MIAMI-DADE COUNTY, FLORIDA

Main Segment and Key Biscayne

COASTAL STORM RISK MANAGEMENT

Draft Integrated Feasibility Study and Environmental Assessment

November 2021

US Army Corps of Engineers ®
Jacksonville District

Using this Document

Report Navigation: To ease navigation through the report, bookmarks are provided in the Adobe document to allow the reader to quickly move to specific sections or graphics. In addition, a Table of Contents is provided at the beginning of the report, along with a detailed Index at the end of the report. This report is compliant with Section 508 of the Rehabilitation Act, which requires Federal agencies' electronic and information technology to be accessible to people with disabilities.

Organization of this report meets the requirements provided in Appendix G of Engineering Regulation (ER) 1105-2-100 (30 June 2004), documenting the iterative U.S. Army Corps of Engineers (USACE) Plan Formulation Process. The planning process consists of six major steps:

(1) Specification of problems and opportunities

(2) Inventory, forecast, and analysis of existing conditions within the study area

(3) Formulation of alternative plans

(4) Evaluation of the effects of the alternative plans

(5) Comparison of the alternative plans

(6) Selection of the TSP based upon the comparison of the alternative plans.

Steps may be repeated as problems become better understood and new information becomes available. The details of how the six step planning process was applied for this study is discussed in Chapter 2. The Tentatively Selected Plan (TSP) is described in Chapter 3.

Each chapter, as well as the executive summary, describes plan development as it progresses through the four integrated environments that shape a coastal storm risk management (CSRM) project: the built environment (upland development, etc.); the natural environment (species of concern and their habitat); the physical environment (currents, tides, sea level change, etc.), and the economic environment (vulnerability of built environment to damages). Concerns relative to plan formulation and National Environmental Policy Act (NEPA) review are summarized and encapsulated in the discussions of these four main environments.

NEPA requirements for an Environmental Assessment (EA) are provided in 40 CFR 1501.5 and have been integrated into this Feasibility Report. The basic table of contents for the report outlines how the EA format has been integrated into the planning process to develop a TSP that meets the requirements of both USACE Plan Formulation Policy and NEPA.

Note that sections pertinent to the NEPA analysis are denoted with an asterisk.

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Main Report

***Sections pertinent to the NEPA analysis are denoted with an asterisk.**

APPENDICES

ACRONYM LIST

AAEQ	Average Annual Equivalent
AIWW	Atlantic Intracoastal Waterway
APE	Area of Potential Effect
BBA 2018	Bipartisan Budget Act of 2018
BCR	Benefit-Cost Ratio
BEC&HP	Beach Erosion Control and Hurricane Protection
BHI	Bakers Haulover Inlet
CBIA	Coastal Barrier Improvement Act
CBRA	Coastal Barrier Resources Act
CBRS	Coastal Barrier Resource System
CCCL	Coastal Construction Control Line
CEQ	Council on Environmental Quality
CNPA	Coastal Navigation Programmatic Agreement
CSHORE	Cross-Shore Numerical Model
CSRA	Cost Schedule Risk Analysis
CSRM	Coastal Storm Risk Management
CWA	Clean Water Act
CY	Cubic Yard
CZMA	Coastal Zone Management Act
DERM	Miami-Dade County Environmental Resources Management
DoD	Department of Defense
EA	Environmental Assessment
ECL	Erosion Control Line
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EOPs	Environmental Operating Principles
EP	Engineering Pamphlet
EPA	U.S. Environmental Protection Agency
EQ	Environmental Quality
ER	Engineering Regulation
ESA	Endangered Species Act
ETOF	Equilibrated Toe of Fill
FAC	Florida Administrative Code
FDEP	Florida Department of Environmental Protection
FEMA	Federal Emergency Management Agency
FFWCC	Florida Fish and Wildlife Conservation Commission

FONSI	Finding of No Significant Impact
FWOP	Future Without-Project Condition
FWP	Future With-Project Condition
FY	Fiscal Year
GDM	General Design Memorandum
HAPC	Habitat Areas of Particular Concern
HS	Significant Wave Height
HTRW	Hazardous, Toxic, and Radioactive Waste
IMP	Inlet Management Plan
IWR	Institute for Water Resources
IWW	Intracoastal Waterway
JCP	Joint Coastal Permit
LAA	Likely to Adversely Affect
LRR	Limited Reevaluation Report
MANLAA	May Affect, Not Likely to Adversely Affect
MBTA	Migratory Bird Treaty Act
MCY	Million Cubic Yards
MHW	Mean High Water
MHWL	Mean High Water Line
MLW	Mean Low Water
MLLW	Mean Lower Low Water
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act
NACCS	North Atlantic Comprehensive Coastal Study
NAVD88	North American Vertical Datum of 1988
NE	No Effect
NED	National Economic Development
NEPA	National Environmental Policy Act
NGO	Non-Governmental Organization
NMFS	National Marine Fisheries Service
NNBF	Natural and Nature-Based Features
NOAA	National Oceanic and Atmospheric Administration
MSC	Major Subordinate Command
OCS	Outer Continental Shelf
OFW	Outstanding Florida Waters
OMRR&R	Operations, Maintenance, Repair, Rehabilitation, and Replacement
OPA	Otherwise Protected Area
OSE	Other Social Effects

PARA	Prepare, Absorb, Recover, and Adapt
PDC	Project Design Criteria
PDT	Project Delivery Team
PED	Preconstruction Engineering and Design
P&G	Principles and Guidelines
PPA	Project Partnership Agreement
P3BO	Programmatic Piping Plover Biological Opinion for Shore Protection Activities in the Geographical Region of the North and South Florida Ecological Services Field Offices
RED	Regional Economic Development
ROM	Rough Order of Magnitude
RSM	Regional Sediment Management
S&A	Construction Management
SACS	South Atlantic Coastal Study
SAFMC	South Atlantic Fish Management Council
SAJ	Jacksonville District
SARBO	South Atlantic Regional Biological Opinion for Dredging and Material Placement Activities in the Southeast United States
SLC	Sea Level Change
SCTLD	Stony Coral Tissue Loss Disease
SLR	Sea Level Rise
SPBO	Statewide Programmatic Biological Opinion for Shore Protection Activities along the Coast of Florida
SPP	Shore Protection Project
SSLA	Sovereign Submerged Lands Authorization
SSLE	Sovereign Submerged Lands Easement
T&E	Threatened and Endangered
TSP	Tentatively Selected Plan
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
WL	Water Level
WRDA	Water Resources Development Act

EXECUTIVE SUMMARY

INTRODUCTION

Structures and infrastructure along the Miami-Dade County, Florida shoreline are vulnerable to damage from erosion, flooding, and waves caused by coastal storms. This study investigates alternatives for a plan that addresses these vulnerabilities, as well as provides incidental opportunities for maintaining recreation and habitat along the shoreline of Miami-Dade County, Florida. This study only evaluates the Atlantic Ocean shoreline. It does not evaluate the coastal storm risks of the interior back bay shorelines of the barrier islands or the Miami-Dade County mainland. The non-Federal sponsor is Miami-Dade County, Florida.

