashore to facilitate hunting, fishing, and other recreational activities, also during specific times of the year (NPS 2016a).

The wilderness breach has changed recreation for some visitors and has created new opportunities for recreation and education. The breach has had an impact on recreational fishermen since there has been a loss of recreational facilities, such as the Old Inlet boardwalk and dock. Despite these losses, there has been an increase in visitation and use at the Old Inlet area since the wilderness breach was formed. The wilderness breach has also provided the Seashore additional opportunities to educate the public about barrier island processes. While there have been changes to recreational activities, visitation, and opportunities from the wilderness breach, the changes are localized and are not a significant factor in the decision on how to manage the wilderness breach; therefore, this issue has been dismissed from detailed analysis in the draft Breach Plan/EIS.

Minority and Low-income Populations and Communities

The Department of the Interior requires its bureaus to specifically discuss and evaluate the impacts of their actions on minority and low-income populations and communities, as well as the equity of the distribution of the benefits and risk of the decision. NPS environmental assessments and environmental impact statements must include either an analysis of impacts to minority and low-income populations and communities or if the issue is dismissed from detailed analysis, the environmental assessment or environmental impact statement must specifically indicate this. (Refer to *Environmental Compliance Memorandum [ECM] 95-3: NEPA Responsibilities Under the Departmental Environmental Justice Policy*.) This resource topic was eliminated from further evaluation because none of the alternatives presented in this document would result in disproportionately high adverse environmental effects on minority or low-income communities. There would be no air or water pollution effects that would affect human health. There would be no change in land use in the surrounding area that could affect minority or low-income communities.

Indian Trust Resources

The Department of the Interior requires its bureaus to explicitly consider effects of its actions on Indian Trust resources in environmental documents. NPS environmental assessments and environmental impact statements must include either an analysis of impacts to Indian sacred sites or a specific dismissal of the issue from detailed analysis (*ECM 97-2: Departmental Responsibilities for Indian Trust Resources and Indian Sacred Sites on Federal Lands, Part 1*). Furthermore, Executive Order 13007 provides that, to the extent practicable, permitted by applicable law, and not clearly inconsistent with essential agency functions, agencies are required to accommodate access to and ceremonial use of Indian sacred sites by Indian religious practitioners and avoid adversely affecting the physical integrity of sites (NPS 2015a). The federal Indian Trust responsibility is a legally enforceable obligation on the part of the United States to protect tribal lands, assets, resources, and treaty rights, and it represents a duty to carry out the directives of federal laws with respect to Native American tribes. There are no known Indian Trust resources located in the project area, and the lands composing the national seashore are not held in trust by the Secretary of the Interior for the benefit of American Indians due to their status as American Indians. Therefore, the issue of Indian Trust resources was dismissed from further analysis.

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Alternatives

2

Wilderness Breach - April 18, 2013

CHAPTER 2: ALTERNATIVES

This chapter describes alternatives for management of the wilderness breach in the Otis Pike Fire Island High Dune Wilderness (Fire Island Wilderness). The alternatives were developed by soliciting input from Fire Island National Seashore (Seashore) staff, other government agencies, and the public on key issues, including protection of life and property, and conditions desired for the Fire Island Wilderness.

- Alternative 1 is mechanical closure of the wilderness breach as soon as possible.
- Alternative 2 (no action) allows natural processes only to determine the status of the wilderness breach with no human intervention.
- Alternative 3 (proposed action and National Park Service (NPS) preferred alternative) allows the status of the wilderness breach to be determined by natural processes with no human intervention unless and until the condition of the breach exceeds established criteria, triggering mechanical closure of the breach.

These alternatives present a range of reasonable and feasible approaches that meet the purpose and need for action.

This chapter also addresses alternatives that were initially considered but dismissed from detailed analysis; identifies the NPS preferred alternative; lists mitigation measures for the alternatives; and lists permits and plans that must be obtained before the preferred alternative can be implemented.

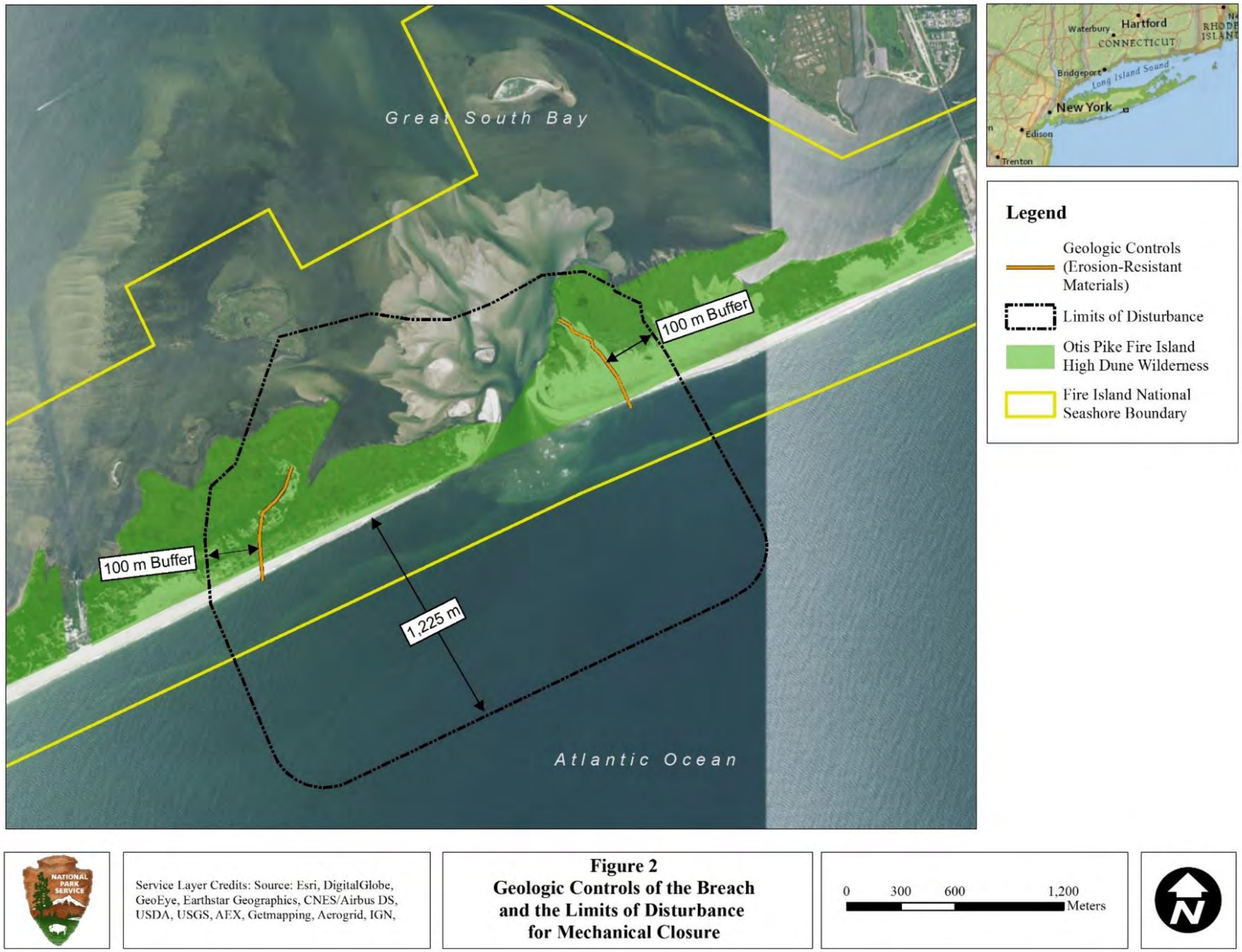
DESCRIPTION OF THE ALTERNATIVES

Alternative 1: Closure Using Mechanical Processes

Under alternative 1, the wilderness breach would be mechanically filled and closed as soon as possible.

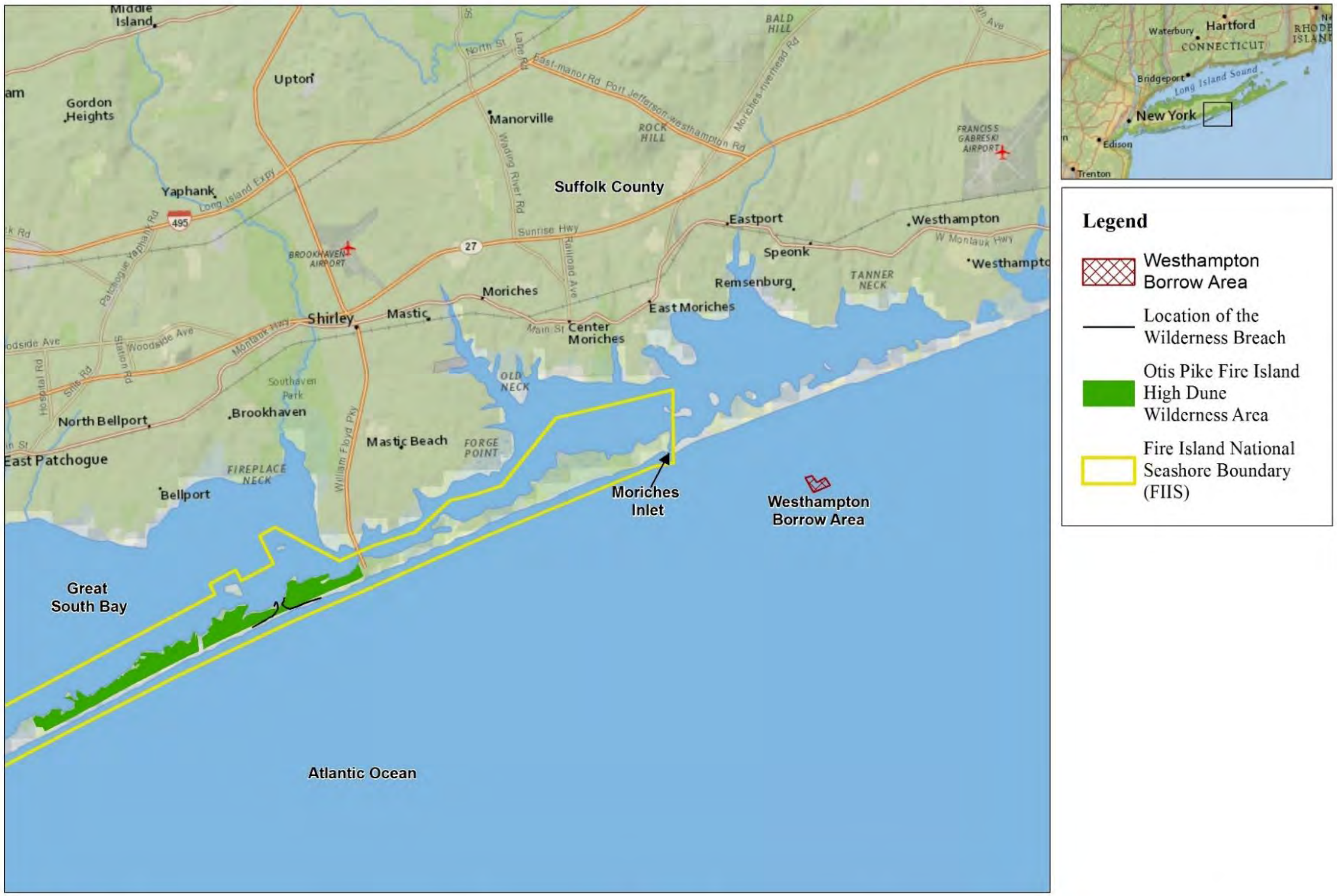
Construction Overview. Figure 2 shows the limits of disturbance for the mechanical closure of the wilderness breach. The limits of disturbance area is defined as the area where all construction activity could occur, which could result in impacts on Seashore resources. Although the details of the closure process may change according to the exact shape, size, and location of the breach at the time of closure, this section describes the major actions that would occur during construction activities.

Sand to fill the wilderness breach would be dredged from the Westhampton Borrow Area (figure 3), transported from the borrow area to the breach area using a dredge, and systematically placed into the breach using bulldozers and other large earth moving construction vehicles to create the island cross-section. Details on dredging activities can be found in the Fire Island Inlet to Moriches Inlet environmental assessment (USACE 2014a).



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN,

Figure 2
Geologic Controls of the Breach and the Limits of Disturbance for Mechanical Closure



Service Layer Credits: Content may not reflect National Geographic's current map policy. Sources: National Geographic, Esri, DeLorme,

Figure 3
Location of Westhampton Borrow Area

0 1.5 3 6 Kilometers

Structural support would be required during placement of the sand to stabilize the fill material as the breach is filled. Sheet piling or sand filled geotextile tubes would be placed on either the bay side or ocean side of the breach to diminish tidal flow and sand would be filled in behind it. If required, a hydraulic sheet pile driver deployed by a crane would be used to vibrate steel sheet piling sections into the breach to form a continuous wall. The sheet pile wall would span the entirety of the breach and tie into the sand on either side of the breach. This method would essentially stop water flow through the breach and prevent the exchange of water between the Great South Bay and the Atlantic Ocean during the sand placement process. The structural supports (sheet piling or geotextile tubes) would be removed after the breach is filled. The sand would be placed to a maximum elevation of +9.5 feet NGVD29[1] or +8.5 feet NAVD88[2] with side slopes contoured to match adjacent bay and ocean shorelines. This design will allow for the beneficial effects of overwash to continue, but protect the immediate area from another breach forming in conditions up to the regional 25-year storm event. It should be noted that these elevations may need to be reevaluated due to sea level rise. Because this *Fire Island Wilderness Breach Management Plan / Environmental Impact Statement* (Breach Plan/EIS) is a long-term management strategy, sea level rise may alter the conditions at the breach. If closure becomes necessary, the maximum elevation and profile of the breach closure and construction procedures should be based on the best available data at the time of closure to make certain that the maximum elevation achieves the stated goals of allowing overwash while protecting the area from breach formation.

Breach closure construction activities are expected to be less than three months in duration. A crane and other heavy earth moving vehicles (e.g., bulldozers, front-end loaders) would be needed for the construction effort. Access to the breach for the construction equipment would be from the east via the William Floyd Parkway, to the Fire Island Wilderness Visitor Center, and then along the beach to the project site (figure 4). Staging for the project would be at the Smith Point County Park parking lot. The Seashore would work with the contractor to identify proper fueling locations during the detailed planning phase. Large crane or construction mats composed of timbers or composite material may be deployed on the beach, if needed, to facilitate mobilization of the necessary equipment from the staging area and project site and to protect the beach habitat. Upon completion of the breach closure, the equipment would leave the project site, the mats would be recovered and transported to the Smith Point County Park staging area for demobilization from the project.

It is important to note that due to the variability in the morphology of this breach, detailed design for the mechanical closure of the breach has not yet occurred; therefore, there may be adjustments to the construction activities. However, the limits of disturbance area for the project (figure 2) is not expected to change during the detailed design.

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[1] NGVD29 refers to the National Geodetic Vertical Datum of 1929. A datum is a set of constants specifying the coordinate system used for geodetic control (i.e., for calculating coordinates of points on the Earth). NGVD 29 is a vertical control datum for the United States established by the US Coast Guard in 1929.

[2] NAVD88 refers to the North American Vertical Datum of 1988. NAVD88 is used for vertical control surveying in the United States. NAVD88 is the national standard vertical datum.

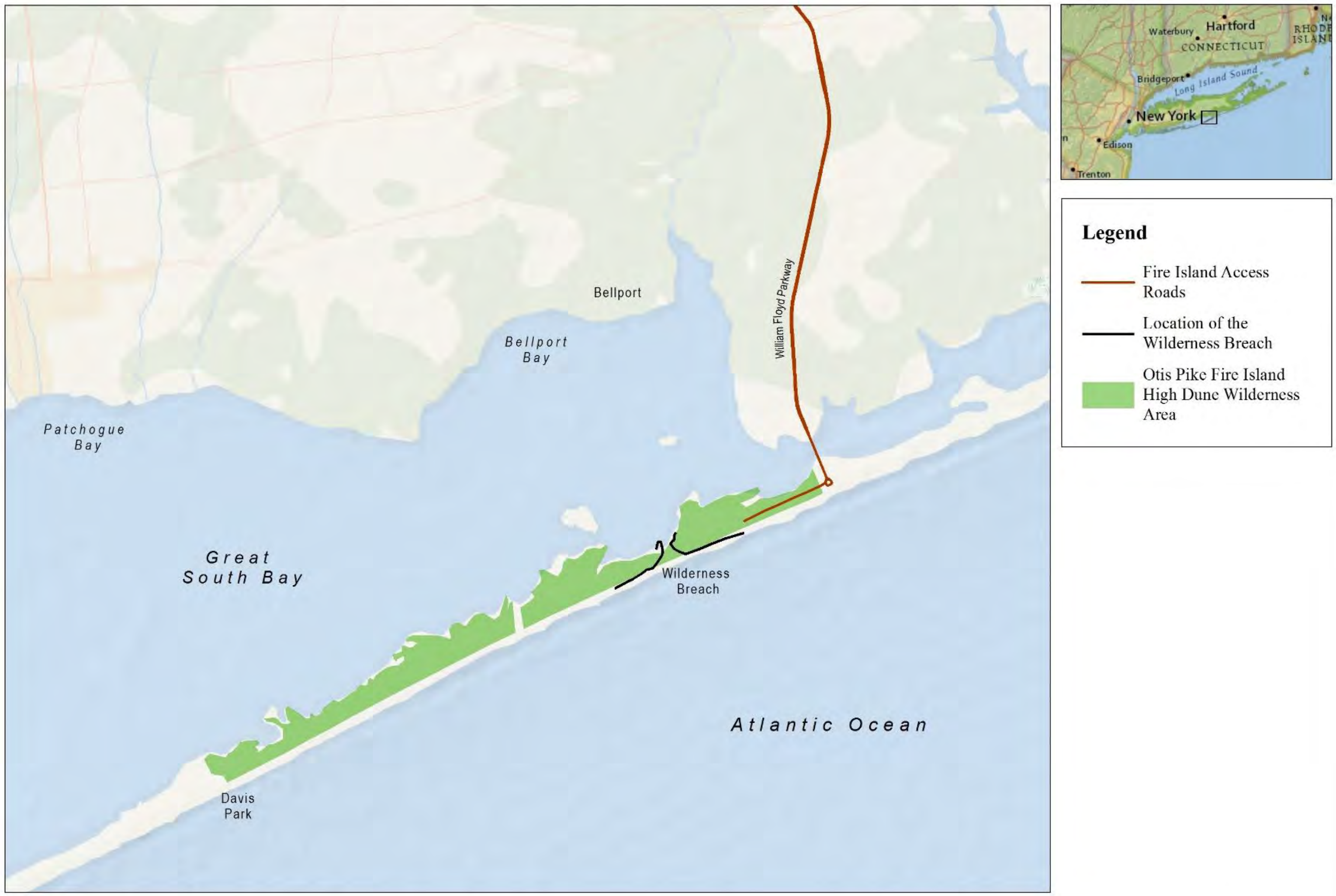

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Figure 4
Wilderness Breach
Access Roads

0 0.75 1.5 3 Kilometers

Alternative 2: Status Determined Entirely by Natural Processes (No-Action Alternative)

Alternative 2 is the no-action alternative. Under alternative 2, the evolution, growth, and/or closure of the breach would be determined by natural barrier island processes and no human intervention would occur to close the breach or to reopen the breach if it were to close by natural processes.

Alternative 3: No Human Intervention Unless Established Criteria are Exceeded (Proposed Action and NPS Preferred Alternative)

Under alternative 3, the evolution, growth, and/or closure of the breach would be determined by natural barrier island processes, and human intervention to close the breach would occur only "to prevent loss of life, flooding, and other severe economic and physical damage to the Great South Bay and surrounding areas."

The National Park Service would establish criteria that indicate the breach poses a threat to life and/or property (see Breach Monitoring below). As long as monitoring data show that the established criteria have not been exceeded, the National Park Service would allow the breach to be shaped entirely by natural processes with no human intervention. The breach may remain open or it may close naturally.

If monitoring data indicate that the established criteria have been exceeded, the Seashore would expand the monitoring program and work with other agencies and scientists to evaluate available information to determine the effects of a growing breach and appropriate next steps, including further study or possible closure. If a decision were made to close the breach, the closure would be done as described under alternative 1.

Breach Monitoring. Monitoring has been ongoing since 2012 to evaluate how the open breach has changed the geomorphology, hydrology, and ecology of the barrier island and estuarine systems. Monitoring data and the professional judgment of physical scientists studying the breach have been used to determine that the two criteria described below are the most logical indicators to alert Seashore staff to changes in the breach that could elevate the risk of severe storm damage, which could lead to a decision to close the breach.

- **Criterion 1: Geologic Controls.** As previously described, erosion-resistant clay to the east and west of the breach serve as geologic controls for the breach (Methratta et al. 2016) (figure 2). The monitoring that has been done to date provides a foundation for understanding the evolution of the breach within that zone. There are no known erosion-resistant materials to control breach migration beyond those shown in figure 2. If the breach migrates beyond these geologic controls, growth of the breach would be less predictable.

- **Criterion 2: Cross-Sectional Area.** The cross-sectional area of the breach has also been monitored periodically since it opened. Initially the cross-sectional area increased rapidly; however, the breach has reached a dynamic equilibrium in which the cross-sectional area has fluctuated between 300 and 600 square meters. A cross-sectional area range within or below this range represents a condition in which the response of the breach is understood. An increase in cross-sectional area above this range would indicate breach growth and a condition in which the evolution of the breach is less predictable.

Annual Breach Condition Evaluation. Alternative 3 requires long-term monitoring to evaluate if the changes in breach conditions alter potential flooding risks. Monitoring methods to determine the cross-sectional area of the breach include bathymetric surveys, monitoring tide gage data, and monitoring the breach shoreline. The location of the breach and the cross-sectional area would be monitored at least once a year and the monitoring data would be used to prepare an annual breach monitoring report.

These monitoring efforts would document the locations of the eastern and western shores of the breach, as well as the width and the depth of the breach. Additionally, selected tide gages would be monitored weekly to identify changes in the tidal prism, which could indicate a change in the breach conditions. Changes identified in tidal data could be caused by other factors, such as storm generated winds, and thus would not, by themselves, document a change in the cross-sectional area. They would serve as an indicator that something in the system was changing, alerting the National Park Service to a potential change in the conditions of the breach.

The criteria described above would be refined with an improved understanding of the duration of change, rate of change, and the size of the breach. An increase in cross-sectional area or migration of the breach beyond the erosion-resistant clay would indicate the need to expand the monitoring program and consider additional information about the conditions of Great South Bay and surrounding areas. The Seashore, working with other agencies and scientists, as appropriate, would evaluate available information to determine the effects of a growing breach and appropriate next steps, including further study or possible closure. In addition to this monitoring data, Seashore staff, agencies, and physical scientists would also incorporate results from flooding models that are being used to evaluate changes to storm damage risks associated with open and closed breach scenarios.

Under alternative 3, if the breach must be mechanically closed, the construction activities would be the same as those described for alternative 1.

ALTERNATIVES CONSIDERED BUT DISMISSED FROM DETAILED ANALYSIS

During the scoping and planning process, the following alternatives were considered and dismissed from further analysis in this Breach Plan/EIS.

Stabilize the Breach to Provide a Permanent Inlet

This alternative would connect Great South Bay and the Atlantic Ocean with a permanent inlet. This alternative was considered because it was raised in internal and public scoping; however, it was dismissed because it is inconsistent with NPS policies and the federal *Wilderness Act.* Section 2(a) of the 1964 *Wilderness Act* states that wilderness areas “shall be administered for the use and enjoyment of the American people in such a manner as will leave them unimpaired for future use and enjoyment as wilderness, and so as to provide for the protection of these areas, the preservation of their wilderness character…" The *Wilderness Act* further acknowledges agency responsibility to preserve wilderness character in section 4(b), "Use of Wilderness Areas." NPS policy further states that: "In addition to managing these areas for the preservation of the physical wilderness resources, planning for these areas must ensure that the wilderness character is likewise preserved" (NPS 2006 section 6.3).

Construction of a permanent inlet in the Fire Island Wilderness would significantly diminish wilderness character. A permanent structure in the Fire Island Wilderness would degrade the wilderness characters of *untrammeled* (wilderness is essentially unhindered and free from modern human control or manipulation), *natural* (wilderness maintains ecological systems that are substantially free from the effects of modern civilization), and *undeveloped* (wilderness retains its primeval character and influence and is essentially without permanent improvements or modern human occupation). In addition, engineered structures to maintain a permanent inlet would require long-term maintenance, which would also diminish wilderness character and be inconsistent with the directives of the federal *Wilderness Act of 1964*.

Manage the Breach under Natural Processes, if the Breach Closes, Reopen the Breach Using Mechanical Processes

This alternative was considered because public scoping comments indicated strong public support to keep the wilderness breach open. Many scoping comments noted improvements to Great South Bay since the breach opened and expressed a desire to leave the breach open. In contrast to alternative 2, which allows the breach to open, close, or migrate as determined by natural processes within a defined geographic area, this alternative would require mechanically opening the breach if natural processes do not maintain an open breach. This alternative was dismissed because it is inconsistent with the federal *Wilderness Act* and NPS *Management Policies 2006* (section 4.8.1.1), which states, "Natural shoreline processes (such as erosion, deposition, dune formation, overwash, inlet formation, and shoreline migration) will be allowed to continue without interference." The legislation establishing the Fire Island Wilderness and the 2016 *Wilderness Stewardship Plan and Backcountry Camping Policy, Otis Pike Fire Island High Dune Wilderness* (NPS 2016a), allow the repair of breaches that may occur in the Fire Island Wilderness in order to prevent loss of life, flooding, and other severe economic and physical damage to the Great South Bay and surrounding area. It does not allow for the mechanical reopening of the breach. In addition, the mechanical processes needed to open the breach would degrade wilderness character, as described above.

Partial Closure of the Breach if Established Criteria are Exceeded

Similar to alternative 3, under this alternative the evolution, growth, and/or migration of the breach within a defined geographic area would be determined by natural barrier island processes; however, this alternative would provide for mechanical management of the breach to maintain the cross-sectional area within the geologic controls (as depicted in figure 2). If partial closure of the breach could not successfully maintain the breach within the cross-sectional area range as described for alternative 3, then mechanical breach closure would occur, consistent with the procedures detailed under alternative 1.

This alternative was dismissed from further analysis because is not feasible and does not meet the goals of the plan. This alternative is not feasible due to many issues:

- Partial closure of a breach is an experimental method; therefore, within the scope of this Breach Plan/EIS it cannot be determined if this method is technically feasible or if it could be successfully implemented for this breach.
- This alternative was determined to be economically infeasible. Partial closure of the breach would cost approximately the same as a full closure. This alternative would provide for one or more partial closures with the ultimate possibility of full closure.
- Mechanical intervention to achieve partial closure of the breach would diminish the untrammeled and natural qualities of the Fire Island Wilderness to the same extent as full closure without similar likelihood of success. If the partial closure is carried out multiple times, impacts on wilderness character would be greater.

NATIONAL PARK SERVICE PREFERRED ALTERNATIVE

The National Park Service has identified alternative 3, the proposed action alternative, as the NPS preferred alternative because it would allow natural processes to continue in the Fire Island Wilderness unless and until it became necessary to close the breach using mechanical processes. Alternative 3 is the only alternative that allows the management of the breach according to NPS resource management policies and wilderness directives while allowing closure if necessary to prevent "loss of life, flooding, and other severe economic and physical damage to the Great South Bay and surrounding areas."

While the breach is allowed to function under natural processes, changes to the central and eastern Great South Bay ecosystem would persist. Initial results (three years of data) indicate that the open breach has generally improved water quality by increasing circulation and reducing nutrients. These changes have benefited benthic communities and finfish, improved available fish nursery habitat, and produced a more robust and mature ecosystem. If the breach were to be closed using mechanical methods, the consensus among the experts consulted by the National Park Service is that the bay would eventually revert to the conditions prior to the breach, eliminating the benefits to the ecosystem attributed to the open breach.

In addition, mechanical closure of the breach would result in adverse impacts to wilderness character, because the construction activities and the placed sand would degrade various qualities of wilderness character. Although this alternative could eventually have the same impacts as alternative 1, this alternative provides an opportunity to manage the breach under natural processes until established criteria are exceeded.

MITIGATION MEASURES

Mitigation, according to *National Environmental Policy Act* (NEPA) regulations (40 CFR 1508.20) includes:

- avoiding the impact altogether by not taking a certain action or parts of an action
- minimizing impacts by limiting the degree of magnitude of the action and its implementation
- rectifying the impact by repairing, rehabilitating, or restoring the affected environment
- reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action
- compensating for the impact by replacing or providing substitute resources or environments

The following mitigation measures would be implemented as part of the NPS preferred alternative. An appropriate level of monitoring would be implemented throughout any construction activities to help ensure that protective measures are being properly implemented and are achieving their intended results.

- The limits of disturbance for the project were designed to avoid and minimize impacts to natural and cultural resources.
- Time-of-year restrictions (April 1 to September 1) for federally and state-listed ground-nesting shorebirds;
- Silt curtains would be used on the bay side of the breach to allow suspended sediment to settle out of the water column in a controlled area, minimizing the area that is affected by the increased suspended sediment;
- The use of both tracked and rubber-tired construction equipment is anticipated. Large crane or construction mats composed of timbers or composite material may be deployed on the beach, if needed, to facilitate mobilization of the necessary equipment from the staging area and project site.
- A spill prevention and response plan would be developed to reduce impacts if equipment leaks or hazardous spills occur. The goal of the plan would be to minimize the potential for a spill, contain any spillage to the smallest area possible, and to protect the environment from leaks and spills.
- A construction safety plan would be prepared that addresses appropriate elements to provide for visitor, worker, and park staff safety.
- Grain size of the sand to be deposited on the beach would be the same or slightly larger than the native sand. The sand to be placed on the beach would be consistent with the grain size (minimize/avoid sand larger than the native sand) and color on the naturally occurring beach to the greatest extent practicable.
- A statement of findings for wetlands and floodplains, a final biological assessment (and formal consultation with US Fish and Wildlife Service, if necessary), and an essential fish habitat assessment would be prepared prior to construction and would address mitigation measures for these resources. A Minimum Requirement Analysis will be completed as necessary regarding the construction activity that will be permitted in the wilderness area.

- A programmatic agreement was prepared with stipulations that prior to any ground disturbing activities the National Park Service would conduct an archeological survey program for identification of terrestrial and submerged archeological sites within the project area of potential effect. Prior to affecting any potentially eligible archeological site, the National Park Service would develop a testing program of sufficient intensity to provide an evaluation of eligibility for the National Register of Historic Places in consultation with the New York State Historic Preservation Office and other consulting parties following the regulations outlined in 36 CFR 800.4(c). If, as a result of the testing program, archeological sites are identified within the project area of potential effect that are eligible for the National Register of Historic Places, the National Park Service will develop a plan for their avoidance, protection, or recovery of information in consultation with the State Historic Preservation Office and other consulting parties. The plan will be submitted to the State Historic Preservation Office and other consulting parties for review and comment prior to implementation.

REQUIRED PERMITS AND PLANS FOR PROPOSED ACTION

A general summary of the anticipated federal and state permits, certifications, and plans required for the proposed action are summarized in table 3. These items may include additional mitigation measures that would be developed in the course of final design and obtaining the required approvals.

TABLE 3. LIST OF REQUIRED FEDERAL APPROVALS, CERTIFICATIONS, AND PLANS

Name	Agency	Description of Approval/Certification/Plan
Federal Issued Permits		
Minimum Requirements Analysis for Wilderness Projects	National Park Service	Section 4(c) of the *Wilderness Act* identifies activities that are generally prohibited in wilderness except as subject to existing private rights or other legislation. Section 4(c) also provides for exceptions to the prohibitions: "as necessary to meet the minimum requirements for the administration of the area for the purpose of wilderness (including measures required in emergencies involving the health and safety of persons within the area)." Section 6.3.5 of NPS *Management Policies 2006* states that the minimum requirement concept will be a two-step process to (1) determine if it is necessary to take action in wilderness; and (2) to determine the minimum tool or activity needed to ensure that impacts on wilderness resources and character are minimized. Wilderness legislation requires that, prior to construction, a minimum requirements analysis would be completed using the process outlined in the Minimum Requirements Decision Guide. The minimum requirements analysis would be completed if a decision to close the breach were reached. This analysis would use techniques that would ensure minimum construction actions are taken to complete the task.

Name	Agency	Description of Approval/Certification/Plan
Clean Water Act Section 404 Individual Permit	US Army Corps of Engineers	Section 404 of the *Clean Water Act* established a program to regulate the discharge of dredged or fill material into waters of the United States, including wetlands. Activities in waters of the United States regulated under this program include fill for development, water resource projects (such as dams and levees), infrastructure development (such as highways and airports) and mining projects. Section 404 requires a permit before dredged or fill material may be discharged into waters of the United States, unless the activity is exempt from section 404 regulation.
Section 10 of the Rivers and Harbors Act Permit	US Army Corps of Engineers	Permit required for any work in United States navigable waters, including construction, excavation, or deposition of materials in, over, or under navigable waters, or any work that would affect the course, location, condition, or capacity of those waters.
Spill Prevention, Control, and Countermeasures	US Environmental Protection Agency	Section 311 of the *Clean Water Act* created regulations to prevent and respond to oil discharges from non-transportation-related facilities into navigable waters of the United States or adjoining shorelines. These regulations apply to petroleum-based oils, such as gasoline, diesel fuel, and motor oil. Spill prevention, control, and countermeasures plans must describe the following: operating procedures at the facility to prevent oil spills; control measures installed to prevent oil spills from entering navigable waters or adjoining shorelines; and countermeasures to contain, cleanup, and mitigate the effects of an oil spill that has impacted navigable waters or adjoining shorelines (USEPA 2010).
State Issued Certifications/Consistency		
State Environmental Quality Review Act Compliance	New York State Department of Environmental Conservation	The New York State *Environmental Quality Review Act* requires all state and local government agencies to consider environmental impacts equally with social and economic factors during discretionary decision-making; however, the State Environmental Quality Review Act Compliance requirement could be covered by the existing NEPA document.
Coastal Erosion Management Permit	New York State Department of Environmental Conservation	The Coastal Erosion Management Permit is the written approval required to undertake any regulated activity within coastal erosion hazard areas as shown on the official coastal erosion hazard area maps issued by the New York State Department of Environmental Conservation.
Tidal Wetlands Permit	New York State Department of Environmental Conservation	Under the *Tidal Wetlands Act*, the New York State Department of Environmental Conservation administers a permit program regulating activities in tidal wetlands and their adjacent areas.

Name	Agency	Description of Approval/Certification/Plan
Protection of Waters Permit	New York State Department of Environmental Conservation	The New York State Department of Environmental Conservation created the Protection of Waters Regulatory Program to prevent undesirable activities on water bodies by establishing and enforcing regulations that are compatible with the preservation, protection and enhancement of the present and potential values of the water resources; protect the public health and welfare; and are consistent with the reasonable economic and social development of the state.
Federal Consistency (Coastal Zone Management / Waterfront Revitalization Program)	New York State Department of State	The New York State Department of State protects designated Coastal Areas, including New York State tidal coastal waters and the adjacent shorelands. The State Coastal Consistency Review process requires a certification to New York State Department of State that the project is consistent with state coastal policies.
Plans		
Borrow Area Monitoring Plan	New York State Department of State	In accordance with New York State Department of Environmental Conservation water quality certificate requirements, a borrow area monitoring plan is required for this project.

