FIRE ISLAND TO MONTAUK POINT
ADAPTIVE MANAGEMENT PLAN OUTLINE

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1.0 INTRODUCTION

This document provides the outline for the development of the feasibility level monitoring and adaptive management plan for the Fire Island to Montauk Point (FIMP) Coastal Storm Risk Management Project. The FIMP Adaptive Management Framework Team will further develop this monitoring and adaptive management plan with assistance from the Project Delivery Team (PDT). This plan identifies and describes the monitoring and adaptive management activities proposed for the FIMP Project and estimates their cost and duration. This plan will be further developed in the preconstruction, engineering, and design (PED) phase as specific design details are made available.

1.1 Authorization for Adaptive Management

Several definitions of adaptive management have been developed by various natural resource management agencies and organizations (e.g., Williams et al. 2007, National Research Council 2004). The following paragraph presented in *Adaptive Management for Water Resources Project Planning* (National Research Council 2004) provides the conceptual basis for adaptive management used in developing this appendix:

> "Adaptive management promotes flexible decision making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood. Careful monitoring of these outcomes both advances scientific understanding and helps adjust policies or operations as part of an iterative learning process. Adaptive management also recognizes the importance of natural variability in contributing to ecological resilience and productivity. It is not a 'trial and error' process, but rather emphasizes learning while doing. Adaptive management does not represent an end in itself, but rather a means to more effective decisions and enhanced benefits. Its true measure is in how well it helps meet environmental, social, and economic goals, increases scientific knowledge, and reduces tensions among stakeholders."

For the purposes of this appendix, adaptive management is defined as a formal science-based approach to undertaking goal-directed actions with uncertain outcomes and evaluating their results in order to determine better-informed future actions.

Adaptive management is necessary within the FIMP project to achieve desired goals by reducing uncertainty, incorporating flexibility and robustness into project design, and using new information to inform decision making. Adaptive management will address engineering, policy, and socioeconomic sources of uncertainty.

1.2 Procedure for Drafting Adaptive Management Plans

During Pre-Construction Engineering and Design, an advisory panel will be convened to develop to the adaptive management alternatives for each feature and to identify the data and criteria to be evaluated to trigger adaptive action.

When a probabilistic decision tool is deemed necessary, it will be created or adapted for use by the Adaptive Management Advisory Team. Corps approved models applied during plan formulation and analysis should be the first alternative considered by the Adaptive Management Advisory Team. Where necessary, technical or peer review of plan features may be appropriate. All available appropriate data will be used in the development of the decision tool and its application.

1.3 Formation of the Adaptive Management Advisory Team

The Adaptive Management Advisory Team will include PDT members and representatives of project stakeholders and non-federal sponsors. One large Advisory Team will be empanelled for development of adaptive management policies, and smaller technical sub teams will convene to assess and implement adaptive management actions specific to the individual project features over the project life. The proposed members of the Advisory Team are: Superintendent, Fire Island National Seashore; Commissioner, New York State Department of Environmental Conservation; County Executive, Suffolk County; Colonel, U.S. Army Corps of Engineers, New York District; Regional Administrator, U.S. Fish and Wildlife Service. Additional members may be identified as necessary to include specific expertise or access to data and computational capabilities. Panel members are invited for their technical expertise and policy development capabilities. The Corps technical staff convenes and conducts virtual and in person meetings for periodic, pre-designated times, and when necessary, for pre or post storm events.

2.0 PROJECT FORMULATION

The Fire Island Inlet to Montauk Point, New York Combined Beach Erosion Control and Hurricane Protection Project (FIMP) was authorized by the River and Harbor Act of 1960. The project is being reformulated to identify a long-term solution to manage the risk of coastal storm damages along the densely populated and economically valuable south shore of Long Island, New York in a manner which balances the risks to human life and property, while maintaining, enhancing, and restoring ecosystem integrity and coastal biodiversity.

There is a long history of damaging storms along the south shore of Long Island, as well as many efforts to mitigate the damages, including construction of several features of the authorized FIMP project that are described later in the report. The study area also includes critical coastal habitat and environmentally sensitive areas, such as the Fire Island National Seashore and the Smith Point County Park.

This current study is called a Reformulation, because it seeks to reexamine the project that was originally formulated in the 1950's. This Reformulation came about in part due to a referral to the Council on Environmental Quality in response to the 1978 Environmental Impact Statement (EIS) that was prepared for the project subsequent to passage of the National Environmental Policy Act of 1969. As a result of the referral the Corps of Engineers agreed to reformulate the project with particular emphasis on identifying and evaluating alternatives that considers cumulative impacts on the overall coastal system. The goal of the Reformulation study is to identify an economically viable, environmentally acceptable plan that addresses the storm damage reduction needs of the study area and is acceptable to the key federal, state, and local stakeholders. Included within the study area is the Fire Island National Seashore (FIIS). The authorizing law for FIIS specified that any plan for shore protection with the boundary of the national Seashore be mutually agreeable with the Secretary of the Interior and the Secretary of the Army.

2.1 Project Goals and Objectives

During the plan formulation process, the project delivery team, with stakeholder input, developed restoration goals and objectives to be achieved by the FIMP project. These goals and objectives were subsequently refined through interactions with the Non Federal Sponsor and relevant stakeholders. The overarching goal of this project is to reduce coastal storm risk of the barrier island system in the study area. This project has been planned to help achieve and sustain a larger-scale coastal risk management system that can maintain the protective features of the barrier island, and reduce the resources at risk of coastal flooding in the back bay communities while maintaining natural coastal processes in the study area and thereby contribute to the well- being of the Nation.