The Jacksonville District (SAJ) has determined that there is Federal interest in a project for Coastal Storm Risk Management (CSRM) purposes along portions of the Atlantic Ocean shoreline of Miami-Dade County, Florida based on the U.S. Army Corps of Engineers (USACE) Planning Process.

PURPOSE AND NEED

The study authority for this project is Section 216 of the Flood Control Act of 1970, Public Law 91-611 (33 U.S.C. 549a), which authorizes the Secretary of the Army , acting through the Chief of Engineers, to review the operation of projects for which construction has been completed and which were constructed in the interest of navigation, flood control, water supply, and related purposes, when found advisable due to significantly changed physical or economic conditions, and to recommend to Congress on the advisability of modifying the structures or their operation, and for improving the quality of the environment in the overall public interest. This report is an interim response to the study authority. The existing Federal Beach Erosion Control and Hurricane Protection (BEC&HP) Project for Dade County, Florida was authorized by the Flood Control Act of 1968.

This study was 100% federally funded by the Bipartisan Budget Act of 2018 (BBA 2018), Public Law 115-123. This law appropriated funds for the initiation and completion of authorized flood and storm damage reduction studies in states and territories impacted by Hurricanes Harvey, Irma, and Maria.

The barrier island beaches of Miami-Dade County are significant to the nation providing protection to upland structures and infrastructure while supporting recreation, tourism, and natural habitat resources. The barrier islands in the focused study area have a population of over 100,000 people. In both 2018 and 2019 over 20 million visitors came to Miami-Dade County, having an $18 billion economic impact in each year. Over 50% of that economic impact was attributable to international visitors. There are over 1,200 structures just along the Atlantic Ocean shoreline with a combined estimated depreciated replacement value of over $20 billion. As a result of the existing Federal BEC&HP Project initially constructed in 1975, this area has experienced very little damage associated with erosion, waves, and storm surge flooding along the Atlantic Ocean shoreline. However, this area will continue to be vulnerable to damages from future coastal storms, especially as sea levels continue to rise.

This single purpose CSRM study focuses on the damaging forces of erosion, flooding, and wave attack during coastal storms that threaten structures and infrastructure fronting the Atlantic Ocean in Miami-Dade County, Florida. This area is highly vulnerable to sea level change (SLC) which is expected to exacerbate these damaging forces into the future.

STUDY SCOPING AND THE FOCUSED STUDY AREA

For this study the risk to areas along the Atlantic Ocean shoreline, the performance of existing measures to reduce risk, and the need for future measures over the next 50 years were all considerations for scoping the study. The Atlantic Ocean fronting shorelines between Bakers Haulover Inlet and Government Cut along with the Village of Key Biscayne were identified as having the most immediate need for a study to assess coastal storm risks and Federal participation in a CSRM project. The focused study area includes 9.4 miles of shoreline between Florida Department of Environmental Protection (FDEP) Range or Reference (R) Monuments R-27 to R-74 (Bakers Haulover Inlet to Government Cut) known as the "Main Segment" and 1.2 miles between R-101 to R-108 (Village of Key Biscayne) known as the "Key Biscayne Segment". R-monuments refer to FDEP survey monuments used for geographic reference.

PROBLEMS AND OPPORTUNITIES

Existing problems in the study area include:

- Storm damages due to erosion, inundation, and waves threaten structures and infrastructure
- Loss of natural habitat due to beach erosion
- Loss of recreational opportunities due to beach erosion
- Loss of national and regional income associated with tourism due to beach erosion

Opportunities are positive conditions in the study area that may result from implementation of a Federal project such as:

- Reduce economic loss due to coastal storm damages
- Maintain coastal habitat, the character of coastal beach communities, and other cultural resources
- Maintain existing recreation opportunities (beach and nearshore)
- Support the local and national tourism industry through the maintenance of stable beaches and healthy coastal ecosystems
- Implement a regional approach to sediment management by utilizing material from nearby accretional areas as a sand source
- Increase community understanding of coastal resilience
- Maintain current life safety or reduce risk to life safety

OBJECTIVES AND CONSTRAINTS

The Federal objective is to contribute to national economic development (NED) consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements. The planning objectives are:

1. Reduce coastal storm damage to structures and infrastructure within the study area for the 50-year planning horizon.
2. Maintain environmental quality for human and natural use within the study area through the 50-year planning horizon.
3. Maintain existing recreation (beach and nearshore) and tourism opportunities within the study area for economic benefit over the 50-year planning horizon.

The planning constraints for this study area are to avoid conflict with Federal regulations, as stated in Federal law, USACE regulations, and executive orders. There are no local constraints on plan formulation.

PLANNING PROCESS

This study applied the iterative six step USACE Planning Process to develop a Tentatively Selected Plan (TSP) that would address the problems and achieve the study objectives described in the previous section.

Beach-fx was used to model future without project (FWOP) erosion, wave attack, and flood damages associated with coastal storms in the focused study area. For plan formulation the USACE high SLC curve was used as the study area is vulnerable to SLC. The final plan will be evaluated against the intermediate and low USACE SLC curves.

In the Main Segment there is a correlation between shoreline erosion and FWOP damages. The Main Segment shoreline currently has a healthy dune and berm that is at least 100 feet wide with a dune crest elevation above 11-feet NAVD88 because of the current Federal project. Without continued beach nourishment the existing shoreline will erode landward. The subsequent result of that erosion will be private property owners constructing armoring and increased vulnerability of upland structures and infrastructure to direct erosion, wave attack, and flooding. The total average present value of FWOP damages in the Main Segment from 2026 through 2075 are estimated at $130M.

In the Key Biscayne Segment, most of the FWOP damages are associated with flooding. The shoreline erosion rates in Key Biscayne are not as significant as in the Main Segment, however the existing dune and beach berm is much narrower and lower. The upland area in Key Biscayne is also very low and flat making the structures and infrastructure, especially single-family homes constructed with slab on grade foundations, vulnerable to flooding from both the Atlantic Ocean and the back bay sides of the island. The total present value FWOP damages from 2026 through 2075 in the Key Biscayne Segment are estimated at $527M.

The existing physical conditions in the study area and FWOP Beach-fx model results were used to inform management measures that were considered and development of alternatives.