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Affected Environment 3

Wilderness Breach - July 7, 2013

CHAPTER 3: AFFECTED ENVIRONMENT

The "Affected Environment" chapter describes the resources that could be affected as a result of implementation of any of the alternatives. The topics presented in this chapter are those related to the key issues described in chapter 1 that could inform the National Park Service (NPS) decision on how to manage the wilderness breach. The descriptions of the resources provided in this chapter serve as an account of the baseline conditions against which the potential effects of the alternatives considered in this *Fire Island Wilderness Breach Management Plan and Environmental Impact Statement* (draft Breach Plan/EIS) are compared. Because the wilderness breach had existed for less than 3 years at the initiation of this draft Breach Plan/EIS, both pre- and post-breach conditions are described to provide a more complete understanding of the resources. The general project setting has been included to provide the background information necessary to understanding the park resources, the environmental setting, and the impetus for this plan. The following resources are included in this chapter: wilderness character, sediment transport and geomorphology, water quality, ecosystem structure and processes, benthic communities, finfish and decapod crustaceans, public health and safety, flooding, and socioeconomics.

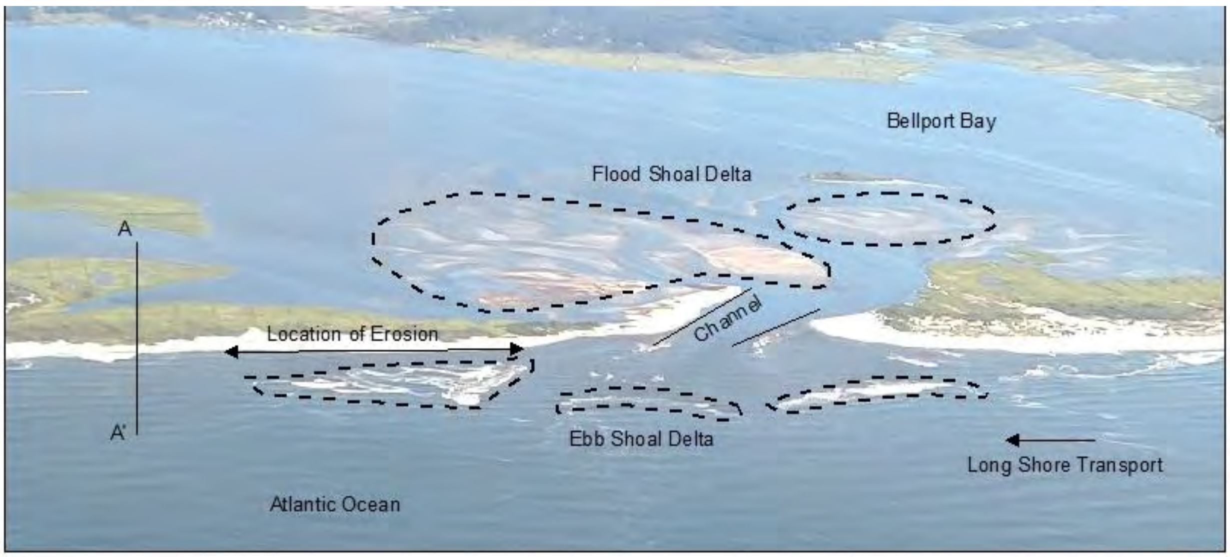
DATA SOURCES

As noted above, the wilderness breach existed for less than three years at the initiation of this draft Breach Plan/EIS, as such, much of the research relating to the breach was or is still underway. To support the development of this draft Breach Plan/EIS, existing and ongoing research pertaining to the pre-breach and post-breach conditions in Great South Bay and surrounding areas was collected, compiled, and synthesized into a technical synthesis report, as described in chapter 1. The technical synthesis report (Methratta et al. 2016) is a compilation of the best available data and describes the current state of the science for the physical and natural resource issues specific to Great South Bay and surrounding areas, as identified by the National Park Service. Unless otherwise cited, the information in this chapter is taken from the technical synthesis report. The technical synthesis report is available as a companion to this Breach Plan/EIS and will be published as part of the NPS Natural Resource Technical Report series.

GENERAL PROJECT SETTING

The wilderness breach formed in the Otis Pike Fire Island High Dune Wilderness (Fire Island Wilderness) in October 2012 during Hurricane Sandy. There are three tidal inlets maintained for navigation along the barrier islands on the south shore, Fire Island Inlet, Moriches Inlet, and Shinnecock Inlet (appendix A). The wilderness breach is located in an area of Fire Island that has a history of being vulnerable to overwash events (described in detail below) and ephemeral inlets (Leatherman and Allen 1985). One of the more recent inlets, known as Old Inlet, formed in the 1800s and remained open for approximately 60 years until it closed naturally. Old Inlet was located immediately west of the current wilderness breach. Through dating of sediment cores, Roman et al. (2007) have documented the establishment of extensive salt marsh areas in the back bay system in the vicinity of the current wilderness breach. These marshes are near relic inlets dating back to the late 1700s, suggesting a natural evolution of flood deltas in this area of Fire Island (Roman and Lynch 2016).

Figure 5 presents the physical features of the wilderness breach and figure 6 is a cross-section of a typical barrier island system. Physical oscillations of the wilderness breach dimensions have been documented. Observations by local experts suggest that these oscillations are seasonally driven. Based on digital imagery, it is evident that the main channel is generally oriented north-south with well-established flood and ebb shoals (figure 5). Seasonally, the eastern ebb shoal grows, blocking the east-west tidal currents. This causes the western shoreline of the wilderness breach to accrete, or grow slowly through the accumulation of sand, forming a spit and progressively rotating the channel to a northeast-southwest orientation (figure 7). Once this spit develops to the deepest point of the channel, the spit is breached and there is a rapid "straightening" of the channel (figure 8). This cycle has caused the wilderness breach to fluctuate between 250 and 750 meters in width; the wilderness breach has remained within this range since 2013. The main channel has migrated approximately 200 meters westward since it first opened, primarily through erosion of the western shoreline.



Photograph: © R. Giannotti and C. Flagg (July 23, 2015)

FIGURE 5. PHYSICAL FEATURES OF THE WILDERNESS BREACH

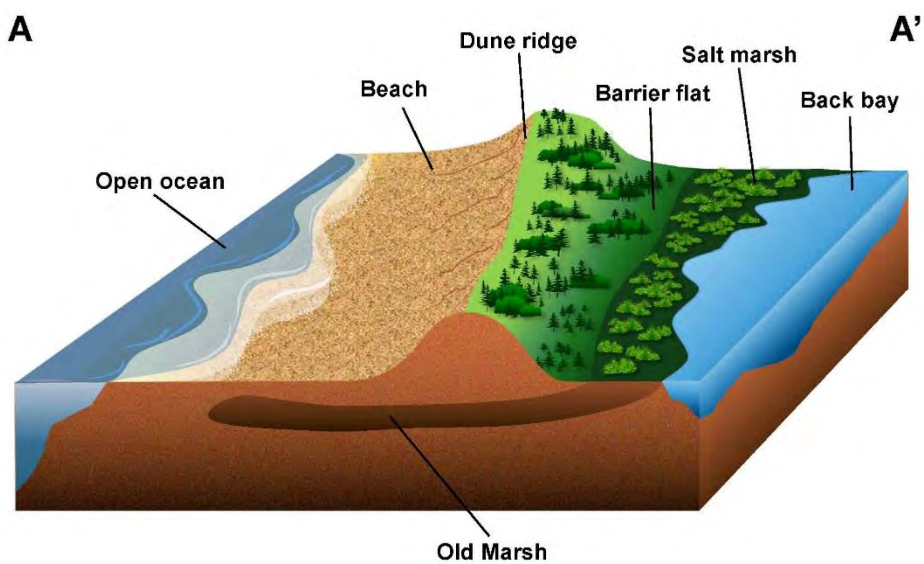


FIGURE 6. CROSS-SECTION OF A BARRIER ISLAND SYSTEM

Photograph: © C. Flagg

FIGURE 7. WILDERNESS BREACH (AUGUST 2015) WHEN WESTERN SPIT HAS GROWN AND CHANNEL IS ORIENTED NORTHEAST-SOUTHWEST

Photograph: © C. Flagg and R. Giannotti

FIGURE 8. WILDERNESS BREACH (JANUARY 2016) WHEN THE CHANNEL STRAIGHTENED TO A NORTH-SOUTH ORIENTATION

The hydrodynamics of a system can be defined as the summation of physical forces that act on or are exerted by moving water. Hydrodynamics can therefore determine water levels and circulation patterns in a given marine/estuarine environment. The main forces that drive hydrodynamics on the bay side of the wilderness breach are daily tides, tidal prism volume (or the volume of water that moves through an inlet between mean high tide and mean low tide), and storm activity. Prior to Hurricane Sandy, hydrodynamics on the bay side of the wilderness breach were controlled primarily by water exchange through Fire Island and Moriches Inlets, and open ocean processes were restricted to the ocean side. Overwash, or the transport of sediment across a dune from wind and wave action, occasionally delivered sediment and ocean water to the back bay environment but did not create a breach in the island. The formation of the wilderness breach altered these processes by providing direct exchange between bay side and ocean side hydrodynamic processes.

Circulation Patterns

Hydrodynamic modeling indicates changes in circulation patterns in central and eastern Great South Bay since the wilderness breach formed. Prior to the wilderness breach, water circulation in the bay was dominated by localized eddies, multiple small areas of circulation that promoted very localized circulation but did not promote circulation through the bay. Since the wilderness breach formed, the circulation has become a continuous flow directed from Bellport Bay to the west out through Fire Island Inlet. This change in circulation causes increased mixing of water and has reduced the residence time (or the amount of time it takes to circulate water throughout the bay).

Circulation on the ocean side of the wilderness breach is dominated by open ocean processes. The sand on this side of Fire Island is subject to seasonal reworking by waves, and the dominant angle at which wave energy approaches the shore also creates an east to west longshore current (figure 5).

Daily Tides

Effects of the wilderness breach on daily mean high water levels in Great South Bay from daily tidal fluctuations and small surge events have been evaluated through the use of hydrodynamic modeling and analyses of tide gage data. Both modeled and measured data show a small increase in high water levels in the western and central parts of Great South Bay and minimal changes in the eastern parts of the bay. The greatest changes in tidal range are seen near Lindenhurst in western Great South Bay, where modeling and tide gage data indicate the elevation of mean high water has increased between 2.0 and 2.5 centimeters; however, the tide gage data suggest that the higher water levels may be more closely related to dredging of Fire Island Inlet than the wilderness breach. Elsewhere in central and eastern Great South Bay, increases in mean high water as a result of the wilderness breach, as shown by modeled and measured data, have been less than 0.8 centimeters.

Numerical model studies and analyses of measured water level data show that the wilderness breach has resulted in a phase shift in the tide and surge in the easternmost part of Great South Bay, causing high and low water in Bellport to arrive 20 to 35 minutes sooner as a result of the wilderness breach.

Storm Activity

Nearshore waves approaching the shoreline are substantially reduced in energy when they interact with shoals and/or offshore bars. On Fire Island, the majority of waves are from the southeast and the more severe storms associated with extratropical storms (commonly referred to as nor'easters) are from the east-southeast (Leatherman 1985; Smith et al. 1999). The US Army Corps of Engineers (USACE) numerical simulations showed that peak water levels in Great South Bay were produced by nor'easters, while tropical storms (commonly referred to as hurricanes) generated the highest water levels in Moriches and Shinnecock Bays. This was attributed to the transference characteristics of Fire Island Inlet, meaning that tropical storm surge tends to pass through the area more quickly than nor'easter surge and is significantly dampened at Fire Island Inlet. Surge generated by nor'easters typically lasts several tidal cycles and therefore increases the total volume of water passing through the inlet, resulting in higher peak water levels.

Climate Change and Sea Level Rise

The effects of climate change in New York State include increasing water and air temperatures, changing precipitation patterns, and accelerated sea level rise (Rosenzweig et al. 2011). Sea level rise intensified the impact of Hurricane Sandy and is predicted to increase coastal storm surge, making future coastal storms more damaging (Center for Climate and Energy Solutions n.d.).

In the Atlantic Ocean, there is an ocean-wide process responsible for thermohaline circulation and heat transport (Boon 2012; Ezer 2013; Goddard et al. 2014; Sallenger, Doran, and Howd 2012; Yin 2012). This process moves warm water in the Gulf Stream to the upper layer of the North Atlantic Ocean and cold North Atlantic Deep Water southward (Smeed et al. 2014). Studies have shown that a reduction in circulation is causing a decrease in southward flow of cold water, effectively accelerating climate change effects, such as sea level rise, in the North Atlantic (Sallenger, Doran, and Howd 2012; Smeed et al. 2014).

Water and air temperatures have been increasing along the northeast coast of the United States. Heat waves are expected to become more frequent and intense. Increased air temperatures have increased projected precipitation, causing increased flood risk (Rosenzweig et al. 2011). Additionally, the North Atlantic region has experienced a 0.83°C sea surface temperature increase from 1901 to 2014, and sea surface temperatures are expected to continue to rise (IPCC 2013; NOAA 2015). This trend could cause major changes to ecosystems including species range shifts, population crashes, and other sudden transformations (Rosenzweig et al. 2011).

The Northeast region of the US Atlantic coast (north of New York City) shows accelerated sea level rise as compared to other Atlantic regions and to the estimated global rate of 1.8 mm/year (Church et al. 2011). While there is variability between years, rates of sea level rise range from 2.5 to 3 mm/year in the North Atlantic region (Goddard et al. 2014; Ezer 2013). This acceleration of approximately double the global rate is attributed to circulation decreases, as described above. Additionally, the increasing sea surface temperatures cause thermal expansion of water, which has shown to contribute 30–40% of sea level rise since the 1970s (Yin 2012).

Studies investigating Northern Hemisphere storm-track changes have not reached consensus on how storm activity will change with a warming climate. In the state of New York, precipitation is projected to increase by 5% every 30 years; however, it will not be distributed evenly over the course of the year – more is expected to fall in heavy downpours rather than in light rains (Rosenzweig et al. 2011). A number of studies show decreased nor'easter activity due to enhanced surface warming at higher latitudes and weaker surface warming at low latitudes, leading to a decreased temperature gradient (Catto, Shaffrey, and Hodges 2011). Other studies show no indication of more intense storms but do show a decrease in weaker storms (Bengtsson and Hodges 2006). This uncertainty presents a substantial challenge for making future predictions about shoreline conditions.

WILDERNESS CHARACTER

Otis Pike Fire Island High Dune Wilderness

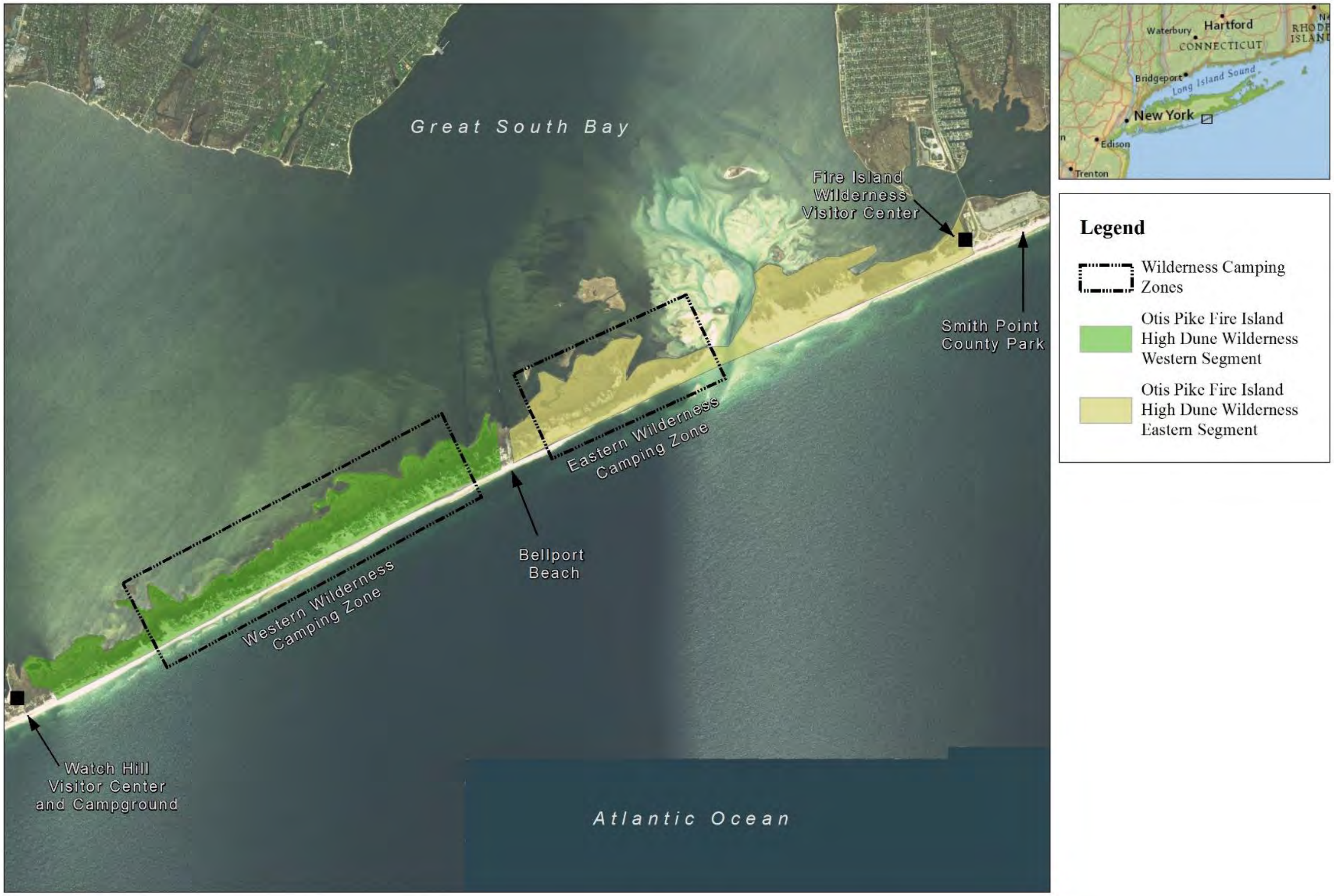
The Otis Pike Fire Island High Dune Wilderness is approximately 11 kilometers long east to west. Bellport Beach, an ocean-to-bay parcel of non-federally owned land, separates the Fire Island Wilderness into eastern and western segments. The eastern segment extends from the eastern boundary of Bellport Beach to the western boundary of the Smith Point County Park; the western segment extends from the easternmost edge of the Watch Hill Campground and nature trail to the western boundary of Bellport Beach. Between these landmarks, both segments of the Fire Island Wilderness encompass the area from Great South Bay at mean high water on the north to the toe of the primary dune on the south (figure 9). The Fire Island Wilderness excludes the existing Wilderness Visitor Center and the 30 meters of land surrounding the perimeter of the building, located just west of Smith Point County Park.

The northern and southern boundaries of the eastern segment of the Fire Island Wilderness extend across the wilderness breach east and west maintaining a continuous wilderness area. This unique feature has created a marine wilderness area where one did not previously exist and where exchange of water occurs between ocean and bay.

Wilderness Character Qualities

The 1964 *Wilderness Act* mandates the preservation of wilderness character; however, the *Wilderness Act* does not clearly define wilderness character. The National Park Service uses the interagency wilderness character framework *Keeping It Wild* (Landres et al. 2008) and an updated version, *Keeping it Wild 2* (Landres et al. 2015) to assess the impacts of proposed management alternatives on wilderness character. This framework describes wilderness character as "the combination of biophysical, experiential, and symbolic ideals that distinguishes wilderness from other lands. These ideals combine to form a complex and subtle set of relationships among the land, its management, its users, and the meanings people associate with wilderness."

The five qualities that contribute to wilderness character are untrammeled, natural, undeveloped, opportunities for solitude or a primitive and unconfined type of recreation, and other features of value. Relevant aspects of these qualities are summarized below from the *Draft Wilderness Stewardship Plan and Backcountry Camping Policy, Otis Pike Fire Island High Dune Wilderness* (NPS 2016a).



Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN,

Figure 9
Otis Pike Fire Island High Dune Wilderness Zones and Wilderness Camping Zones

Untrammeled Quality. The *Wilderness Act* states that wilderness is "an area where the earth and its community of life are untrammeled by man" that "generally appears to have been affected primarily by the forces of nature." Therefore, wilderness is essentially unhindered and free from the actions of modern human control or manipulation. This quality is influenced by any activity or action that is intended to control or manipulate the components or processes of ecological systems. Actions that are taken to preserve or restore the natural quality often degrade the untrammeled quality, even though these actions are taken to protect resources. For example, the Fire Island National Seashore (Seashore) has management and resource plans that authorize actions that diminish the untrammeled quality of the wilderness. Examples of these plans include the following: the *Mosquito Action Plan and Surveillance Protocols* (NPS 2013), which authorizes mosquito treatments; the *Fire Island National Seashore White-tailed Deer Management Plan* (NPS 2015b), which provides guidance to manage the growing population of white-tailed deer to protect native vegetation; and the Threatened and Endangered Species Monitoring and Management program that authorizes the installation of symbolic fencing and predator exclosures to protect the federally threatened piping plover (*Charadrius melodus*) and its nesting and foraging habitat. Seashore staff also monitor for and authorize the removal of nonnative invasive species, including the Japanese black pine (*Pinus thunbergii*) and autumn olive (*Elaeagnus umbellata*).

Similarly, the suppression of naturally ignited fires would also detract from the untrammeled quality. The NPS fire management policies and the *Fire Island National Seashore Wildland Fire Management Plan* (NPS 2005) allow naturally ignited (lightning) fires to burn, if they contribute to the attainment of Seashore and/or wilderness management objectives and do not compromise the safety of firefighters and the public. Human-ignited fires are the most common type of fires at the Seashore and often destroy Seashore resources. Suppression of a human-ignited fire would not be considered degradation of wilderness character.

Natural Quality. The *Wilderness Act* states that wilderness is "protected and managed so as to preserve its natural conditions." Ecological systems within wilderness are to be substantially unaffected by modern civilization. This quality aims to preserve native species, patterns, and ecological and evolutionary processes, and to understand and learn from natural systems. The natural quality is degraded by such things as the loss of native species and the alteration of ecological processes such as fire regimes. Internal and external forces have diminished the natural quality of the wilderness. Its proximity to densely populated areas affects air and water quality, as well as other biophysical processes.

The southern boundary of the Fire Island Wilderness is characterized by primary dunes. North of these dunes (on the bay side) lies the island swale, and in some areas, a line of secondary dunes and ancestral dunes within the interior of the island. A variety of plant communities are found in the dune and swale zones, including scrub and grasslands, high thickets, pine woodlands, and occasional patches of maritime forest. Interspersed among the dunes are unique freshwater bogs and marshes. Vast expanses of coastal grasslands and tidal salt marsh stretch beyond the swale and secondary dunes, extending into Great South Bay. The most extensive tidal marsh areas of the Seashore lie within the Fire Island Wilderness. These marsh areas are highly productive biological systems and provide habitat for a variety of mammals, reptiles, amphibians, insects, and birds. Tidal marshes also provide habitat for many intertidal and marine organisms and are the nursery grounds for various finfish and invertebrates. The marshes further provide very effective buffers against wave energy and protect adjacent uplands from erosion and saltwater intrusion by dissipating wave and tidal energy.

The habitats of the Fire Island Wilderness support common species such as white-tailed deer (*Odocoileus virginianus*), eastern cottontail rabbit (*Sylvilagus floridanus*), red fox (*Vulpes vulpes*), and black racer (*Coluber constrictor*). Fire Island National Seashore and the Fire Island Wilderness in particular, is located along the Atlantic Flyway and provides refuge to a variety of both migratory and resident bird species. In addition the Fire Island Wilderness supports several special-status species, including the federally threatened piping plover (*Charadrius melodus*), red knot (*Calidris canutus rufa*), and seabeach amaranth (*Amaranthus pumilus*). Piping plovers nest and seabeach amaranth plants grow in the Fire Island Wilderness near the toe of the primary dune in certain sections and in overwash areas where primary dunes used to be present. Red knots use the shorelines adjacent to the Fire Island Wilderness as a migratory stopover and forage along the ebb and flood shoal deltas at the wilderness breach.

Breaching is a natural process that supports the natural quality of wilderness. The wilderness breach has changed the presence/absence, population densities, and distribution of some species, but has not degraded the natural wilderness quality. Detailed information of these changes can be found in the "Water Quality," Benthic Communities," and "Finfish and Decapod Crustaceans" sections in this chapter as well as in the technical synthesis report (Methratta et al. 2016).

The natural quality of the Fire Island Wilderness has been diminished by internal and external forces. Its proximity to densely populated areas affects air and water quality, as well as other biophysical processes. The natural quality of the Fire Island Wilderness is still recovering from previous human occupation and disturbance; salt marsh mosquito ditches from the 1930s to the 1950s, ornamental plantings around old homes, broken glass and debris, and water well and utility remnants detract from natural qualities. However, the area is still largely composed of native species and continues to provide habitat for much of the wildlife at Fire Island.

Undeveloped Quality. The *Wilderness Act* defines wilderness as "an area of primeval character and influence, without permanent improvements or human habitation…where man himself is a visitor who does not remain" and "with the imprint of man's work substantially unnoticeable." Wilderness is to retain its primeval character and influence. This quality is affected by what are commonly called section 4(c) prohibited uses — the presence of structures, and the use of motor vehicles, motorized equipment, or mechanical transport. Removal of structures and avoiding these prohibited uses preserves or improves this quality.

Over the past several decades, the undeveloped quality of the Fire Island Wilderness has vastly improved. With a few exceptions authorized by the *Otis Pike Fire Island High Dune Wilderness Act*, the structures and facilities that were in the area at the time of designation and that were incompatible with wilderness have been removed, the uses and activities inconsistent with wilderness have ended, and the area has largely been restored to its natural state. Hurricane Sandy exposed several structural remains that were removed from the Fire Island Wilderness. Boardwalks, dune crossings, signs, and posts can be found in the Fire Island Wilderness, although the majority of these structures are in place to protect resources, preserving the natural quality of the Fire Island Wilderness. Several non-culturally significant structures remain, and large quantities of debris exist, either as remains of old settlements or current visitor use on the beach adjacent to the Fire Island Wilderness. Electric lines that are no longer active stretch along the length of the Fire Island Wilderness. Nonetheless, the Fire Island Wilderness remains an exceptional retreat from surrounding urban areas, with relatively little evidence of modern human occupation.

Opportunities for Solitude or Primitive and Unconfined Recreation Quality. The *Wilderness Act* states that wilderness offers "outstanding opportunities for solitude or a primitive and unconfined type of recreation." This quality is primarily about the opportunity for people to experience wilderness, and is influenced by factors that affect these opportunities. It provides for primitive recreation, the use of traditional skills, personal challenge, risk, and self-discovery, and freedom from constraints of modern life. Wilderness managers can preserve or improve this quality by reducing visitor encounters, signs of modern civilization inside wilderness, facilities, and management restrictions on visitor behavior.

Visitor use in the Fire Island Wilderness includes day hiking, sunbathing, camping, regulated waterfowl hunting, and collecting of beach plums and blueberries. The Shinnecock and Unkechaug tribes conduct some traditional uses and ceremonial activities in the Fire Island Wilderness as well.

The Fire Island Wilderness is isolated from the mainland, which amplifies the feeling of solitude. In many cases, even visual access to the mainland of Long Island is completely cut off by fog, the secondary dunes, or by tall vegetation behind the primary dune. Limited trail maintenance contributes to opportunities for visitors to explore a wild, natural area with minimal human influences.

The user density within the Fire Island Wilderness is relatively low; therefore, threats to solitude mostly originate from outside the Fire Island Wilderness. Motorized access along the beach and bay, as well as air traffic, detract from one's sense of solitude. The presence of the wilderness breach has reduced the vehicle traffic west of the wilderness breach, thus reducing the amount of vehicle noise experienced by wilderness visitors. Large numbers of people may be encountered at Fire Island Wilderness access points, Watch Hill, and the Wilderness Visitor Center. The volume of visitors at these sites can detract from one's sense of solitude. In addition, the large number of bright lights in nearby New York City and other urban areas degrade the quality of dark night sky.

Facilities and restrictions that decrease self-reliant recreation, such as dune crossings, trail markers, and development of user trails, detract from this quality of wilderness. In addition, limitations on user behavior, such as numbers of campers, camper group size, length of stay, campfire prohibition, and restricted access to dunes also limit unconfined recreation. Current restrictions are in place for the protection of visitors and for the protection of the resources.

On Long Island, primitive camping in a wilderness setting is presently available only at the Seashore. The Seashore permits primitive/dispersed camping; campers may choose their own campsites within one of two wilderness camping zones. The eastern camping zone is approximately 2.8 kilometers west of the Wilderness Visitor Center, stretches to the west, and ends approximately 300 meters east of the Bellport Beach boardwalk/trail (figure 9). The current location of the wilderness breach has altered access to the eastern camping zone. Visitors must now access the eastern zone from Watch Hill, as opposed to the Wilderness Visitor Center, making access more difficult and time consuming for visitors. Camping is not allowed east of the wilderness breach.

Other Features of Value Quality. The *Wilderness Act* section 2(c)(4) states that a wilderness "may also contain ecological, geological, or other features of scientific, educational, scenic, or historical value." These may include paleontological features, cultural resources, or even mining structures that are of wilderness-enhancing historical value. This fifth quality captures important elements or "features" of a particular wilderness that are not covered by the other four qualities. The types of features that would be preserved under this fifth quality may or may not occur within a wilderness thereby making each wilderness unique from one another.

There are no known cultural resources within the project area that could be impacted by closure of the wilderness breach. Any culturally significant resources that are discovered will be preserved and protected. Agency consultation detailing the approach to cultural resources is available on the NPS Planning, Environment and Public Comment athttp://parkplanning.nps.gov/FireIslandBreachManagementPlan.

Science and research are a stated purpose of wilderness and are essential for its preservation, as it can help provide a scientific basis for planning, operations, management, education, and interpretive activities. Scientific activities will be encouraged in the Fire Island Wilderness, if the benefits of what may be learned outweigh the negative impacts on wilderness character. The wilderness breach has presented opportunities for scientific study on wilderness lands and waters, and the surrounding area.

SEDIMENT TRANSPORT AND GEOMORPHOLOGY

Net sediment transport along open coast shorelines is typically determined by longshore, or littoral, drift, caused by a combination of prevailing wind, wave, and tidal current energies. This transport can be interrupted by breaches and tidal inlets, which provide conduits for the transport of littoral drift into flood and ebb shoal complexes, back barrier bays, and salt marsh systems. Breaches or inlets that remove material from the longshore transport system are sediment sinks. In cases where a significant percentage of the annual littoral drift is lost through landward transport into the inlet, erosion of the downdrift shorelines can be an issue. Inlets that are not sediment sinks typically allow sediment bypassing through one or more mechanisms that help to feed the downdrift shorelines with sediment. The geomorphology of inlet/breach systems and the surrounding features is greatly influenced by sediment transport and can therefore provide insight to changes in those processes.

Sediment Transport

Ocean Side. The dominant direction of longshore transport is established based on the angle at which wind, wave, and tidal energy approach the shoreline. The wave climatology offshore of Long Island is characterized by moderate Atlantic waves typically from the southeast quadrant. There are seasonal variations with mild waves during summer, severe waves associated with nor'easters during winter and spring, and severe waves associated with hurricanes during fall. Nearshore waves approaching the shoreline are substantially reduced in energy as waves shoal across the shelf. This results in a net westerly longshore transport direction. Longshore transport rates in the vicinity of the wilderness breach are likely similar to those estimated as influx at Moriches Inlet.

Existing data on the Fire Island sediment budget and conceptual modeling suggest that the wilderness breach is not causing a significant interruption in longshore sediment transport and is therefore not currently a sediment sink (an inlet that removes material from the longshore transport system). Review of aerial photographs provides further support that the wilderness breach is relatively efficient at bypassing sediment to the downdrift shoreline approximately 1.0 kilometer downdrift of the wilderness breach where the ebb shoal merges with the nearshore bathymetry.

Studies specifically looking at impacts of the wilderness breach on the nearshore ocean side wave climatology have not been conducted. The USACE and Deltares model studies have simulated wave conditions in the wilderness breach; however, the results have not been extracted at the fine resolution needed to evaluate localized wave changes and resulting impacts on sediment transport. Data collected to date suggests that shoreline erosion resulting from wave interaction with the ebb-tidal shoals is small and localized to the downdrift or western side of the inlet within the Fire Island Wilderness. Supporting evidence includes a relatively small ebb shoal complex and evidence of localized downdrift increased shoreline erosion since formation of the wilderness breach, as discussed in the geomorphology section.

Bay Side. Prior to the formation of the wilderness breach, sediment transport in Great South Bay and Moriches Bay was determined by relatively low-energy estuarine processes. Ocean exchange occurred through Fire Island Inlet and Moriches Inlet, and episodic overwash could supply material to the back bay during storms. Extensive salt marshes are located to the east of Watch Hill and extend to Moriches Inlet, an area vulnerable to overwash and breaching. Studies have shown that these salt marshes can be correlated to historic inlets, as they often colonize or are established on former flood deltas.

Sediment is transported from the ocean via shallow channels into the main wilderness breach channel from the east and moves out to the west through ebb shoal channels, resulting in negligible net influx to the flood shoal complex in Great South Bay. The width of the wilderness breach and shallow nature of the flood tidal delta are primary factors that dampen energy, and therefore sediment transport, from the open ocean through the wilderness breach to Great South Bay. The width range of the wilderness breach (discussed further in "Wilderness Breach Features") provides a relatively narrow window of exposure for Great South Bay, and the shallower waters will break any waves that enter the wilderness breach over the flood tidal delta. While aerial photographs suggest the flood tidal delta is increasing in size, existing data suggest that the wilderness breach is not acting as a sediment sink. Further volumetric change analyses on bathymetric data from the flood delta suggests that this may be the result of reworking of deposits and addition of sediment derived from channel deepening rather than the import of sediment from the ocean side of the system. This dampening further reduces possible erosion that could occur in Great South Bay as a result of the wilderness breach.

Geomorphology

Shoreline Features. Geomorphic surveys have been performed parallel and perpendicular to the shoreline to capture the base of the dune, the mid-beach, and the upper and lower foreshore along the length of Fire Island west of the wilderness breach. The average net shoreline movement from immediately before Hurricane Sandy to the most recent September 2015 survey was erosional, with an average movement of -12 meters. While the net shoreline response shows distinct zones of erosion and accretion along the length of Fire Island, there is no indication that the wilderness breach is creating a change in erosion or sand deposition west of the breach. Rather, the wilderness breach appears to be responsible for localized erosion immediately west of the opening, but this erosion does not extend further than 1 kilometer west of the breach.