The goal of the Reformulation Study is to reduce storm damages and attendant loss of life from tidal flooding, waves and erosion, by restoring the natural coastal processes to the maximum extent possible while minimizing environmental impacts.

A "Vision Statement for the Reformulation Study" that integrates the policies of the Corps of Engineers, the State of New York and the National Park Service was developed in 2004 and commits the partner agencies to recognize the following during the plan formulation process:

- Decisions must be based upon sound science, and current understanding of the system,
- Flooding will be addressed with site specific measures that address the various causes of flooding,
- Priority will be given to measures which both provide protection, and restore and enhance coastal processes and ecosystem integrity,
- Preference will be given to Non-structural measures that protect and restore coastal landforms and natural habitats,
- Project features should avoid or minimize adverse environmental impacts and address long-term demands for public resources,
- Balances dune and beach replenishment considering storm damage reduction and environmental considerations, and
- Consideration will be given to alteration of existing shore stabilization structures, inlet stabilization measures, and dredging practices.

The specific objectives for the FIMP project are to:

1. Reduce tidal flooding on the mainland and barrier islands and attendant loss of life, property and economic activity.
2. Reduce damages to structures due to beach and bluff erosion in critical areas.
3. Restore coastal processes and utilize coastal process measures to the maximum extent possible to provide resiliency and reduce storm damages.
4. Ensure that any plan within the jurisdictional boundaries of the National Park Service is compatible with the goals and objectives of the Fire Island National Seashore, and is mutually acceptable to the Secretary of the Army and Secretary of the Interior.

2.2 Coastal Storm Risk Management Features

The PDT performed a thorough plan formulation process to identify potential management measures and coastal risk reduction actions that address the project objectives. Many alternatives were considered, evaluated, and screened in producing a final array of alternatives. The PDT subsequently identified a Tentatively Selected Coastal Storm Risk Management Plan.

The specific features of the TSP, as conveyed in a 10 August 2015 letter to the State of New York, are described below.

Inlet Modifications

- Continuation of authorized navigation projects, and scheduled O&M dredging with beneficial reuse of sediment at Fire Island, Moriches and Shinnecock Inlets:

- Additional dredging of 73,000 to 379,000 cy from the ebb shoals of each inlet, outside of navigation channel, with downdrift placement undertaken in conjunction with scheduled O&M dredging of the inlets.
- Placement of the bypassed material consisting of a +13 ft. dune and berm, as needed in identified placement areas
- Monitoring to facilitate adaptive management changes in the future.

Mainland and Non-Structural

- Addresses approximately 4,400 structures within 10 year flood plain using non-structural measures, primarily through building retrofits, with limited relocations and buy-outs, based upon structure type and condition
- Includes road raising in four locations, totaling 5.91 miles in length, that reduce flooding to 1,020 houses

Barrier Islands

- Breach Response
  - Proactive Breach Response is a plan where action is triggered when the breach and dune are lowered below a 25 year design level of risk reduction, and provides for restoration to the design condition (+13 ft. dune and 90 ft. berm). This plan is included on Fire Island in vicinity of Lighthouse, Smith Point County Park East (to supplement when needed the sand bypassing), and Smith Point County Park West (after short-term beachfill to allow relocation of infrastructure) and also on the Westhampton barrier island fronting Shinnecock Bay.
  - Reactive Breach Response - is a plan where action is triggered when a breach has occurred, e.g. the condition where there is an exchange of ocean and bay water during normal tidal conditions. It will be utilized as needed when a breach occurs.
  - Conditional Breach Response – is a plan that applies to the large, federally-owned tracts within Fire Island National Seashore, where the breach response team determines whether a breach should be closed. Conditional Breach closure provides for a 90 ft wide berm at elevation 9.5 ft. only.
- Beach and Dune Fill
  - Provides for a continuous 90 ft. width berm and +15 ft. dune along the developed shorefront areas fronting Great South Bay and Moriches Bay on Fire Island and Westhampton barrier islands.
  - On Fire Island the alignment follows the post-Sandy optimized alignment that includes overfill in the developed locations and minimizes tapers into Federal tracts.

- Renourishment: up to 30 years approximately every 4 years.

Sediment Management at Downtown Montauk and Potato Road

- Provides for placing about 120,000 CY on front face of existing berm at each location approximately every 4 years as advance fill to offset erosion.
- The Potato Road feeder beach is contingent upon implementation of a local pond opening management plan for Georgica Pond

Groin Modifications

- Shorten existing Westhampton groins (1-13) between 70 — 100 ft., to increase sediment transport (0.5M to 2M CY) to the west and reduce renourishment requirements
- Shorten existing Ocean Beach groins

Coastal Process Features

- Project Features that contribute to coastal storm risk management through the reestablishment of the coastal processes are included at seven locations as follow:
    - Sunken Forest – Reestablishes coastal protective features by reestablishing the natural conditions of dune, upper beach and bay shoreline by removing bulkhead adjacent to marina and existing boardwalk, regrading and stabilizing disturbed areas using bioengineering and shoreline,
    - Reagan Property – Reestablishes coastal protective features by improving natural conditions of dune, upper beach and shoreline by burying bulkhead, regrading and stabilizing disturbed areas using bioengineering, and creating intertidal areas.
    - Great Gun – Reestablishes salt marsh features by reestablishing hydrologic connections and disturbances.
    - Tiana – Reestablishes the bay shoreline natural protective features by reestablishing the dune, salt marsh, and enhancing the SAV beds.
    - WOSI – Reestablishes the bay shoreline natural protective features by reestablishing the existing salt marsh
    - Islip Meadows – reestablishing salt marsh habitat in conjunction with nonstructural measures by restoring hydrologic connections.
    - Seatuck Refuge – reestablishing salt marsh habitat in conjunction with nonstructural measures by restoreing hydrologic connection and plantings.