A number of structural and non-structural management measures were considered to address problems and to realize the opportunities and planning objectives listed above. During the plan formulation process, management measures were preliminarily screened against the four Principles and Guidelines (P&G) accounts described in **Section 2.5**, planning objectives, and constraints using a qualitative assessment. The measures that would best address the problems in the study area, the four P&G accounts, and study objectives were grouped based on their function. Beach nourishment, erosion control structures, and reinforced dune measures were carried forward and developed into the following focused array of alternatives.

- No Action
- Beach Nourishment
- Erosion Control Structures
- Beach Nourishment with Erosion Control Structures
- Reinforced Dune with Beach Nourishment (Key Biscayne Segment Only)

Four planning reaches were established based on existing physical conditions and the FWOP damages to reflect areas where alternatives could be implemented, and benefits could be achieved independently. The Main Segment includes Planning Reaches 1 (R-27 to R39.3), 2 (R-39.3 to R-56.5), and 3 (R-56.5 to R-74). Various scales of beach nourishment were considered along with Erosion Control Structures at select locations that experience the greatest erosion. Beach-fx was set up to simulate the performance of each alternative within its respective planning reach. The planning strategy for the Main Segment was to determine the TSP for planning reaches 1, 2, and 3 individually and then combine the plan for each planning reach into a single TSP for the Main Segment. The Key Biscayne Segment consists of Planning Reach 4. Various scales of beach nourishment were considered along with erosion control structures and a reinforced dune. The planning strategy was to determine a separate TSP for the Key Biscayne Segment due to its distance and separation from the Main Segment.

The alternatives for each Planning Reach were set up and modeled using Beach-fx to determine the life-cycle damage reduction benefits provided. Parametric cost estimates for the alternative features were used to develop life-cycle costs for each alternative that could be compared to the benefits. The plan maximizing NED benefits for each Planning Reach was identified, and incidental recreation benefits were calculated for the NED plan in each Planning Reach. The incrementally justified plans in Planning Reaches 1, 2, and 4 were carried forward and combined for the overall TSP. No economically justified plan was identified for Planning Reach 3.

TENTATIVELY SELECTED PLAN

The key features of the TSP are listed below and shown in **Figure ES-1**.

Main Segment TSP Features

- Beach Nourishment (all beach nourishment will include a dune feature)
  - Full template from R-27 to R-34.5 with taper to R-36.5 (1.9 miles)
  - Full template from R-39.5 to R-56.5 with tapers to R-38.5 and R-57.5 (3.8 miles)
- Sand Sources
  - Bakers Haulover Inlet (BHI) Complex By-passing
  - South Miami Beach Back-passing
  - Offshore Borrow Areas
- Erosion Control Structures
  - Five Groins from R-28 to R-31.5

Key Biscayne Segment TSP Features

- Beach Nourishment (all beach nourishment will include a dune feature)
  - R-101.3 to R-107.8 (1.2 miles)
- Sand Sources
  - Upland Truck Haul (upland sand mines not shown in **Figure ES-1**)
- Reinforced Dune
  - Steel Sheet Pile Dune Core Wall from R101.3 to R107.8 (6,560 feet)
  - Northern Tieback Wall (1,800 feet)
  - Southern Tieback Wall (700 feet)

The Main Segment TSP total project first cost (constant dollar basis in October 2022 price levels), including contingency, is $267.6 million. The Key Biscayne Segment TSP total project first cost (constant dollar basis in October 2022 price levels), including contingency, is $176.2 million. The Cost Engineering Appendix provides additional cost details.

Table ES-1 provides an economic summary of the TSP. CSRM benefits were based on the results of Beach-fx modeling. Primary CSRM benefits are based on reducing structure and content damages and coastal armor construction costs in the focused study area. Incidental recreation benefits are based on reducing unmet demand and enhancing willingness to pay between the future without project and future with project conditions.

Implementation of the plan for the Key Biscayne Segment is contingent upon local efforts to address back bay flooding such that the benefits for the Key Biscayne Segment are realized; therefore, USACE will evaluate the engineering and environmental sufficiency of those efforts to determine whether to proceed with construction of this project and whether supplemental NEPA is required. This review will be appropriately documented (Design Documentation Report, Engineering Documentation Report, Letter Report, or Memorandum for Record, etc.) and approved prior to construction of the Key Biscayne Segment. USACE will not construct the Key Biscayne Segment until USACE has determined that the back

bay efforts constructed by local interests are constructed in a manner that will allow for achievements of the benefits. NEPA will be updated as appropriate.