Wilderness Breach Features. Flood shoals formed inside Great South Bay as a result of the wilderness breach and showed rapid initial growth in the first winter after Hurricane Sandy, importing large amounts of sediment from erosion of the adjacent barrier islands. Following the winter of 2013, growth of the flood shoals stabilized. As previously discussed, although these shoals appear to have increased in size in aerial photographs, this may be the result of reworking of deposits rather than the import of sediment from the ocean side of the system.

Changes in the geomorphology of the wilderness breach have been documented using surveys of the breach cross-sectional area, width, depth, and location. Bathymetric surveys conducted by US Geological Survey and Stony Brook University between December 2012 and August 2015 show that the cross-section increased during the first 2 years after the wilderness breach formed, then decreased somewhat during 2015. The inlet maximum depths have ranged from 3 to 7.5 meters NAVD88[3] and the location of the wilderness breach centerline has migrated approximately 200 meters to the west since initial formation. Data from July 2015 indicate the cross-sectional area of the wilderness breach is approximately 450 square meters.

The wilderness breach is a dynamic system with the potential for continued changes in breach geomorphology. There is general agreement between experts that storm activity could result in widening, but uncertainty as to the stability of the breach in a wider configuration. Primary controls on breach migration are thought to be based on barrier beach geology documented in US Geological Survey unpublished sediment cores, which show erosion-resistant clay in the barrier island located approximately 1.5 kilometers west of the wilderness breach centerline and in the marsh resource 0.5 kilometers east of the breach. The breach has been monitored since it formed in 2012. Based on these data and the professional judgment of scientists studying the breach (Methratta et al. 2016), the evolution and migration of the breach within the boundaries of these geologic controls is understood.

WATER QUALITY

Water quality describes the physical and biological parameters in a waterbody that influence the abundance and distribution of upper trophic level organisms, including nutrient concentrations, salinity, temperature, dissolved oxygen levels, phytoplankton, and harmful algae.

Water quality in Great South Bay is influenced by mixing between fresh and marine waters through the tidal inlets. The wilderness breach has the potential to change bay water quality by increasing tidal and subtidal flushing. Key estuarine water quality parameters such as temperature and salinity are partially controlled by the extent of tidal and subtidal flushing, and these parameters are important factors that influence the bay ecology.

Suffolk County began monitoring the physical water quality parameters of Great South Bay, including salinity and temperature, in 1976. Stony Brook University has been measuring a full suite of physical parameters for tracking water quality in the bay since 2005. These monitoring efforts are described in detail in the technical synthesis report (Methratta et al. 2016) and summarized in this section.

Temperature. Water temperatures in Great South Bay vary seasonally. Prior to the wilderness breach, summer surface water temperatures of the bay are 25 to 26°C, with occasional measurements

[3] NAVD88 refers to the North American Vertical Datum of 1988. A datum is a set of constants specifying the coordinate system used for geodetic control (i.e., for calculating coordinates of points on the Earth). NAVD88 is used for vertical control surveying in the United States.

up to 29°C. Wintertime data of 0 to 2°C were common. Comparison with data collected after the wilderness breach shows that summer temperatures are somewhat cooler, while winter temperatures do not seem to be affected by the breach. Summer water temperatures have decreased as much as 3°C in the Bellport Bay, Narrow Bay, and western Moriches Bay since the wilderness breach formed. However, these data are inconclusive, as water temperatures in Great South Bay are mostly dependent on air-sea interactions rather than bay-ocean exchange.

Salinity. Salinities in the bay are greatly influenced by the influx of groundwater, rainfall, wind stress, and location. Areas closest to the inlets have the highest salinities and areas along the northern shoreline closest to streams and areas of groundwater influx have the lowest salinities. In general, salinities are the lowest in the northeast and north central areas of the bay, and increase toward the western end of the bay and Fire Island Inlet. Before formation of the wilderness breach, average salinities typically ranged from 25 to 30 practical salinity units, except near Bellport where values were between 20 and 25 practical salinity units. Since formation of the wilderness breach, average salinities in the eastern half of the bay have increased. This is attributed to the influx of seawater coming through the wilderness breach.

Residence Time. Residence time, as discussed here, is the amount of time water spends within a system. Residence times for Great South Bay have been estimated using modeling. Without the wilderness breach, residence time was estimated to be 96 days, and with the presence of the breach, the modeling showed a residence time of 40 days. This estimate suggests that flushing characteristics in Great South Bay would be enhanced by the wilderness breach. However, flushing would not be uniform across the bay, with potential residence times considerably greater in the northern portions of the bay near the mainland and lower in the southern reaches. This is demonstrated through modeling for the Bellport Bay area near the wilderness breach, which showed a decrease in residence time from 25 to 10 days. A decrease in residence time means that materials such as excess nutrients would spend less time in the system.

Nitrogen. Prior to the wilderness breach, areas of the bay system more distant from the two existing inlets generally had higher nutrient levels than areas closer to inlets due to increased exchange of oligotrophic ocean water through the inlets. Recent research suggests that farms within the watershed of the bay contribute high nitrogen loads that influence nutrient concentrations, particularly in areas of Great South Bay that are far removed from oceanic water exchange. After the wilderness breach formed, total nitrogen concentrations decreased in the areas of Bellport Bay, Narrow Bay, and western Moriches Bay, due to the dilution of the nutrient rich estuarine water with oceanic water.

Dissolved Oxygen. Prior to the wilderness breach, dissolved oxygen monitoring showed similar conditions from the Fire Island Inlet to Bellport Bay; surface dissolved oxygen typically followed expected seasonal trends at the stations in Great South Bay. Data suggests that dissolved oxygen concentrations were variable in the years following the wilderness breach at both the immediate breach area and areas surrounding the breach. Despite some improvements in daytime dissolved oxygen, nighttime dissolved oxygen levels in North Bellport Bay are still capable of reaching anoxic levels since the wilderness breach formed.

Phytoplankton. Phytoplankton, or microalgae, are mostly microscopic, single-celled organisms that live suspended in water and produce energy through photosynthesis. Phytoplankton are primary producers and form the base of aquatic food chains, determine the quality and quantity of food for consumer organisms, and if blooms are excessive, can have a profound negative effect on water quality. Large phytoplankton blooms can limit light availability to seagrass leading to seagrass mortality. Blooms can also cause hypoxia, a condition where the dissolved oxygen in the water column is so low, it cannot support aquatic organisms, leading to mortality in fish and invertebrate populations. Phytoplankton communities are highly variable, responding quickly to changes in light, temperature, and water quality because of their rapid life cycle. Predicting the nature and timing of changes in the phytoplankton is not possible but it is important to describe the phytoplankton communities because they play such an important role in ecosystem structure and function.

Phytoplankton production is extremely high in Great South Bay with one of the highest rates of primary production ever measured. Great South Bay has high levels of inorganic nutrients, high turbidity, and a shallow euphotic zone (<2 meters), all of which shape the phytoplankton community. Areas near inlets tend to have lower phytoplankton production because of active mixing of estuarine waters with ocean water. Proximity to inlets is also associated with larger form algae, which provide higher quality food resources for suspension feeders. Monitoring data show that areas furthest from the inlets had the greatest mean abundance of smaller phytoplankton in each bay, while mid-bay sites had a greater mean abundance of larger phytoplankton, especially stations near inlets. Phytoplankton blooms occur periodically in Great South Bay; however, since the formation of the wilderness breach, there has been a net decrease in phytoplankton in the Bellport Bay area.

Brown Tide. Blooms of brown tide algae occur periodically in Great South Bay, and *Aurecoccus anophagefferens* is the species responsible for these blooms. Brown tides are considered harmful because they can inhibit sunlight penetration, thus limiting the ability for plants such as eelgrass to photosynthesize. Brown tides can also reduce the amount of dissolved oxygen in the water column and are a poor source of nutrition for suspension feeders. These water quality impacts have resulted in decreased submerged aquatic vegetation biomass and reduced hard clam (*Mercanaria mercenaria*) landings in Long Island bay systems. Brown tide incidence appears to be related to nutrient and dissolved organic matter in the water column. First observed in Great South Bay in the 1950s, harmful blooms were infrequent for 30 years after Moriches Inlet opened and duck farming practices were changed. However, since the summer of 1985, the brown tide species *Aurecoccus anophagefferens* has bloomed periodically to disruptive levels. Although there has been a great deal of study on brown tide organisms, predicting the bloom cycle in any given year is not possible.

Brown tides can be characterized by their frequency (how often they occur) and intensity (density or concentration of brown tide cells). Since the wilderness breach formed, there has been a reduction in the intensity of brown tide in eastern Great South Bay in the areas of Bellport Bay and the Narrow Bay. In addition, there has been an increase in the frequency and intensity of brown tide in central Great South Bay. Overall, the frequency of brown tide blooms has increased in Great South Bay since the breach. The increased flushing and decreased water retention time in eastern Great South Bay (Bellport Bay and Narrow Bay) may be alleviating the intensity of brown tide events in these areas. Conversely, more intense brown tide in central Great South Bay compared to eastern Great South Bay may be attributable to increased water retention time in this portion of the bay brought about by new circulation patterns associated with the wilderness breach. However, water quality conditions in central Great South Bay, including pathogen numbers and brown tide intensity and frequency, have been getting worse since the early-2000s; therefore, the recent changes in brown tide intensity in the central bay may not be wholly attributable to changes in circulation patterns related to the wilderness breach.

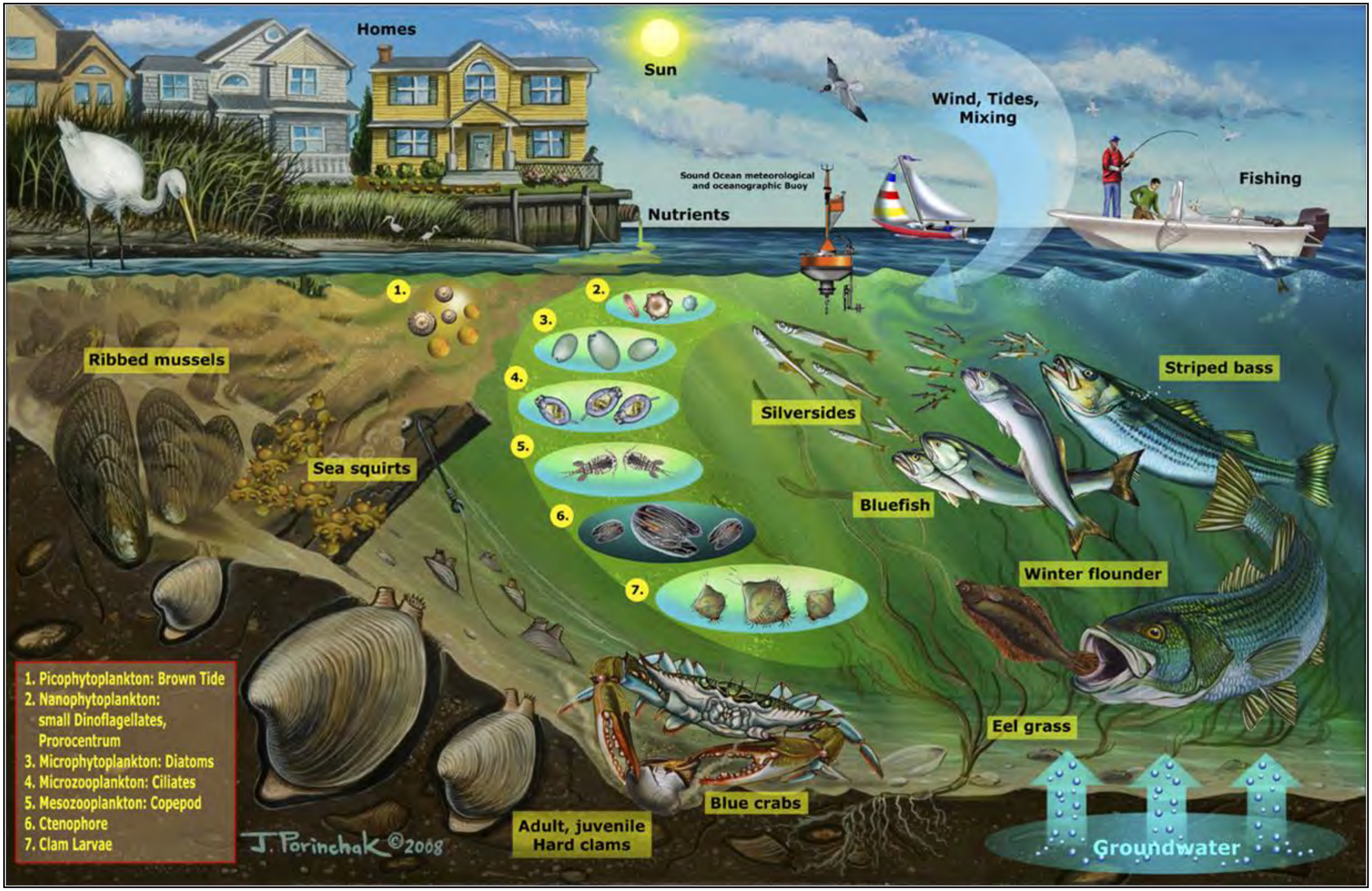
ECOSYSTEM STRUCTURE AND PROCESSES

An ecosystem includes the ecological community together with its environment, and the health of an ecosystem can be described as a complex measure of system resilience and organization. A change in population size of one species, taxa, or functional group, will have direct effects on groups of species to which it is directly linked in the food web, and indirect effects on potentially many more groups of species through diffuse food web linkages. Figure 10 provides an illustration of the exchange of energy and nutrients among organisms that occurs through trophic relationships.

Prior to the wilderness breach, ecosystem maturity in the bay had declined over the last 120 years, but the formation of the breach has triggered an increase in ecosystem maturity in Great South Bay. This is demonstrated by direct evidence showing an increase in several attributes of ecosystem maturity, including total biomass and species diversity due to greater connectivity with the ocean. Several other attributes of ecosystem maturity including an increase in food web complexity, diversity of feeding relationships, upper trophic level predators, and migratory fish species are also possible, but there are not yet any data to indicate that these factors have increased. More mature ecosystems are healthier, more stable, and more resilient to disturbance. The Great South Bay ecosystem is home to a diverse array of fauna and flora that interact dynamically in the variety of habitats in the bay, and a suite of processes that operate in the system such as nutrient cycling and decomposition.

The wilderness breach produces conditions in which water is freely exchanged between Great South Bay and the Atlantic Ocean. The mixing of bay and ocean waters creates bay conditions with increased salinity, higher flow, more moderate temperatures (cooler in summer, warmer in winter), and an increased exchange of organisms with the ocean.

Submerged aquatic vegetation can improve water quality by absorbing wave energy and nutrients, producing oxygen, improving water clarity, and aiding in the settlement of suspended sediment in water. Submerged aquatic vegetation also performs other ecological functions, such as providing habitat for fish and shellfish that protects them from predators and providing food for waterfowl, fish, and mammals. The presence of submerged aquatic vegetation is an indicator of estuarine health and good water quality. The two submerged aquatic vegetation species in south shore estuaries of New York are eelgrass (*Zostera marina*) and widgeongrass (*Ruppia maritima*). Eelgrass provides habitat that serves as refugia for small fish and crustaceans, substrate for epiphytes and grazers, and preferred habitat for economically important species, including bay scallops (*Argopecten irradians*). Eelgrass is also officially designated as essential fish habitat for several interstate and federally managed fish species including summer flounder (*Paralichthys dentatus*), which supports the most economically important recreational fishery in New York. Field studies of eelgrass communities show that both distance from eelgrass in estuaries and biomass of the eelgrass have a pronounced effect on the composition of the associated community of fishes, decapods, and crustaceans. Widgeongrass is more opportunistic and grows in shallower waters where higher temperatures would not allow eelgrass to survive. Widgeongrass is a source of food and refuge for aquatic species; however, because it is shorter than eelgrass with thinner leaves, it likely provides fewer ecological services (e.g., wave attenuation and particle trapping).



Source**:** Gobler, Collier, and Lonsdale 2014

FIGURE 10. FOOD WEB STRUCTURE OF GREAT SOUTH BAY

Overall, seagrass is in a state of decline in Great South Bay, and there has been a decline in eelgrass, specifically. Prior to the wilderness breach, surveys showed a significant reduction or complete removal of the eelgrass beds in some areas where eelgrass was historically abundant (e.g., the eastern bay in the town of Brookhaven and the shallows around east and west Fire Island). In other areas, such as the shallow areas between Watch Hill and Smith Point, widgeongrass was growing in habitat previously occupied by eelgrass. Hurricane Sandy caused significant overwash of sandy sediment and a shift of sandbars and a change in water quality. The water in the immediate vicinity of the wilderness breach is currently more marine in nature due to mixing with seawater, more moderate in temperature, and contains more oxygen. The more ocean-like conditions, including clearer water with better light penetration, higher salinity, more moderate temperatures including cooler summer temperatures, favor eelgrass. For eelgrass, there has been an increase in percent cover between 2009 and 2015 in certain areas just east of the wilderness breach where water quality has improved. Widgeongrass density has increased at 14 sites and decreased at 16 sites between 2009 and 2015; however, the direction of change has not been uniform throughout.

Other habitats such as marshland, and the sediments on the bay bottom provide unique spatial resources for fauna at Great South Bay. Marshes provide habitat for shellfish and foraging habitat for shorebirds. Sand and mud sediments support unique benthic communities. In addition to the potential for expansion of eelgrass, there is also potential for new marsh habitat to develop in newly formed flood tide deltas and overwash areas that provide platforms on which marsh vegetation is likely to become established, given appropriate elevation and available propagules. These new flood tide deltas have the potential to support new marshes, which has occurred historically in other overwash areas throughout Great South Bay. The formation of the wilderness breach has contributed to the expansion of eelgrass beds, which in turn have been associated with increased fish and invertebrate production. There is potential for marsh habitat expansion on the developing flood tide deltas, which could likewise provide new habitats for floral and faunal species.

Changes in species composition in the areas affected by the wilderness breach have been reported; however, the long-term impact on these shifts on ecosystem function is not yet understood. Specific changes in submerged aquatic vegetation, benthic, decapod crustacean, and finfish communities since the wilderness breach are detailed in the following sections. Although there has been an improvement in some aspects of ecosystem maturity and ecosystem health since the formation of the wilderness breach, it is not known whether other ecosystem functions will also recover, such as consumption by upper trophic levels or suspension feeding and its impact on water clarity.

BENTHIC COMMUNITIES

Benthic communities considered within this draft Breach Plan/EIS include animals (e.g., mussels, clams, polychaetes) living in or on the sediment surface in subtidal and intertidal areas of Great South Bay. The wilderness breach has changed the benthic community environment. Past studies of the benthic communities in Great South Bay were used to characterize the benthic communities in the region, since there are no pre- or post-breach benthic community data in the immediate vicinity of the wilderness breach. However, there are pre- and post-breach data on the hard clam (*Mercanaria mercenaria*), so this species is discussed in more detail in this section. The hard clam is also a species of great historical and functional significance to the region, because of its role as a suspension feeder, and its value as a fishery.

Benthic communities near Fire Island Inlet and Moriches Inlet have been described as "characteristic of a high salinity, high flow habitat." The most abundant species in these near-inlet areas include blue mussel (*Mytilus edulis*), northern dwarf tellin (*Tellina agilis*), polychaetes (*Nephtys picta* and *Nereis arenaceodentata*), hermit crab (*Pagurus longicarpus*), lady crab (*Ovalipes ocellatus*), and the sea star (*Asterias forbesi*). In contrast, areas further from the inlets had benthic communities that were more estuarine and less salt-tolerant in character and included polychaetes (*Sabellaria vulgaris* and *Trichobranchus glacialis*), snails (*Rictaxis punctostriatus* and *Acteocina canaliculata*), bivalves (*Mercenaria mercenaria, Mulinia lateralis*, and *Gemma gemma*), sand shrimp (*Crangon septemspinosa*), and blue crab (*Callinectes sapidus*).

Salinity and sediment type are drivers of benthic community composition. For example, the bivalve *Tellina agilis*, which prefers saltier water, was widely distributed in western Great South Bay waters but absent from eastern Great South Bay water; in contrast the razor clam (*Ensis directus*), which is less salt-tolerant, was abundant in Brookhaven waters but totally absent from western Great South Bay. Macrofaunal abundances were found to decrease with increased sediment grain-size. The pre-breach benthic subtidal community in Great South Bay in unvegetated areas was described as diverse, highly affected by proximity to inlets, and strongly associated with sediment type.

Epibenthic communities (e.g., crab, shrimp) are often associated with vegetation. Vegetated subtidal areas on the bay side of Fire Island provide habitat for a number of epibenthic species. Common species found in areas with submerged aquatic vegetation in Great South Bay, Moriches Bay, and Shinnecock Bay included green crab (*Carcinus maenas*), Atlantic mud crab (*Panopeus herbstii*), eastern mudsnail (*Ilyanassa obsoleta*), grass shrimp (*Palaemonetes vulgaris*), golden star tunicate (*Botryllus schlosseri*) and red beard sponge (*Microciona prolifera*). Submerged aquatic vegetation beds were found to have a diverse epibenthic community (50 species overall).

Intertidal benthic communities on the bay side of Fire Island are shaped by frequent wetting and drying. Oligochaeta, Nematoda, Nematomorpha, *Corophium* sp. (a burrowing amphipod), and *Gemma gemma* (amethyst gem clam) were the dominant species found in this habitat. Other common groups found in the intertidal included insects, bivalves, annelids, and amphipods.

Change in Benthic Communities After the Wilderness Breach

In general, it is likely that the benthic community in proximity to the wilderness breach has changed to more closely resemble benthic communities that occur in the vicinity of existing inlets due to increases in salinity, water flow, sediment grain size, and cooler summer water temperatures. Populations of mobile, short-lived species in this area are likely to have changed rapidly, while populations of long-lived species including hard clams are expected to show slower changes, as described below in the “Hard Clams” section. The wilderness breach caused burial of certain intertidal and subtidal communities where flood tide deltas have formed. Formation of new habitat occurred and may have led to a shift in epibenthic species composition in the immediate vicinity of the breach. For example, a potential shift from blue crab to lady crab associated with changes in salinity has been reported as discussed in the “Finfish and Decapod Crustaceans” section.

The wilderness breach also created an opportunity for blue mussel populations to develop in this area due to preference for high salinity and cooler temperatures. Blue mussels were common in the Old Inlet area during the early 1800s in the same time period when Old Inlet was open. Changes in epibenthic communities may have also occurred after the wilderness breach formed; low numbers of shrimp were found in submerged aquatic vegetation beds near the wilderness breach in 2014. The low shrimp numbers were thought to be associated with high predation rates from the greater presence of foraging fish, which likely entered the area from marine waters.

Hard Clams

Hard clam populations in Great South Bay fluctuated throughout the 1900s, peaked in the 1960s and 1970s, and have since declined. Poor environmental conditions and overharvesting have been the primary drivers of this population loss. Depressed clam density has contributed to lower rates of successful spawning and reproduction. The loss of hard clams from Great South Bay has also meant a loss of the crucial ecosystem function of water filtration and water quality improvement that hard clams once provided through suspension feeding, their mechanism for obtaining food resources which has had a direct impact on water quality in the bay.

Comparison of Hard Clams Before and After the Wilderness Breach

Several factors that affect hard clam growth and reproduction have been affected by the wilderness breach, mainly the availability of high quality food resources (i.e., large cell phytoplankton ≥5 micrometers) for hard clams and water temperature (optimal range for clam growth between 20 and 23°C; Stanley 1983). Sufficient food resources are essential for clam growth and reproduction. Brown tide algal blooms can cause severe food limitation; small form algae, *Aureococcus anophagefferens*, is a poor food source for suspension feeding bivalves like hard clams. See the "Water Quality" section for a discussion on brown tides. Two blooms in the same year can be devastating for hard clams, sometimes affecting more than one spawning season.

Increased exchange of water through the wilderness breach may have led to decreased summer water temperatures in Bellport Bay, Narrow Bay, and western Moriches Bay, which has the potential to moderate summer and winter temperatures. Hard clams may be negatively affected when the temperature reaches above or below the optimal range for this species. However, it should be noted that some data indicate that the impact of the wilderness breach on water temperature is inconclusive. The important role of food limitation and temperature for hard clam growth was demonstrated in a pre-breach study in Great South Bay. The results of this study provided strong field-based evidence for the effect of food availability and temperature on hard clam growth rates in Great South Bay.

Predation can exert a strong top down control on clam populations. Predation on invertebrates can increase near inlets where environmental conditions allow for marine predators as well as high salinity tolerant estuarine predators to occur. Given that the wilderness breach has created a new gateway through which ocean predators can enter Great South Bay, increased predation on hard clams may be expected within areas of Great South Bay that are affected by the marine influence.

Salinity may also play a role in hard clam distribution patterns. Increased salinity in Great South Bay caused by the influx of ocean water through the wilderness breach could have negative effects on hard clam populations if the range of optimal salinity for survival is exceeded, although there are no recorded incidences of this. Additionally, high salinity water favors the growth of QPX (Quahog Parasite Unknown), a hard clam parasite.

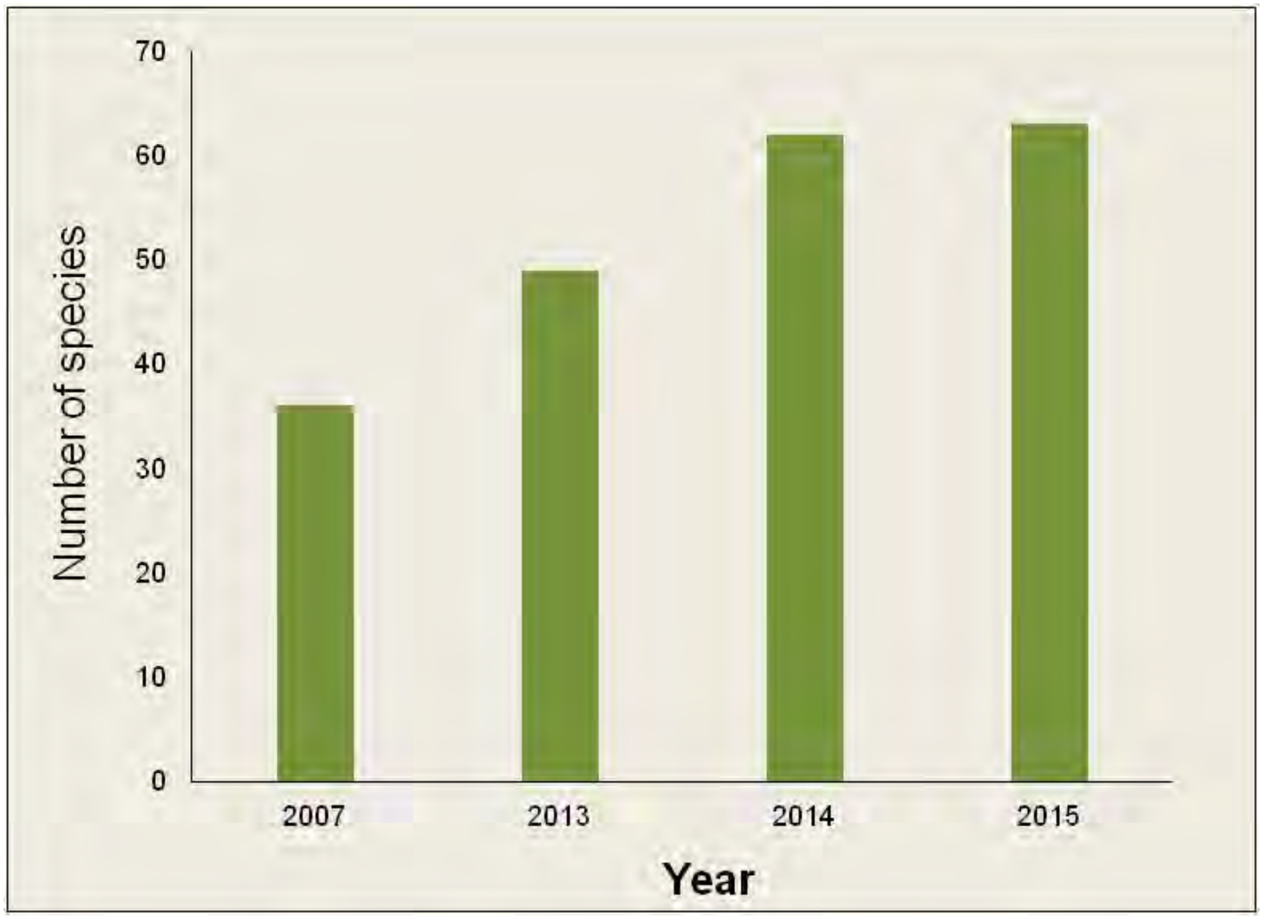
FINFISH AND DECAPOD CRUSTACEANS

Great South Bay is a shallow, well-mixed lagoon ecosystem that supports numerous finfish and decapod crustacean species (e.g., crabs and shrimp). Changes in the abundance and distribution of salt water species including finfish and decapod crustaceans in Great South Bay have occurred since the wilderness breach formed, particularly in the areas of the bay affected by the influx of ocean water. These changes are evident from comparisons made between faunal surveys conducted in the decade prior to the wilderness breach and surveys conducted after the wilderness breach formed.

Comparison of Finfish and Decapod Crustaceans Before and After the Wilderness Breach

Great South Bay has undergone significant shifts in ecosystem structure and function since the 1880s from one that is biologically and trophically diverse, to one that has fewer upper level finfish and reduced food web complexity. The movement of more saline water into the bay may be improving the water quality (see the “Water Quality” section), allowing for the movement of higher trophic level fish into Great South Bay. This pattern has been emerging since the wilderness breach formed in October 2012. Great South Bay has experienced an increase in species richness and in marine species since the wilderness breach formed in areas where water temperature has reportedly decreased and salinity has increased due to an influx of ocean water, namely Bellport Bay, Narrow Bay, and western Moriches Bay. Overall, there was an increase in species richness of fishes from 35 to 60 species (figure 11), and a change in species composition after the wilderness breach formed. There was an 80% decline in the blue crab, which is a more estuarine species, and a 500% increase in the lady crab, which prefers marine environmental conditions. Similarly, squid, butterfish, and bay anchovy (*Anchoa mitchilli*) catch per unit effort increased; however, it is not known whether these changes in catch size are associated with the wilderness breach.

Finfish abundance prior to the breach was recorded at sites in Great South Bay, Moriches Bay, and Shinnecock Bay. In 2003, the numerically dominant fish species included the fourspine stickleback (*Apeltes quadracus*) (32%), Atlantic silverside (*Menidia menidia*) (16%), and blackfish (*Tautoga onitis*) (15%). In 2005, Atlantic silversides (26%), bay anchovy (16.5%), and Atlantic tomcod (*Microgadus tomcod*) (13.9%) dominated. Seasonal trends for abundance and species richness followed expected patterns for both years, with lower values in the early spring and a peak in the late summer/early fall. This reflected an influx of fish into the bay as rising temperatures warm bay waters.



Source: Frisk et al. 2015

FIGURE 11. NUMBER OF SPECIES COLLECTED IN GREAT SOUTH BAY TRAWL SURVEYS PER YEAR

After the wilderness breach formed, the relative abundance of fish near and east of the breach increased. Sites near Old Inlet and at Pattersquash in Moriches Bay had higher finfish abundance compared to three other sites ranging geographically from Great South Bay to Moriches Bay. The most common species collected included bay anchovy, silverside, three-spine stickleback (*Gasterosteus aculeatus*), killifish (*Fundulus* spp.), and pipefish (Syngnathinae). The abundance of some migratory finfish species was also found to increase. For example, long-term data collected indicates that the anadromous (migrating from salt water to spawn in fresh water) alewife (*Alosa pseudoharengus*) returns at Carmans River have increased since the wilderness breach formed, which could be due to alewife entering Great South Bay through the wilderness breach. Glass (juvenile) eel abundance was notably higher during 2012 and 2013 as compared to the previous nine years; however, glass eel abundance declined in 2014 and 2015. Although increased numbers of glass eels during the 2013 survey could be associated with conditions caused by the wilderness breach, similarly high numbers were recorded in the spring 2012 survey, which pre-dated the wilderness breach. Therefore, it is not clear whether the wilderness breach affected glass eel abundance at Carmans River.

Habitat for freshwater and brackish water species has declined in close proximity to the wilderness breach since it formed. The distribution and abundance of aquatic organisms is closely tied to their salinity preferences. Estuarine species that prefer freshwater or brackish water have declined in the areas of Great South Bay that receive higher salinity water from the ocean. As noted above, an 80%

decline in blue crab occurred after the wilderness breach formed; however, it is not known whether this change is associated with the wilderness breach. Blue crab prefers estuarine salinity conditions; therefore, it is possible that blue crabs have retreated to more brackish salinity water in the tributaries, but no data are yet available to determine this.

Submerged aquatic vegetation provides habitat for finfish and invertebrates. Since the wilderness breach formed, the clearer, cooler water caused by the open exchange of ocean water into Great South Bay has promoted the rapid recovery of eelgrass beds particularly in areas just east of the wilderness breach. Eelgrass provides high quality nursery habitat for juvenile fish and also refugia from predation for juveniles and adults. After the wilderness breach, increasing fish abundance was found in beds of eelgrass and higher densities of juvenile summer flounder and tropical species with higher salinity preferences in eelgrass beds adjacent to the wilderness breach.

Invertebrates might experience high predation by finfish near the wilderness breach. Pre-breach studies demonstrated an inverse relationship between finfish and invertebrate abundance at certain locations. For example, invertebrates were found to have greatest abundance where fish abundance was lowest which may suggest that low fish abundance translates to lower predation on invertebrates in these locations. After the wilderness breach formed, lower grass shrimp (*Palaemonetes pugio*) densities were observed near the wilderness breach where higher fish densities were also observed, which could be driving down shrimp abundance.

PUBLIC HEALTH AND SAFETY

There are nine fire departments serving the 17 communities within the boundaries of the Seashore on Fire Island. Six of the communities have medical clinics; however, those clinics provide limited services and are not adequate for most medical emergencies. The western communities (Kismet to Fire Island Pines) inherently incur the majority of medical and law enforcement incidents due to the higher number of residents and visitors within the communities.

Emergency medical services on Fire Island are provided by the NPS rangers, the Suffolk County Police Marine and Aviation Bureaus, and the members of the nine Fire Island volunteer fire departments. All have varying levels of emergency medical services certifications, ranging from first responder to paramedic. The Saltaire, Fair Harbor, and Ocean Beach Fire Departments each have an ambulance and can provide advanced lifesaving patient care and transport.

Emergency medical responses are coordinated through the Emergency 911 notification system and the Fire Response and Emergency Services call-out protocols. Police, fire departments, and commissioned park rangers can communicate via radio and monitor each other's communications for emergency notifications. Currently, the National Park Service does not track the annual number of law enforcement, fire, and emergency medical service incidents of the Seashore's cooperating agencies but understands the operations and response protocols to an emergency.