Adaptive Management

- Will provide for monitoring for project success, relative to the original objectives and the ability to adjust specific project features to improve effectiveness.
- Climate change will be accounted for with the monitoring of climate change parameters, identification of the effect of climate change on the project design, and identification of adaptation measures that are necessary to accommodate climate changes as it relates to all the project elements.

Integration of Local and Land Use Regulations and Management

- Local land management regulations to include enforcement of federal and state zoning requirements, as a necessary complementary feature for long-term risk reduction.

3.0 ADAPTIVE MANAGEMENT PROCESS

The TSP integrates land management, acquisition, and scheduled renourishment to manage coastal storm risk to life and property in the study area. A key component of plan implementation is recognizing that uncertainty that exists. The variability of physical elements, storm risk, and human responses introduce uncertainty to a situation that is already uncertain due to the complexities of evaluating the system. Adaptive Management was specifically identified as a project feature to ensure that feature construction and maintenance over time continues to advance the study objectives in an efficient manner.

The level of detail in this plan is based on currently available data and information developed during plan formulation as part of the feasibility study. Uncertainties remain concerning the exact project features, monitoring elements, and adaptive management opportunities. Components of the monitoring and adaptive management plan, including costs, were similarly estimated using currently available information. Uncertainties will be addressed in the preconstruction, engineering, and design (PED) phase a detailed monitoring and adaptive management plan, including a detailed cost breakdown, will be drafted as a component of the design document.

Uncertainties that persist throughout the project study period include

- Renourishment needs and timing;
- Functioning of the inlets;
- Future sea level change;
- Storm severity and frequency during the study period;
- Breach occurrence;
- Voluntary Participation within the Non-structural program;

- Pace of completion of Non-structural program due to crew availability and volume; and
- Application of land use policies in at risk communities.

Given all these uncertainties, the project will adopt an incremental adaptive management approach to pursue coastal storm risk project goals proposed within the Reformulation study. Since risk management success may vary as a result of the uncertain factors influencing vulnerability in the study area, the PDT proposes the joint development of an adaptive management process, or contingency planning to adapt project features as appropriate to maintain risk management opportunities over the proposed project life.

3.1 Adaptive Management Components

This PDT proposes the coordinated development of prescribed actions and threshold conditions for contingency planning to revisit the achievement of risk management efforts in the study area. The necessary elements of an adaptive approach include agreement upon the following actions and a timeframe for their completion:

1) Data collection that would be implemented to maintain and update an thorough understanding of the physical, social and environmental setting.

2) Modeling efforts (engineering and formulation) to analyze the data, and adaptive management framework to establish the overall objectives, decision rules, and identify the adaptations to the feature that could be accomplished with the project. This adaptation strategy is based upon the concept that with the passage of time the trends become established and more appropriate strategies can be executed.

3) Schedule for reanalysis of with project conditions, which is expected that this adaptation strategy would require a periodic review of the project execution (5-yr basis) and recommendations for the adaptation of the project, based upon the findings. Some features may require designation of post storm assessment to compare study area conditions to a designated threshold condition.

3.2 Study Features Proposed for Adaptive Management

It is expected that the adaptive management plan would integrate the lifecycle management of the project, as it relates to the following elements:

- Breach Response. Improved understanding of breaching processes and consequences, refinement of the breach triggers and the implementing procedures, optimization of maintenance requirements, and the improved integration of habitat improvements.
- Inlet Management: Improved understanding of inlet functioning, the volume and frequency of bypassing, and the optimal alternatives for achieving the long-term objectives for inlet management.
- Beachfill. Improved understanding of beachfill performance, refinement of renourishment triggers and allowable variability in design, accounting for alignment changes based upon non-structural plan implementation, consideration of durations, changed structure inventory at risk.
- Non-Structural. Improved delineation of structure vulnerability, and identification design details, identification of implementation effectiveness, identification of acquisition effectiveness, identification of the effectiveness of land management regulations, faster implementation of non-structural improvements.
- Restoration of Coastal Process Features. Identification of relative effectiveness of alternatives, identification of design improvements, and better definition of overall restoration success objectives.

4.0 DATA AND MODEL MANAGEMENT

Database and model management is an important component of the monitoring plan and the overall adaptive management program. Data collected as part of the monitoring and adaptive management plans for the FIMP project will be archived in accordance with the plan developed by the Adaptive Management Advisory Team. Any special data requirements for any specific feature of the plan should be noted in the feature specific sub section of the Adaptive Management Plan.

4.1 Designated Systems and Best Management Practice

The data management plan should identify the computing hardware and any specialized or custom software used in data management for an adaptive management program. Opportunities exist to develop either a centralized or distributed data management system. With input from the FIMP Adaptive Management Planning Team, the data managers should determine which approach best suits the needs of the overall adaptive management program.