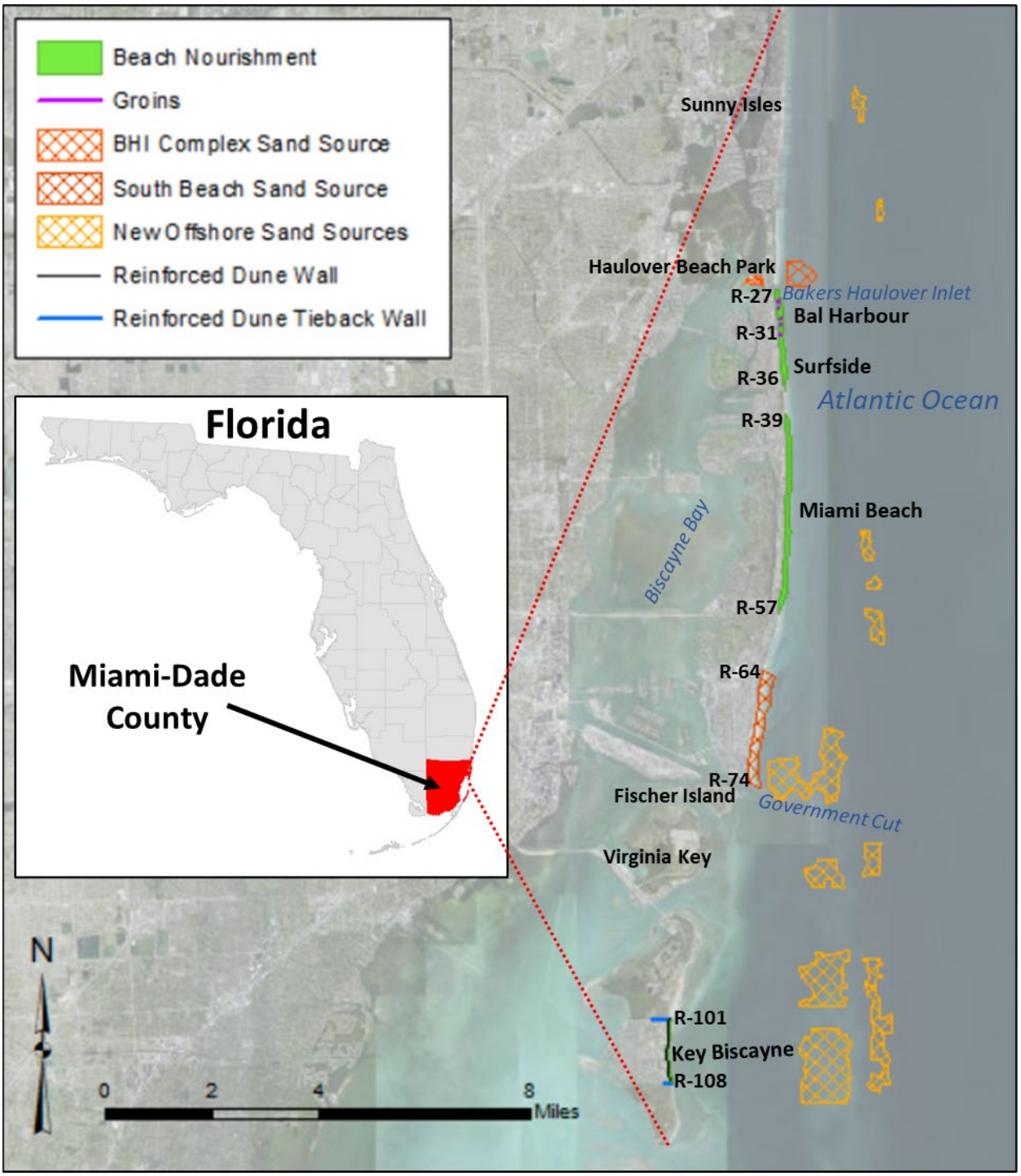


Figure ES-1. Tentatively Selected Plan Overview.

Table ES-1. Tentatively Selected Plan Economic Summary

Segment	**Main Segment**		**Key Biscayne Segment**	
Benefits	CSRM Only	With Incidental Recreation	CSRM Only	With Incidental Recreation
Total AAEQ Cost	$6,309,000	$6,309,000	$4,279,000	$4,279,000
AAEQ Damage Reduction Benefits	$3,735,000	$3,735,000	$9,872,000	$9,872,000
AAEQ Recreation Benefits		$36,817,000		$102,000
AAEQ Total Benefits	$3,735,000	$40,552,000	$9,872,000	$9,974,000
AAEQ Net Benefits	$-2,574,000	$34,243,000	$5,593,000	$5,695,000
Benefit-Cost Ratio (BCR)	0.6	6.4	2.3	2.3

Note: AAEQ Costs and Benefits use the FY21 water resources discount rate (2.5%).

COORDINATION WITH AGENCIES AND THE PUBLIC

An initial scoping period for the study was conducted from November 16, 2018 through January 9, 2019. The U.S. Environmental Protection Agency (EPA) and the National Marine Fisheries Service (NMFS) accepted USACE's invitations to join as participating agencies in this study. Stakeholders associated with the study include the City of Miami Beach, Village of Key Biscayne, Town of Surfside, and Bal Harbour Village, as well as other Federal environmental agencies, state and local agencies, and non-governmental organizations (NGO). A public meeting was held on December 5, 2018 from 4:00pm to 7:00pm at the Miami-Dade County Environmental Resources Management (DERM) Training Room located at 701 NW 1st Court in Miami, Florida. This meeting was merged with the scoping meeting for the Miami-Dade County Back Bay Feasibility Study. The purpose of the scoping public meeting was to brief stakeholders and the public on the upcoming work to determine the scope of analysis and identification of potential project components as well as discussing any potentially significant issues and information needed to evaluate alternatives. At least one public meeting will be held during the draft report's public comment period to brief stakeholders and the public on the TSP and to provide these groups with the information needed to effectively review and comment on the draft report.

ENVIRONMENTAL CONSIDERATIONS

The TSP was coordinated with State and Federal agencies and is compliant with applicable Federal statutes and regulations. The proposed existing sand sources have also been mined/dredged in the past for either shore protection or navigation purposes. No hardbottom resources are located at either the beach placement or sand source locations. The proposed beach nourishment that is part of the TSP falls within the footprint as previously constructed beach nourishment. The beneficial effects of beach nourishment in the proposed project area include establishing a larger buffer beach to protect upland infrastructure against storms and flooding, providing additional habitat for beach flora and fauna, and increasing beach space for recreational activities relative to the FWOP condition (also referred to as the "No Action"

alternative). The proposed project would likely produce more favorable environmental conditions than would exist without a project, although construction operations would produce temporary adverse effects to resources including ambient noise levels, aesthetics, sea turtle and shorebird nesting, and benthic habitats. Noise levels and aesthetics will return to preconstruction conditions (or better) immediately following construction. Sea turtle nesting, shorebird nesting, and benthic resources are expected to return to pre-construction conditions or more favorable conditions within one- or two-years following construction.

For all alternatives, the potential effects were evaluated, as appropriate. All practicable and appropriate means to avoid or minimize adverse environmental effects were analyzed and incorporated into the recommended plan. Best management practices (BMPs) as detailed in the IFR/EA will be implemented, if appropriate, to minimize impacts.

CHAPTER 1: INTRODUCTION

1 INTRODUCTION

1.1 Study Purpose and Need*

Structures and Infrastructure along the Miami-Dade County shoreline are subject to damages from waves, erosion, and storm surge caused by coastal storms. The impacts of these damage mechanisms are expected to be compounded by SLC. The majority of the coastal areas in Miami-Dade County are highly developed and vulnerable to coastal storm damages along both the ocean and back bay shorelines.

Congress has authorized Federal participation in restoring and protecting the shores of the United States, its territories, and its possessions. Under current policy, coastal storm risk management projects are designed to reduce damages caused by wind-generated and tide-generated waves and currents along the nation's ocean coasts, Gulf of Mexico, the Great Lakes, and estuary shores. Hurricane protection was added to the erosion control mission in 1956 when Congress authorized cost-shared Federal participation in shore protection and restoration of publicly owned shore areas. USACE participates in single purpose projects formulated exclusively for hurricane and storm damage reduction, with economic benefits equal to or exceeding the costs, based solely on damage reduction benefits, or a combination of damage reduction benefits and recreation benefits.