Almost all medical transports are by boat or by helicopter. The Suffolk County Police Department Marine and Aviation Bureaus provide medical transport for incidents within the Seashore. Except for the most severe emergencies, transports take place via designated landing zones. There are six designated helicopter landing areas. These are the ball fields in Saltaire, Ocean Beach, and Ocean Bay Park and the helipads located at Saliors Haven, The Fire Island Pines, and Watch Hill. If a helicopter is not available due to weather or another incident, Suffolk County Police will transport the patient via vessel to Timber Point on Long Island where an ambulance will be waiting to transport the patient to the appropriate hospital.

During the off-season, emergency access by police, medical responders, and public utilities on Fire Island is made possible via the Robert Moses Causeway and the William Floyd Parkway bridges on either side of the Seashore. During the summer, this is generally not practical due to the heavy visitation and vehicle traffic.

Law enforcement and emergency services operations have not changed since Hurricane Sandy and the creation of the wilderness breach; however, the breach has had a small impact on how law enforcement responds to Davis Park and Water Island by altering the route Suffolk County Police units use to access the eastern communities. Prior to the wilderness breach, law enforcement access by vehicle to Davis Park and Water Island was from the east at Smith Point County Park and the Wilderness Visitor Center. Since the formation of the breach, Suffolk County Police gain access through the western end of Fire Island.

FLOOD CONDITIONS

In the years following Hurricane Sandy, several studies were performed in the Great South Bay to collect data and evaluate the post-Hurricane Sandy ecosystem response. These data have been incorporated into numerical modeling efforts, which use the collected data to provide computer-based mathematical simulations to simulate potential outcomes. Mathematical models are useful tools used to improve our understanding of complex processes. Two modeling efforts were examined for use in this draft Breach Plan/EIS, as presented in the following paragraphs. Detailed descriptions of these models, methodologies employed, and final outputs are provided in the technical synthesis report (Methratta et al. 2016).

Examining Changes in Breach Morphology and the Impacts on Neighboring Areas. The US Geological Survey post-breach modeling was conducted by Deltares with the required geospatial data provided by the US Geological Survey. Models capable of predicting stability of future breaches on Fire Island or other similar environments were also developed. The US Geological Survey model provides information on potential water level changes and changes in the width of the breach.

Evaluating Storm Surge Elevation under a Range of Storm and Breach Scenarios. The 2006 USACE report, *Baseline Conditions Storm Surge Modeling and Stage Frequency Generation: Fire Island to Montauk Point Reformulation Study* (hereafter "Storm Surge Model") details the modeling effort. The USACE Storm Surge Model is a numerical model of physical processes for the south shore of Long Island. This hydrodynamic modeling effort was initially completed in support of the Fire Island Inlet to Montauk Point Reformulation Study. The Storm Surge Model incorporated a wide array of physical processes, such as winds, barometric pressure, astronomic tides, and waves. Individual models capable of simulating hydrodynamics, waves, and sediment transport were used collectively to evaluate surge elevation in Great South Bay and surrounding areas under a range of storm and breach scenarios. The USACE modeled potential changes in peak water levels in the Great South Bay and surrounding properties. Since tidal changes can also contribute to flooding issues, modeling efforts using tide gage data were performed to evaluate possible breach-related changes in the timing and return frequency of tides. Based on this information, models were used to develop stage frequency curves, which are used to predict peak water levels expected under different storm event scenarios. Stage frequency curves were developed for the open breach condition based on a severe storm scenario known as a 100-year return period storm event. These storms have a 1% or less chance of returning in a given year.

Evaluating Breach-Relevant Storm Surge Elevation to Predict Potential Flood Risk with and without the Breach. In 2015, at the request of the US Army Corps of Engineers, Moffatt and Nichol validated and adapted the existing USACE Storm Surge Model (2006) to incorporate the 2014 breach open condition at the wilderness breach, as described in the technical synthesis report (Methratta et al. 2016). The model was adjusted to account for the influence of the wilderness breach and its impact on storm and non-storm tides within the bays. The information provided from this analysis was then used as the baseline condition in modeling efforts for the USACE General Reevaluation Report and subsequent economic damage analyses (2016).

Moffatt and Nichol (2015) modeling effort used the 2014 breach open condition to develop updated flood hazard predictions based on the same three storm frequency scenarios for comparison to breach closed flood hazard scenarios. Stage frequency curves were developed for the open breach condition based on a 100-year return period storm event. Based on concerns that the breach could expand its footprint at some point in the future, the final component of the modeling effort evaluated the potential flood hazard differences based on various breach dimensions. These data were then used to evaluate potential effects of the wilderness breach on bayside flood extent under each scenario, as discussed later in this chapter and summarized below. This model represents the best available science and therefore is used in this draft Breach Plan/EIS for evaluating and predicting potential future flooding scenarios based on currently available data.

Model Assumptions

Each of the models was developed based on numerous assumptions, some of which include: physical data input for storm conditions and future erosion potential as well as associated impacts to shoreline and dune profiles. The model assumes that future storms will occur within the study area in a similar manner to those that have occurred and been documented in the past. Each of the models utilized data output from other models, such as SBEACH and Delft3D. Within each of those models, additional assumptions were made.

Model Limitations

Flood dynamics in a coastal environment are shaped by a variety of physical processes often driven by storm events. As such, the physical features of the breach (i.e., breach dimensions) and adjacent bay systems are highly sensitive to storm events. Although reviews of past storm events can provide some predictive capability regarding potential future storm scenarios, uncertainties surround such predictions due to natural climatic variabilities and potential impacts from climate change. Further, the duration and evolution of previous breaching events in the immediate area of the wilderness breach can provide approximations for the lifespan of this breach, but this is not an overly reliable substitute, as environmental conditions in this area are constantly adapting to global and regional changes. Predicting flooding in a coastal barrier system is difficult due to the naturally dynamic processes that shape and define these systems. As such, predictions based on potential future scenarios include a degree of uncertainty regarding the type and severity of storm events. This directly affects the ability of the model to predict future flooding scenarios accurately.

The flood modeling effort performed by Moffatt and Nichol (2015) was specifically focused on validating the existing USACE Storm Surge Model (2006) and to adapt and validate the model for the breach open condition due to the existing wilderness breach. The validated data was then compared to pre-breach opening model data from 2006 to evaluate the flooding impacts associated with the wilderness breach. The model predictions showed general agreement with flooding predictions from the previous model effort. One limitation of the model is that it did not incorporate or evaluate the impact of the presence of the flood and ebb shoal deltas. The model was also incapable of evaluating potential changes in breach width over time, and assumed that the position and limits of the breach were fixed or stationary.

Modeling Results

Storm Surge Elevation. Modeling results indicate that the post-breach changes in daily peak high water levels based on normal tides and small surge events, for both observed and predicted data, are small when compared to the total water level variations that typically occur within the system. At the far western end of Great South Bay and Hempstead Bay, data indicate that daily peak high water levels have not been affected by the breach. Furthermore, results under the *high water levels and small storm surge levels* scenario are in general agreement with the *small surge events* scenario, indicating that water levels and associated flood risks in Great South Bay have been minimally impacted by the breach (Moffatt and Nichol 2015).

Under the *high water levels and small storm surge levels* scenario, daily peak water and surge levels in Hudson Bay (located in the far western end of the system) were not affected by the breach. Lindenhurst, which is near the western end of Great South Bay, showed an increase of between 2.0 and 2.5 centimeters in daily peak high water levels and an increase of 4.2% in surge levels during model runs. At Bellport, which is near the eastern end of Great South Bay, there was an increase of 0.3 centimeters in peak water level and an increase of 1.3% in surge levels related to storm events with the breach open, both of which contributed to peak high and low water levels occurring approximately 35 minutes sooner than under pre-breach conditions. These data are consistent with results from the Deltares modeling effort (Methratta et al. 2016; van Ormondt et al. 2015) which used real-time, field data collected during the time period from Hurricane Sandy in October 2012 to June 2014. The Deltares model of field-collected data suggests breach-related increases in peak water levels were less than 10 centimeters regardless of location within the bays.

Results of both modeled and measured data suggest that the presence of the breach may result in small increases in high tide water levels in the western parts of Great South Bay and minimal changes in the central and eastern parts of the bay. However, subject matter experts believe that these increases in western Great South Bay can be attributed to the maintained Fire Island Inlet. More information is needed to determine the cause of these increases in peak water levels.

A separate analysis was performed to determine the effects of the wilderness breach on peak water levels within the bays, under a *severe storm* scenario represented by the 100-year storm frequency curve. Differences were determined between the peak water levels predicted by the 2006 (pre-breach) and 2014 (post-breach) versions of the 100-year storm frequency curve, which represents the predicted difference in peak water levels resulting from the wilderness breach opening. The results of the comparison indicated predicted increases in peak water levels between 20 to 60 centimeters (7.8 to 23.6 inches) depending on the location within the bays, with the maximum value occurring near the mouth of the Connetquot River in central Great South Bay (Moffatt and Nichol 2015).

Storm Surge Elevation and Changes in Breach Width. Model evaluations of potential breach width changes indicated that expansion of the breach could result in increases in peak high water levels of up to 80 centimeters (31.5 inches) under 100-year return period storm conditions. A 100-year storm is considered a large or extratropical storm. However, the breach width used in the model is much larger than previous or current breach widths, and larger than would be ever be expected to occur, thus producing a model scenario of the worst possible case (Methratta et al. 2016). These model predictions are informative, but are only likely to occur under extreme conditions like those predicted in future climate change and sea level rise scenarios, representing events that are estimated to occur more than 30 years in the future.

Flood Risk. An evaluation of the effect of the wilderness breach on bayside flooding was performed for a range of storms (2-, 10-, 100-year return period storms) using data developed by the US Army Corps of Engineers (2006) and modified to account only for changes in response to the presence of the wilderness breach (Moffatt and Nichol 2015). The comparison evaluated the potential water level, or spatial extent of flooding differences between pre-breach baseline conditions (2006) and post-breach (2014) baseline conditions. The terms 2-, 10-, and 100-year floods are used as a means of providing the estimated probability of a flood event (of a particular size and duration) happening in any given year. The 2-, 10-, and 100- year events are the most frequently used in describing storms and flooding, and correspond broadly to small thunderstorms, severe or tropical storms, and extratropical storms based on their frequency of occurrence and severity of damage.

The comparison identified areas that are most likely to experience increased flooding around Great South Bay and Moriches Bay as a result of the breach open condition. The model comparison of baseline conditions[4] for a 2-year storm event (thunderstorm) predicted a 45.5% increase in flood extent within the project area, primarily affecting lands classified as vacant, open areas, agricultural or recreational. Model predictions for a 10-year storm event (severe or tropical storm) indicated an 8.2% increase in flood extent, a smaller effect in comparison to the 2-year storm flooding. Model predictions for a 100-year storm (large or extratropical storm) predicted a 20.6% increase in flood extent, a smaller flood area impact in comparison to the 2-year return storm but much larger than the 10-year return storm.

The pattern of flooding observed between the return storm events is most likely a result of response to increasing size of flooded area in conjunction with topographic constraints. The additional flood affected acreage is not concentrated in any specific location within the bays or surrounding vicinity. The limit of the flood extent is well-dispersed around the pre-breach flood model, as indicated by measured data and model predictions. Further, model results are also in general agreement with the recently updated (to address post-Hurricane Sandy changes along the coast of New York) Federal Emergency Management Agency Federal Insurance Rate Map coverages, released January 1, 2015, (FEMA CASE 15-02-0537S). As such, the model predicts flooding to occur in the same locations in which the Federal Emergency Management Agency requires flood insurance for the 100-year Flood Hazard Zone. Moreover, land use in the affected area is predominantly agricultural and recreational lands. Regardless, modeling results indicate an increase in water levels with the breach open, and thus an increase in mainland flooding.

However, the models predicted flooding levels that are substantially higher than and contrary to observed, or empirical data.

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[4] Determined by finding the difference in area covered by the 2014 baseline with 2-year storm and the 2006 baseline with 2-year storm.

SOCIOECONOMICS

Several modeling efforts have been completed to evaluate flood risks in response to potential increases in mean high water levels in the proposed study area, as described in the Hydrodynamics and Flood Conditions sections of the technical synthesis report (Methratta et al. 2016). However, only one site-specific model has been developed to evaluate potential damages and economic impacts of future storm events. The 2006 modeling effort by USACE is described in detail in the report, *Baseline Conditions Storm Surge Modeling and Stage Frequency Generation: Fire Island to Montauk Point Reformulation Study* (hereafter "Storm Surge Model") was developed to quantify the inundation, erosion, and wave action related storm damages and storm damage reduction benefits to shorefront areas along the Atlantic Coast of New York, including Fire Island. As described in the "Flood Conditions" section, an updated version of the Storm Surge Model was used to quantify flood extent, structural damage, and economic impacts of potential increases in peak high water levels based on the current conditions in Great South Bay (USACE 2016). The 2016 Storm Surge Model update incorporated some components of the 2015 Moffatt and Nichol modeling effort described in the "Flood Conditions" section. Primarily, hydrologic information from the 2014 breach open condition was used to update the model and establish a new baseline condition representing all existing conditions (USACE 2016).

The model includes regions in the study area that were considered to be at a high-risk to damage from storm events prior to the breach due to their proximity to the bay and major rivers. These regions also include underdeveloped areas, such as agricultural and park lands. All regions at risk of inundation occur within the 100-year floodplain regardless of the presence of the breach. The structures and developed areas located in the study area are susceptible to damage from inundation due to storm water levels, undermining due to storm erosion or shoreline change, and structural failure due to intense force or wave impacts (USACE 2006, 2016). The 2016 Storm Surge Model was used to evaluate potential flooding risks based on the updated baseline conditions. The resulting flood extent data was used to develop a structural damage model, which utilized a life cycle analysis approach to determine flood related damages and resulting economic costs, referred to here as the Economic Model (USACE 2016).

Storm Damage Model and Economic Impact Assumptions

The Economic Model was developed by assigning economic values to the model-estimated damages, resulting in a quantitative assessment of flood-related structural damages to arrive at an economic cost (USACE 2016). The model assumed a 50-year planning period, beginning in the year 2020, to evaluate and quantify impacts from multiple storm damage sources and to capture the effect of predicted sea level rise and associated economic cost increases due to inflation (USACE 2016). One assumption of the model is that future storms would occur within the study area in a similar manner to those historically documented in the region. As such, storm data used in the model was based on existing data from 36 historical storm events, including 14 tropical storms occurring from 1930 through 2001, and 22 extratropical storms occurring between 1950 and 1998 (USACE 2016). Additional assumptions made during model development included the effect of abandonment and rebuilding of damaged structures and the potential storm impacts to shoreline and dune profiles. The model does not include natural and man-made recovery of land and habitat, and it does not include compounding impacts on current negatively-impacted regions within the study area.

Model Limitations

The model was designed to predict flooding and economic impacts from multiple storm damage sources over a 50-year planning period (USACE 2016), and was designed specifically to identify the largest or critical damage occurring from each storm event. One limitation of this approach is that real storms are unique, where one storm event may not cause as much damage as a different storm event, and a single storm event may change in strength and direction over its course of movement. An additional weakness of the model includes the model predicting values for property damages in areas where there would be no damage (as provided in USACE 2016). The model design results in a representation of worst-case scenario flood risk, which is used to develop the economic damages component of the model. The modeling approach for damage extent and frequency of repairs likely resulted in overestimates of property damage.

The modeling effort included predictions of sea level rise rates over a 50-year period that were based on current average sea level rise rates reported in *Climate Change: Impacts, Adaptation, and Vulnerability* (IPCC 2014). Based on current trends in average sea level rise, sea level could increase by up to 0.5 feet over the timeframe addressed by this analysis. Therefore, only two sea level rise scenarios are addressed in this draft Breach Plan/EIS – no change and a change of 0.5 feet in sea level. Since the model used potential sea level rise rates up to 2.0 feet over the 50-year period, as performed by USACE 2006 and Moffat and Nichols 2015, the model may have overestimated sea level rise rates.

Flood frequency curves and other hydraulic data specific to the wilderness breach were developed by Moffatt and Nichol (2015); however, the hydraulic data to predict the impact of the existing breach on bay flood elevations under the full range of future conditions were not available. Developing hydraulic data specific to the wilderness breach or modifying baseline frequency curves to evaluate the 50-year USACE planning scenario would have been prohibitively time and resource consuming, and were not within the scope of the modeling effort (AECOM pers. comm. 2016). Instead, a more conservative approach was taken and the model was developed using a conservative estimate of flooding-related damage to evaluate the potential economic costs of the wilderness breach remaining open. As such, the economic costs of the wilderness breach may be underestimated (AECOM pers. comm. 2016).

The USACE developed the Storm Damage Model to determine if proposed management actions are justified based on a comparison of proposed economic benefits and model-predicted economic damage and associated economic costs. As such, the Storm Damage Model meets the project needs of the USACE, but does not meet the needs of the National Park Service since it does not specifically evaluate the individual effects attributed to the wilderness breach across the 50-year model scenario. The National Park Service needs to estimate actual expected damages specifically attributed to the wilderness breach; however, this model is used in the analysis because it is the best available information on the economic impact of breach open and breach closed scenarios.

Although the model is representative of the best available science, the limitations of the model result in overestimates of risk and economic costs associated with flood and storm damage. As such, data provided by the model should be viewed as representing a worst-case scenario for both flood risks and economic costs of damages to structures.

Affected Environment (Based on Models)

The model was designed to predict flooding and economic impacts from multiple storm damage sources over a 50-year planning period (USACE 2016), and was designed specifically to identify the largest or critical damage occurring from each storm event. One limitation of this approach is that real storms are unique, where one storm event may not cause as much damage as a different storm event, and a single storm event may change in strength and direction over its course of movement. An additional weakness of the model includes the model predicting values for property damages in areas where there would be no damage (as provided in USACE 2016). The model design results in a representation of worst-case scenario flood risk, which is used to develop the economic damages component of the model. The modeling approach for damage extent and frequency of repairs likely resulted in overestimates of property damage.

The modeling effort included predictions of sea level rise rates over a 50-year period that were based on current average sea level rise rates reported in *Climate Change: Impacts, Adaptation, and Vulnerability* (IPCC 2014). Based on current trends in average sea level rise, sea level could increase by up to 0.5 feet over the timeframe addressed by this analysis. Therefore, only two sea level rise scenarios are addressed in this draft Breach Plan/EIS – no change and a change of 0.5 feet in sea level. Since the model used potential sea level rise rates up to 2.0 feet over the 50-year period, as performed by USACE 2006 and Moffat and Nichols 2015, the model may have overestimated sea level rise rates.

Flood frequency curves and other hydraulic data specific to the wilderness breach were developed by Moffatt and Nichol (2015); however, the hydraulic data to predict the impact of the existing breach on bay flood elevations under the full range of future conditions were not available. Developing hydraulic data specific to the wilderness breach or modifying baseline frequency curves to evaluate the 50-year USACE planning scenario would have been prohibitively time and resource consuming, and were not within the scope of the modeling effort (AECOM pers. comm. 2016). Instead, a more conservative approach was taken and the model was developed using a conservative estimate of flooding-related damage to evaluate the potential economic costs of the wilderness breach remaining open. As such, the economic costs of the wilderness breach may be underestimated (AECOM pers. comm. 2016).

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Although the model is representative of the best available science, the limitations of the model result in overestimates of risk and economic costs associated with flood and storm damage. As such, data provided by the model should be viewed as representing a worst-case scenario for both flood risks and economic costs of damages to structures.

Environmental Consequences

4

Wilderness Breach - June 24, 2014

CHAPTER 4: ENVIRONMENTAL CONSEQUENCES

GENERAL METHODOLOGY

This chapter describes the potential environmental consequences of implementing any of the alternatives being considered. It is organized by resource topic and provides a comparison among alternatives based on issues and topics discussed in chapter 1 and further described in chapter 3. In accordance with the Council on Environmental Quality regulations, direct, indirect, and cumulative impacts are described, and the impacts are assessed in terms of context, intensity, and duration (40 CFR 1502.16). This analysis is based on the assumption that the mitigation measures – actions taken to lessen the severity and probability of a potential impact – would be implemented for all of the alternatives.

The information on conditions prior to and after the breach presented in this chapter, unless otherwise stated, is taken from the technical synthesis report (Methratta et al. 2016). It is important to note that although the technical synthesis report contains a large amount of data from both before and after the breach, 3 years of data is typically not enough to definitively identify trends in ecological conditions. Some changes have been observed since the breach formed; however, there are not enough data at this time to determine if the changes are wholly attributable to the breach or if other factors are influencing the changes. Additionally, data from prior to the breach are not available or not directly comparable to data from after the breach in all instances. Therefore, the information in the analyses in this chapter was obtained through the synthesis of available data, best professional judgment of park staff and experts in the field, as well as supporting literature, where appropriate. For each resource topic addressed in this chapter, the applicable analysis methods are discussed, including assumptions, and the geographic area evaluated for impacts is identified individually for each resource topic, as the area of influence of the breach changes with the resource being considered.

ANALYZING CUMULATIVE IMPACTS

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 and reasonably foreseeable future actions, regardless of what agency (federal or nonfederal) or person undertakes such other actions” (40 CFR 1508.7). Cumulative impacts can result from individually minor, but collectively significant, actions taking place over a period of time.

To determine potential cumulative impacts, past, present, and foreseeable future actions and land uses were identified in or near the wilderness breach. Cumulative impacts are considered for all alternatives, including the no-action alternative, by combining the impacts of the alternative being considered with other past, present, and reasonably foreseeable future actions and are presented at the end of each impact topic discussion. Table 4 shows the projects considered in the cumulative impact analysis for each resource.

TABLE 4. PAST, CURRENT, AND FUTURE ACTIONS USED IN ANALYSIS OF CUMULATIVE IMPACTS

Project	Project Description	Impact Topics
Fire Island Inlet to Moriches Inlet Fire Island Stabilization Project (ongoing)	The Fire Island Inlet to Moriches Inlet stabilization project is an expedited approach to complete a stabilization effort independent of the Fire Island to Montauk Point Reformulation Study. The US Army Corps of Engineers, State of New York, and US Department of the Interior have developed the Fire Island Inlet to Moriches Inlet stabilization project, a mutually acceptable one-time stabilization plan along Fire Island, to provide protection until implementation of the larger Fire Island Inlet to Montauk Point Reformulation Study initiative occurs. The Fire Island Inlet to Moriches Inlet stabilization project was developed as an emergency stabilization in response to Hurricane Sandy. The Fire Island Inlet to Moriches Inlet stabilization project was designed to provide for coastal storm risk management from coastal erosion and tidal inundation through construction of a beach berm and dune at various locations along Fire Island, from Fire Island Inlet to Moriches Inlet, New York. These stabilization efforts are one-time placement projects and include no nourishment cycles. The project area stretches from Robert Moses State Park in the west to Smith Point County Park in the east. The purpose of the project is to provide a level of storm damage protection to mainland development protected by the barrier island. The selected design includes beachfill at Robert Moses State Park, Fire Island Lighthouse Tract, all of the communities outside of Federal Tracts, and Smith Point County Park. Beachfill is not included in any Major Federal Tracts, except Fire Island Lighthouse, which was requested by the National Park Service to protect the Lighthouse and the only access road to the communities on Fire Island.	• Sediment Transport and Geomorphology • Public Health and Safety • Flood Conditions • Socioeconomics

Project	Project Description	Impact Topics
Fire Island Inlet to Montauk Point Reformulation Study (current)	The US Army Corps of Engineers has developed *the Draft Fire Island Inlet to Montauk Point Reformulation Report and Draft Environmental Impact Statement* to protect areas along the south shore of Long Island with the potential for flooding, erosion, and other storm damage. Specifically, the Fire Island Inlet to Montauk Point Reformulation Study intends to "identity, evaluate, and recommend long-term solutions for hurricane and storm damage reduction" along the shoreline between Fire Island Inlet and Montauk Point (USACE 2012). The Fire Island Inlet to Montauk Point Reformulation Study takes a comprehensive approach to storm management and replaces the individual storm management regulations and guidance currently in use. Actions could include beach widening, dune creation or enhancement, or breach closure. The study area encompasses approximately 83 miles of shoreline, including the Fire Island National Seashore (Seashore). Communities within the floodplain include the Towns of Babylon, Islip, Brookhaven, Southampton, and East Hampton and incorporated villages. For approximately 35 years, the Secretary of the Interior and the Secretary of the Army have been attempting to achieve a "mutually agreeable" approach to coastal management involving several interim projects in addition to advancing the Fire Island Inlet to Montauk Point Reformulation Study and associated environmental compliance. Through the US Department of the Interior, National Park Service (NPS) staff is working closely with the US Army Corps of Engineers and New York State staff to develop preferred alternatives that comply with NPS policies, the Seashore mission, stakeholder concerns, and management priorities.	• Water Quality • Sediment Transport and Geomorphology • Ecosystem Structure and Processes • Benthic Communities • Finfish and Decapod Crustaceans • Public Health and Safety • Flood Conditions • Socioeconomics
US Fish and Wildlife Service (USFWS) Habitat Restoration Projects (ongoing and future)	The Long Island National Wildlife Refuge Complex comprises 6,500 acres, including nine National Wildlife Refuge Units and one Wildlife Management Area. The US Department of the Interior's Hurricane Sandy Fund will restore salt marsh in Suffolk County, which will help buffer Long Island communities from future storms and sea-level rise. Part of this effort is the restoration of degraded habitat at Wertheim National Wildlife Refuge by addressing tidal hydrology, surface water habitat, invasive species, living shoreline stabilization, and sea level rise. Marsh restoration techniques will restore natural tidal channels, which can reduce the prevalence of invasive reed species. Improved marsh will strengthen shorelines and reduce mosquito production. Access via the boardwalk will greatly enhance monitoring capability and educational opportunities (USFWS 2014b, 2014c).	• Water Quality • Ecosystem Structure and Processes • Benthic Communities • Finfish and Decapod Crustaceans • Public Health and Safety

Project	Project Description	Impact Topics
Suffolk County Wetlands Projects (future)	Suffolk County plans to restore two wetland areas as part of the Vector Control and Wetlands Management Long-Term Plan, which aims to create an effective long-term vector control program including a comprehensive wetlands management component. The restoration of the marsh at Smith Point North County Park in Shirley is designed to improve protection against flooding, storm damage, and to increase resilience to sea level rise for the adjoining community. Approximately 77 acres of tidal wetlands would be restored. Techniques could include ditch filling, conversion of some ditches to tidal creeks, installation of shallow sill connections to impounded waters and possible small pond additions for fish reservoirs. The goal of this project is to replace mosquito grid ditches with tidal channels and fill other ditches. By raising marsh elevation, the conditions for native vegetation will be improved. Proper hydrology and healthy native vegetation can prevent future hydrology and allow sediment to be captured. Construction would take approximately 6 weeks and would occur between October 1 and March 31. Portions of Beaverdam Creek in Brookhaven Hamlet, a tributary to the New York State South Shore Estuary Reserve, will also be restored. This area, formerly productive tidal wetlands, was damaged by the long-term dumping of dredge spoils; however, the Beaverdam site is at or near the correct elevation to support typical marsh vegetation, especially as sea level continues to rise. A tidal channel will be installed through the earthen berm that surrounds the site and into the center of the site to allow for tidal flooding during high tide events.	• Water Quality • Sediment Transport and Geomorphology • Ecosystem Structure and Processes • Benthic Communities • Finfish and Decapod Crustaceans • Public Health and Safety • Flood Conditions
Hard Clam Stocking (ongoing)	In 2008, the Great South Bay Hard Clam Restoration Working Group was established by Suffolk County to develop a sustainable management plan for the Great South Bay hard clam population. Fire Island National Seashore was represented on the working group. The goal of the group was to "reestablish and protect populations of hard clams that are necessary to support ecological, economic, cultural, and recreational values associated with restoration of the Great South Bay." Based on their research, the working group concluded that the hard clam population is generally low and inconsistently distributed in Great South Bay. The current population cannot support commercial clamming within the bay. The primary reason for the diminished population is believed to be water quality. The report concluded that "changes in harvest management, increased and improved recreation, and concerted effort to address the environmental factors that are negatively impacting hard clam growth and survival" are necessary to reestablish and protect the hard clam population in Great South Bay. A large area of the bay targeted by the Hard Clam Restoration Project falls within the boundary of the Seashore. The National Park Service continues to be a partner is this effort.	• Water Quality • Ecosystem Structure and Processes • Benthic Communities • Finfish and Decapod Crustaceans • Socioeconomics

Project	Project Description	Impact Topics
Long Island Intracoastal Waterway Federal Navigation Project (ongoing)	The Rivers and Harbors Act of August 26, 1937, authorized the Long Island Intracoastal Waterway Federal Navigation Project. The existing project provides for a navigation channel 6 feet deep and 100 feet wide from the federally improved channel in Great South Bay, opposite Patchogue, to the south end of Shinnecock Canal. The lengthy project (33.6 miles) traverses the inland waters through Great South Bay, the Bellport Bay, the Narrow Bay, the Moriches Bay, the Quantuck Bay, and the Shinnecock Bay. The channel is maintained by the US Army Corps of Engineers, which performs maintenance dredging as necessary. Dredge materials are typically placed at upland locations after coordination with local sponsors.	• Sediment Transport and Geomorphology • Flood Conditions
New Bridge to Smith Point (future)	The new bridge to Smith Point will be built in approximately the same location as the current bridge. Once construction is complete, the current bridge would be razed. The new bridge would be much taller than the current bridge to allow boats to pass underneath, as opposed to the current drawbridge that causes temporary traffic delays. The bridge would have two lanes, as the current bridge does, but there would be enough space to also allow pedestrians and bicyclists to safely use the bridge. The project will likely require some dredging under the bridge.	• Wilderness Character • Socioeconomics • Public Health and Safety

WILDERNESS CHARACTER

Methodology

A description of the baseline conditions of the wilderness character and qualities is provided in "Chapter 3: Affected Environment." Alternatives were evaluated against this baseline to determine the changes that would occur to each quality under each alternative.

Geographic Area

The geographic area analyzed for impacts on wilderness character is the Otis Pike Fire Island High Dune Wilderness (Fire Island Wilderness).

Alternative 1: Closure Using Mechanical Processes

Under alternative 1, the wilderness breach would be mechanically closed using heavy mechanized construction equipment and sand dredged from the Westhampton borrow area (see figure 3, in chapter 2). Sheet piling or sand-filled geotextile tubes would be placed on either the bay side or ocean side of the breach to diminish tidal flow and sand would be filled in behind it; these structures would be removed after sand placement. All wilderness qualities would be affected for the duration of the construction operations, which would be expected to last less than 3 months.

The *untrammeled, natural, and undeveloped* qualities would be degraded during construction activities due the installation of structural supports (sheet piling or geotextile tubes) and use of mechanized equipment in Fire Island Wilderness. The mechanical closure represents a major manipulation and change to the *untrammeled*, *natural,* and *undeveloped* qualities of wilderness. These adverse impacts would be short-term and would only last for the duration of the construction activities. The sand would be brought to the wilderness breach from the Westhampton Borrow Area approximately 16 kilometers away, and therefore, is considered non-local material. Upon completion of the mechanical closure, the support structures would be removed; however, the placement of the sand would be considered a permanent man-created installation in the Fire Island Wilderness.

The *opportunities for solitude and primitive and unconfined recreation* quality would be degraded during the mechanical closure. The area surrounding the breach would be closed to visitors during construction activities for visitor safety. The noise from the equipment and views of operations would be heard and seen by visitors in adjacent Fire Island Wilderness areas. These impacts would last for the duration of the construction activities.

The *other features of value* (cultural resources and research and education) may be adversely impacted or remain preserved. For cultural resources, surveys would be conducted prior to construction. If cultural resources were discovered, avoidance would be the preferred approach. If cultural resources cannot be avoided, other mitigation to reduce adverse effects would be developed through the section 106 process. Shipwrecks and other submerged resources would likely be outside the Fire Island Wilderness boundary, and therefore not affected.

The Seashore would continue to provide education and interpretation. Breach management may be integrated into education and interpretation opportunities during this period; however, these programs would be conducted at off-site locations. Researchers would not be allowed in this area during active construction for safety reasons; however, data collection could occur while construction is ongoing. Researchers wishing to continue studying the breach would no longer have opportunities to conduct this type of research in this location.

Upon completion of the construction activities, impacts directly associated with these activities would cease; however, some activities would result in permanent changes to the wilderness qualities.

Although the legislation establishing the Fire Island Wilderness does not preclude the repair of breaches that occur, the *untrammeled, natural, and undeveloped* qualities would be permanently degraded after construction activities. The filling of the breach would change the immediate area from a marine/submerged wilderness environment that had been created through natural processes to an artificially created barrier island setting. Although, prior to Hurricane Sandy, the area of the breach was terrestrial land comprising part of the barrier island, this new land form would be considered a newly man-created and permanent terrestrial land mass. Eventually, as vegetation returns, it would have a natural and untrammeled appearance and function with the adjacent terrestrial lands, ocean, and bay as before the breach. Overall, the filled breach would be considered trammeled, unnatural, and developed in perpetuity, resulting in adverse impacts on the *untrammeled, natural, and undeveloped* qualities of wilderness. Unrelated authorized actions that are designed to improve the *natural* quality can degrade the *untrammeled* quality (e.g., removal of non-native species, deer management, mosquito management, and suppression of fire). These activities are currently occurring and would continue after the closure of the breach.

The *opportunities for solitude and primitive and unconfined recreation* quality would be preserved overall with minimal change. There would be a feeling of isolation from the mainland, similar to those described under pre-construction conditions. Access to the Fire Island Wilderness on the west side of the breach would be restored, which could reduce the feeling of solitude for visitors in that area. Greater dispersal would also allow for greater dispersal of visitors in the Fire Island Wilderness, resulting in an increase in solitude for visitors to the east of the breach. Other restrictions would remain in place.

After the breach is closed, minimal effects to *other features of value* would be anticipated. There would be no change to cultural resources and no changes to cultural resources management after mechanical closure. Cultural resources, therefore, would be preserved. The Seashore would continue to provide education and interpretation and allow for appropriate research. Researchers wishing to continue studying the open wilderness breach would no longer have those opportunities to conduct this type of research; however, new opportunities to study a recently closed system would be available.

Alternative 2: Status Determined Entirely by Natural Processes (No-Action Alternative)

Under alternative 2, allowing natural process to determine the condition of the wilderness breach would preserve wilderness qualities in their current state as described below.

The *untrammeled* quality would be preserved with no change. Authorized actions that degrade this quality (e.g., removal of non-native species, deer management, mosquito management, and suppression of fire) would continue. There would be no authorized action during this phase that would alter the breach; therefore, there would be no additional trammeling.

The *natural* quality would be preserved overall with no to minimal changes. Natural processes would continue. Some special-status species (nesting/staging piping plovers and seabeach amaranth) may experience less disturbance; visitor access to Fire Island Wilderness west of the breach would be more difficult, resulting in fewer visitors in those areas.

The *undeveloped* quality would be preserved with no change. The terrestrial area adjacent to the breach is relatively undeveloped with the exception of the underground electric and phone utilities and some signage and symbolic fencing primarily for resource protection. This quality would continue to improve as these structures and utilities are removed from the Fire Island Wilderness. There would be no development within the breach.