Individuals with responsibility for data management activities (data managers) in support of an adaptive management program should be identified. The data managers should collaborate with the Adaptive Management Planning Team in developing a data management plan to support the adaptive management program. The data management plan should be incorporated into the overall program adaptive management plan, either in the main body of the adaptive management plan or as an appendix.

4.2 Analysis, Summary, and Reporting

Data analysis and reporting responsibilities will be shared between project and programmatic adaptive management efforts in order to provide reports for the FIMP project Assessment Team, project managers, and decision-makers. Adaptive Management Advisory Teams will formally establish the question and answer formats for analysis, summary and reporting of adaptive inquiries of the with project condition and feature functions.

5.0 ASSESSMENT

The assessment phase of the framework compares the results of the monitoring efforts to the desired project performance measures and/or acceptable risk endpoints (i.e., decision criteria) that reflect the goals and objectives of the coastal storm risk management feature or action. The assessment process addresses the frequency and timing for comparison of monitoring results to the selected measures and endpoints. The nature and format (e.g., qualitative, quantitative) of these comparisons are defined as part of this phase. The resulting methods for assessment should be documented as part of the overall adaptive management plan.

The results of the FIMP project monitoring program will be regularly assessed in relation to the desired project outcomes as described by the previously specified project performance measures. This assessment process continually measures the progress of the project in relation to the stated project goals and objectives and is critical to the project's adaptive management program. The assessments will continue through the life of the project or until it is decided that the project has successfully achieved (or cannot achieve) its goals and objectives.

5.1 Assessment Process

The Assessment Team assigned to the FIMP project will identify a combination of qualitative (i.e., professional judgment) and quantitative methods for comparing the values of the performance measures produced by monitoring with the selected values of these measures that define criteria for decision-making.

Appropriate statistical comparisons (e.g., hypothesis testing, ANOVA, multivariate methods, etc.) will be used to summarize monitoring data and compare these data with the FIMP project decision criteria. These continued assessments will be documented as part of the project reporting and data management system.

5.2 Documentation and Reporting

The Assessment Team will document each of the performed assessments and communicate the results of its deliberations to the managers and decision-makers designated for the F I M P project. The Assessment Team will work with the project monitoring team and monitoring workgroup to produce periodic reports that will measure progress towards project goals and objectives as characterized by the selected performance measures. The results of the assessments will be communicated regularly to the project managers and decision-makers.

6.0 DECISION-MAKING

Adaptive management is distinguished from more traditional monitoring in part through implementation of an organized, coherent, and documented decision process. For the FIMP Adaptive Management program, the decision process includes (1) anticipation of the kinds of management decisions that are possible within the original project design, (2) specification of values of performance measures that will be used as decision-criteria, (3) establishment of a consensus approach to decision making, and (4) a mechanism to document, report, and archive decisions made during the timeframe of the Adaptive Management Program.

6.1 Decision Criteria

Decision criteria, also referred to as adaptive management triggers, are used to determine if and when adaptive management opportunities should be implemented. These criteria are usually ranges of expected and/or desirable outcomes. They can be qualitative or quantitative based on the nature of the performance measure and the level of information necessary to make a decision. Desired outcomes can be based on reference sites, predicted values, or comparison to historic conditions. A potential decision criterion is identified below, based on the project objectives and performance measures. More specific decision criteria will be developed during the pre-construction engineering and design phase of the project. The Adaptive Management Advisory Team shall pre-identify applicable triggers applicable to feature implementation and subsequent adaptation. Triggers shall be noted in ranges to recognize variability of study area conditions over time.

To effectively implement adaptive management, predicted outcomes from modeling may need to be revisited and recalibrated in the light of field observations and field data, so that the

Adaptive Management Advisory Team can develop appropriate recommendations for changes. Additional modeling might be required to understand and manage observed island responses. An adaptive management action should include incorporation of findings into future actions.

Given the distinct dynamics of the project features and the applicable triggers within the FIMP project, the specific criteria and assessment tools will be defined by the feature specific Adaptive Management Advisory Team. Summary documents and procedures will describe different considerations for adaptation of the feature, but will conform to a comparable format for documenting the applicable data collection, reanalysis, and findings.

6.2 Process Documentation

Feature specific Adaptive Management Advisory Teams will summarize the periodic comparison of decision criteria with the project goals and applicable metrics. Summary documents will present applicable data comparisons and characterize feature performance, and opportunities to implement appropriate adaptive management actions. Feature specific findings will be consolidated into subsections of a FIMP adaptive management summary document.

7.0 IMPLEMENTATION COSTS OF MONITORING AND ADAPTIVE MANAGEMENT PROGRAMS

The costs associated with implementing these monitoring and adaptive management plans will be estimated based on currently available data and information developed during plan formulation as part of the feasibility study. Significant uncertainties remain as to the exact project features, monitoring elements, and the scale and universe of adaptive management actions to be recommended. However, a preestablished plan for data collection and performance inquiry facilitates the estimate of labor needs, meeting times, and modeling actions to satisfactorily perform monitoring and assessment of project performance as proposed in the Adaptive Management Plan. The adaptive management costs shall include two subsets, 1) the conceivable costs of necessary adaptive management plans, such as ongoing construction or feature adaptation, and the necessary staff costs to assess project performance, collect data, and update applicable models. These costs are expected to be quantified in the PED phase during the development of the detailed monitoring and adaptive management plans. Plan development will seek to maximize the applicability of data collection and reanalysis to ensure that monitoring expenditures support investigation of project success or changed conditions.