The barrier island beaches of Miami-Dade County are significant to the nation providing protection to upland structures and infrastructure while supporting recreation, tourism, and natural habitat resources. The barrier islands in the focused study area have a population of over 100,000 people. In both 2018 and 2019 over 20 million visitors came to Miami-Dade County, having an $18 billion economic impact in each year. Over 50% of that economic impact was attributable to international visitors. There are over 1,200 structures just along the Atlantic Ocean shoreline with a combined estimated depreciated replacement value of over $20 billion. As a result of the existing Federal BEC&HP Project initially constructed in 1975, this area has experienced very little damage associated with erosion, waves, and storm surge flooding along the Atlantic Ocean shoreline. However, this area will continue to be vulnerable to damages from future coastal storms, especially as sea levels continue to rise.

The Federal government's purpose for this study is to review existing project performance, evaluate CSRM measures, and formulate alternatives to recommend a plan for CSRM management to include incidental opportunities for maintaining environmental resources and recreational opportunities. This study uses the USACE plan formulation process to develop management measures and alternative plans that meet the planning objectives and avoid planning constraints while being technically sound, environmentally acceptable, and economically justified. Alternatives considered are described in detail in **Chapter 2**.

This report integrates the components of the Environmental Assessment (EA) prepared pursuant to the National Environmental Policy Act of 1969 (NEPA). Section headings denoted with an asterisk identify information typically included in a NEPA analysis.

1.2 Study Background and Location*

Miami-Dade County is located along the southeast coast of Florida between Broward County (north of Dade) and Monroe County (south of Dade), and contains the city of Miami. The Miami-Dade County Atlantic Ocean shoreline extends along several barrier island segments separated from the mainland by Biscayne Bay. The barrier islands vary in width from about 0.2 to 1.5 miles, with an average width of approximately 0.5 miles. Elevations along the entire coastal region (and much of the mainland) are generally low, whereas elevations along the barrier islands are generally the highest along the Atlantic Ocean shorefront, and slope gradually downward toward the bay.

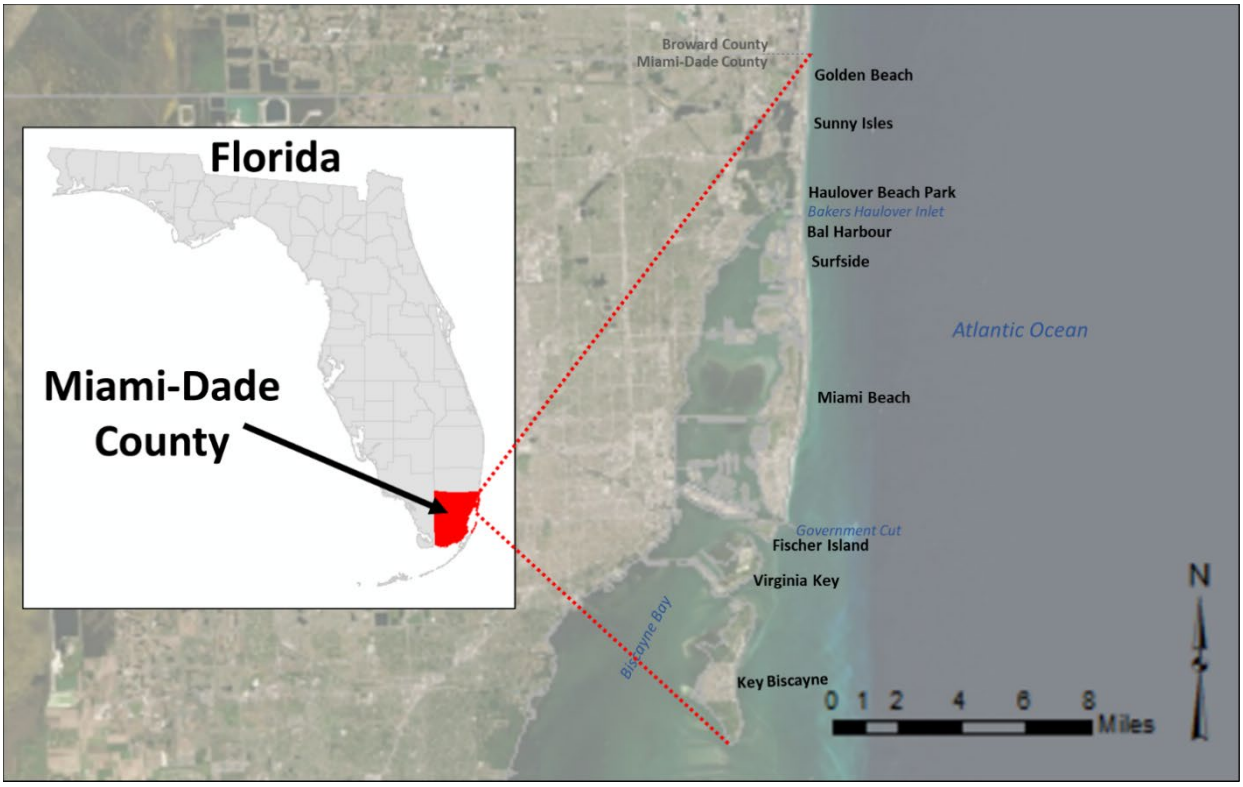


Figure 1-1. Study Area Vicinity Map.

1.3 Study Sponsor

The non-Federal sponsor is Miami-Dade County, Florida.

1.4 Study Authority

Section 216 of the Flood Control Act of 1970 (Public Law 91-611, 33 U.S.C. 549a) authorizes the Secretary of the Army, acting through the Chief of Engineers, to review the operation of projects for which construction has been completed and which were constructed in the interest of navigation, flood control, water supply, and related purposes, when found advisable due to significantly changed physical or economic conditions, and to recommend to Congress on the advisability of modifying the structures or their operation, and for improving the quality of the environment in the overall public interest.

Title IV, Division B of the Bipartisan Budget Act of 2018 (Public Law 115-123), enacted February 9, 2018, authorizes the Government to conduct this study at full Federal expense to the extent that appropriations provided under the Investigations heading of the Act are available and used for such purpose.

For this study, the Section 216 authority outlined above is being used to review the operation of the existing Federal BEC&HP project in Miami-Dade County, Florida based on changed conditions. Approval to use Section 216 to investigate a new investment decision as the study authority was concurred on by USACE Headquarters. As such, this authority was documented in the executed feasibility cost sharing agreement for this study, dated October 9, 2018.