The *opportunities for solitude and primitive and unconfined recreation* quality would be preserved overall with no to minimal change from current condition. Access to the Fire Island Wilderness west of the breach would continue to be more difficult; therefore, opportunities for solitude would remain high in this portion of the Fire Island Wilderness. However, more visitors would be congregated in the eastern portion of the Fire Island Wilderness, reducing solitude in this area. Other restrictions on visitor behavior (e.g., camping, campfires) would continue.

The *other features of value* include cultural resources and research and education. There would be no change to cultural resources in the area of breach and no changes to cultural resources management due to breach. There would also be no change to research and education. The Seashore would continue to provide education/interpretation and allow appropriate research. There has been an increase in research (e.g., people, equipment) due to the breach, and there would continue to be requests for research and monitoring. It would be incumbent upon the Seashore staff to ensure the wilderness character is minimally affected by research projects.

Natural closure of the breach could occur. A gradual closure could happen as sand is deposited in and around the breach via altered sediment transport if the breach were to close naturally; there would be no changes to the *untrammeled, natural, undeveloped,* and *other features of value* qualities of wilderness.

The *opportunities for solitude and primitive and unconfined recreation* quality would be preserved with minimal changes. If the breach were to close completely, the areas of Fire Island Wilderness currently east and west of the breach would be connected by the naturally filled wilderness breach. This connectivity would allow for greater dispersal of visitors in the Fire Island Wilderness resulting in an increase in solitude on the east side of the breach but a decrease for those visitors west of the breach.

Alternative 3: No Human Intervention Unless Established Criteria are Exceeded (Proposed Action and NPS Preferred Alternative)

Under alternative 3, the Seashore would manage the wilderness breach similar to alternative 2, except that alternative 3 would incorporate monitoring to track migration and cross-sectional area of the breach. Under natural conditions, the impacts on wilderness character would be the same as described for alternative 2. There would be no impacts on the *untrammeled, undeveloped,* and *other features of value* qualities. There would be no to minimal changes on the *natural qualities* and *opportunities for solitude and primitive and unconfined recreation* qualities due to reduced access to the Fire Island Wilderness west of the breach, but these qualities would be preserved overall. If the breach were to close under natural processes, there would be no changes to the *untrammeled, natural, undeveloped,* and *other features of value* qualities of wilderness. The *opportunities for solitude and primitive and unconfined recreation* quality would be preserved with minimal changes. Closure of the breach would connect the areas of Fire Island Wilderness currently east and west of the breach, allowing for greater dispersal of visitors in the Fire Island Wilderness resulting in an increase in solitude on the east side of the breach but a decrease for those visitors west of the breach.

If the open breach were determined to elevate the risk of severe storm damage, it would be closed mechanically under this alternative. The impact on wilderness character under alternative 3 for a closed breach scenario would be similar to those described for alternative 1. Construction activities would degrade the *untrammeled, natural, and undeveloped* qualities temporarily during construction activities due to the installation of structural supports and use of mechanized equipment in Fire Island Wilderness. The *opportunities for solitude and primitive and unconfined recreation* quality would be degraded during the mechanical closure, as visitors would be restricted from the construction area and would be affected by the noise of and views from construction equipment. The *other features of value* (cultural resources and research and education) may be adversely impacted or remain preserved. If cultural resources were discovered during construction, avoidance or other mitigation to reduce adverse effects would be developed through the section 106 process. Research, education, and interpretation could continue during construction, but researchers and education programs would be restricted from wilderness breach access for safety reasons. The impacts on wilderness character from construction activities would be temporary, as they are expected to last less than 3 months.

The artificially closed wilderness breach would cause the *untrammeled, natural, and undeveloped* qualities to be permanently degraded. In the Fire Island Wilderness, the filled breach would be considered an adverse impact in perpetuity, despite efforts that would use placement sand with similar grain size and the natural succession of the habitat over time. The marine/submerged wilderness environment created through natural processes would be changed to an artificially created barrier island setting. The closed breach setting would allow for the *opportunities for solitude and primitive and unconfined recreation* quality to be preserved overall with minimal change. With restored access to the Fire Island Wilderness west of the wilderness breach, the feeling of solitude for visitors in that area would be reduced, but the feeling of solitude east of the breach would increase. After the breach is closed, minimal effects to *other features of value* would be anticipated. Cultural resources would be preserved, as cultural resources management would remain unchanged. The Seashore would continue to provide education and interpretation and allow for appropriate research. Researchers would have an opportunity to study a recently closed barrier island system.

Cumulative Impacts

There is one reasonably foreseeable future action that has a detectable effect on wilderness character. The new bridge to Smith Point would be constructed directly adjacent to the current bridge and would be designed to be tall enough to allow ships to pass underneath, which is a change from the current drawbridge design and size. The new bridge would degrade one quality of wilderness character, *opportunities for solitude and primitive and unconfined recreation*, as the new bridge would be more visible to Fire Island Wilderness visitors, reducing the feeling of isolation from the developed mainland.

Under all of the alternatives, the *opportunities for solitude and primitive and unconfined recreation* quality of wilderness character would be preserved overall with no or minimal changes, depending on the connectivity of the Fire Island Wilderness on the east and west sides of the breach. When considered with the future bridge project described above, none of the alternatives would contribute to the cumulative adverse impacts on the *opportunities for solitude and primitive and unconfined recreation* quality of wilderness character.

Conclusion

Under alternatives 2 and 3, if the breach remains open and changes under natural processes, the wilderness qualities would remain unchanged from current conditions. The wilderness qualities are currently slightly degraded due to authorized actions, effects of nearby communities, some development, loss of access and solitude in certain areas, and visitor use restrictions. If the breach were to close naturally under these alternatives, there would be no changes to the *untrammeled, natural, undeveloped,* and *other features of value* qualities of wilderness. There would be a slight change in the *opportunities for solitude and primitive and unconfined recreation* quality, as the connectivity would decrease solitude in the area west of the breach and increase solitude for visitors east of the breach.

During mechanical closure (alternatives 1 and 3), all wilderness qualities would be affected and degraded for the duration of the construction activities. The mechanical closure would be a major manipulation to the natural environment, as the fill would be considered a man-made creation; the *untrammeled, natural, and undeveloped* qualities of wilderness would be diminished. Visitors and researchers would not be allowed in the area during activities, and visitors in adjacent areas would be affected by the noise from and presence of construction equipment, degrading *opportunities for solitude and primitive and unconfined recreation* and the *other features of value*.

Upon completion of the construction activities (alternatives 1 and 3), impacts directly associated with these activities would cease. Over time, the closure area would regain a more natural appearance; however, the presence of the man-made fill area would result in a permanent and significant adverse impact to the *untrammeled*, *natural*, and *undeveloped* wilderness qualities, as the marine/submerged wilderness environment that had been created through natural processes would be changed to an artificially created barrier island setting. Impacts to *opportunities for solitude and primitive and unconfined recreation* would mostly revert to the conditions prior to construction. There would be access to the western portion of the Fire Island Wilderness, and there would be adverse and beneficial impacts on visitors to the areas west and east of the breach, respectively, resulting from visitor dispersal. Although research related to the breach would cease, there would be a new opportunity to study a newly closed barrier island system.

SEDIMENT TRANSPORT AND GEOMORPHOLOGY

Methodology

The impacts on sediment transport and geomorphology were analyzed quantitatively where data were available and were based on bathymetric surveys, analyses of shoreline and flood shoal changes, and beach surveys, conducted by US Army Corps of Engineers, US Geological Survey, and Stony Brook University, as well as interpreting a model run by Deltares in the immediate vicinity of the breach. The breach is geographically bound by what experts consider to be erosion-resistant clay in the geological record to the east and west of the breach.

While some sediment transport and geomorphological patterns have been suggested, three years of data is not enough to draw definitive conclusions about how the breach will evolve in the future. Its physical features are highly sensitive to storm events, which can vary widely due to offshore open ocean effects. The historical duration and evolution of previous breaching in the immediate area of the wilderness breach offer approximations for the lifespan of this breach; however, this is not an overly reliable proxy as environmental conditions in this area are constantly adapting to global and regional changes.

Geographic Area

The geographic area analyzed for impacts on sediment transport and geomorphology consists of the waterbodies and the shoreline in the immediate vicinity of the wilderness breach, specifically 1.5 kilometers west and 0.5 kilometers east of the wilderness breach centerline.

Alternative 1: Closure Using Mechanical Processes

Alternative 1 would mechanically fill and close the breach as soon as possible. Sheet piling or sand-filled geotextile tubes would be placed on either the bay side or ocean side of the breach to diminish tidal flow and sand would be filled in behind it. The placement of sand would introduce additional material into the sediment budget. The structural supports would keep most of the sand in the designated area; however, the construction activities would result in the release of fine sediments into the water column. Silt curtains would be used on the bay side of the breach to allow suspended sediment to settle out of the water column in a controlled area, minimizing the area that is affected by the increased suspended sediment. Therefore, effects on sediment transport from construction are expected to be minimal. Grain size of the sand to be deposited on the beach would be the same or slightly larger than the native sand. Using similar grain size would ensure that the newly placed sand would be consistent with present conditions and would not create substantial changes as sand moves through natural processes after construction.

Once the breach is closed, sediment transport on the ocean side and bay side would return to pre-breach processes. In Great South Bay and Moriches Bay before the breach was created, sediment transport was determined by relatively low-energy estuarine processes with limited direct ocean exchange from storm-generated overwash. Once the breach is closed, the extensive flood delta established by the wilderness breach would likely not grow or redistribute due to reduced water velocities. It would serve as habitat for benthic communities, and depending on water depth, current velocity, and clarity, could become colonized by eelgrass. Areas of the flood delta that are intertidal have the potential for salt marsh colonization as well. On the ocean side after closure, sediment transport would continue to be dominated by longshore westward transport. Although the breach does not cause a significant interruption in longshore sediment transport, once the breach is closed, longshore sediment transport would not be influenced by the breach in any way. The localized erosion immediately west of the breach would lessen and/or stop.

Alternative 2: Status Determined Entirely by Natural Processes (No-Action Alternative)

Under alternative 2, the current sediment transport patterns would remain unchanged, as described in chapter 3. On the bay side of the breach, sediment is transported via shallow channels into the main breach channel from the east and moves out to the west through ebb shoal channels. This movement results in negligible net influx to the flood shoal complex on the bay side of the breach. The relatively narrow width of the breach and shallow nature of the flood tidal delta dampen energy, reducing sediment transport through the breach to Great South Bay and reducing the potential for bayside erosion as a result of the breach.

On the ocean side, sediment transport patterns would also remain unchanged. Data suggest that the wilderness breach is not causing a substantial interruption in longshore sediment transport or direction and is therefore not currently a sediment sink. Review of aerial photographs provides further support that the breach is relatively efficient at bypassing sediment to the western shoreline via migration of large bar complexes to the downdrift or western beaches.

The migration of the main channel of the breach would remain unchanged, as described in chapter 3. Data from July 2015 indicate that the location of the breach centerline has migrated approximately

200 meters to the west since initial formation. Although the rate of migration is not currently known, experts agree that the breach is expected to migrate in a westerly direction within the identified primary controls, approximately 1.5 kilometers west and 0.5 kilometer east of the breach centerline.

Natural closure of the breach could occur while the National Park Service is managing it under natural conditions. Closure would happen gradually as sand is deposited in and around the breach via altered sediment transport from current conditions. The closure would reduce the frequency of exchange between the ocean and bay waters, and this change would happen slowly over time. Overwash would occur regularly during this process, as the depth of the breach channel would gradually decrease with increased infilling. This process would change sediment transport and geomorphology over time, gradually reverting to conditions prior to the breach opening. However, since the open breach does not cause much change in sediment transport pattern, the natural closure similarly would not result in much change.

Alternative 3: No Human Intervention Unless Established Criteria are Exceeded (Proposed Action and NPS Preferred Alternative)

Under alternative 3, while the breach remains open, the impacts on sediment transport and geomorphology would be the same as described for alternative 2. The sediment transport and geomorphology patterns would continue, unchanged. Although the exact pattern or rate of breach migration is not known, it is believed by experts to be bounded 1.5 kilometers west and 0.5 kilometer east of the current breach orientation. If the breach were to close naturally, the impacts on sediment transport and geomorphology would also be the same as described for alternative 2. This would change sediment transport and geomorphological features to conditions similar to before the breach opened, and would be expected to happen slowly as part of natural coastal processes.

If the open breach is determined to elevate the risk of severe storm damage, the breach would be closed using mechanical processes. The impacts of this closure would be the same as those described for alternative 1. The impacts from construction would be temporary and localized to the area of sand placement. Permanent impacts would occur from elimination of ocean mixing directly with bay water. This would create lower energy environments and decreased sediment transport on the bay side, possibly supporting benthic community and marsh growth at suitable water depth and clarity conditions. On the ocean side, longshore transport would continue uninterrupted and the localized erosion downdrift of the breach would likely decrease or stop altogether.

Cumulative Impacts

There are several past, present, or reasonably foreseeable future actions that have a detectable effect on sediment transport and geomorphology including the Fire Island Inlet to Moriches Inlet stabilization project, the Fire Island Inlet to Montauk Point Reformulation Study, Suffolk County wetlands projects, and Long Island Intracoastal Waterway Federal Navigation Project. The Fire Island Inlet to Moriches Inlet stabilization project and the Fire Island Inlet to Montauk Point Reformulation Study beach nourishment projects have the potential to add material to the longshore sediment budget, and those that are located east of the wilderness breach may affect the sediment transport patterns and geomorphology associated with the breach. Beach nourishment projects east of the breach could increase deposition in the vicinity of the wilderness breach. Ebb shoals could grow and/or the dimensions of the breach could decrease, reducing exchange between the ocean and bay side of the breach. The improvements to the wetland areas in Smith Point North County Park under the Suffolk County wetlands restoration would affect sediment transport and geomorphology near the breach by dampening current velocities, providing platforms for sediment deposition and providing a new source of sediment. Future dredging for the Long Island Intracoastal Waterway Federal Navigation Project may introduce sediment into the bay side system near the breach.

If the breach remains open, the direct exchange of sediment between the bay and ocean sides would continue, as would the localized erosion downdrift of the breach. The breach would likely continue to migrate in a westerly direction, although experts believe this migration would be bounded by erosion-resistant clay 1.5 kilometers west of the current location, and the rate of this migration is not known. The past, present, and reasonably foreseeable future actions identified above along with the open breach would cumulatively result in changes to the existing dynamic breach system (e.g., an increase in the longshore sediment budget, deposition, and ebb shoals and potential breach closures). However, this is a dynamic system within the bay that continues to experience natural changes in beach sediment transport and geomorphology and these cumulative changes would not necessarily be considered either adverse or beneficial; rather, a function of a natural dynamic system.

If the breach is closed mechanically, construction could have temporary impacts on sediment transport and would create a permanent geomorphological change to the breach. It would ultimately cause sediment transport to change towards conditions similar to before the breach opened. This includes a low energy environment on the bay side with an influx of ocean water only occurring during large storm events, and longshore transport occurring uninterrupted on the ocean side. This would also happen if the breach closed naturally. Similar to the cumulative impact scenario for the open breach, the past, present, and reasonably foreseeable future actions identified above along with the closed breach would cumulatively affect sediment transport and geomorphology in the vicinity of the breach; however, these effects would not necessarily be considered adverse or beneficial, but would result in changes in this dynamic system within the bay that naturally continues to experience changes in beach sediment transport and geomorphology.

Conclusion

Two different scenarios for sediment transport and geomorphology of the breach itself and the surrounding features would occur with an open breach under alternatives 2 and 3. The open breach has changed sediment transport and geomorphology in the vicinity of the breach, although not to the potential extent it could, based on analysis of conditions since its opening in 2012. The open breach provides a conduit for stable exchange between the ocean and bay; however, it does not seem to be acting as a sediment sink and is therefore not interrupting longshore processes on the ocean side. Instead, it is bypassing sediment to the downshore ebb shoal and causing localized erosion downshore of the breach, but not past 1 kilometer. Beaches greater than 1 kilometer west of the breach are continuing to be nourished naturally from longshore drift.

On the bay side of the breach, there is a potential for erosion, resulting from increased current velocities with the breach open. The width of the breach and shallow nature of the flood tidal delta are primary factors that dampen energy and therefore have reduced possible erosion that could occur in Great South Bay because of the wilderness breach.

Since it opened in 2012, the breach has migrated approximately 200 meters west from its original location. Experts believe that erosion-resistant clay bound possible migration of the breach 1.5 kilometers west and 0.5 kilometer east of its current centerline. The ocean side and bay side conditions within these bounds are similar to where the breach is currently active and migration would likely produce similar effects to those observed since the breach opened.

Once the breach is closed (alternatives 1 and 3), sediment transport on the ocean side and bay side would return to pre-breach processes. The extensive flood delta established by the wilderness breach would likely not grow or redistribute due to reduced water velocities. On the ocean side after closure, sediment transport would continue to be dominated by longshore westward transport, but it would no longer be influenced by the breach. The localized erosion immediately west of the breach would lessen or stop.

Currently, the breach has affected sediment transport and geomorphology; however, these impacts along with impacts from a closed breach seem to be localized and may be more accurately termed changes that occur naturally as part of a dynamic barrier beach system, rather than beneficial or adverse impacts.

WATER QUALITY

Methodology

Water quality describes the physical and biological parameters in a waterbody that influence the abundance and distribution of upper trophic level organisms. The physical drivers include water clarity, nutrient concentrations, salinity, temperature, and dissolved oxygen levels. Several biological drivers, including phytoplankton, and harmful algae are sensitive to nutrients and other physical drivers and therefore provide a natural indicator of water quality. Changes in some of these parameters are reported to have occurred in central Great South Bay and areas east of the wilderness breach (as described for the geographic area below) since the breach formed.

Available data were reviewed and evaluated to describe changes observed since the formation of the breach. The ecological consequences for the changes in water clarity and quality since the wilderness breach formed are just beginning to be quantified, so it is uncertain whether the observed changes will remain over the long term. Several factors — in particular the ongoing trend in water quality reduction, increase in brown tide frequency, natural variability in water quality and phytoplankton communities, and the relatively short time period over which breach effects have been evaluated — are sources of uncertainty. This uncertainty limits the understanding of the dynamic long-term effects of the presence of the wilderness breach on phytoplankton, water quality, or algal blooms. Data collected prior to the breach were used to describe conditions expected if the breach is closed.

Geographic Area

The geographic area analyzed for impacts on water quality consists of the areas from central Great South Bay east to western Moriches Bay. Water quality will be discussed for two regions: central Great South Bay and areas east of the wilderness breach, specifically Bellport Bay, Narrow Bay, and western Moriches Bay. These locations are identified in appendix A.

Alternative 1: Closure Using Mechanical Processes

Alternative 1 would mechanically fill and close the breach as soon as possible. Construction activities related to filling the breach with sand would result in the release of fine sediments into the water column, which could temporarily affect water clarity in the immediate vicinity of the breach. Silt curtains would be used on the bay side of the breach to allow suspended sediment to settle out of the water column in a controlled area, minimizing the area that is affected by the increased suspended sediment. Therefore, effects from this temporary impact are expected to be slight.

Once the breach is closed, the exchange of ocean and bay waters would be greatly reduced with mixing occurring only during storms large enough to cause overwash. This flushing is the basis for most of the positive changes to water quality from the open breach; therefore, water quality would be expected to return to pre-breach conditions and these changes would be expected to happen quickly, as the mixing of ocean and bay waters would end abruptly with the mechanical closure. With a closed breach, salinity would decrease, summer water temperatures would increase, water clarity would be reduced, dissolved oxygen levels would decrease, phytoplankton concentrations would increase, intensities of brown tides in areas east of the wilderness breach would increase, brown tide cells would be retained longer, and phytoplankton species would shift to higher concentrations of smaller form algae. Overall, water quality would be reduced with the largest changes occurring east of the wilderness breach. Water quality could be improved in central Great South Bay, which is seeing a higher frequency and intensity of brown tides with the circulation patterns created by the breach; however, the decline of the water quality in central Great South Bay is likely due to a combination of factors.

Climate change is expected to impact water quality in the northeast United States over the next 10 to 20 years; however, breach closure under alternative 1 would be complete as soon as possible. Therefore, the breach would be closed before any effects of climate change would start to manifest. Changes to water quality during the duration of the Breach Plan/EIS under this alternative would be minimal.

Alternative 2: Status Determined Entirely by Natural Processes (No-Action Alternative)

Under the alternative 2, the mixing of ocean and bay waters would continue through the wilderness breach and the mixing of marine and estuarine waters would continue to have an effect on a suite of water quality parameters. The changes in water quality are not uniform across Great South Bay; most of the changes are greater east of the wilderness breach. Many of these changes would be expected to continue while the breach remains open, including increased salinity, decreased water temperatures during the summer months, increased water clarity, increased dissolved oxygen, decreased nitrogen, decreased concentrations of phytoplankton, decreased brown tide intensity in areas east of the wilderness breach, lower brown tide cell densities during brown tide events, faster clearing out of brown tide cells following bloom events, and a change in species composition toward larger form algae.

While temperature and salinity changes represent modifications to the aquatic environment in Great South Bay, these changes cannot be identified as adverse or beneficial. However, the water quality east of the wilderness breach from other changes (e.g., increased water clarity, decreased nitrogen) would continue to improve. The new circulation patterns associated with the wilderness breach could be contributing to the degradation of water quality in central Great South Bay. Brown tides in this area would be expected to continue to be more frequent and more intense than those that occurred prior to the wilderness breach, though the increase cannot be directly attributed to the breach. Water quality in central Great South Bay has been declining since the mid-2000s; therefore, this negative change since the wilderness breach cannot be wholly attributed to the breach.

Natural closure of the wilderness breach could occur if it is governed by natural conditions. Closure by coastal processes could happen gradually as sand is deposited in and around the breach via sediment transport. The closure would reduce the amount and intensity of ocean and bay waters mixing, but the change would happen slowly. Overwash would occur regularly during this process, as the topography of the breach progressively increases. This process would change water quality back to pre-breach conditions over time: salinity would decrease, summer water temperatures would increase, water clarity would be reduced, phytoplankton concentrations would increase, intensities of brown tides in areas east of the breach would increase, brown tide cells would be retained longer, and phytoplankton species would shift to higher concentrations of smaller form algae. Although natural closure of the wilderness breach would eventually reduce the benefits from flushing of the bay water with ocean water, the process would happen slowly and would be considered part of natural coastal processes.

Predicted rising water levels from climate change are expected to impact water quality by increasing the amount of marine water being pushed into estuaries, increasing nitrogen levels from a greater wastewater input into Great South Bay, and increasing eutrophication and sedimentation from loss of wetlands. Actions proposed by the Seashore under alternative 2 would not exacerbate the impacts caused by these climate change effects. By allowing natural process to govern the condition of the breach, the dynamic barrier island system would be able to reach a natural equilibrium under these changing conditions.

Alternative 3: No Human Intervention Unless Established Criteria are Exceeded (Proposed Action and NPS Preferred Alternative)

Under alternative 3, while the status is determined by natural processes, the impact on water quality would be similar to those described for alternative 2. The changes in physical parameters would continue with increased salinity and decreased temperatures in areas east of the breach. Water quality in these areas would be enhanced by increased water clarity, increased dissolved oxygen, a reduction in the intensity of brown tides in areas east of the breach, and reduced nitrogen levels. Water quality in central Great South Bay would continue to be affected by increased frequency and intensity of brown tides, which could be due at least in part to changed circulation patterns caused by the wilderness breach. The breach could also close naturally as described for alternative 2. While this would eventually reduce the benefits from flushing of the bay water with ocean water, the closure of the breach would happen slowly and would be considered part of natural coastal processes.

Alternative 3 would differ from alternative 2 in that the Seashore and other agencies would continue to monitor the breach, and if the open breach were determined to elevate the risk of severe storm damage, it would be closed mechanically. The impact on water quality under alternative 3 for a closed breach scenario would be similar to those described for alternative 1. The impacts during construction would be temporary, localized to the area of sand placement, and limited to the duration of construction activities. Permanent impacts on water quality would occur from elimination of ocean water flushing and mixing with the bay water. This would cause a decrease in circulation, decreased water clarity, decreased dissolved oxygen, and increase intensities of brown tides east of the wilderness breach.

While the wilderness breach remains within established criteria, the Seashore would allow natural processes to continue under alternative 3. As such, the alternative would not add to the impacts caused by climate change, as described for alternative 2. If the breach were to elevate the risk of severe storm damage and require mechanical closure, the actions under alternative 3 would exacerbate the effects of climate change on water quality. The Old Inlet breach from the 1800s remained open for approximately 60 years. There is no way to accurately predict when the wilderness breach would close, but the breach remaining open for over 50 years is a reasonable prediction; therefore, the breach could remain open when the effects of climate change begin to manifest. Over the next 50 years, Great South Bay is expected to incur a number of changes due to climate change. Nutrient input from wastewater entering the bay and loss of wetlands due to rising water levels would be expected to cause the largest change to water quality. As discussed in chapter 3, this would result in greater amounts of nitrogen in the surface water. Closure of the wilderness breach would add to the eutrophication from the decrease in circulation and loss of the daily flushing of the bay and ocean waters.

Cumulative Impacts

Several past, present, or reasonably foreseeable future actions have a detectable effect on water quality, including the Fire Island Inlet to Montauk Point Reformulation Study, USFWS habitat restoration projects, Suffolk County wetlands projects, and hard clam stocking. Development of the Fire Island Inlet to Montauk Point Reformulation Study has been an ongoing US Army Corps of Engineers (USACE) effort since its authorization in 1963. This program is aimed at managing the risk of coastal storm damages through beach nourishment and breach closures. Interim projects aimed at reducing changes in storm damage risk, such as the Breach Contingency Plan and Fire Island Inlet to Moriches Inlet stabilization project, have carried out beach nourishment projects and breach closures; therefore, the conditions under the Fire Island Inlet to Montauk Point Reformulation Study would not represent a change in current conditions. Although these programs only close breaches outside of the Fire Island Wilderness, they could have adverse impacts on the water quality in the areas analyzed for this Breach Plan/EIS. For example, Hurricane Sandy created three breaches, with two occurring east of the wilderness breach outside of the Fire Island Wilderness. By closing these breaches, natural barrier island processes were interrupted by eliminating the mixing of bay and ocean waters, thus retaining the current degraded conditions of the estuarine waters. Based on observations and data collected in central Great South Bay and areas east of the wilderness breach, allowing those breaches to remain open would have increased water clarity, reduced excess nutrients, and reduced residence time, all of which improve water quality. Conversely, the three wetland restoration projects within the geographic area analyzed for this Breach Plan/EIS would enhance water quality – a USFWS habitat restoration project in the Wertheim National Wildlife Refuge, which borders Bellport Bay, and two Suffolk County wetlands projects (the tidal wetlands at Beaverdam Creek, a tributary to Bellport Bay and the marsh at Smith Point County Park). Additionally, the Great South Bay Clam Restoration Project would benefit water quality within the bay because clams are filter feeders, which allows them to absorb and sequester nutrients, as well as remove suspended solids from the water column. A large portion of the bay targeted for this project falls within the boundary of the Seashore. The wetlands and hard clam restoration projects would be beneficial to water quality, but the effects would be localized and slight.

The beneficial impacts of the wilderness breach under natural conditions would contribute greatly to improving water quality in central Great South Bay and areas east of the breach. When considered with actions identified above, the beneficial impacts of the wilderness breach managed under natural conditions along with the beneficial impacts of the restoration projects would offset some of the impacts of breach closures under the Fire Island Inlet to Montauk Point Reformulation Study and its interim projects.

Mechanical closure of the wilderness breach would quickly return the water quality of the bay to pre-breach conditions, specifically in areas east of the wilderness breach. Although the restoration projects would have beneficial impacts on water quality, the effects would be extremely localized. The adverse impacts of breach closures under the Fire Island Inlet to Montauk Point Reformulation Study and its interim projects, combined with the closure of the wilderness breach, would result in significant degradation of the water quality with water quality conditions similar to those present prior to the wilderness breach.

Conclusion

Water quality is the foundation for other resources in Great South Bay, and in many cases, controls the composition of species that can survive there. For example, temperatures above 25°C are detrimental to submerged aquatic vegetation and hard clam growth rates and since the breach occurred, temperatures in Bellport Bay have not exceeded 24°C (Gobler pers. comm. 2016). In general, water quality in the bay has improved since formation of the breach. The most substantial changes occur east of the wilderness breach in Bellport Bay, Narrow Bay, and western Moriches Bay, where improved water clarity and reduced nitrogen levels are significant. Residence time near the breach has decreased, allowing nutrients, phytoplankton, and other suspended material to exit the system to the ocean through the breach. The cooler temperatures of the bay during summer months help retain higher levels of dissolved oxygen. Managing the breach under natural conditions (alternatives 2 and 3) would continue to result in significant improvements in water quality east of the wilderness breach. Under these alternatives, the breach could also close naturally from coastal processes. Closure would happen slowly as the system deposits sand in and around the breach. The water quality would also gradually change as the mixing of estuarine and marine waters is reduced over time. If the breach is closed mechanically, under either alternative 1 or alternative 3, the benefits of the water exchange would be abruptly stopped and water quality would return to pre-breach conditions. This degradation, including increased residence time, decreased in circulation, decreased water clarity, and increased intensities of brown tides east of the wilderness breach, would result in a significant adverse change in water quality, also contributing to significant degradation of water quality throughout the bay in combination with other similar projects.

ECOSYSTEM STRUCTURE AND PROCESSES

Methodology

The analysis of impacts on ecosystem structure and processes considered the changes to ecosystem structure characteristics such as total abundance, species diversity, diversity of feeding relationships, and the abundance of upper trophic level predators, as well as ecosystem processes or functions, such as suspension feeding. The effects of the wilderness breach that formed during Hurricane

Sandy in 2012 are just beginning to be quantified and understood. Little information is available, from either before or after the breach, to describe some of the ecosystem level processes such as nutrient cycling, decomposition, and biomass turnover rates. The impacts on ecosystem structure and processes from the alternatives were analyzed qualitatively using available research data and observations on the components of the Great South Bay ecosystems and the best professional judgment of those researchers with experience with the ecosystems of the Great South Bay. More details on the analyses of specific species follow in the "Benthic Communities" and "Finfish and Decapod Crustaceans" sections.

Geographic Area

The geographic project area for ecosystem structure and processes is central Great South Bay east to western Moriches Bay.

Alternative 1: Closure Using Mechanical Processes

Construction activities related to filling the breach with sand would affect the ecosystem structure and processes to the extent that the flora and fauna of Great South Bay and the functions that they provide would be affected. Construction activities would result in both permanent and temporary impacts from heavy equipment construction noise, pumping and placement of the sand, and increased turbidity. Measures would be taken to reduce the impacts from construction activities. Grain size of the fill sand would be the same or slightly larger than the native sand, to the extent practicable. Using similar grain size would ensure that the newly placed sand would be consistent with present conditions and would not create measurable changes as sand is moved through natural processes after construction. Structural supports (sheet piling or sand filled geotextile tubes) would keep most of the sand in the designated area; however, the release of fine sediments into the water column could affect plants and other aquatic life in the immediate vicinity of the breach. The increased turbidity would temporarily reduce water clarity. Silt curtains would be used on the bay side of the breach to allow suspended sediment to settle out of the water column in a controlled area, minimizing the area that is affected by the increased suspended sediment. The impacts from construction are discussed in detail in the "Benthic Communities" and "Finfish and Decapod Crustaceans" sections.

A closed breach would result in a long-term change in ecosystem structure and processes east of the wilderness breach. Mainly the fauna, flora, and the ecosystem functions that they provide would be affected. The lack of connectivity would lead to pre-breach conditions such as reduced water quality. With the expected reduction in water clarity and salinity and a rise in temperature, eelgrass beds would likely decline, especially in the immediate vicinity of the breach. If the conditions are appropriate, widgeongrass could colonize areas previously occupied by eelgrass. This shift in submerged aquatic vegetation species would result in decreased refuge habitat for juvenile and adult fish and shellfish, which in turn would result in decreased species abundance and diversity. Widgeongrass also provides refuge habitat for aquatic species, but it is lower-quality habitat than eelgrass. The contribution of the breach to the recovery of ecosystem maturity in Great South Bay would be lost when the breach is closed resulting in long-term significant negative impacts. Less mature ecosystems are less healthy, less stable, and less resilient to disturbance. Specific adverse impacts from a decrease in ecosystem maturity would include decreased finfish abundance and species diversity, lower connectivity to the ocean, and poorer water quality.

Climate change is expected to impact water quality, and therefore the aquatic ecosystem of Great South Bay over the next 10 to 20 years; however, breach closure under alternative 1 would be complete as soon as possible. Therefore, the breach would be closed before any effects of climate change would start to manifest. Changes to ecosystem structure and processes for the duration of the Breach Plan/EIS under this alternative would be minimal.

Alternative 2: Status Determined Entirely by Natural Processes (No-Action Alternative)

The breach has positively affected the Great South Bay ecosystem east of the wilderness breach; ecosystem maturity has increased in Great South Bay since the formation of the breach. The wilderness breach created platforms of sandy substrate in overwash areas and continues to allow the exchange of ocean and bay waters, which results in changes in salinity and temperature. These changes would lead to water quality conditions that favor eelgrass and allow recolonization in areas within the influence of the breach. Establishment of eelgrass is important, as it provides refuge habitat for fish and shellfish and is associated with an increase in biodiversity. Widgeongrass, the other submerged aquatic vegetation species in Great South Bay, would continue to inhabit the shallow, warmer areas of the bay where the temperatures are unfavorable for eelgrass. Post breach surveys have shown improvements in water quality, return of important eelgrass nursery and refuge habitat, and an increase in the abundance and diversity of finfish and invertebrates, demonstrating the onset of recovery of ecosystem maturity in Great South Bay. More mature ecosystems are healthier, more stable, and more resilient to disturbance. Several other attributes of ecosystem maturity including an increase in the diversity of feeding relationships, upper trophic level predators, and migratory fish species are also possible, but there is not yet any data to indicate that these factors have increased. The open breach would have a significant positive effect on ecosystem structure and processes.

Natural closure of the breach could occur while the National Park Service is managing it under natural conditions, as discussed previously. The gradual closure of the breach would alter the aquatic habitats over time, gradually reverting to conditions prior to the breach opening. Although the process would occur naturally, the ecosystem maturity would also be expected to eventually decrease to pre-breach conditions.

Climate change in the northeast United States is expected to cause increases in the amount of marine water being pushed into estuaries, in nitrogen levels from a greater wastewater input into Great South Bay, and eutrophication and sedimentation from loss of wetlands. Because alternative 2 would allow natural process to govern the condition of the breach, the dynamic barrier island system would be able to reach a natural equilibrium under these changing conditions. Therefore, alternative 2 would not exacerbate the impacts on ecosystem structure and processes from climate change.