ADAPTIVE MANAGEMENT PLAN

APPENDIX A

BREACH RESPONSE PROTOCOLS

Breach Response Protocols

1. Introduction

The Fire Island to Montauk Point Storm Risk Management Project will encompass a variety of measures to reduce storm-induced damages to mainland and barrier island communities within the project area.

As part of the Fire Island to Montauk Point Project, it may be necessary to close breaches along the Barrier Islands within the project area, to prevent additional flooding within the bays during major storm events and to reduce impacts to areas adjacent to the breach. It is cost-effective to close breaches quickly rather than wait to close breaches after they enlarge.

It is acknowledged that barrier island breaching can be beneficial to coastal processes and ecological services within the ocean, barrier and bay system along the south shore of Long Island (see Attachment A, developed by New York State Department of State).

There will be three types of Breach Response measures along project shorelines: Pro-Active Breach Response, Reactive Breach Response, Conditional Breach Response in Large, Publicly-owned Tracts of Land along Fire Island, and Conditional Breach Response in the Wilderness Area. The designation of which shoreline areas will be covered by each type of response is shown in Figure 1.

A breach is defined as the condition where a channel across the island permits the exchange of ocean and bay waters under normal tidal conditions. Two degrees of morphological response to breaching were considered in this study: A ***partial breach*** is a storm-induced barrier island cut that has a scoured depth between MHW and Mean Low Water (MLW) while a ***full breach*** is a storm-induced barrier island cut that has a scoured depth at or below Mean Low Water (MLW). A partial breach will allow for water to exchange between the ocean and bay during a portion of the normal tidal cycle while a full breach will allow water exchange during the complete tidal cycle. The breach may be temporary or permanent (i.e., a new inlet) depending on the size of the breach, adjacent bay water depths, potential tidal prism, littoral drift, and water level and wave conditions following the storm.

2. Proactive and Reactive Breach Response

Proactive Breach Response plan is triggered when protection is compromised. This trigger would be an evaluation of the level of protection against breaching, and serve as a trigger when the beach and dune are lowered below a particular design level, comparable to a 25-year level of protection.

Reactive breach closure is triggered when a breach has occurred. A breach is defined as the condition where a channel across the island permits the exchange of ocean and bay waters under normal tidal conditions.

3. Conditional Breach Response

Implementation of conditional breach response requires action be taken to develop processes for conditional breach response within the large, publicly owned tracts along Fire Island, considered the undeveloped areas within the purview of the Fire Island National Seashore. Within the national seashore boundary, the NPS needs to determine the likelihood of natural closure. All areas of the barrier island between Moriches Inlet and Shinnecock Inlet will either be a Pro-Active or Reactive Breach Response and therefore not addressed by the conditional breach management procedures.

Within the large, publicly owned tracts of land along Fire Island there is a desire to determine the likelihood of natural breach closure before specific design or construction activities are undertaken to close breaches. This would entail monitoring and standardized decision protocols to determine whether or not a breach appears to be naturally closing on its own. The conditional breach protocol authorization will be a part of the overall FIMP work. Breach Response Protocols are to be re-examined and updated every five to ten years. The PPA should be updated if there are adjustments to the response protocols to ensure readiness. Other agreement documents, including Certified Real Estate and Water Quality Certificates should be ready to avoid delays of processing from Senior Leaders of Agencies, State and Local communities.

Details on actions during post-authorization design, annual/continuous monitoring, and before, during and after a breach, within these specific areas, are described below. Tasks that will be completed post-authorization, pre-construction should be clearly detailed in the General Reevaluation Report and EIS.

4. Conditional Breach Response Decision Team

The Decision Makers Are: Superintendent, Fire Island National Seashore; Commissioner, New York State Department of Environmental Conservation; County Executive, Suffolk County; Colonel, U.S. Army Corps of Engineers, New York District; Regional Administrator, U.S. Fish and Wildlife Service.

5. Science and Engineering Advisory Team

The Science and Engineering Advisory Team will include representatives from the National Park Service, U.S. Army Corps of Engineers, U.S. Geological Survey, the U.S. Fish and Wildlife Service, New York State Department of Environment Conservation and Department of State, and Suffolk County.

6. Locations Considered for Conditional Breach Response

The locations of the Large, Publically Owned Tracks of Land on Fire Island are listed below:

- East of Point of Woods to west of Cherry Grove
- East of Cherry Grove to Fire Island Pines (Carrington)
- East of FI Pines to west of Water Island (Talisman/Barrett Beach)
- East of Water Island to Davis Park
- East of Davis Park to Smith Point County Park (Wilderness Area – with requirements for EIS Development)
- Smith Point County Park to RV Campground.

7. Allowable Conditional Breach Closure Characteristics within the Large, Publically Owned Tracts

Breach closure will be accomplished, if the breach is not naturally closing (or is not predicted to close based on modeling results), within 45 to 60 days of the breach opening. Contracting procedures shall be started at the occurrence of the breach, but may need to be cancelled if the breach closes naturally. The cross-section of the breach closure would be at +9.5 ft NGVD height at a minimum, the breach cross-section would match the 0.0 ft NGVD shorelines on both the ocean and bay sides making smooth shorelines without indentations, and the cross-section slope would match adjacent bayside and ocean-side slopes. No cross-sectional sand maintenance of the breach closure template would be allowed after the breach closure.