1.5 Existing Federal Project

1.5.1 Authorization of the Existing Authorized Project

The BEC&HP Project for Dade County, Florida was authorized by Section 203 of the Flood Control Act of 1968 (Public Law 90-483); it states, in relevant part:

> The following works of improvement for the benefit of navigation and the control of destructive floodwaters and other purposes are hereby adopted and authorized to be prosecuted under the direction of the Secretary of the Army and supervision of the Chief of Engineers in accordance with the plans in the respective reports hereinafter designated and subject to the conditions set forth therein. The necessary plans, specifications, and preliminary work may be prosecuted on any project authorized in this title with funds from appropriations hereafter made for flood control so as to be ready for rapid inauguration of a construction program. The projects authorized in this title shall be initiated as expeditiously and prosecuted as vigorously as may be consistent with budgetary requirements....
>
> …
>
> The project for beach erosion control and hurricane flood protection of Dade County, Florida, is hereby authorized substantially in accordance with the recommendations of the Chief of Engineers in House Document Numbered 335, Ninetieth Congress, at an estimated cost of $11,805,000.

The authorized project, as described in the 1968 Chief's Report for the project, provided for the construction of a protective and recreational beach and a protective dune for 9.4miles of shoreline between Government Cut and Bakers Haulover Inlet (encompassing Miami Beach, Surfside, and Bal Harbour) and for the construction of a protective and recreational beach along 1.2 miles of shoreline at Haulover Beach Park. In addition, Section 69 of the 1974 Water Resources Development Act (WRDA) (Public Law 93-251) modified the authorized project and authorized initial construction by non-Federal interests, as well as subsequent nourishments by Federal or non-Federal interests, of the 0.85-mile segment along Bal Harbour Village, immediately south of Bakers Haulover Inlet.

The Sunny Isles segment of the project was added in 1985. Specifically, the BEC&HP Project for Dade County, Florida, North of Haulover Beach Park was authorized by the Supplemental Appropriations Act of 1985 (Public Law 99-88) and Section 501 of the WRDA of 1986 (Public Law 99-662). However, only the authority of the Supplemental Appropriations Act of 1985 has been implemented through the execution of a local cost sharing agreement. This authorization provides for modification of the authorized 1968 BEC&HP Project for Dade County, Florida, to provide for the following:

a) The construction of a protective beach along a reach of shore extending 2.5 miles through Sunny Isles, and for periodic nourishment of this area.

b) The extension of the period of Federal participation in the cost of nourishing the existing Dade County BEC&HP Project from 10 years to the life of the project.

The Chief of Engineers' Report dated December 27, 1983 ("Dade County, North of Haulover Beach Park, Florida") provides more details on the Sunny Isles segment of the project.

Although the Supplemental Appropriations Act of 1985 authorized the Sunny Isles segment and extended the period of Federal participation of the existing Dade County (BEC&HP) Project but did not specify a time limit for Federal participation, Section 156 of WRDA 1976 (Public Law 94-587), as amended by Section 934 of WRDA 1986 (Public Law 99-662), limits the period of Federal participation to 50 years from the date of initiation of construction.

1.5.2 Description of the Existing Authorized Project

The originally authorized Dade County BEC&HP Project as described in the 1968 Chief's Report provided for the placement of beach fill along the 9.4-mile reach of shoreline extending from Bakers Haulover Inlet to Government Cut and along the 1.2-mile length of Haulover Beach Park located immediately north of Bakers Haulover Inlet. This segment of the existing project is referred to as the "Main Segment." The Main Segment project as authorized provided for beach erosion control and hurricane surge protection by initial placement of sand to form a protective and recreational beach and protective dune for 9.4 miles of shore between Government Cut and Bakers Haulover Inlet (encompassing Miami Beach, Surfside, and Bal Harbour) and for beach erosion control by initial placement of sand to form a protective and recreational beach along 1.2 miles of shore at Haulover Beach Park. Between Government Cut and Bakers Haulover Inlet, the plan provided a dune 20 feet wide at 11.5 feet above mean low water (MLW) and a level berm 50 feet wide at elevation 9 feet MLW with natural slopes as shaped by wave action. At Haulover Beach Park, the plan provided a level berm 50 feet wide at elevation 9 feet MLW and natural slopes. As authorized, the Main Segment did not have a recommended renourishment interval, but the project was intended to be nourished periodically as needed to compensate for erosion losses throughout the 50-year period of Federal participation. The average annual nourishment requirements were estimated at 191,000 and 20,000 cubic yards (cy) of material for Government Cut to Bakers Haulover Inlet and Haulover Beach Park, respectively. Sand for initial construction and periodic nourishments was intended to be obtained from offshore borrow areas.

The 2.5-mile length of Sunny Isles was added to the project in 1985 under a separate authorization and construction was initiated in 1988. The authorized project for the Sunny Isles Segment of the Dade County BEC&HP Project provided for the construction of a 20-foot berm seaward of the Erosion Control Line (ECL), with front slopes of 1 vertical to 10 horizontal from berm crest to MLW, then 1 vertical on 25 horizontal to the existing bottom. The beach fill extends along the 2.5-mile length of Sunny Isles, and is bordered on the south end by the Main Segment (50-foot berm width), and to the north by the town of Golden Beach, which is not a part of the Dade County BEC&HP. The authorized renourishment volume was 715,000 cy every 10 years. Sand for initial construction and periodic nourishments was intended to be obtained from offshore borrow areas.

1.5.3 Construction History

Initial construction of the Main Segment was completed in phases between 1975 and 1982. Initial construction of the Sunny Isles segment was completed in 1988. Several periodic beach nourishments have been performed under the authority of the BEC&HP project since initial construction. Several beneficial-use placements of beach-quality material dredged from adjacent Federal navigation projects and small nourishments performed by local interests have also taken place along reaches of the BEC&HP project. **Figure 1-2**, **Figure 1-3**, and **Figure 1-4** shows the location of beach nourishment events associated with the existing Federal project. **Table 1-1** provides additional detail on the events shown in these figures.