Alternative 3: No Human Intervention Unless Established Criteria are Exceeded (Proposed Action and NPS Preferred Alternative)

The impact on ecosystem structure and processes under alternative 3 while the breach remains within established criteria would be similar to those as described for alternative 2. Allowing for natural processes (open breach) would have an overall significant positive effect on ecosystem structure and processes, resulting in the beginning of recovery of ecosystem maturity in central Great South Bay and areas east of the wilderness breach. If the breach were to close naturally, the gradual closure of the breach would alter the aquatic habitats over time, gradually reverting to conditions prior to the breach opening. While the wilderness breach remains open and within established criteria, alternative 3 would not add to the impacts caused by climate change, as explained for alternative 2.

If the breach were to elevate the risk of severe storm damage and require mechanical closure, the impact on ecosystem structure and processes under alternative 3 would be similar to those described for alternative 1. Artificially closing the breach would have an overall significant negative effect on ecosystem structure and processes, as system maturity would regress to pre-breach conditions. Climate change will likely produce measureable effects on the Great South Bay over the next 10 to 20 years. The Old Inlet breach from the 1800s remained open for approximately 60 years. There is no way to predict when the wilderness breach would close, but the breach remaining open for over 50 years is a reasonable prediction. Therefore, mechanical closure actions under alternative 3 could exacerbate the effects of climate change on ecosystem structure and processes. The impacts from climate change that would have the greatest impact on ecosystem structure and processes are the same as those identified for water quality: additional nutrient input from wastewater entering the bay and loss of wetlands due to rising water levels, which would result in greater amounts of nitrogen and sediment in the surface water, as well as decreased levels of dissolved oxygen. Closure of the wilderness breach would add to these impacts from the decrease in circulation and loss of the daily flushing of the bay and ocean waters.

Cumulative Impacts

The past, present, or reasonably foreseeable future actions that have a detectable effect on ecosystem structure and processes are the same as those identified for water quality: the Fire Island Inlet to Montauk Point Reformulation Study, USFWS habitat restoration projects, Suffolk County wetlands projects, and hard clam stocking. The impacts from these actions as described in the "Water Quality" section would also affect ecosystem structure and processes, as the aquatic ecosystem is driven by the quality of the water. Specific to ecosystem structure and processes, the breach closures under the Fire Island Inlet to Montauk Point Reformulation Study and its interim projects would immediately prohibit species transiting through the breaches outside of the Fire Island Wilderness, which would have a direct effect on the abundance and distribution of species that comprise the ecosystem. Conversely, in addition to restoring ecosystem functions, the wetland restoration projects would reestablish wetland habitat for aquatic species, benefitting these species and the ecosystem.

The beneficial impacts of the wilderness breach under natural conditions would contribute greatly to improving ecosystem structure and processes in central Great South Bay and areas east of the breach. When considered with actions identified above, the beneficial impacts of the wilderness breach managed under natural conditions along with the beneficial impacts of the restoration projects would offset some of the impacts of the breach closures under the Fire Island Inlet to Montauk Point Reformulation Study. The open wilderness breach and restoration projects would retain and perhaps continue to increase the maturity of the ecosystem.

Mechanical closure of the wilderness breach would have significant adverse impacts on ecosystem structure and processes, specifically on the maturity of the ecosystem. Although the restoration projects would have beneficial impacts on water quality and species habitat, the effects would be extremely localized. The adverse impacts of breach closures under the Fire Island Inlet to Montauk

Point Reformulation Study and its interim projects, combined with the closure of the wilderness breach, would result in a significant and quick decline in the maturity of the system, including a decline in eelgrass beds and species abundance and diversity.

Conclusion

Under alternatives 2 and 3, the open breach would continue to allow the exchange of saltwater, organisms, and energy between the ocean and Great South Bay east of the wilderness breach. This has positively affected ecosystem structure by increasing total fish abundance and species diversity and ecosystem processes by increased connectivity with the ocean, improved water quality, reduced intensity of brown tides in areas east of the breach, increased salinity, and moderated water temperatures. There has been an increase in the abundance of some species and a decrease in other species since the breach formed. Increases in abundance are attributed to improved water quality, moderated water temperatures, and greater eelgrass habitat availability. Decreased abundance for some species may be related to changes to the environment (e.g., temperature and salinity) that are no longer favorable for those species. Improvements in water quality and more moderate summer water temperatures have favored the establishment of eelgrass, a high quality habitat type for fish and invertebrates, east of the wilderness breach. The formation of the breach has created the potential for marsh habitat expansion on the flood tide deltas, which in turn could provide new habitat for fauna in the bay. Overall, connectivity between the bay and the ocean is creating environmental conditions consistent with a more mature, ecologically and functionally diverse ecosystem, resulting in a long-term significant beneficial effect.

Mechanically closing the breach (alternatives 1 and 3) would create short-term adverse impacts. During construction, increased turbidity would affect ecosystem structure and processes; however, this impact would be short-term and localized and mobile species would be able to relocate away from the turbidity at the onset of construction. In addition, silt curtains would be used to reduce turbidity in the bay. The abrupt closure of the wilderness breach would return the bay to conditions that existed prior to the breach forming, resulting in long-term significant adverse effects on ecosystem structure and processes due to reduced connectivity with the ocean. Water quality, the potential for marsh habitat expansion, and the availability of eelgrass habitat would also decline, which would lead to decreased faunal abundance and diversity. There would be a decrease in species that prefer saline habitats and an increase in species that prefer freshwater or brackish habitats. The contribution of the breach to the recovery of ecosystem maturity in Great South Bay would be lost when the breach is closed resulting in long-term adverse impacts. Adverse impacts would include decreased biomass, decreased species diversity, lower connectivity to the ocean, lower water quality, decreased eelgrass, and lower potential for marsh habitat expansion.

Under alternatives 2 and 3, the breach could close naturally. Although the conditions would eventually be the same as those for a mechanically closed breach, the natural processes would close the breach gradually. The resulting effects would not be considered adverse, as they would be the result of barrier island processes.

BENTHIC COMMUNITIES

Methodology

The analysis of impacts on benthic communities (e.g., mussels, clams, polychaetes) considered the changes and disturbance to habitat, species, and the natural processes sustaining them that would occur from implementation of the alternatives. No pre- or post-breach benthic community data exists for the area in the immediate vicinity of the breach. The short time that has elapsed since the formation of the breach limits our understanding of the dynamic long-term effects of the breach on benthic communities. Like most biological communities, benthic communities can be highly dynamic, making it difficult to distinguish between natural variation and changes that occur as part of a recovery or transition to a different type of community. The impacts on benthic communities were analyzed qualitatively using data collected from past studies of the benthic communities in Great South Bay as documented in the technical synthesis report (Methratta et al. 2016). In addition, pre- and post-breach data on hard clams was also used in the analysis.

Geographic Area

The geographic project area for benthic communities is Great South Bay in areas east of the breach, which include Bellport Bay, Narrow Bay, and western Moriches Bay.

Alternative 1: Closure Using Mechanical Processes

Under alternative 1, the construction activities to close the breach would affect benthic organisms. Direct adverse impacts would result from sand placement and installation of sheet piling, which would smother sessile or slow moving invertebrates in the breach, resulting in direct loss of these resources. Indirect impacts would result from increased turbidity due to the release of fine sediments into the water column. Increased sedimentation and siltation from turbidity can result in harm to habitat areas for aquatic life. To reduce turbidity, silt curtains would be used to allow suspended sediment to settle out of the water column, minimizing the area that would be affected by increased suspended sediment. Grain size of the fill sand would be the same or slightly larger than the native sand to the extent practicable. Using similar grain size would ensure that the newly placed sand would be consistent with present conditions, which would help to mitigate impacts to benthic community habitat.

Closing the wilderness breach would cause a reduction in the exchange of surface water between the ocean and the bay, resulting in a shift of the benthic community structure similar to pre-breach conditions, where a lower-flow estuarine community was present. The east-west gradients apparent in certain species in Great South Bay prior to the wilderness breach would likely be re-established, along with pre-breach water column properties. The Great South Bay estuary would change from marine-influenced, benthic dominated system to a more pelagic-dominated system fueled by relatively high nutrient concentrations.

Changes in sediment composition may occur if the breach closes, although the nature and rate of change depends on whether and how quickly the flood shoals spread out to the surrounding region, and whether high-organic sediments accumulate in the region. Reduced flow would allow settling of smaller, high-organic sediments in the region, so eventually the sediments could become organic-enriched, favoring a low-flow, high-organic, less saline benthic community development. Similarly, changes in water depth would accompany the spreading of the flood shoals. In general, any areas where eelgrass or marshes have colonized would likely be more resistant to rapid movement or spreading, the present channel area would be filled, and any surrounding channelized areas that become depositional in nature due to reducing water flow would fill and become shallower. The benthic species composition in the submerged aquatic vegetation might change, as conditions favoring eelgrass (higher salinity, more moderate water temperatures) would be reversed after breach closure.

Benthic communities of Great South Bay will be affected by climate change over the next 10 to 20 years; however, under alternative 1, the wilderness breach would be mechanically closed as soon as possible. Therefore, the breach would be closed before any effects of climate change would start to manifest. Although the effects of climate change on water quality are currently being observed, the changes to benthic communities for the duration of the Breach Plan/EIS under this alternative would be minimal and would not add to the adverse impacts anticipated in the long-term from climate change.

Alternative 2: Status Determined Entirely by Natural Processes (No-Action Alternative)

The breach has changed and modified the benthic community environment due to increases in salinity, water flow, sediment grain size, and cooler summer water temperatures. Populations of mobile, short-lived species in this area are likely to have changed rapidly, while populations of long-lived species including hard clams are expected to show slower changes. The breach has caused burial of certain intertidal communities where flood tide deltas have formed, but formation of new intertidal areas at the edges of these deltas occurred and may have led to a shift in epibenthic species composition. For example, a potential shift from blue crab to lady crab associated with changes in salinity has been reported, as discussed in the "Finfish and Decapod Crustaceans" section. Changes in epibenthic communities may have also occurred after the wilderness breach, as low numbers of shrimp were found in submerged aquatic vegetation beds near the breach in 2014. The low shrimp numbers were thought to be associated with high predation rates from the greater presence of foraging fish, which likely entered the area from marine waters.

Overall, the formation of the breach has had positive and negative effects on hard clams depending on the region of the bay where they are located. Several factors that affect hard clam growth and reproduction have been affected by the breach, mainly the availability of high quality food resources for hard clams and water temperature. Severe food limitation can be caused by brown tide algal blooms, which cannot be used as food by hard clams. Increased exchange of water through the breach may have led to decreased water temperatures in the bay, which has the potential to negatively affect hard clams. The important role of food limitation and temperature for hard clam growth was demonstrated in a pre-breach study in Great South Bay. The results of this study provided strong field-based evidence for the effect of food availability and temperature on hard clam growth rates in Great South Bay.

Predation is another factor affecting hard clams. Predation on invertebrates was found to increase near inlets where environmental conditions allow for marine predators, as well as high salinity tolerant estuarine predators to occur. In addition, predation by jellyfish and other grazers on clam larvae can have a negative effect on the clam population in Great South Bay. The increased salinity in the immediate vicinity of the wilderness breach could have negative effects on hard clam populations if the range of optimal salinity for survival is exceeded. Additionally, high salinity water favors the growth of a hard clam parasite that could have negative effects on the hard clam population. Taken together, this information indicates that the change in salinity as a result of the breach has the potential to create unfavorable conditions for hard clams in the immediate vicinity of the wilderness breach.

Since the breach formed, several studies have shown that the success of hard clams has greatly improved in Great South Bay. Improvements in clam growth are attributed to improvements in water quality, as increased rates of flushing are able to locally suppress blooms of brown tide algae and improve food quality. However, despite improved measures of clam success, there has been no reported change in the size of the hard clam population in Great South Bay since the breach formed. Landings data from before and after the breach formed indicate no major change in the number of clams harvested from Great South Bay. However, given that hard clams require at least four years to attain harvestable size after settlement, any recovery in hard clam populations brought about by the breach would not yet be reflected by harvest statistics. There are no fisheries-independent bay-wide surveys of clam population size in Great South Bay; therefore, the response of the hard clam population standing stock to the change in environmental conditions caused by the breach remains unresolved. Although environmental conditions that favor hard clam success have occurred since the breach, it is not well understood whether these improvements will be able to overcome the low spawning and reproductive success that has resulted from extremely low clam densities throughout the bay.

Natural closure of the breach could occur while the National Park Service is managing it under natural conditions. Closure by coastal processes could happen gradually as sand is deposited in and around the breach via sediment transport. The closure would slowly reduce the exchange of surface water between the ocean and the bay slowly resulting in a benthic community structure shift back to similar pre-breach conditions where a lower flow estuarine community (similar to those that have existed during times when the Old Inlet and breach were not open) was present.

Climate change in the northeast United States is expected to cause increases in the amount of marine water being pushed into estuaries, in nitrogen levels from a greater wastewater input into Great South Bay, and eutrophication and sedimentation from loss of wetlands. Because the Seashore would manage the wilderness breach under natural conditions, alternative 2 would not exacerbate the impacts on benthic communities from climate change. The dynamic barrier island system would be able to reach a natural equilibrium under the changing conditions.

Alternative 3: No Human Intervention Unless Established Criteria are Exceeded (Proposed Action and NPS Preferred Alternative)

While the wilderness breach remains open and within established criteria, the impacts on benthic communities under alternative 3 would be similar to those described for alternative 2. An open breach would continue to allow for conditions that favor a high-flow, high-salinity benthic community. If the breach were to close naturally, it would slowly reduce the exchange of surface water between the ocean and the bay slowly resulting in a benthic community structure shift back to similar pre-breach conditions where a lower flow estuarine community was present. Under these conditions, alternative 3 would not add to the impacts on benthic communities caused by climate change, as explained for alternative 2.

If the breach were to elevate the risk of severe storm damage and require mechanical closure, the impact on benthic communities under alternative 3 would be similar to those described for alternative 1. Closing the breach would likely change the Great South Bay estuary from marine-influenced, benthic dominated system to a more pelagic-dominated system fueled by relatively high nutrient concentrations. It is estimated that climate change will produce measureable effects on the Great South Bay over the next 10 to 20 years. Based on the breach at Old Inlet, it is not unreasonable to assume that the wilderness breach could remain open for 50 years or more. Therefore, the breach could be open when the effects of climate change begin to manifest. Climate change is expected to cause additional nutrient input from wastewater entering the bay and loss of wetlands due to rising water levels, which would result in greater amounts of nitrogen and sediment in the surface water, as well as decreased levels of dissolved oxygen. The mechanical closure actions under alternative 3 would exacerbate the effects of climate change on benthic communities due to a decrease in circulation and loss of the daily flushing of the bay and ocean waters.

Cumulative Impacts

The past, present, or reasonably foreseeable future actions that have a detectable effect on benthic communities are the same as those identified for water quality: the Fire Island Inlet to Montauk Point Reformulation Study, USFWS habitat restoration projects, Suffolk County wetlands projects, and hard clam stocking. The impacts from these actions as described in the "Water Quality" section would also affect benthic communities, as benthic species are extremely sensitive to changes in temperature, salinity, and water circulation. Specific to benthic communities, the breach closures under the Fire Island Inlet to Montauk Point Reformulation Study and its interim projects would limit dispersal of larvae of benthic species, alter sediment composition, and reduce eelgrass beds that are used as refuge. In addition to restoring ecosystem functions, the wetland restoration projects would reestablish wetland habitat for aquatic species, benefitting these species and the ecosystem, and the hard clam restocking could bolster the species in Great South Bay.

The wilderness breach managed under natural conditions would continue to provide a more marine, less estuarine benthic community and improved water quality in areas east of the breach. When the actions described above are combined with open wilderness breach, there would be slight beneficial impacts on the benthic community; the improved water quality, restored habitat, and hard clam stocking would work to offset the adverse impacts of the breach closures under the Fire Island Inlet to Montauk Point Reformulation Study and its interim projects.

If the breach were closed mechanically, the Great South Bay estuary would change from a marine-influenced, benthic dominated system to a more pelagic-dominated system fueled by relatively high nutrient concentrations. The closure of the wilderness breach, combined with the actions described above, would result in an overall adverse impact on benthic communities. Although the restoration projects would improve water quality and habitat and stock hard clams throughout Great South Bay, the beneficial impacts from these projects would be extremely localized.

Conclusion

The conditions of the open breach (alternatives 2 and 3) have resulted in areas near the breach, including southern Bellport Bay, Narrow Bay, and western Moriches Bay becoming more saline, higher in dissolved oxygen, and more moderate in summer and winter water column temperatures.

All of this favors the development of a more marine, less estuarine benthic community. The formation of the breach has resulted in adverse and beneficial effects on hard clams depending on the region of the bay where they are located. In Bellport Bay, Narrow Bay, and Western Moriches, water quality has improved due to the export of water to the open ocean, which has improved the effects of brown tide, moderated summer temperatures, and improved the quality and quantity of food resources for hard clams. Right at the breach, food resources are reported to be less abundant and of lower quality and predation is reported to be greater. Leaving the breach open is likely to allow the areas near the breach to become more like the benthic communities near the existing inlets and would allow the ongoing change toward a high salt, higher flow regime to continue. Leaving the breach open may also reduce the former west-east gradients in both water column properties and the benthic community.

Construction activities under alternatives 1 and 3 to close the breach would adversely affect benthic organisms. Direct adverse impacts would result from sand placement and installation of sheet piling, which would smother sessile or slow moving invertebrates in the breach, resulting in direct loss of these resources. Indirect impacts would result from increased turbidity, which can affect benthic habitat quality due to increased sedimentation, and siltation, which can result in harm to habitat areas for fish and aquatic life.

A closed breach (closed either mechanically under alternatives 1 and 3 or by natural processes under alternatives 2 and 3) would return the bay to pre-breach conditions. There would be a reduction in the exchange of surface water between the ocean and the bay resulting in a benthic community structure shift back to similar pre-breach conditions where a lower flow estuarine community (similar to those that have existed during times when the breach was not open) was present.

FINFISH AND DECAPOD CRUSTACEANS

Methodology

The analysis of impacts on finfish and decapod crustaceans (e.g., crabs and shrimp) considered the changes and disturbance to habitat, species, and the natural processes sustaining them that would occur as a result of the implementation of the alternatives. The impacts on finfish and decapod crustaceans from the alternatives were analyzed qualitatively using fish and invertebrate population data collected from surveys by the US Army Corps of Engineers and EEA Inc., as documented in the technical synthesis report (Methratta et al. 2016).

There are limitations in the available data. Patterns of change in the finfish and decapod crustacean community since the breach formed are just beginning to emerge, as researchers only have three years of data and observations. There has been little elaboration on how the observed changes may affect ecosystem function or how burgeoning populations of species such as lady crab may affect the overall ecology of Great South Bay, although such efforts are planned. Increased energy exchange with the open ocean could prove to have important implications for finfish and decapod communities. There has not been time for studies to take place to address these questions or for results of such studies to make it into the published literature. While much work has been done, the long-term effects of the breach on the Great South Bay finfish and decapod communities are not known.

Geographic Area

The geographic project area for finfish and decapod crustaceans is Great South Bay east of the breach including Bellport Bay, Narrow Bay, and Moriches Bay.

Alternative 1: Closure Using Mechanical Processes

Alternative 1 would close the wilderness breach without any further monitoring of the conditions. Construction activities to close the breach would result in short-term adverse impacts on finfish and decapod crustaceans. Indirect impacts would result from increased turbidity due to the release of fine sediments into the water column from construction activities. Turbidity can affect fish habitat quality due to increased sedimentation and siltation, which can result in harm to habitat areas for fish and aquatic life. Most mobile species, such as fish and crabs, would be able to relocate away from the turbidity at the onset of construction. To reduce turbidity in the bay, silt curtains would be used to allow suspended sediment to settle out of the water column in a controlled area, minimizing the area that is affected by increased suspended sediment. Actions to drive sheet piling would likely cause concussive forces and shock waves that could adversely impact fish in the vicinity of project site. Fish would likely leave the construction area temporarily but return once the activity is complete.

Overall, a closed breach would result in impacts on finfish and decapod crustaceans due to reduced connectivity between the open ocean and Great South Bay. This lack of connectivity would lead to pre-breach conditions, such as reduced water quality and decreased eelgrass habitat availability, resulting in decreased finfish species abundance and diversity. The decline of eelgrass beds in favor of widgeon grass is likely, which is less effective as refugia from predation for shellfish and juvenile and adult fish. There would be a decrease in abundance for species that prefer higher salinities (e.g., lady crab) and an increase in abundance on species that require freshwater and brackish water habitats (e.g., blue crab). Invertebrate abundance may increase where fish abundance is low after the breach is closed, as predation by fish would be reduced. The distribution of the finfish and invertebrate species would likely change from current conditions.

Climate change is expected to impact water quality, and therefore aquatic species, in the northeast United States over the next 10 to 20 years; however, mechanical closure of the breach under alternative 1 would be complete as soon as possible. Therefore, the breach would be closed before any effects of climate change would start to manifest. Changes to finfish and decapod crustaceans from climate change during the timeframe of this Breach Plan/EIS under this alternative would be minimal.

Alternative 2: Status Determined Entirely by Natural Processes (No-Action Alternative)

The opening of the breach has resulted in an increase in salinity and moderated summertime water temperatures due to an influx of ocean water in the bay thus leading to changes in the distribution and abundance of finfish and decapod crustaceans. The analysis of the impacts of the open breach to finfish and decapod crustaceans was reached by looking at comparisons made between faunal surveys conducted in the decade prior to the breach and surveys conducted after the breach formed.

The distribution and abundance of aquatic organisms is closely tied to their salinity preferences. Finfish abundance at sites in Great South Bay has increased relative to other sites on the south shore of Long Island since the breach formed, resulting in beneficial effects to finfish. There has also been an increase in lady crab abundance, a species that prefers higher salinities. With the increased salinity, habitat for freshwater and brackish water species has declined since the breach formed. Blue crab prefers estuarine salinity conditions, and there has been an 80% decline in blue crab catch after the breach formed. However, it is possible that blue crabs have retreated to more brackish water in the tributaries, but no data are yet available to determine this.

Another effect from the breach to fish is the establishment of eelgrass beds. Eelgrass provides nursery habitat for juvenile fish and refugia from predation for juvenile and adult fish. Since the breach, researchers have found increasing fish abundance in beds of eelgrass and higher densities of juvenile summer flounder and tropical species in eelgrass beds adjacent to the breach. As previously stated, there is an inverse adverse/beneficial relationship between fish and invertebrates near the breach. After the breach formed, lower grass shrimp densities were observed near the wilderness breach where higher fish densities were observed, which could be driving down shrimp abundance.

Natural closure of the breach could occur while the Seashore is managing it under natural conditions. Closure by coastal processes could happen gradually as sand is deposited in and around the breach via sediment transport. The closure would slowly reduce the exchange of surface water between the ocean and the bay resulting in changes to finfish and decapod crustaceans habitat due to reduced connectivity. This would lead to pre-breach conditions, such as reduced water quality and decreased eelgrass habitat availability, resulting in decreased species abundance and diversity.

Over the next 10 to 20 years, climate change could affect finfish and decapod crustaceans through increases in the amount of marine water being pushed into estuaries, in nitrogen levels from a greater wastewater input into Great South Bay, and eutrophication and sedimentation from loss of wetlands. However, alternative 2 would allow natural processes to dictate the condition of the wilderness breach. These natural barrier island processes would be able to reach a natural equilibrium under changing conditions. Therefore, alternative 2 would not exacerbate the impacts on finfish and decapod crustaceans from climate change.

Alternative 3: No Human Intervention Unless Established Criteria are Exceeded (Proposed Action and NPS Preferred Alternative)

The impact on finfish and decapod crustaceans under alternative 3 while the breach is open under natural conditions would be the same as described for alternative 2. The open wilderness breach has resulted in an increase in abundance for finfish and crustacean species that prefer higher salinities and a decrease in abundance on species that require freshwater and brackish water habitats. Overall, there has been an increase in finfish species abundance and diversity. If the breach were to close naturally, changes in species abundance and diversity would occur at a slower rate if the breach closes on its own. Under these conditions, alternative 3 would not add to the impacts of climate change on finfish and decapod crustaceans, as described for alternative 2.

If the breach were to elevate the risk of severe storm damage and were to be closed, the impact on finfish and decapod crustaceans from mechanical closure would be similar to those described in for alternative 1. A closed breach would result in a decrease in abundance for finfish and crustacean species that prefer higher salinities and an increase in abundance of species that require freshwater and brackish water habitats. Overall, there would be a decrease in finfish species abundance and diversity from the decline of eelgrass beds, and an increase in invertebrates in the immediate vicinity of the breach from the decline in fish predation in this area. Climate change will likely produce measureable effects on the Great South Bay over the next 10 to 20 years. The Old Inlet breach from the 1800s remained open for approximately 60 years. There is no way to predict when the wilderness breach would close, but the breach remaining open for over 50 years is a reasonable prediction. Therefore, the breach would be open when the effects of climate change would start to manifest. The impacts from climate change that would have the greatest impact on finfish and decapod crustaceans are the same as those identified for water quality. The mechanical closure actions under alternative 3 would exacerbate the effects of climate change on finfish and decapod crustaceans from the decrease in circulation and loss of the daily flushing of the bay and ocean waters.

Cumulative Impacts

The past, present, or reasonably foreseeable future actions that have a detectable effect on finfish and decapod crustaceans are the same as those identified for water quality: the Fire Island Inlet to Montauk Point Reformulation Study, USFWS habitat restoration projects, Suffolk County wetlands projects, and hard clam stocking. The impacts from these actions as described in the "Water Quality" section would also affect finfish and crustaceans, as the aquatic ecosystem is driven by the quality and the physical parameters of the water. Specific to finfish and decapod crustaceans, the breach closures under the Fire Island Inlet to Montauk Point Reformulation Study and its interim projects would immediately prohibit species transiting through the breaches outside of the Fire Island Wilderness, which would have a direct effect on the abundance and distribution of species that comprise the ecosystem. Additionally, the breach closures would inhibit the mixing of bay and ocean waters, artificially retaining a more estuarine environment. Conversely, in addition to restoring ecosystem functions, the wetland restoration projects would reestablish wetland habitat for aquatic species, benefitting these species and the ecosystem.

The wilderness breach managed under natural conditions would continue to provide more marine, less estuarine habitat, improved water quality in areas east of the breach, and increased diversity and abundance of finfish. When the actions described above are combined with open wilderness breach, there would be slight beneficial impacts on finfish; the connectivity between the bay and the ocean, the improved water quality, and the restored habitat would work to offset the adverse impacts of the breach closures under the Fire Island Inlet to Montauk Point Reformulation Study and its interim projects.

If the breach were closed mechanically, the Great South Bay estuary would revert to a more estuarine habitat with degraded water quality. The closure of the wilderness breach, combined with the actions described above, would result in an overall adverse impact on finfish and decapod crustaceans. Although the restoration projects would improve water quality, the beneficial impacts from these projects would be extremely localized.

Conclusion

Under alternatives, 2 and 3, the open wilderness breach would continue the exchange of saltwater, organisms, and energy between the open ocean and Great South Bay. There has been an increase in the abundance of some species (e.g., finfish, lady crab) and a decrease in other species (e.g., blue crab) since the breach formed. Finfish diversity has also increased since the breach formed. Increases in abundance for finfish are attributed to improved water quality, moderated water temperatures, and greater eelgrass habitat availability. Decreased abundance for some species may be related to changes to the environment (e.g., temperature and salinity) that are no longer favorable for those species. The movement of more saline water into the bay is improving the water quality, allowing for the movement of higher trophic level fish into Great South Bay, thus creating environmental conditions consistent with a more mature, ecologically and functionally diverse ecosystem. Overall, there has been an increase in finfish species abundance and diversity due to the wilderness breach, resulting in a benefit to finfish. A change in species composition has also occurred such that data shows a decrease in abundance for species that prefer higher salinities (e.g., blue crab) and an increase in abundance on species (e.g., lady crab) that require freshwater and brackish water habitats.

Alternative 1 would mechanically close the wilderness breach and mechanical closure is a potential future action under alternative 3. The construction activities would create increased turbidity, which would adversely affect finfish and decapod crustaceans; however, this impact would be localized and these mobile species would be able to relocate away from the turbidity at the onset of construction. In addition, silt curtains would be used to reduce turbidity in the bay. A closed breach (either mechanically under alternatives 1 and 3 or naturally under alternatives 2 and 3) would return the bay to pre-breach conditions, resulting in impacts on finfish and decapod crustaceans due to reduced connectivity to the open ocean. The resulting reduced water quality and decreased eelgrass habitat availability would lead to decreased finfish species abundance and diversity, resulting in an adverse impact to finfish. A decrease in abundance for species that prefer higher salinities, such as the lady crab, and an increase in abundance on species that require freshwater and brackish water habitats, such as blue crab, would also occur. Impacts would include decreased abundance and species diversity, lower connectivity to the ocean, and development of a less complex food web with fewer trophic links.

PUBLIC HEALTH AND SAFETY

Methodology

The health and safety of residents west of the breach and residents of the south shore of Long Island was determined by examining the potential effects of storm events on these communities. This was done by analyzing modeling results for pre- and post-breach scenarios. In addition, emergency service access and response time was analyzed for residents between Sailors Haven and the breach. Impacts on residents were analyzed quantitatively using information from relevant studies, modeling data, personal communication, and professional judgment to predict changes in flooding during storm events and emergency response under each alternative.

Geographic Area

The geographic project area for public health and safety includes the south shore of Long Island and the communities between Sailors Haven and the breach.

Alternative 1: Closure Using Mechanical Processes

Alternative 1 would mechanically fill and close the breach as soon as possible. During construction, heavy equipment would be operated in a national seashore. To address potential health and safety concerns, prior to construction, the Seashore would prepare a health and safety plan. The plan would meet Occupational Safety and Health Act requirements and would identify areas of concern to health and safety and would describe measures to eliminate or reduce these risks. Visitors would be excluded from the construction area. Time-of-year restrictions for federal and state-listed ground-nesting shorebirds and federal listed sea turtles (April - October) coincide with the popular and more crowded summer beach season at the Seashore, thus mitigating impacts to visitors since construction would occur during lower visitation periods.

Construction would take less than 3 months, and following construction, connectivity would be restored between the east and west portions of the Fire Island Wilderness. Law enforcement would be able to access Davis Park and Water Island by vehicle from the east at Smith Point County Park and the Wilderness Visitor Center; this is consistent with pre-breach conditions. This connectivity could increase the response time for non-critical patients in Davis Park and Water Island; however, patients suffering severe, life-threatening emergencies would continue to be transported via helicopter or vessel. Closure of the wilderness breach would have a slight benefit on public health and safety due to restored connectivity, but would not have a significant beneficial impact on patient care or response times.

Alternative 2: Status Determined Entirely by Natural Processes (No-Action Alternative)

Under alternative 2, the wilderness breach would be managed under natural conditions. The breach could close naturally under this alternative. If this were to occur, there would be slight beneficial changes to public health and safety due to restored connectivity between the east and west portions of the Fire Island Wilderness, as described for alternative 1.

The wilderness breach had an effect on how law enforcement responds to Davis Park and Water Island by altering the route emergency response units use to access the eastern communities. Prior to the wilderness breach, emergency response access by vehicle to Davis Park and Water Island was from the east at Smith Point County Park and the Wilderness Visitor Center. Since the breach formed, emergency response personnel gain access through the western end of Fire Island instead of the east. This process would continue under alternative 2; however, since patients suffering severe, life-threatening emergencies would continue to be transported via helicopter or vessel, there would not be a change in emergency response time.

Alternative 3: No Human Intervention Unless Established Criteria are Exceeded (Proposed Action and Preferred Alternative)

Under alternative 3, while the breach remains open, the impacts on emergency response time would be the same as described for alternative 2. Emergency response personnel would continue to gain access through the western end of Fire Island instead of the east. However, patients suffering severe, life-threatening emergencies would be transported via helicopter or vessel. Thus, the emergency response time for these patients has not been significantly impacted since the formation of the breach.

If the wilderness breach is determined to exceed established criteria, it would be closed using mechanical processes. The impacts of this closure would be the same as those described for alternative 1. The potential impacts from the presence and operation of construction would be avoided through a health and safety plan. Once closed, emergency access would return to pre-breach conditions, resulting in a slight beneficial impact on emergency response times for non-critical patients.

Cumulative Impacts

Several past, present, or reasonably foreseeable future actions have a detectable effect on public health and safety, including the Fire Island Inlet to Moriches Inlet stabilization project, the Fire Island Inlet to Montauk Point Reformulation Study, USFWS habitat restoration projects, Suffolk County wetlands projects, and the new bridge to Smith Point. Development of the Fire Island Inlet to Montauk Point Reformulation Study has been an ongoing USACE effort since its authorization in 1963. This program is aimed at managing the risk of coastal storm damages through beach nourishment and breach closures. Interim projects aimed at reducing changes in storm damage risk, such as the Breach Contingency Plan and Fire Island Inlet to Moriches Inlet stabilization project, have carried out beach nourishment projects and breach closures; therefore, the conditions under the Fire Island Inlet to Montauk Point Reformulation Study would not represent a change in current conditions. These projects would continue to provide beneficial impacts on public health and safety from reducing coastal storm damage. The three wetland restoration projects within the geographic area analyzed for this Breach Plan/EIS – a USFWS habitat restoration project in the Wertheim National Wildlife Refuge, which borders Bellport Bay, and two Suffolk County wetlands projects (the tidal wetlands at Beaverdam Creek, a tributary to Bellport Bay and the marsh at Smith Point County Park) – would enhance water quality and therefore, benefit public health and safety. Finally, the new bridge to Smith Point would include a lane to allow pedestrian and bicyclists to safely cross the bridge along with vehicular traffic.

If the breach remains open, the wilderness breach would continue to affect how law enforcement responds to Davis Park and Water Island by altering the route emergency response units use to access the eastern communities; however, since patients suffering severe, life-threatening emergencies would be transported via helicopter or vessel, there would not be a significant impact on emergency response time. When the actions described above are combined with open wilderness breach, there would be beneficial impacts on public health and safety. The slight adverse impact from loss of connectivity east and west of the breach would not offset the beneficial impacts from the Fire Island Inlet to Moriches Inlet stabilization project, the Fire Island Inlet to Montauk Point Reformulation Study, USFWS habitat restoration projects, Suffolk County wetlands projects, and the new bridge to Smith Point.

If the breach is closed mechanically, construction could have temporary impacts on visitor safety; however, visitors would be excluded from the construction area and closure would be completed following a site-specific health and safety plan. Following construction, the closed breach would have a slight beneficial impact on health and safety, as connectivity between the east and west side of the breach would be returned. The past, present, and reasonably foreseeable future actions identified above along with the closed breach would beneficially affect human health and safety.

Conclusion

The conditions of the open breach (alternatives 2 and 3) have resulted in a loss of connectivity between the east side of the breach and the eastern communities on the west side of the breach. This loss of connectivity has altered the way emergency response personnel gain access to these communities. However, for patients suffering severe, life-threatening emergencies, transport is completed via helicopter or vessel, the same as prior to the breach, and would not have a significant impact on emergency response time.