If a breach closed naturally, no additional fill material would be allowed in that location to bring the section to the above cross-section characteristics. Only on the occurrence of a new breach, that did not close naturally in that location, would additional material be allowed to be placed to bring the cross-section to the +9.5 ft NGVD height and shoreline to shoreline width. There would be increasing likelihood of re-breaching and subsequent vulnerability in those locations that did not close naturally with the increased berm height.

Placement of additional sand material in the bay during the hydraulic construction closure of the breach could be included in the condition breach closure, to emulate flood shoal volumes of breaches allowed to remain open. Proposed volume and dimensions of any additional bay material placed during breach closure operations will need to be determined during the Pre-Construction Engineering and Design Phase.

8. Actions to be undertaken during the Engineering and Design Phase (post-authorization, pre-construction)

a) During Pre-Construction Engineering and Design, a Bayesian Model will be developed to aid in the determination of likelihood of natural closure of breaches in the large, publically owned tracts on Fire Island. Using a probabilistic, Bayesian approach, based on empirical physical, climatological and hydraulic data, time of year considerations, etc. a decision tool will be created for use by the Science and Engineering Advisory Team (see 5.c below) in their role in advising the decision makers regarding breach closure actions. Development and use of a Bayesian model will determine the likelihood of natural closure and confidence values for that likelihood. All available appropriate data will be used in the development of the Bayesian model, including data from USGS and its modeling efforts. Tabletop exercises will be conducted at the time of model development to run through multiple breaching and closing scenarios, to validate the modeling process for the Fire Island barrier island.

Data collection of conditions will be necessary to continually improve the validity of the Bayesian model as a tool for decision Advisory of closure actions. The majority of the data that would be used in the Bayesian model would be physical and meteorological data. Data collection requirements are described below.

The Bayesian model developed under this effort will be exercised prior to and/or in the event of a breach by the Science and Engineering Advisory Team, and the model outcomes will guide the closure activities.

b) Develop a detailed, specific siting plan for additional water level gages within Great South Bay, Moriches Bay and Shinnecock Bay. This plan will be developed by the Science and Engineering Advisory Team. The water level gage data will be used for the development and yearly updating of the Bayesian model, and for post-breach monitoring of bay water levels. Determine if additional nearshore ocean wave gages are needed, and if so develop a siting plan.

c) Formation of the Science and Engineering Advisory Team

The Science and Engineering Advisory Team will advise decision makers for conditional closure within the large publically owned tracts on Fire Island, based on the Bayesian Model and specific post-storm and time of year conditions.

9. Post-Authorization Actions including Data Collection to Advisory Decision Tools for Conditional Breach Response Protocols

Physical Ongoing/Pre-Storm Monitoring

- Ocean Water Levels
- Bay Water Levels –continuous recording measurements Great South Bay, Moriches Bay and Shinnecock Bay, as determined by 4.b above.
- Continue data collection at Buoy 44025 and additional nearshore wave gages as determined by 4.b. above.
- Back Bay Bathymetry – 1500 ft north of barrier island
- Yearly LiDAR of the entire barrier island system: develop pre-storm conditions along all barrier islands. More vulnerable areas may require more frequent, specifically for those locations, especially pre-storm
- May: Annual assessment of vulnerable locations, topography: island height, width, slopes (see 6. below)
- Tide range/Phase changes
- Barrier Island Cross sectional cores in areas determined to be of high probability of breaching.
- Development of a communication and information plan (primary and alternate given that availability of power and facilities within the storm impacted area may vary from storm to storm).
- Environmental Monitoring

10. Annual Actions to Catalogue Barrier Island Conditions

A brief "letter" report will be prepared in late May of each calendar year to describe the condition of the barrier islands of the Atlantic Coast of New York, from Fire Island Inlet to Southampton. The letter report will summarize, from information gathered up to 1 May of the calendar year, the highly vulnerable locations along the barrier island system with respect to barrier island breaching.

The annual survey will characterize the coastal barriers with physical parameters such as cross section width, height and volume. Locations that fall below a threshold percentile for each reach (for example: 50% on any two parameters: dune height, berm width, barrier width, cross sectional area/volume) should be identified. The threshold for reporting vulnerable locations will be determined and may not be uniform among different reaches. Reports should be clear that potential breaches are not limited to the identified locations and will identify the breach response type of the vulnerable areas.

The letter report will describe the breach closure protocols and reference all the required permits and coordination. The letter report will include multiple appendices (described below) to provide information needed to enact the breach closure protocols, if necessary, from 1 June of the present calendar year, to 1 June of the next calendar year. The letter report and appendices will be sent to all identified as part of Breach Protocol Team (as comprised of members from the Federal, State and Local Agencies who are partners in FIMP) in preparation for the summer hurricane season, and the fall-winter northeaster season.

2. The letter report will be prepared by the Corps, with Corps information and additional information provided by state and local agencies, and other Federal agencies. It will be shared with the entities listed for review prior to finalization.