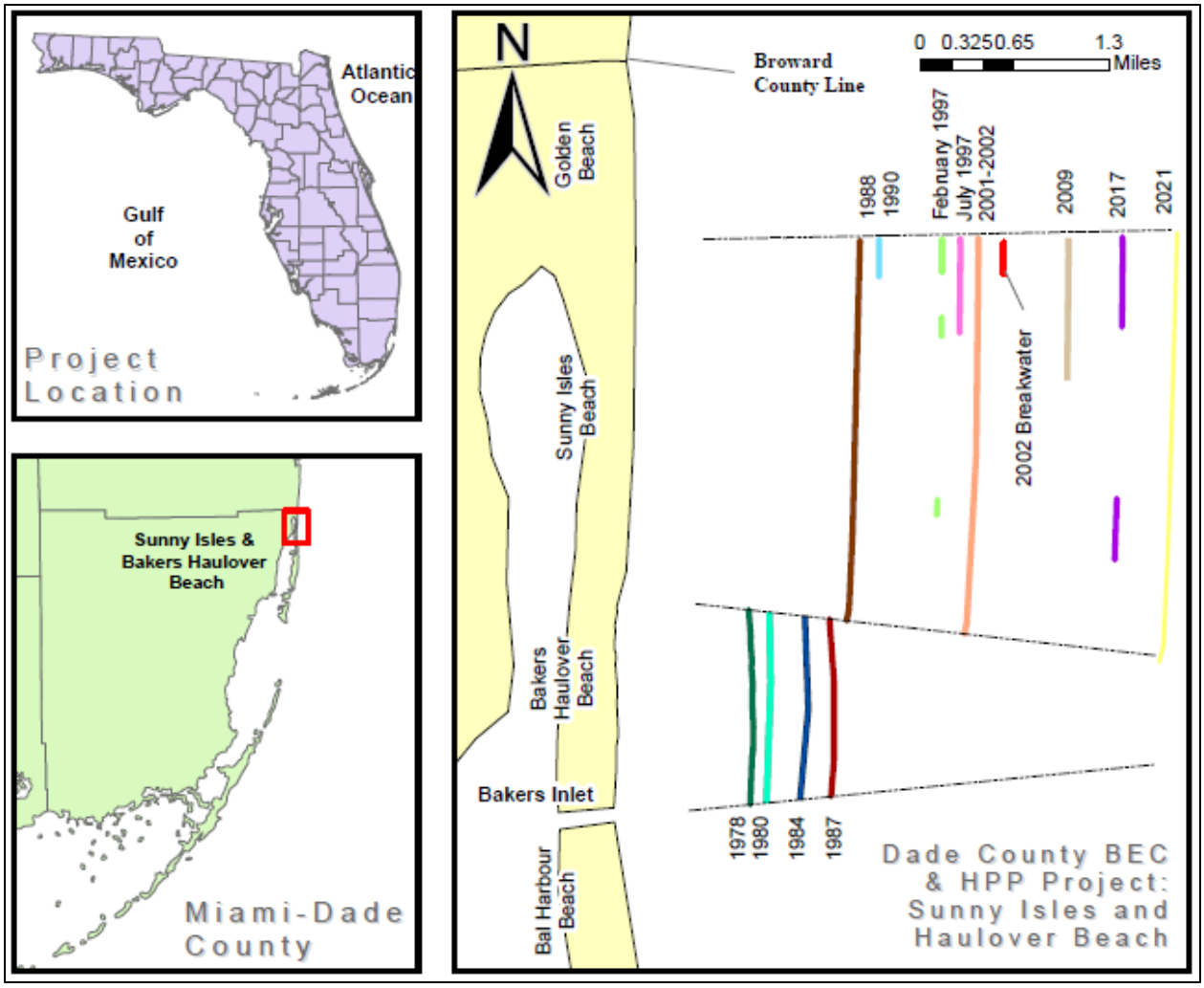


Figure 1-2. Existing Project Nourishment Event Locations – Sunny Isles and Haulover Beach Park.

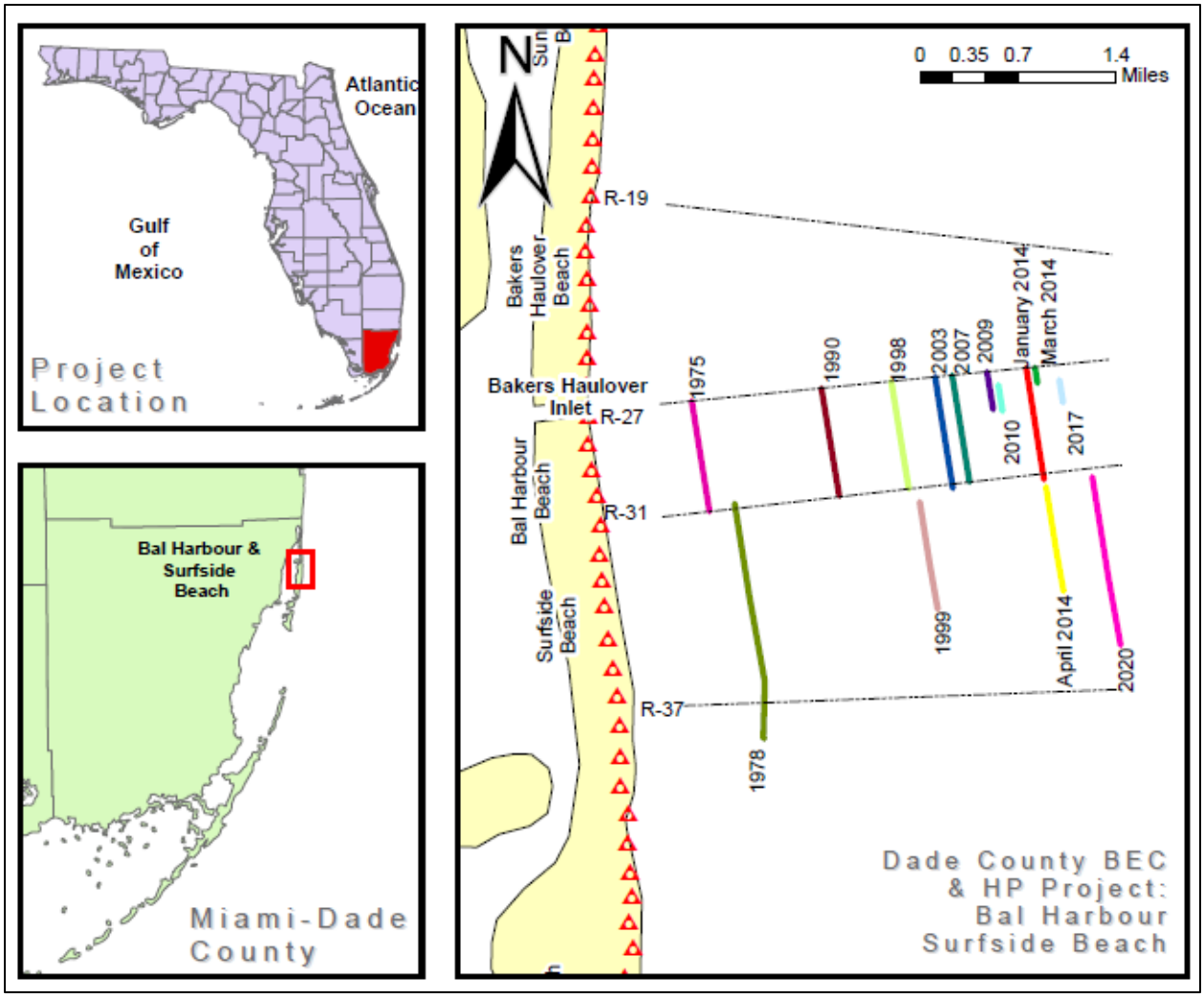


Figure 1-3. Existing Project Nourishment Event Locations – Bal Harbour and Surfside.