Construction activities under alternatives 1 and 3 to close the breach could have a slight adverse impact on visitor safety; however, visitors would be excluded from the construction area and a health and safety plan would be followed. A closed breach (closed either mechanically under alternatives 1 and 3 or by natural processes under alternatives 2 and 3) would return the bay to pre-breach conditions, resulting in the return of connectivity between the east and west sides of the breach. This connectivity would increase response time for non-emergency incidents in the eastern communities west of the breach. For emergency situations, there would not be an effect on response time, as these patients are reached and transported via helicopter or vessel.

FLOODING

Methodology

A mathematical modeling approach was used to evaluate potential post-breach flood levels that may result during storm events. Flooding from storm events can be the result of multiple factors, including the size of the breach, the presence/size of ebb and flood shoal deltas, tidal activity, storm surge, wave action, and winds. However, there are many assumptions and limitations associated with modeling that limit the applicability of their predictions, as presented in chapter 3.

Potential effects of the wilderness breach to flood hazard risks were evaluated using hydrodynamic modeling efforts performed by Moffat and Nichol (2015) on behalf of the US Army Corps of Engineers. Information describing the objectives, assumptions, inputs, and results of the model is provided in detail in the technical synthesis report (Methratta et al. 2016). Although the Storm Damage Model is based on some assumptions and limitations, the model represents the best available science based on the data currently available and is therefore used in this draft Breach Plan/EIS for evaluating and predicting potential future scenarios. It is important to note that models generally provide information on possible outcomes, not guaranteed outcomes.

Geographic Area

The extent of the geographic area evaluated for flooding effects for each of the proposed alternatives includes the Great South Bay (bound by South Oyster Bay to the west), Patchogue Bay, Bellport Bay, Narrow Bay, Moriches Bay (bound by Potunk Point to the east), shorelines on the bayside of the island, north to Highway 27, and includes the lower reaches of contributing tributaries and backwater areas.

Alternative 1: Closure Using Mechanical Processes

The impact on hydrologic and flood conditions under alternative 1 would be the equivalent of returning the study area to pre-breach conditions. Under this alternative, the open breach would be mechanically closed using heavy equipment and sand dredged from the Westhampton borrow area. Activities associated with the closure would not result in direct effects to the hydrologic or flood conditions during construction. However, mechanical closure of the breach would result in permanent impacts to flooding scenarios from elimination of ocean mixing directly with bay water. This would create lower energy environments and would only allow direct water exchange between the ocean and the bay during storm-generated overwash events and through existing and maintained inlets. Peak water levels and shoreline flooding from storm surges and winds would return to conditions similar to those existing prior to the breach. Further, once the breach is closed, growth of the extensive flood delta established by the wilderness breach would likely cease and would be redistributed due to reduced water velocities.

Climate change is expected to cause sea level rise in the northeast United States over the next 10 to 20 years. Breach closure under alternative 1 would be complete as soon as possible; therefore, the breach would be closed before any effects of climate change would start to manifest. Changes to hydrology and flood conditions from climate change during the duration of the Breach Plan/EIS under this alternative would be minimal. However, it is important to note that mechanically closing the breach would not prevent sea-level rise from climate change. If sea levels rise at the rates currently predicted, they will have an effect on flooding in the project area, with or without the open wilderness breach. The Intergovernmental Panel on Climate Change concluded that sea level rise projections for the 21st century and beyond will result in increased adverse impacts to coastal systems and low-lying areas along the Atlantic Coast in their report *Climate Change: Impacts, Adaptation, and Vulnerability*; adverse impacts may include submergence, coastal flooding, and coastal erosion (IPCC 2014). The observed average rate of sea level rise is currently 2.0 mm/year, but could be substantially higher in the future (IPCC 2014).

Alternative 2: Status Determined Entirely by Natural Processes (No-Action Alternative)

Under alternative 2, the breach would remain open and under natural processes, allowing the continued mixing of ocean and bay waters. Based on model predictions of peak water levels resulting from storm surge events, and subsequent shoreline flooding, there is a slight possibility for increased shoreline impacts. Both modeled and measured data indicate that the presence of the breach may result in small increases in peak water levels in the western parts of Great South Bay and minimal changes in the central and eastern parts of the bay. However, subject matter experts believe that these changes in western Great South Bay can be attributed to the maintained Fire Island Inlet.

Although the exact pattern or rate of breach migration is not known, subject matter experts believe that breach migration would continue and would be bounded 1.5 km to the west and 0.5 km to the east of the current breach orientation. Breach migration is not likely to result in additional changes to hydrology or flood conditions; however, breach expansion could result in greater water exchange and potentially increase the flood risk zone (extent) along the surrounding shorelines. Modeling results indicate that the expansion of the breach could result in peak high water levels of up to 80 centimeters (31.5 inches). However, the breach modeled is much larger than the actual wilderness breach and the storm scenarios modeled were for large or extratropical storms (100-year storms), resulting in predictions that are largely overestimated.

The models also evaluated the amount of flooding that would occur with and without the breach for 2-year (small), 10-year (severe or tropical), and 100-year (large or extratropical) storms. The open breach scenarios for these storms resulted in 8.2 to 45.5% increase in areas flooded. As described in chapter 3, these increases are in agreement with the most recent Federal Emergency Management Agency insurance maps (January 2015), indicating that the flooding predicted by the models for the open breach is within the area at risk during 100-year storms according to the Federal Emergency Management Agency.

Closure of the breach could occur while the National Park Service is managing it under natural conditions. Closure would happen gradually as sand is deposited in and around the breach via altered sediment transport from current conditions. The closure would reduce the frequency of exchange between the ocean and bay waters, and this change would happen slowly over time. Overwash would occur regularly during this process, as the depth of the breach channel would gradually decrease with increased infilling. This process would change sediment transport and geomorphology over time, gradually reverting to pre-breach conditions. In response, hydrologic and flood related scenarios would revert to conditions similar to those that occurred pre-breach.

The future effects of climate change on flooding is unknown. Peak water levels along the Atlantic Coast associated with climate change and sea level rise will most certainly increase in the coming decades. Actions proposed by the Seashore under alternative 2 would not exacerbate the impacts caused by climate change effects. As previously stated, if sea levels rise at the rates currently predicted, they will have an effect on flooding in the project area, with or without the open wilderness breach. By allowing natural process to govern the condition of the breach, the dynamic barrier island system would be able to reach a natural equilibrium under these changing conditions.

Alternative 3: No Human Intervention Unless Established Criteria are Exceeded (Proposed Action and NPS Preferred Alternative)

While the wilderness breach remains open and within established criteria, the impacts on hydrology and flood conditions under alternative 3 would be similar to those described for alternative 2. An open breach would continue to allow the exchange of ocean and bay waters. The breach is expected to migrate and would not necessarily impact hydrology or flood conditions. If the breach were to expand beyond its current cross-sectional area, this could result in greater water exchange and potentially increase the flood risk zone (extent) along the surrounding shorelines. If the breach were to close naturally, the effect on hydrology and flood conditions would eventually be the same as described for alternative 1. Natural closure of the breach would change hydrologic exchange and flood conditions back to conditions similar to before the breach opened; however, this process would happen slowly as part of natural coastal processes, as described for alternative 2.

If the breach were to exceed established criteria and the NPS determined that mechanical closure were necessary, the impact on hydrology and flood conditions under alternative 3 would be similar to those described for alternative 1. Activities associated with the closure would not result in direct effects during construction. Once the breach is closed, water exchange and subsequent peak water levels and flood scenarios on the oceanside and bayside would return to conditions similar to those that existed pre-breach. Namely, mechanical closure of the breach would create lower energy environments; would only allow direct water exchange between the ocean and the bay during storm-generated overwash events and through existing and maintained inlets; and would return peak water levels and shoreline flooding from storm surges and winds to conditions similar to those existing prior to the breach. Additionally, growth of the extensive flood delta established by the wilderness breach would likely cease and would be redistributed due to reduced water velocities.

The future effects of climate change on flooding is unknown. Peak water levels along the Atlantic Coast associated with climate change and sea level rise will most certainly increase in the coming decades. As stated for alternative 2, allowing the breach to remain open under natural conditions would not exacerbate the impacts caused by climate change effects. There is no way to accurately predict when the wilderness breach would require closure, if at all, but the breach remaining open for over 50 years is a reasonable prediction; therefore, the breach could remain open when the effects of climate change begin to manifest. Over the next 50 years, Great South Bay is expected to incur a number of changes due to climate change. However, as discussed under alternative 1, mechanically closing the breach would not prevent sea-level rise from climate change and would not offset the effects of sea level rise.

Cumulative Impacts

There are several past, present, or reasonably foreseeable future actions that have a detectable effect on flood hazard risks including the Fire Island Inlet to Moriches Inlet stabilization project, the Fire Island Inlet to Montauk Point Reformulation Study, Suffolk County wetlands projects, and Long Island Intracoastal Waterway Federal Navigation Project. Development of the Fire Island Inlet to Montauk Point Reformulation Study has been an ongoing USACE effort since its authorization in 1963. This program is aimed at managing the risk of coastal storm damages through beach nourishment and breach closures. Interim projects aimed at reducing changes in storm damage risk, such as the Breach Contingency Plan and Fire Island Inlet to Moriches Inlet stabilization project, have carried out beach nourishment projects and breach closures; therefore, the conditions under the Fire Island Inlet to Montauk Point Reformulation Study would not represent a change in current conditions. These projects would continue to provide beneficial impacts on public health and safety from reducing coastal storm damages. The improvements to the wetland areas in Smith Point North County Park under the Suffolk County wetlands restoration would affect sediment transport and geomorphology in the vicinity of the breach by dampening current velocities and providing platforms for sediment deposition. Future dredging for the Long Island Intracoastal Waterway Federal Navigation Project may introduce sediment into the bayside system in the vicinity of the breach. Each of these projects has the potential to affect sediment transport and geomorphology within the system, which could potentially affect peak water levels and flood conditions within the Bay.

If the breach remains open under natural conditions (alternatives 2 and 3), the direct exchange of water between the bay and ocean sides would continue, potentially resulting in an ongoing (although small) increases in peak water levels in portions of the Great South Bay. The slight adverse impacts from the small increases in peak water levels would not offset the beneficial impacts from the past, present, and reasonably foreseeable future actions identified above.

If the breach is closed mechanically (alternatives 1 and 3), construction would not result in temporary impacts on flood hazards or peak water levels; however, the end result (closure of the breach) would create a permanent geomorphological change to the breach and return water levels and flood hazard risks in the bay, to pre-breach conditions. The past, present, and reasonably foreseeable future actions identified above along with the closed breach would beneficially affect peak water levels and flood hazard in the vicinity of the breach.

Conclusion

Despite positive ecological influences from the breach forming, it has also been implicated in changes observed in the timing, duration, and peak of high water levels within the bays. The wilderness breach has changed the hydrologic connectivity between the ocean and the bays, and results of field data and modeling efforts indicate that the open breach has altered flood conditions for the Great South Bay and surrounding lands. However, the changes indicated by field data were small in comparison to the normal variation typically observed within the study area, and as such, are more reflective of changes that occur naturally as part of a dynamic barrier beach system, rather than a beneficial or adverse impact. Additionally, modeling results are likely overstated, as described below. While the breach remains open under natural conditions (alternatives 2 and 3), these conditions would continue.

Construction activities under alternatives 1 and 3 to close the breach would not have an effect on hydrology or flood conditions. A closed breach (closed either mechanically under alternatives 1 and 3 or by natural processes under alternatives 2 and 3) would return the bay to pre-breach conditions, resulting in a lower-energy environment where direct water exchange between the ocean and the bay would only occur during storm-generated overwash events and through existing and maintained inlets. Peak water levels and shoreline flooding from storm surges and winds would return to conditions similar to those existing prior to the breach.

Modeling efforts predict an increase in maximum flood extent under three different flood return frequency scenarios (2-, 10-, and 100-year return) for the Great South Bay and portions of the communities located adjacent to the bays, as a result of the breach. The flood models are based on certain assumptions, reducing the accuracy of their predictions, and creating varying levels of uncertainty associated with the modeling process. Therefore, the flooding predictions based on the models include some quantity of over-prediction from the assumptions and associated model uncertainty. The model therefore predicts a worst-case scenario of peak water levels and flood extents well in excess of those observed from monitoring data collected since the breach formed. The flooding predicted by the model occurs within the Federal Emergency Management Agency -designated 100-year Flood Hazard Zone, much of which is used as agricultural and recreational lands. The model results are informative and represent the best available scientific data; however, the model predictions are more representative of future conditions that may occur under substantial sea level increases (greater than 1.0 feet) resulting from climate change.

SOCIOECONOMICS

Methodology

Desktop-based research was performed to determine the availability of economic impact information relevant to the current analyses of the proposed alternatives. The USACE Storm Damage Model (USACE 2016) is the only available hydraulic model that provides economic impact predictions for modeled flood impacts related to the wilderness breach. The 2016 USACE Storm

Damage Model generated predictions were used to compare flood risk scenarios and their associated economic costs under two scenarios: (1) all breaches remaining open (unmanaged), and (2) breaches closed scenarios (with wilderness breach remaining open). This complex model predicts flood and storm-related damages and associated economic impacts using a variety of data inputs developed by other modeling efforts. The Storm Damage Model was designed to evaluate multiple storm damage sources over a 50-year planning cycle and uses the largest, or most critical, source of damage for each event modeled. The model was developed based on a specific set of assumptions and there are limitations to the applicability of the model predictions. The model assumptions and limitations are discussed in the "Socioeconomics" section of chapter 3 and in greater detail in Methratta et al. (2016).

One limitation of the model was the lack of hydraulic data needed to predict the impact of the existing wilderness breach on bay flood elevations under the full range of future conditions. Instead, the model used a conservative estimate of breach-related flooding damage to estimate the economic costs of the breach remaining open. As such, the economic costs of the wilderness breach may be underestimated (AECOM pers. comm. 2016).

The USACE developed the Storm Damage Model to determine if proposed management actions are justified based on a comparison of proposed economic benefits and model-predicted economic damage and associated economic costs. As such, the Storm Damage Model meets the project needs of the USACE, but does not meet the needs of the National Park Service since it does not specifically evaluate the individual effects attributed to the wilderness breach across the 50-year model scenario. The National Park Service needs to estimate actual expected damages specifically attributed to the wilderness breach; however, this model is used in the analysis because it is the best available information on the economic impact of breach open and breach closed scenarios.

Geographic Area

The geographic area analyzed for impacts on water resources consists of the areas from central Great South Bay east to western Moriches Bay. This area includes over 200 miles of back bay shoreline along Great South, Moriches, and Shinnecock Bays.

Alternative 1: Closure Using Mechanical Processes

Under alternative 1, the breach would be closed as soon as possible. Closing the breach would be equivalent to returning the study area to pre-breach conditions. The resulting economic impact within the study area could be a potential reduction in flood damage costs of $4,733,300 per year (USACE 2016). As stated in chapter 3, these annual damage estimates are based on the 50-year management period of the Fire Island Inlet to Montauk Point Reformulation Study. The estimated flood damage cost incorporates escalations in cost due to sea level rise of 0.5 feet (over the 50-year management plan cycle) and resulting from economic inflation. The flood damage costs attributed to the wilderness breach represents 3.4 percent of the total average annual costs, a fraction of the projected flood damage costs associated with all breaches. Although the costs associated with the wilderness breach-related flooding appear large, the portion of flooding attributed to differences between breach management alternatives (open or closed) are within natural water level fluctuations previously observed in the study area. Closing the breach, or any other management alternative, would not alter the potential future impacts of climate change-driven sea level rise on coastal communities.

Alternative 2: Status Determined Entirely by Natural Processes (No-Action Alternative)

Under alternative 2, the breach would be left open and the status of the breach would be determined by natural processes. If the breach remains open, hydrology and flood conditions would be the same as the current conditions described in chapter 3. The hydrologic connectivity and exchange between the bay and the ocean would continue to provide a pathway for exchange-related improvements observed within the bay.

Water level changes, and subsequent damage costs, attributed to the wilderness breach are within natural water level fluctuations previously observed in the study area. Changes expected in water levels are predicted to be within the Federal Emergency Management Agency 100-year Flood Hazard Zone. As such, the potential economic effects have been factored into existing Federal Emergency Management Agency-based Flood Insurance Rating Maps. Further, the Storm Damage Model predicts potential increases in flood risk resulting from the breach; however, the majority of the areas that would be affected are non-residential and consist of open space and recreational and agricultural areas. The Storm Damage Model provides predictions about potential future conditions, is not a guarantee of future scenarios, and presents a worst-case scenario approach to potential flood risks and associated economic costs.

This alternative would have no effect on potential future costs associated with sea level rise impacts. According to the most recent USACE model updates (2016), the predicted annualized flood damages are significantly affected by predicted rates of sea level rise and would be significant regardless of breach management decisions. If the wilderness breach closed naturally under this alternative, any of the beneficial ecological effects that have occurred post-breach formation would be eliminated slowly over time, such as increased exchange of saltwater, organisms, and energy between the open ocean and Great South Bay as discussed in the technical synthesis report (Methratta et al. 2016). The beneficially ecological effects have not been quantified but could also offset the potentially overestimated economic costs from increased damage predicted by the model if the breach were to remain open.

If the breach were to close naturally, the impacts on hydrology, flood conditions, and subsequent economic impacts would be the same as described for alternative 1. This would change hydrologic exchange and flood conditions back to conditions similar to before the breach opened. This typically happens slowly as part of natural coastal processes and would not result in any short- or long-term construction related flood severity impacts.

Alternative 3: No Human Intervention Unless Established Criteria are Exceeded (Proposed Action and Preferred Alternative

Under alternative 3, the breach would remain open and would be governed by natural processes unless pre-established criteria – that indicate the breach would elevate the risk of severe storm damage – were exceeded. If the breach remains open, the impacts on hydrology and flood conditions would be the same as described for alternative 2.

If the breach were to require closure under alternative 3, the breach would be closed through mechanical processes. Because the timing of the closure is unknown, the conditions of the breach and the extent of the sea level rise cannot be predicted. Therefore, economic impact associated with mechanical closure within the study area could be a potential reduction in flood damage costs, at a minimum currently estimated to be $4,733,300 per year.

Cumulative Impacts

There are several past, present, or reasonably foreseeable future actions that have a detectable effect on flood hazard risks including the Fire Island Inlet to Moriches Inlet stabilization project, the Fire Island Inlet to Montauk Point Reformulation Study, Suffolk County wetlands projects, and Long Island Intracoastal Waterway Federal Navigation Project. Development of the Fire Island Inlet to Montauk Point Reformulation Study has been an ongoing USACE effort since its authorization in 1963. This program is aimed at managing the risk of coastal storm damages through beach nourishment and breach closures. Interim projects aimed at reducing changes in storm damage risk, such as the Breach Contingency Plan and Fire Island Inlet to Moriches Inlet stabilization project, have carried out beach nourishment projects and breach closures; therefore, the conditions under the Fire Island Inlet to Montauk Point Reformulation Study would not represent a change in current conditions. These projects would continue to provide beneficial impacts on public health and safety from reducing coastal storm damages. The improvements to the Smith Point North County Park wetlands under the Suffolk County wetlands restoration would affect sediment transport and geomorphology near the breach. The wetlands would dampen current velocities and provide platforms for sediment deposition. Future dredging for the Long Island Intracoastal Waterway Federal Navigation Project may introduce sediment into the bay near the breach. Each project has the potential to effect sediment transport and geomorphology within the system, resulting in potential effects to the peak water levels within the bays.

If the breach remains open under natural conditions (alternatives 2 and 3), the direct exchange of water between the bay and ocean sides would continue, potentially resulting in ongoing but small increases in peak water levels in portions of the Great South Bay. The past, present, and reasonably foreseeable future actions identified above, along with the open breach, would continue to operate in response to the dynamic coastal system in which they occur. The breach may naturally close, expand, or decrease, each of which, based on the analyses above, would likely result in a small increase to flood extent associated with the breach.

If the breach is mechanically closed (alternatives 1 and 3), construction would not temporarily impact flood hazards or peak water levels. However, closing the breach would permanently change the breach geomorphology and return the bay system water levels and flood hazard risks to pre-breach conditions. The past, present, and reasonably foreseeable future actions identified above along with the closed breach would affect peak water levels and flood hazards near the breach. However, these actions are not necessarily adverse or beneficial, which is similar to the analysis under an open breach. These actions would affect the geomorphology and sediment deposition within the bay, while the bay would continue to experience natural changes in hydrologic conditions and flood hazards.

Conclusions

Under alternatives 2 and 3, model predictions used in (AECOM pers. comm. 2016) and resulting from the Storm Damage Model (USACE 2016) indicate that the open breach contributes approximately 3.4% to the total average annual costs predicted by USACE. This value is based on the estimated water level changes attributed to the wilderness breach remaining open, which are within normal variations observed within the project area. Further, the open breach has created beneficial impacts from improved environmental conditions. Although the beneficial ecological impacts have not been quantified, they could offset some or all of the economic costs predicted from the model. Closing the breach under alternative 1 could result in a reduction of flood damage costs, currently estimated at $4,733,300 per year. Because the timing and conditions of closure, if necessary, under alternative 3 are unknown, the economic impact is also unknown, but would likely be comparable to the currently estimated value.

Differences in flood damage costs for the proposed breach management alternatives represent a fraction of the projected flood damage costs for a single storm event. Although the model-projected costs associated with the flooding from increased water levels appear fairly large, the portion of flooding attributed to differences between the breach open and breach closed conditions are within natural water level fluctuations previously observed in the study area. The flood risks associated with predicted changes in flood extent, under all storm return frequency scenarios, are consistent with the extent of the 2015 Federal Emergency Management Agency 100-year Flood Hazard Zone, despite the presence of the breach.

SUSTAINABILITY AND LONG-TERM MANAGEMENT

For each alternative evaluated in an environmental impact statement, the National Park Service must consider the following: (a) whether the effects of the alternatives involve tradeoffs between the long-term productivity and sustainability of park resources and the immediate short-term use of those resources; and (b) whether the effects of the alternatives are sustainable over the long term without causing adverse environmental effects for future generations (NEPA section 102(c)(iv)).

Adverse Environmental Effects that Cannot be Avoided

Unavoidable impacts constitute a substantial change to existing environmental conditions that cannot be completely offset by the implementation of mitigation measures. Unavoidable impacts on wilderness character, water quality, ecosystem structure and processes, benthic communities, and finfish and decapod crustaceans could arise from mechanical closure of the breach under alternatives 1 and 3.

Under alternative 1 and potentially alternative 3, the wilderness breach would be closed mechanically. This action would adversely affect the ecosystem of the Great South Bay. By abruptly closing the breach, the Seashore would be hindering natural barrier island processes, rapidly ending the mixing of bay and ocean waters. Water quality would likely decline rapidly, thus causing shifts and possible regressions in the submerged aquatic vegetation, benthic, decapod crustacean, and finfish communities, and ecosystem maturity. Under these alternatives, the *untrammeled*, *natural*, and *undeveloped* qualities of wilderness character would be permanently impacted, as the filled breach would be considered a development in the Fire Island Wilderness.

Relationship of Local Short-term Uses versus Long-term Productivity

Short-term uses of resources would occur under alternatives 1 and 3 during construction activities. The placement of sheet piling or sand-filled geotextile tubes would likely cause concussive forces and shock waves that could adversely impact fish in the vicinity of project site. During the process of placing the fill sand in the breach, there would be an increase in turbidity due to the release of fine sediments into the water column. Turbidity can affect water quality, and in turn, aquatic plants and wildlife. Most mobile species, such as fish and crabs, would be able to relocate away from the turbidity at the onset of construction, but sessile organisms would likely be buried by the sediment or affected by the reduction in water clarity. To reduce turbidity in the bay, silt curtains would be used to allow suspended sediment to settle out of the water column in a controlled area, minimizing the area that is affected by increased suspended sediment. These impacts would be temporary, as construction is expected to last less than 3 months.

Once the wilderness breach is closed, there would be a long-term loss in productivity of the Great South Bay. As previously discussed, the ecosystem maturity in the bay had been declining over the last 120 years. The breach triggered an increase in ecosystem maturity, including total biomass and species richness. Closing the breach would stop the exchange of water between the Great South Bay and the Atlantic Ocean. The Great South Bay would be expected to return to pre-breach conditions, including a decline in system maturity, likely resulting in lower species richness and biomass and potentially a decrease in food web complexity, diversity of feeding relationships, upper trophic level predators, and migratory fish species. Overall, the Great South Bay would be expected to be less healthy, less stable, and less resilient to disturbance.

Irreversible and Irretrievable Commitment of Natural and Cultural Resources

The National Park Service must consider whether the effects of the alternatives are irreversible or irretrievable commitments of resources. Irreversible impacts are those effects that cannot be changed over the long term or are permanent. Irretrievable commitments are those resources that, once gone, cannot be replaced. The National Park Service must also consider whether the impacts on park resources would mean that once gone, the resource could not be replaced; in other words, the resource could not be restored, replaced, or otherwise retrieved (NEPA section 102(c)(v)).

Mechanical closure of the wilderness breach under alternatives 1 and 3, would have irreversible impact on the *untrammeled*, *natural*, and *undeveloped* qualities of wilderness character.

Natural or Depletable Resource Requirements and Conservation Potential of Various Alternatives and Mitigation Measures

Petroleum is an example of a depletable resource that would be required for the alternatives. Under alternatives 1 and 3, the mechanical closure of the breach would require heavy equipment including land and sea vehicles. Petroleum products (e.g., gasoline, oil) would be needed to operate this equipment. Although the construction is expected to take less than 3 months, these alternatives would consume depletable resources.

Consultation and Coordination

5

Wilderness Breach - March 29, 2015

CHAPTER 5: CONSULTATION AND COORDINATION

This chapter summarizes the process undertaken by the National Park Service to contact individuals, agencies, and organizations for information or that assisted in identifying important issues, analyzing impacts, or that will review and comment on the *Fire Island Wilderness Breach Management Plan and Environmental Impact Statement (Breach Plan/EIS)*. Throughout the planning process, the Fire Island National Seashore (Seashore) staff encouraged elected officials, culturally associated American Indian tribes and groups, partners in other agencies, park visitors, and private citizens to participate in this planning effort, as summarized below.

THE SCOPING PROCESS

Scoping is the process of determining the scope of issues to be addressed in an environmental document. It includes internal scoping with National Park Service (NPS) staff, consultation with all interested parties and any agency with jurisdiction by law or with special expertise, and the general public.

Informal internal scoping discussions for the plan started in the winter of 2014 among NPS staff from the Seashore and the Northeast Region. Formal internal scoping for the Breach Plan/EIS was initiated at a meeting held at the Watch Hill Ferry Terminal at Fire Island National Seashore on July 27, 2015, among the National Park Service (staff from the Seashore, Northeast Region, and Denver Service Center), local governments, and agencies. Topics discussed included breach research and monitoring, environmental impact statement process and timeline, draft alternatives, and issues associated with the breach. The following local governments and agencies attended the internal scoping meeting:

- Town of Brookhaven
- Village of Bellport
- Village of Ocean Beach
- Village of Saltaire
- Suffolk County
- New York State Department of Environmental Conservation
- New York State Department of State
- US Army Corps of Engineers, New York District
- US Fish and Wildlife Service
- US Geological Survey

Another formal internal scoping meeting was conducted on October 13–15, 2015, with NPS staff from the Seashore, the Northeast Region, the Denver Service Center, and their consultant. Representatives from the New York State Department of Environmental Conservation and the US Army Corps of Engineers also attended the meeting. Participants identified the purpose of and need for action, discussed potential alternatives, and suggested management issues that could be addressed in the Breach Plan/EIS.

The public was notified of the plan through a Public Scoping Newsletter that was released on August 31, 2015, which invited the public, agencies, and stakeholders to submit comments and engage in the planning process. Scoping was officially initiated with the publication of a Notice of Intent to prepare an environmental impact statement in the *Federal Register* on September 8, 2015. On September 9, 2015, the National Park Service issued a press release to area news organizations. Information was also posted to the Seashore's website and Facebook page. The public scoping comment period was open from August 31 through October 8, 2015. During the public comment period, 366 individual correspondences were received. All comments were read and analyzed; similar comments were grouped together and concern statements were developed to reflect the public sentiment for specific topics. The Public Scoping Comment Summary Report is available on the NPS Planning, Environment and Public Comment website at http://parkplanning.nps.gov/FireIslandBreachManagementPlan. The National Park Service considered the issues raised during public scoping as they developed the preliminary draft alternatives for the plan and identified environmental issues to be examined in detail.

AGENCY AND TRIBAL GOVERNMENT SCOPING

Agency and tribal government scoping was held in an effort to obtain early input on the scope of issues to be addressed in this Breach Plan/EIS. Copies of scoping letters and responses can be found on the NPS Planning, Environment and Public Comment website at http://parkplanning.nps.gov/FireIslandBreachManagementPlan. Scoping letters were sent to the following entities:

- US Fish and Wildlife Service
- National Oceanic Atmospheric Administration–National Marine Fisheries Service
- New York State Historic Preservation Office
- Advisory Council on Historic Preservation
- Shinnecock Nation
- Unkechaug Indian Nation
- New York Department of Environmental Conservation
- New York State Department of State
- US Army Corps of Engineers, New York District
- US Environmental Protection Agency
- Town of Brookhaven

Cooperating Agencies

The National Park Service is the lead agency on the Breach Plan/EIS. The US Army Corps of Engineers, New York District, accepted cooperating agency status by letter dated November 10, 2015. A cooperating agency relationship was established between the National Park Service, Northeast Region, and the State of New York, Department of Environmental Conservation for this project was signed in September 2015.

Endangered Species Act Section 7 Consultation

The Endangered Species Act of 1973, as amended (16 USC 1531 et seq.), requires all federal agencies to consult with the US Fish and Wildlife Service to ensure that any action authorized, funded, or carried out by the agency does not jeopardize the continued existence of listed species or critical habitat. The Fish and Wildlife Coordination Act, as amended in 1964, was enacted to protect fish and wildlife when federal actions result in the control or modification of a natural stream or body of water. The Fish and Wildlife Coordination Act requires that all federal agencies consult with the US Fish and Wildlife Service, National Marine Fisheries Service, and State wildlife agencies regarding the impacts on fish and wildlife resources and measures to mitigate these impacts for activities that affect, control, or modify waters of any stream or bodies of water.

In accordance with these acts, the Seashore has been in consultation with the US Fish and Wildlife Service since the internal scoping meeting in July 2015. At this meeting, the Seashore presented the state of the wilderness breach and monitoring, the environmental impact statement process and timeline, and the draft alternatives. The participants then discussed the potential issues related to management of the wilderness breach.

US Fish and Wildlife Service. The Seashore initiated consultation with the US Fish and Wildlife Service with a letter dated January 21, 2016, which identified the draft alternatives and requested comments from the US Fish and Wildlife Service. On a February 16, 2016, conference call, the National Park Service and US Fish and Wildlife Service discussed project updates and a consultation strategy. On March 9, 2016, the US Fish and Wildlife Service responded to this initial letter with a list of potentially affected species and the expected impacts as related to the consultation with US Army Corps of Engineers for the Fire Island Inlet to Montauk Point Reformulation Study. These species are the federally threatened piping plover (*Charadrius melodus*), the federally threatened red knot (*Calidris canutus rufa*), and the federally threatened seabeach amaranth (*Amaranthus pumilus*). On March 29, 2016, the National Park Service and US Fish and Wildlife Service met to continue informal consultation regarding threatened and endangered species from impacts associated with the Breach Plan/EIS. The Seashore responded in writing in April, 2016, via letter and email to clarify that the Breach Plan/EIS is not related to the Fire Island Inlet to Moriches Inlet stabilization project or the Fire Island Inlet to Montauk Point Reformulation Study and is a stand-alone project that concerns lands managed under the *Otis Pike Fire Island High Dune Wilderness Act* (Public Law 96-585), the *Wilderness Act* (Public Law 88-577), and the *Wilderness Stewardship Plan and Backcountry Camping Policy* (NPS 2016a). An additional conference call occurred on May 11, 2016, in which the National Park Service and US Fish and Wildlife Service discussed potential impacts on the three listed species if closure were to become necessary.

The National Park Service is continuing informal consultation with the US Fish and Wildlife Service. The National Park Service has prepared a preliminary draft biological assessment for piping plover, red knot, and seabeach amaranth that fully addresses the impacts that could occur to these species and their habitats if closure was required under the preferred alternative. This preliminary draft biological assessment was prepared to expedite the formal consultation process in the event that a decision to close the wilderness breach is made in the future. It is important to note that due to the variability in the morphology of this natural inlet, detailed design for the mechanical closure of the breach cannot occur at this time. If closure becomes necessary, the preliminary draft biological assessment would be updated with construction details that pertain to the size and location of the breach at that time. The National Park Service will continue to consult with the US Fish and Wildlife Service on an annual basis to obtain the most current information on the piping plover, red knot, and seabeach amaranth and to determine if any new species would require analysis in the biological assessment. At minimum, annual informal consultation meetings would ensure the status of threatened and endangered species are considered in conjunction with data on the evolution of the wilderness breach.

National Oceanic and Atmospheric Administration-National Marine Fisheries Service. The Seashore also initiated consultation with National Oceanic and Atmospheric Administration-National Marine Fisheries Service with a letter on January 21, 2016. On February 8, 2016, the National Park Service held a conference call with National Oceanic and Atmospheric Administration-National Marine Fisheries Service and the US Environmental Protection Agency to provide an update on the project and discuss the Seashore's proposed consultation approach. National Oceanic and Atmospheric Administration-National Marine Fisheries Service responded to the Seashore's request in a letter dated May 5, 2016, indicating that the New York Bight Distinct Population Segment of Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*), the northwest Atlantic Ocean Distinct Population Segment of loggerhead sea turtle (*Caretta caretta*), Kemp's ridley sea turtle (*Lepidochelys kempii*), green sea turtle (*Chelonia mydas*),leatherback sea turtle (*Dermochelys coriacea*), right whale (*Eubalaena glacialis*), humpback whale (*Megaptera novaeangliae*), and finback whale (*Balaenoptera physalus*) could be affected by the Breach Plan/EIS, specifically the construction activities if closure of the breach were necessary.

On a May 10, 2016 conference call, the Seashore and National Oceanic and Atmospheric Administration-National Marine Fisheries Service determined that managing the breach under natural conditions would not impact these species, as the likelihood of these species being present in the immediate vicinity of the breach is small and impacts from natural barrier island processes would not be considered adverse. Additionally, these species have been analyzed under the Fire Island Inlet to Moriches Inlet environmental assessment for activities that would occur at the Westhampton Borrow Area, and it was determined that the actions would not have adverse impacts. Therefore, National Oceanic and Atmospheric Administration-National Marine Fisheries Service and the Seashore concluded that further evaluation of these species would be appropriate if/when it were determined that the wilderness breach should be closed. This is due to the dynamic nature of barrier island processes. If the breach were to be closed, the Seashore has no way of predicting at this time when closure would be necessary, the conditions of the breach (i.e., location, cross-sectional area), or the amount of sand that would be required to fill it. Consultation with National Oceanic and Atmospheric Administration-National Marine Fisheries Service will continue throughout the environmental compliance process for the Breach Plan/EIS.