3. Appendices:
A. Listing of Breaching Protocol Team
B. Listing of current breaching closure protocols
C. Federal Permits/State Permits
D. Updated Construction Documents – Plans and Specifications for Breach Closure
E. Fish and Wildlife Report – ESA mapping most recent available by May of the calendar year.
F. History of Beachfill/Risk Reduction Actions by Federal, State and Locals – from previous year 1 May to current Year 1 May.
G. Availability of Environmental Condition Data (ocean and bay water levels, waves, wind, etc.) as of 1 May of present year; listing of online sources.
H. Physical Monitoring Data collected 1 May past year to 1 May current year.
I. Aerial Photos – as recent as possible – spring of current year
J. September Condition Assessment of Federal Projects from prior calendar year from Corps Operations Division, including most recent condition surveys of navigation channels.
K. Written Topographic Assessment – May of present year
L. Confirmation of Permits/Contract Available for various breach closure alternatives – listing of available sources of breach closure material
M. Post-Storm Data Collection Resources: Confirmation of availability of equipment, resources
N. Annual Letter from the Corps to New York State – confirming protocols, Real Estate coordination
O. Informal Consultation with FWS: Provide Breach Response Protocols Updates to create an administrative record documenting that NAN coordinated with the FWS and that they concurred that the Breach Response Protocols Update (has no change to the prior Section 7 decision) is not likely to adversely affect the species or habitat.
P. Explanatory information on breaches and natural processes, similar to the content inserted here as “Attachment A” to reinforce local officials’ and residents’ understanding of coastal processes as a basis for decisions, and to provide a realistic framework for breaches and adaptive management.

11. Immediately Pre-Storm Actions

Upon the incipient occurrence of a breach, monitoring of critical areas with possibilities of breaching identified either in the annual assessment or additional pre-storm information will begin during the pre-storm preparations. Both the Decision Team and the Science and Engineering Advisory Team will be activated at the incipient occurrence of a storm that may have breaching potential (predicted water levels and wave heights higher than a 25 year return period event). A protocol for data collection, methods of vulnerability assessments, and a clear plan for how these data and analyses will be disseminated to the group will be developed during Pre-Construction Engineering and Design. Data will be stored in a portal-type digital interface.

- Assistance from NPS rangers regarding barrier island physical conditions, identification of potentially breach-vulnerable locations.
- Photography of potential vulnerable locations
- Examine wave and water level conditions, and wave and water level predictions
- Exercise Bayesian Model, if pre-storm barrier island vulnerability and predicted storm climate indicates post-breach conditions favorable to natural breach closure, with the Science and Engineering Advisory Team
- Based on vulnerability assessment and wave conditions, pre-storm beach measurements will be taken at specific locations. If conditions appear stable, no measurements taken. If conditions are vulnerable, take island cross-section measurements to obtain conditions prior to the possible breaching (one day of RTKS in the field).
- Environmental Monitoring as required

12. Post-Storm Actions, with significant changes to topography alongshore for a Full Breach or Partial Breach:

- The Science and Engineering Advisory Team will come together to exercise the probabilistic Bayesian of breach closure, to predict natural breach closure or growth within fourteen days of breach occurrence. The Science and Engineering Advisory Team will report the results of the probabilistic model (with confidence limits) within twenty-one days of the breach occurrence. The Bayesian model may have to exercise multiple times if the naturally remains open through a storm season (August through April). If a full breach does not form, no breach closure activities will be enacted.
- **Weekly:** Topography/Bathymetry through the throat of the breach area
- Aerial Photography: including flood tide delta
- Ground Level Photography
- Continuous Mainland Water Levels while breach is open, with assessment of tide gauge data and water level recurrence intervals in the time period the breach remains open.
- Mainland Flood Marks immediately post-breach and in the event of a subsequent storm while breach is open
- ADCP: **weekly** current flow in the channels (new breach, Moriches and Fire Island Inlets)
- Bathymetry at Fire Island and Moriches Inlets
- Ocean Waves just outside the breaches area

- Shallow cores within the breach area
- **Weekly:** Water Quality: Temp/Salinity/Clarity after breaching

13. Mechanical Closure Activities:

Mechanical Closure procedures and contracting to be initiated with within 45 days of breach opening within the large publically owned tracts on Fire Island, if there is not clear indication of imminent natural breach closure, such as decreasing cross-section width or breach depth from day 30 onward, and the Bayesian model predicts that breach will remain open. Closure procedures will have to be by hydraulic placement due to the locations of the large, publically owned tracts and the time period for closing. Flexibility should be integrated into the Breach Response Project Agreements as part of the FIMP PPA, so breach closure work can be done by State, County or Municipal entities if dredging equipment is already mobilized by those entities for other dredging projects. No maintenance fill for breach closure will be allowed in the large, publically owned tracts; stabilization actions taken only when subsequent breaching occurs.

14. Actions Upon Natural or Constructed Breach Closure:

- Continuation of Pre-Storm/Ongoing monitoring items in 5. above
- Documentation of Breach Closure Activities

15. Funding Requirements

All costs incurred for the conditional breach response protocols including development of the Bayesian Model, water level gauging, pre-storm monitoring, post-storm monitoring, meeting of the science response teams and their activities to develop a recommendation on breach closure, the updating of protocols over the life of the project will be cost-shared as part of the authorized project measures.

Breach Response Protocols: Attachment A

Information on Coastal Barrier Breaches

Managing breaches of New York's coastal barriers has become increasingly important with the progress of development. Breaches occur periodically through a combination of sea level rise, erosion and storms. Before the 20th century most breaches closed naturally over time unless they were maintained by jetties and dredging. One study documented at least 31 breaches between 1500 and 1980 in the region from Fire Island Inlet to Shinnecock Inlet. Since 1900 most breaches have been closed by human actions. At Moriches (1931) and Shinnecock (1938) breaches were maintained as navigation inlets. From a geologic perspective breaches are episodic events that help form the coastal barriers by depositing sediment in shoals that widen the barrier and form a platform where aquatic plants help accumulate sand. Washovers, or sand driven up onto the barriers during storms, also help build sand volume. Management efforts that prevent breaches and washovers may destabilize the barriers by preventing retreat in response to sea level rise. The shore face will continue to erode and steepen, while the bayshore will shrink with encroaching sea level and lack of sediment input. This combination of factors could lead to thinning the barriers, loss of volume and possible catastrophic breaches in a major storm. It's important to understand coastal barrier processes and the role of breaches to formulate effective management plans. The need to reduce impacts while respecting essential natural processes underscores the importance of resilient land use planning.