Magnuson–Stevens Fishery Conservation and Management Act Consultation

The Magnuson-Stevens Fishery Conservation and Management Act is the primary law governing marine fisheries management in United States federal waters. This act requires National Oceanic and Atmospheric Administration-National Marine Fisheries Service to work with other federal agencies to conserve and enhance essential fish habitat, the habitat necessary for managed fish to complete their life cycle, thus contributing to a fishery that can be harvested sustainably. As a result, whenever federal agencies authorize, fund, or carry out actions that may adversely impact essential fish habitat, they must consult with National Oceanic and Atmospheric Administration-National Marine Fisheries Service regarding the impact of their activities on essential fish habitat. National Oceanic and Atmospheric Administration-National Marine Fisheries Service must provide the consulting federal agency with essential fish habitat conservation recommendations for any action that would adversely affect essential fish habitat. National Oceanic and Atmospheric Administration-National Marine Fisheries Service has interpreted through regulation that essential fish habitat must be described and identified for each federally managed species at all life stages for which information is available.

As stated in the previous section, the Seashore initiated consultation with National Oceanic and Atmospheric Administration-National Marine Fisheries Service with a letter on January 21, 2016, and on a March 4, 2016 conference call, the Seashore and National Oceanic and Atmospheric Administration-National Marine Fisheries Service discussed the project, future consultation, and methods for analyzing essential fish habitat. Using tools on the National Oceanic and Atmospheric Administration-National Marine Fisheries Service website, the Seashore identified essential fish habitat that was present in Great South Bay; based on environmental conditions available in the immediate vicinity of the wilderness breach, the Seashore identified 13 species of fish and shellfish that could be present. On May 5, 2016, the Seashore sent a letter to National Oceanic and Atmospheric Administration-National Marine Fisheries Service requesting input on the preliminary species list, which included the following species: juvenile pollock (*Pollachius virens*); juvenile summer flounder (*Paralichthys dentatus*); juvenile and adult scup (*Stenotomus chrysops*); adult windowpane flounder; adult sandbar shark; early juvenile and late juvenile dusky shark (*Carcharhinus obscurus*); larval, juvenile and adult black seabass (*Centropristis striata*); juvenile silver hake (*Merluccius bilinearis*); eggs of longfin inshore squid (*Loligo pealeii*); juvenile and adult surf clam; and all life stages of king mackerel (*Scomberomorus cavalla*), Spanish mackerel (*Scomberomorini*), and cobia (*Rachycentron canadum*).

The Seashore has prepared a preliminary draft essential fish habitat assessment, as required by and set forth in the document Essential Fish Habitat: New Marine Fish Habitat Conservation Mandate for Federal Agencies by the National Oceanic and Atmospheric Administration-National Marine Fisheries Service Habitat Conservation Division (NOAA-NMFS 2000). The essential fish habitat assessment identifies potential impacts to fish habitat and resources resulting from activities proposed in the Breach Plan/EIS. If closure becomes necessary, the National Park Service will consult with National Oceanic and Atmospheric Administration-National Marine Fisheries Service to determine if there are any additional species that should be analyzed in the essential fish habitat assessment. The preliminary draft essential fish habitat assessment will then be updated and submitted to National Oceanic and Atmospheric Administration-National Marine Fisheries Service. The essential fish habitat assessment will satisfy requirements of the Magnuson-Stevens Fishery Conservation and Management Act and agency consultation between the National Park Service and National Oceanic and Atmospheric Administration-National Marine Fisheries Service.

Section 106 of the National Historic Preservation Act Consultation

Section 106 of the National Historic Preservation Act requires that federal agencies take into account the effect of any proposed undertakings on properties that are listed or eligible for listing in the National Register. New York State Historic Preservation Office representatives were invited to attend the internal scoping meeting in July 2015, but did not participate in the meeting. The National Park Service sent a letter to the New York State Historic Preservation Office on December 18, 2015, outlining the preliminary alternatives and requesting a conference call to discuss the area of potential effects and the available information on known historic properties. A conference call was subsequently held on January 21, 2016, which was attended by representatives from the National Park Service, the New York State Historic Preservation Office, and the US Army Corps of Engineers. As a result of that call, on April 18, 2016, the National Park Service formally notified the State Historic Preservation Office of its intent to prepare a programmatic agreement per 36 CFR 800.4(2) for the management of a breach in the Otis Pike Fire Island High Dune Wilderness (Fire Island Wilderness) Area within Fire Island National Seashore and sought concurrence on the area of potential effect as defined in 36 CFR 800.16(d) for the proposed undertaking. The National Park Service received an electronic notification of State Historic Preservation Office concurrence on these issues through the New York Cultural Resource Information System on April 20, 2016.

The process also included consultation with the Advisory Council on Historic Preservation, US Geological Survey, US Army Corps of Engineers (New York District), New York Department of Environmental Conservation, and affiliated American Indian Tribes (Shinnecock Nation and Unkechaug Indian Nation). These stakeholders were invited to be consulting parties to the programmatic agreement per 36 CFR 800.6(a)(2).

The National Park Service received a signed programmatic agreement from the State Historic Preservation Office that has been received and accepted by the Advisory Council on Historic Preservation. The programmatic agreement includes stipulations for conducting surveys and identifying cultural resources within the area of potential effect, and establishes steps for meeting its National Historic Preservation Act responsibility as it implements the breach management decision and prior to subsequent project-specific actions. The stipulations in the programmatic agreement serve to outline future project reviews and identify avoidance, minimization, and mitigation measures for potential adverse effects to any historic properties within the area of potential effect.

Coastal Zone Management Act of 1972

The Coastal Zone Management Act was enacted by Congress to balance the competing demands of growth and development with the need to protect coastal resources (16 USC 1451 et seq.). The act encourages states to conduct self-evaluations of their coastal management programs every five years to assess significant changes in their coastal resources, management practices, critical needs, and priorities for enhancement. The State of New York currently administers its federally approved coastal zone program (New York Executive Law section 910 et seq.) through the New York State Department of State. Pursuant to the Federal Coastal Zone Management Act, New York State has defined its coastal zone boundaries and the policies to be utilized to evaluate projects occurring within the designated zones. In 1981, New York State adopted the Waterfront Revitalization and Coastal Resources Act, creating the New York State Coastal Management Program. The Coastal Management Program embodies 44 policy statements supportive of the Act’s intent to promote a balance between economic development and coastal resource preservation and optimization.

The Seashore initiated consultation with the New York State Department of State, Division of Coastal Resources on January 21, 2016. The letter explained the preliminary alternatives and requested comments on the proposed plan. The New York State Department of State responded in a letter dated March 8, 2016, with preliminary comments on the alternatives. Consultation with the New York State Department of State is ongoing, as the Seashore is in the process of preparing the draft Federal Consistency Assessment for consistency review by the New York State Coastal Management Program.

LIST OF RECIPIENTS

A copy of the draft Breach Plan/EIS was provided to the following agencies and organizations. These agencies and organizations will also receive a copy of the final Breach Plan/EIS. A notice of availability of the Breach Plan/EIS has been sent to others listed on the project mailing list.

Federal Agencies

- Advisory Council on Historic Preservation
- National Oceanographic and Atmospheric Administration-National Marine Fisheries Service)
- US Army Corps of Engineers, New York District
- US Department of Public Health
- US Environmental Protection Agency, Region 2
- US Fish and Wildlife Service, Long Island Field Office

State and Local Agencies or Governments

- New York State Department of Environmental Conservation, Coastal Erosion Management Section
- New York State Department of Environmental Conservation, Division of Marine Resources
- New York State Department of Environmental Conservation, Region 1 Office
- New York State Department of Health
- New York State Department of State
- New York State Historic Preservation Officer
- Robert Moses State Park
- Suffolk County Parks

Suffolk County

- Town of Brookhaven
- Town of Islip
- Village of Bellport
- Village of Mastic Beach

- Village of Ocean Beach
- Village of Ocean Beach Environmental Commission
- Village of Patchogue
- Village of Saltaire

American Indian Tribes

- Shinnnecock Indian Nation
- Unkechaug Indian Nation

Organizations and Partners

- Environmental Defense Fund
- Fire Island Association
- Fire Island Lighthouse Preservation Society
- Fire Island School District
- Fire Island Wilderness Committee
- Friends of Fire Island National Seashore
- Friends of Watch Hill
- National Park Conservation Association
- National Park Service, Northeast Region Regional Director
- Seatuck Environmental Association
- Sierra Club
- The Nature Conservancy
- Wilderness Society

Libraries

- Babylon Public Library
- Bay Shore- Brightwaters Public Library
- Bayport-Blue Point Public Library
- Brentwood Public Library
- Brookhaven Free Library
- East Islip Public Library
- Mastic Moriches Shirley Community Library
- Patchogue Medford Library
- Sayville Library
- South Country Library
- West Islip Public Library

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References

Wilderness Breach - May 26, 2016

REFERENCES

LAWS AND POLICIES REFERENCED

Endangered Species Act of 1973, as amended. 16 USC 1531–1544; PL 93-205; 87 Stat. L. 884. Approved December 28, 1973.

Executive Order 13007, *Indian Sacred Sites*. May 24, 1993.

Executive Order 11990: *Protection of Wetlands*. May 24, 1977.

Executive Order 11988: *Floodplain Management*. May 24, 1977

Fish and Wildlife Coordination Act of 1934, as amended, 16 USC 661-666c; PL 114-38; 48 Stat. 401. Approved March 10, 1934.

House of Representatives Bill 7814, 96th Congress: *A bill to designate certain lands of the Fire Island National Seashore as the "Otis Pike Fire Island High Dune Wilderness" and for other purposes.* Public Law 96-585, December 23, 1980.

Implementation of the National Environmental Policy Act of 1969. 43 CFR 46. Final Rule October 15, 2008.

Magnuson-Stevens Fishery Conservation and Management Act, as amended. Public Law 94-265. Approved April 13, 1976.

National Environmental Policy Act of 1969, as amended. 42 USC 4321 et seq.; PL 91-190, Sec. 2; 83 Stat. L. 852. January 1, 1970.

New York State Waterfront Revitalization and Coastal Resources Act of 1981. New York Executive Law Section 910 et seq.

Office of Environmental Policy & Compliance Environmental Compliance Memorandum 95-3: National Environmental Policy Act Responsibilities under the Departmental Environmental Justice Policy. May 30, 1995.

Office of Environmental Policy & Compliance Environmental Compliance Memorandum 97-2: Departmental Responsibilities for Indian Trust Resources and Indian Sacred Sites on Federal Lands. May 8, 1997.

Protection of Historic Properties. 36 CFR Part 800. Final Rule December 12, 2000.

Senate and House of Representatives Bill 1365, 88th Congress: *An act to establish the Fire Island National Seashore, and for other purposes.* Public Law 88-587, September 11, 1964.

Wilderness Act of 1964. 16 USC 1131–1136; PL 88-577; 78 Stat. L. 890. September 3, 1964.

LITERATURE CITED

AECOM

2016 Personal Communication. Email from Mike Cannon, AECOM, to Suzie Boltz, EA Engineering, regarding EIS Breach Modeling. September 29, 2016.

Bengtsson, L. and K.I. Hodges.

2006 "Storm Tracks and Climate Change." *Journal of Climate*, 3518-3543.

Boon, J.D.

2012 "Evidence of Sea Level Acceleration at U.S. and Canadian Tide Stations, Atlantic Coast, North America." *Journal of Coastal Research*, vol 28 no 6, 1437-1445.

Catto, J.L., L.C. Shaffrey, and K.I. Hodges

2011 "Northern Hemisphere Cyclones in a Warming Climate in the HiGEM High-Resolution Climate Model." *Journal of Climate*: 5663-5352.

Center for Climate and Energy Solutions

n.d. "Hurricanes and Climate Change." Available online: http://www.c2es.org/science-impacts/extreme-weather/hurricanes. Accessed May 11, 2016.

Church, J.A., N.J. White, L.F. Konikow, C.M. Domingues, J.G. Cogley, E. Rignot, J.M. Gregory, M.R. van den Broeke, A.J. Monaghan, and I. Velicogna

2011 "Revisiting the Earth's Sea Level and Energy Budgets from 1961 to 2008." *Geophysical Research Letters*: vol 8 L18601.

Costanza, R.

1992 Toward an operational definition of ecosystem health. *Ecosystem Health: New Goals for Environmental Management.* Island Press, Washington, DC, 269 pp.

DeRose-Wilson, A., J.D. Fraser, D.H. Catlin, and S.M. Karpanty

2014 *2014 Shorebird Survey Report.* Department of Fish and Wildlife Conservation Virginia Tech Shorebird Program. January.

Ezer, T.

2013 "Sea Level Rise, Spatially Uneven and Temporally Unsteady: Why the U.S. East Coast, the global tide gauge record, and the global altimeter data show different trends." *Geophysical Research Letters*, vol 40, 5439-5444.

Frisk, M., R. Cerrato. J. Nye, M. Sclafani, and C. Flagg

2015 Effects of a storm-induced breach on community assemblages and ecosystem structure within a temperate lagoonal estuary. Powerpoint Presentation.

Gobler, C.

2016 Personal Communication. Participation in National Park Service Subject Matter Expert Workshop for the Fire Island National Seashore Wilderness Breach Management Plan/Environmental Impact Statement. January 2016.

Gobler, C.J., J. Collier, and D. Lonsdale

2014. Assessing the response of the Great South Bay plankton community to Hurricane Sandy. SUNY Stony Brook Powerpoint presentation.

Goddard, P.B., J. Yin, S.M. Griffies, and S. Zhang

2014 An Extreme Event of Sea Level Rise Along the Northeast Coast of North America in 2009-2010. Nature Communications.

Intergovernmental Panel on Climate Change (IPCC)

2013 Climate Change 2013: The Physical science basis. Working Group I contribution to the IPCC fifth Assessment Report. Cambridge, United Kingdom: Cambridge University Press.

2014 Climate Change 2014: Impacts, Adaptation, and Vulnerability. Top-level Findings from the Working Group !! AR5 Summary for Policymakers.

Janjua, M.Y., R.F. Tallman, and K.L. Howland

2015 "Preliminary analysis of trophic relationships in Great Bear Lake using Ecopath model." *Can. Tec. Rep. Fish. Aquat. Sci.* 3137: vi + 24 p.

Landres, P., C. Barns, J.G. Dennis, T. Devine, P. Geissler, C.S. McCasland, L. Merigliano, J. Seastrand, and R. Swain

2008 Keeping it Wild: An interagency strategy to monitor trends in wilderness character across the National Wilderness Preservation System. General Technical Report RMRS-GTR-212. USDA Forest Service Rocky Mountain Research Station, Fort Collins, CO.

Landres, P., C. Barns, S. Boutcher, P. Dratch, A. Lindholm, L. Merigliano, N. Roeper, and E. Simpson

2015 Keeping It Wild 2: An updated interagency strategy to monitor trends in wilderness character across the National Wilderness Preservation System. October 2015. General Technical Report MRS-GTR-340. USDA Forest Service Rocky Mountain Research Station, Fort Collins, CO.

Leatherman, S.A.

1985 "Geomorphic and stratigraphic analysis of Fire Island, New York." *Marine Geology*, 63, 173-195.

Leatherman, S.P. and J.R. Allen

1985 Geomorphic analysis: Fire Island Inlet to Montauk Point Long Island, New York. Final Report, Reformulation Study for US Army Corps of Engineers, New York District.

Methratta, E., C. Pacelli, L. Fields, K. Bosma, and H. Clark

2016 Technical Synthesis Report for Physical and Ecological Resources at Fire Island National Seashore. Natural Resource Report NPS/XXXX/NRR—2016/XXX.

Moffatt and Nichol

2015 Memorandum to US Geological Survey: Numerical Modeling of Breach Open at Old Inlet for the Fire Island to Montauk Point, NY Project. September 2015.

Monk, J.D., A. DeRose-Wilson, J.D. Fraser, D.H. Catlin, and S.M. Karpanty

2015 *Migratory Shorebird Monitoring on Fire Island, NY*. Department of Fish and Wildlife Conservation Virginia Tech Shorebird Program. 2015 Field Operations Report.

National Park Service (NPS)

1983 *Wilderness Management Plan, Fire Island National Seashore*. November 1983.

2002 National Park Service Director's Order 77-1: *Wetland Protection*. October 2002.

2003 National Park Service Director's Order 77-2: *Floodplain Management*. September 2003.

2005 *Fire Island National Seashore Wildland Fire Management Plan*. National Park Service. February 2005.

2006 *Management Policies 2006*. National Park Service, Washington, D.C.

2011 Directors Order 12. *Conservation Planning, Environmental Impact Analysis, and Decision-making*. Approved October 5, 2011.

2013 *2013 Mosquito Action Plan and Surveillance Protocols (Protocols)*. Fire Island National Seashore's Mosquito Surveillance and Management Program.

2015a *National Park Service NEPA Handbook*. September 2015.

2015b *Fire Island National Seashore Final White-Tailed Deer Management Plan and Environmental Impact Statement*. December.

2016a Draft Wilderness Stewardship Plan and Backcountry Camping Policy, Otis Pike Fire Island High Dune Wilderness. Fire Island National Seashore.

2016b *Fire Island National Seashore Draft General Management Plan Environmental Impact Statement*.

2016c National Park Service Procedural Manual #77-1: *Wetland Protection*. May 2016.

National Oceanic and Atmospheric Association (NOAA)

2015 Merged land-Ocean Surface Temperature Analysis: Global gridded 5°x5° data. National Centers for Environmental Information. Accessed May 2015.

National Oceanic and Atmospheric Administration-National Marine Fisheries Services (NOAA-NMFS)

2000 Essential Fish Habitat: New Marine Fish Habitat Conservation Mandate for Federal Agencies. National Marine Fisheries Services, Habitat Conservation Division. April 2000.

2014 Letter from Louis Chiarella (NMFS) to Robert Smith (USACE New York District) dated May 14, 2014. Subject: Draft Environmental Assessment for the Fire Island Inlet to Moriches Inlet, Fire Island Stabilization Project – Hurricane Sandy Reevaluation Report.

Ries, L., R. Diamond, D. Nemire-Pepe, and S. Davis

2010 Fire Island National Seashore Threatened and Endangered Species Monitoring Program 2010 Summary.

Ries, L. and K. Donovan

2013 Fire Island National Seashore Threatened and Endangered Species Monitoring Program 2013 Summary.

Ries, L., C. Moore, and A. Sloop

2011 Fire Island National Seashore Threatened and Endangered Species Monitoring Program 2011 Summary.

Ries, L., C. Peretz, and B. Tendick-Matesanz

2014 Fire Island National Seashore Threatened and Endangered Species Monitoring Program 2014 Summary.

Ries, L. J. Popham, and M. Sorlien 2012

2012 Fire Island National Seashore Threatened and Endangered Species Monitoring Program 2012 Summary.

Roman, C. and J. Lynch

2016 Personal Communication. Overview of Fire Island National Seashore salt marshes and the Wilderness Breach: Some notes for the Technical Report on marine and estuarine resources. Memorandum to NPS and technical team. March 16, 2016.

Roman, C.T., J.W. King, D.R. Cahoon, J.C. Lynch, and P.G. Appleby

2007 Evaluation of Marsh Development Processes at Fire Island National Seashore (New York): Recent and Historic Perspectives. Technical Report NPS/NER/NRTR – 2007/089. July 2007.

Rosenzweig, C., W. Solecki, A. DeGaetano, M. O'Grady, S. Hassol, and P. Grabhorn (Eds.)

2011 Responding to Climate Change in New York State: The ClimAID Integrated Assessment for Effective Climate Change Adaptation: Synthesis Report. New York State Energy Research and Development Authority.

Sallenger, A.H., K.S. Doran, and P.A. Howd

2012 Hotspot of Accelerated Sea-Level Rise on the Atlantic Coast of North America. Nature Climate Change, published online.

Smeed, D.A., G.G. McCarthy, S.A. Cunningham, E. Frajka-Williams, D. Rayner, W.E. Johns, C.S. Meinen, M.O. Baringer, B.I. Moat, A. Duchez, and H.L. Bryden

2014 "Observed Decline of the Atlantic Meridional Overturning Circulation 2004-2012." *Ocean Science* vol 10, 29-38.

Smith, W.G., K. Watson, D. Rahoy, C. Rasmussen, and J.R. Headland

1999 "Historic geomorphology and dynamics of Fire Island, Moriches, and Shinnecock Inlets, New York." In: *Proceedings of Coastal Sediments* '99, pp. 1597-1612.

Stanley, J.G.

1983 Species profiles: Life histories and environmental requirements of coastal fishes and invertebrates (North Atlantic) hard clam, US Fish and Wildlife Service Report Number FWS/OBS-82/11.18 1-19pp.

US Army Corp of Engineer's (USACE)

1996 *Fire Island to Montauk Point Long Island, New York. Breach Contingency Plan Executive Summary and Environmental Assessment.* U.S. Army Corps of Engineers, New York District, North Atlantic Division.

2006 Baseline Conditions Storm Surge Modeling and Stage Frequency Generation: Fire Island to Montauk Point Reformulation Study. Draft Report July 2006.

2012 *Fire Island to Montauk Point Reformulation Study*. Available online: http://www.nan.usace.army.mil/Missions/CivilWorks/ProjectsinNewYork/FireIslandtoMontaukPointReformulationStudy/FIMPAbout.aspx. Accessed April 7, 2016.

2014a *Fire Island Inlet to Moriches Inlet Fire Island Stabilization Project Environmental Assessment.* Evaluation of a Stabilization Plan for Coastal Storm Risk Management in Response to Hurricane Sandy & Public Law 113-2. USACE New York District. June 2014.

2014b *Fire Island Inlet to Moriches Inlet Fire Island Stabilization Project Essential Fish Habitat Assessment.* USACE New York District. May 2014.

2015 "Fire Island Inlet to Montauk Point, NY Fact Sheet." Accessed November 24, 2015. http://www.nan.usace.army.mil/Media/FactSheets/FactSheetArticleView/tabid/11241/Article/487483/fact-sheet-fire-island-to-montauk-point.aspx.

2016 *Fire Island to Montauk Point Reformulation Study Draft General Reevaluation Report.* USACE New York District. July 2016.

n.d. "FIMP - Interim Work in Progress." Available online: http://www.nan.usace.army.mil/Missions/CivilWorks/ProjectsinNewYork/FireIslandtoMontaukPointReformulationStudy/FIMPWorkinProgress.aspx. Accessed November 24, 2015.

US Environmental Protection Agency (USEPA)

2010 Spill Prevention, Control, and Countermeasure (SPCC) Regulation, 40 CFR part 112, A Facility Owner/Operator's Guide to Oil Pollution Prevention. June 2010.

US Fish and Wildlife Service (USFWS)

2014a Rufa Red Knot Background Information and Threats Assessment, Supplement to Endangered and Threatened Wildlife and Plants; Final Threatened Status for the Rufa Red Knot (Calidris canutus rufa). Docket No. FWS–R5–ES–2013–0097, RIN AY17. Available online: http://www.fws.gov/northeast/redknot/pdf/20141125_REKN_FL_Supplemental_doc_FINAL.pdf

2014b Salt marsh restoration project will strengthen coastal areas near Seatuck, Wertheim and Lido Beach refuges. News Bulletin, Northeast Region External Affairs Office. December 18, 2014.

2014c Salt Marsh Restoration and Enhancement. Seatuck & Wertheim National Wildlife Refuge, Lido Beach Wildlife Management Area. Available online: http://www.fws.gov/hurricane/sandy/projects/LongIslandSaltMarsh.html. Accessed April 11, 2016.

van Ormondt, M., C. Hapke, D. Roelvink, and T. Nelson

2015 The effects of geomorphic changes during Hurricane Sandy on water levels in Great South Bay. In: Proceeding of Coastal Sediments 2015.

Williams, S.J., K. Dodd, and K.K. Gohn

1995 *Coasts in Crisis*. U.S. Geological Survey Circular 1075.

Williams, S.J. and M.K. Foley

2007 Recommendations for a Barrier Island Breach Management Plan for Fire Island National Seashore, including the Otis Pike High Dune Wilderness Area, Long Island, New York. Technical Report NPS/NER/NRTR—2007/075. Boston, MA.

Williams, S.J. and E.P. Meisburger

1987 "Sand sources for the transgressive barrier coast of Long Island, New York—evidence for landward transport of shelf sediments." In: *Proceedings of Coastal Sediments '87* (New Orleans, Louisiana, ASCE), pp. 1517–1532.

Yin, J.

2012 "Century to Multi-Century Sea Level Rise Projections from CMIP5 Models." G*eophysical Research Letters*, vol 39, L17709.

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Glossary

Wilderness Breach - November 25, 2015

GLOSSARY

ecosystem maturity. Generally, a descriptor and indicator of ecosystem health (Janjua, Tallman and Howland 2015). Attributes of ecosystem maturity include total biomass and species diversity, food web complexity, diversity of feeding relationships, and numbers of upper trophic level predators, and migratory fish species. More mature ecosystems are healthier, more stable, and more resilient to disturbance.

health of an ecosystem. A comprehensive, multiscale, dynamic, hierarchical measure of system resilience, organization, and vigor (Costanza 1992).

NAVD88 (North American Vertical Datum of 1988). A datum is a set of constants specifying the coordinate system used for geodetic control (i.e., for calculating coordinates of points on the Earth). NAVD88 is used for vertical control surveying in the United States.

overwash. The flow of water and sediment over the crest of the beach that does not directly return to the water body where it originated after water level fluctuations return to normal

tidal prism. The volume of water exchanged during a tidal cycle excluding any contributions from freshwater inflows

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Reference Maps

A

Wilderness Breach - June 1, 2016

APPENDIX A: REFERENCE MAPS

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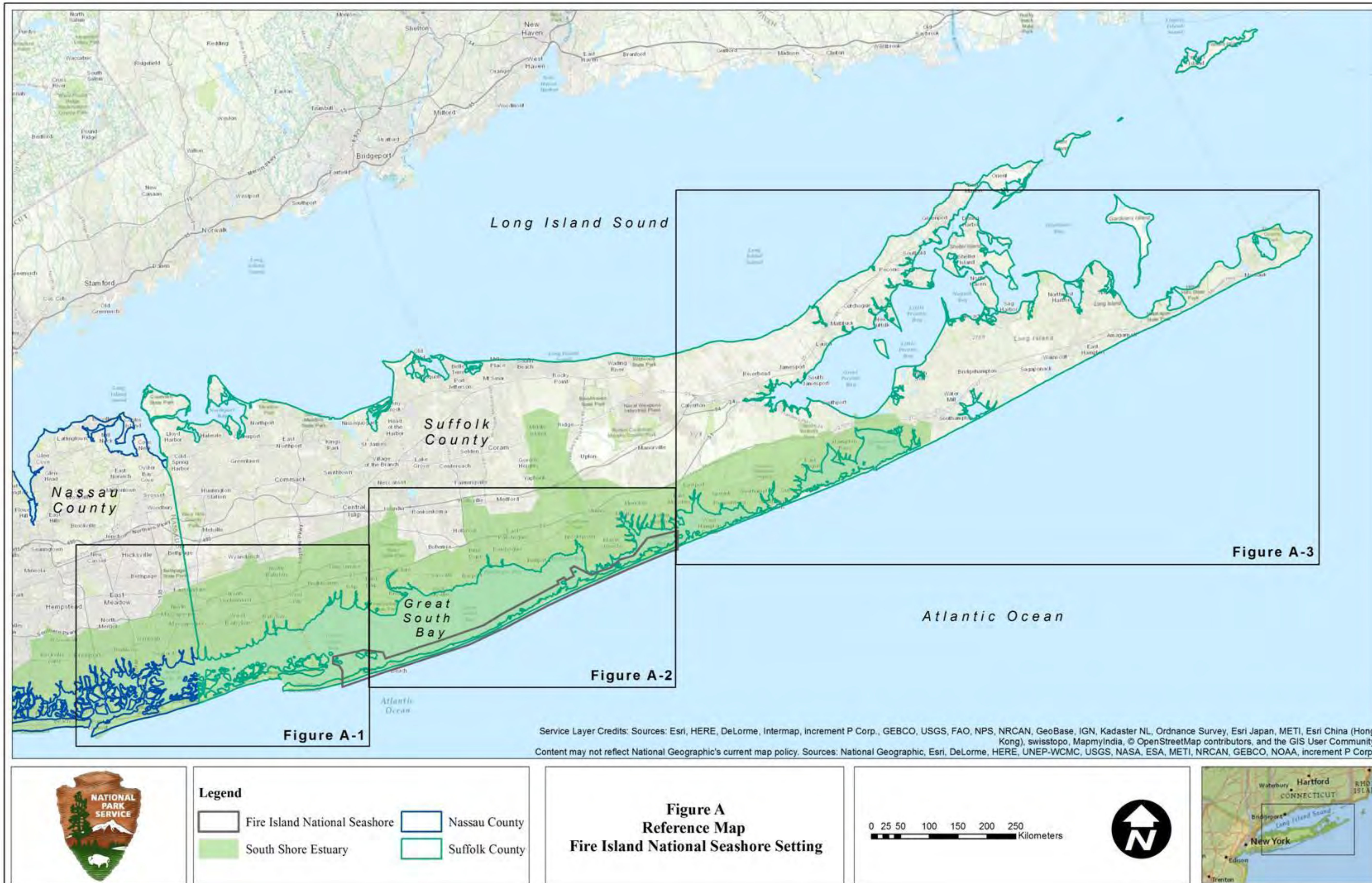

Figure A
Reference Map
Fire Island National Seashore Setting

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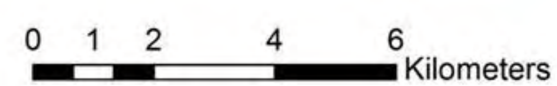

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Figure A-1
Reference Map
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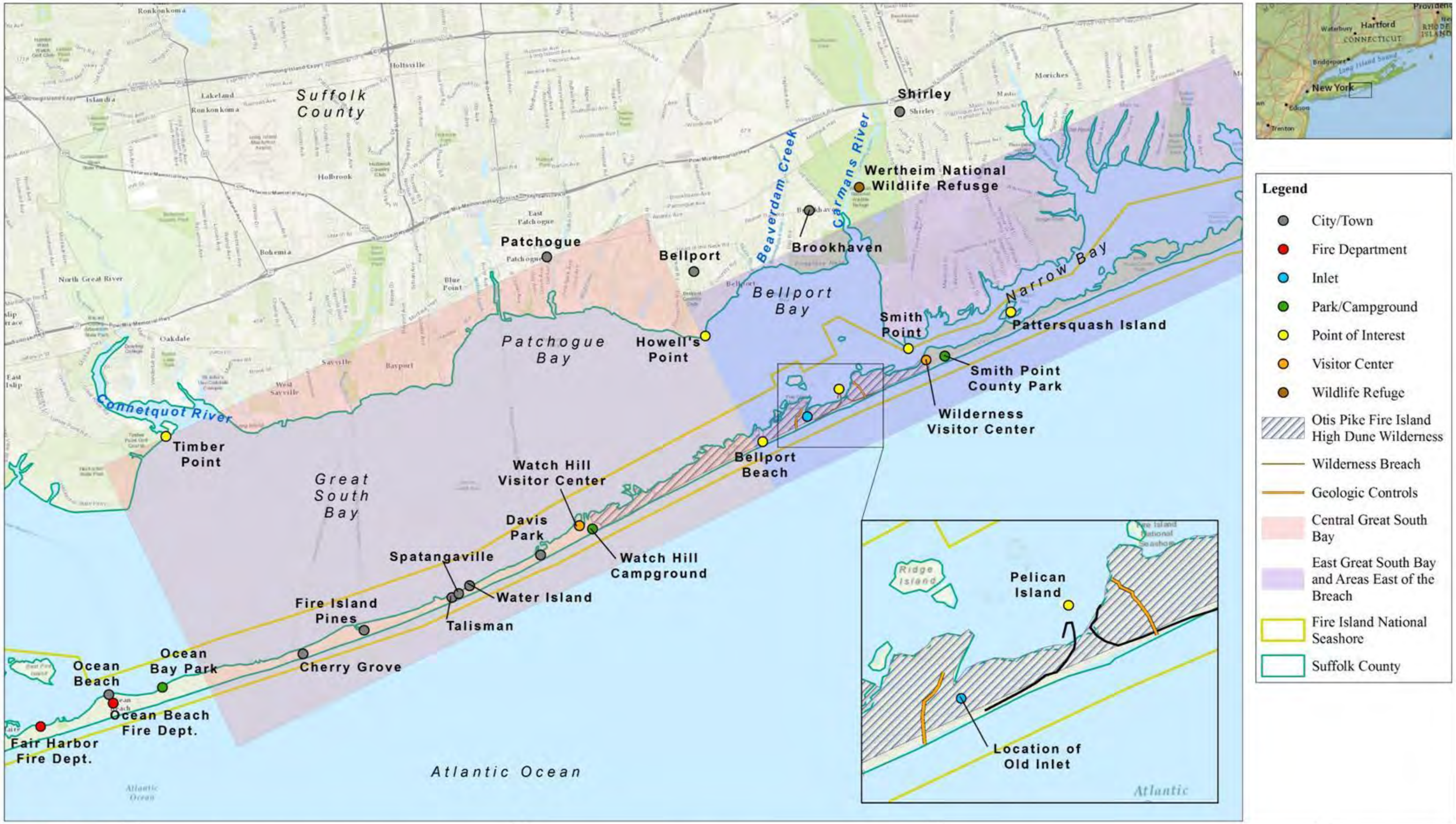

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Figure A-2
Reference Map
Fire Island National Seashore Setting

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Figure A-3
Reference Map
Fire Island National Seashore Setting

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Subject Matter Experts

B

Wilderness Breach - September 8, 2016

APPENDIX B: SUBJECT MATTER EXPERTS

The following subject matter experts assisted the Fire Island National Seashore staff and contractors gather and synthesize the current science related to the wilderness breach through providing data, participating in conference calls, attending the January 2016 workshop, and/or reviewing documents.

Name	Title
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Cooperating Agencies	
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Alan Fuchs	Director, Bureau of Flood Protection and Dam Safety
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Charles Flagg	Ph.D., Continental Shelf Dynamics
Michael Frisk	Ph.D., Fish Ecology
Chris Gobler	Ph.D., Coastal Ecosystem Ecology
Steve Heck	Ph.D. student, Marine Science
Claudia Hinrichs	Ph.D. student, Marine Science
Janet Nye	Ph.D., Fish Ecology
Jill Olin	Postdoctoral Researcher, Aquatic Ecology
Bradley Peterson	Ph.D., Marine Science

Name	Title
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Karl Nordstrom	Ph.D. Coastal Processes
The Nature Conservancy	
Carl LoBue	Senior Marine Scientist
Moffatt & Nichol	
Rafael Canizares	Civil Engineer, US Army Corps of Engineers Consultant
Deltares	
Maarten van Ormondt	Coastal Engineer, US Geologic Survey Consultant

As the nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.

NPS/FHS/615/134216 OCT2016

Draft Fire Island National Seashore Wilderness Breach Management Plan / Environmental Impact Statement

September 2016

US Department of the Interior
National Park Service

Cooperating Agencies:

New York State, Department of Environmental Conservation

US Army Corps of Engineers, New York District