The origin of the coastal barriers is uncertain but evidence indicates they have existed since the end of the last ice age. Processes that created the barriers include the deposition of outwash sediments from glaciers, erosion and transport of sand along the shore, and sediment reworking by storms and waves. Geologic records show that the barriers evolved as a result of shore face retreat in response to sea level rise. "The geophysical data from the inner shelf and shoreface suggest that Fire Island has migrated continuously, albeit intermittently, during the past 7,000 years from its previous position 2 km (1.2 mi.) offshore."ii There has been debate about the relative stability of parts of the coastal barrier. During the past 300 years eastern sections have been breaching more frequently and migrating landward faster than central Fire Island, where portions of the land form show ages of 750-1300 years before the present time.iii This is attributed to greater exposure to weather events toward the east end and increased sediment supply in the west.iv Western Fire Island has seen ocean side and bayside erosion, coupled with spit growth as sediment accumulates at Democrat Point. Current research indicates offshore sand formations may help stabilize central Fire Island by contributing substantial quantities of sand to the beach.v But the capacity of this source to continue the stability of central Fire Island may be drawing to a close, as the width of the island is thinning over time. "…the system will continue to migrate landward in response to a rising sea level…"vi

The current protocol for managing barrier breaches between Fire Island Inlet and Shinnecock Inlet is established in a Breach Contingency Plan (BCP) of the U.S. Army Corps of Engineers.vii Through the BCP a technical team will review breaches and initiate a process to fill them in if they are likely to remain open. The Army Corps and participating agencies recognize that the BCP and other management plans can reduce but not eliminate breaches, so some breaches are inevitable. More frequent breaches in the eastern region and accelerated shoreline retreat suggest this area is more likely to experience new breaches in the future. In addition, flooding from storm water flowing into the bays through the existing inlets, which causes more damage in the region over the course of time, is not addressed by breach management. Efforts are underway to prepare a regional plan to reduce storm impacts. The success of these measures will depend to a large extent on the level of participation of all partners, private, local, state and federal, in utilizing their capacities to reduce impacts. Given the fact that some breaches are inevitable, and that healthy coastal barriers depend on restoring sediment processes that allow the barriers to migrate in response to sea level rise, efforts must be made to adapt if we are to reduce impacts to development. Breach management must be coupled with development management to carry out this adaptation. Communities surrounding the bays, on the barriers and the mainland, should use their land use authority to avoid flood and erosion damages. Where these damages occur elevation, relocation or voluntary acquisition should be considered as options to avoid repeat damages. Adaptive measures should be coordinated with management efforts at all levels. Cooperative planning among neighboring communities is one option for creating programs to address these needs.

If appropriate measures are taken, losses can be reduced to a manageable level. This would allow natural sediment processes to resume, including breaches, washovers and barrier migration, which are essential to maintain the barriers. Without these sediment processes the barriers will become increasingly unstable. “Processes such as wave run-up, overwash and barrier beaching, which occur during elevated storm surge are all necessary processes in enabling the efficient transfer of sediments, nutrients and marine water from the Atlantic Ocean across the barriers and into Great South Bay. A large body of scientific data and information published over the past 50 years shows that such transfers of sediment and water from the ocean to the bays are essential for the long-term maintenance of the barrier island and back-bay systems and their biologically diverse habitats and ecosystems.” viii Preventing these natural processes could be harmful: “…interruption or prevention of these processes over a long period of time (lifetime of the Corps project [Fire Island Reformulation] is assumed to be 50 years) could have demonstrable, adverse effects.”ix New York’s coastal barriers will have to evolve over time if they are to be sustained. The present need is to adapt both development patterns and breach management to arrive at a point where communities can coexist successfully with their environment.

i Leatherman, Stephen P. and Joneja, Danielle, Final Report, Geomorphic Analysis of South Shore Barriers Long Island, New York: Phase I, National Park Service Cooperative Research Unit Report 47, 1980

ii Leatherman, Stephen P. and Allen, James R. editors, Geomorphologic Analysis of South Shore of Long Island Barriers, report to the U.S. Army Corps of Engineers, New York District, 1985. (page 269)

iii Leatherman and Allen, (pages 174-5)

iv Leatherman and Allen, (page 57)

v Hapke, Cheryl J., et al, A Review of Sediment Budget Imbalances along Fire Island, New York: Can Nearshore Geologic Framework and Patterns of Shoreline Change Explain the Deficit?, Journal of Coastal Research, May 2010, V. 26, no. 3, p. 510-522

vi Leatherman and Allen, page 62

vii US Dept. of the Army, Barrier Islands and Atlantic Coastline Fire Island Inlet to Montauk Point, Babylon to Southampton, NY, NYS-DEC Permit Number 1-4799-00015/00005, NYS Coastal Consistency Number F-2010-0878

viii Williams, S.J. and M.K. Foley, 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 National Park Service. Boston, MA, February 2007.
ix Leatherman and Allen, page 270