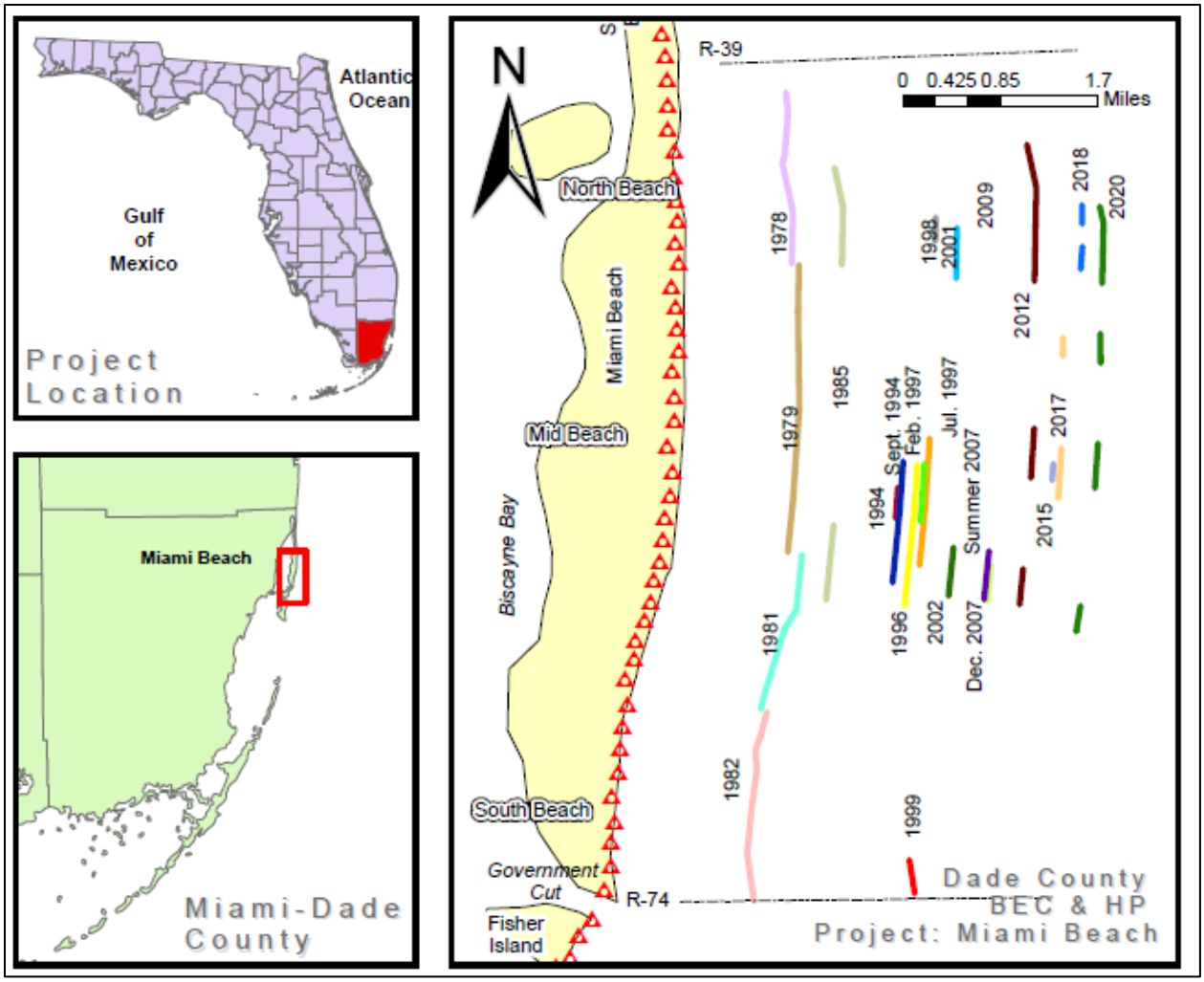


Figure 1-4. Existing Project Nourishment Event Locations – Miami Beach.

Table 1-1. Existing Project Nourishment Event Details.

Project Type	Construction Date	Event Type	Location		Volume (cy)	Activity/Borrow Source	Length (miles)
			Name	R-mons			
USACE	1975	Initial Construction	Bal Harbour Beach	R-27 to R-31	1,625,000	Offshore Borrow Areas A, B & C	0.8
USACE	1978	Initial Construction	Haulover Beach	R-19 to R-26	2,940,000	Borrow Areas A, B & C	1.4
USACE	1978	Initial Construction	Surfside Beach	R-31 to R-39	2,640,000	Offshore Borrow Areas A, B & C	1.7
USACE	1978	Initial Construction (Phase II)	North Beach	R-39 to R-46	1,530,000	Offshore Borrow Area D	1.5
USACE	1979	Initial Construction (Phase III)	Mid Beach	R-46 to R-58	3,177,100	Offshore Borrow Areas D & E	2.4
USACE	1980	Maintenance Disposal	Haulover Beach	R-19 to R-26	43,163	Bakers Haulover Inlet Flood Shoal	1.4
USACE	1981	Initial Construction (Phase IV)	Mid Beach	R-58 to R-65	2,200,000	Offshore Borrow Area E	1.4
USACE	1982	Initial Construction (Phase V)	South Beach	R-65 to R-74	2,400,000	Offshore Borrow Area E & 5th Contract Borrow Area	1.9
USACE	1984	Maintenance Disposal	Haulover Beach	R-19 to R-26	35,000	Bakers Haulover Inlet Flood Shoal	1.4
Local	1985	Renourishment	Mid Beach	R-42 to R-46 R-57 to R-60	110,000 50,000	Unknown	0.8 & 0.6
USACE	1987	Renourishment	Haulover Beach	R-19 to R-26	235,000	Unspecified Offshore Borrow Area	1.4

Project Type	Construction Date	Event Type	Location		Volume (cy)	Activity/Borrow Source	Length (miles)
			Name	R-mons			
USACE	1988	Initial Construction	Sunny Isles Beach	R-7 to R-19.3	1,320,000	Offshore Borrow Area #2	2.4
USACE	1990	Maintenance Disposal	Sunny Isles Beach	R-7 to R-8.5	32,000	Bakers Haulover Inlet and Atlantic Intracoastal Waterway (AIWW)	0.3
USACE	1990	Renourishment	Bal Harbour Beach	R-27 to R-31	225,000	Unspecified Offshore Borrow Area	0.8
USACE	Sept. 1994	Renourishment	Mid Beach	R-55 to R-56	122,096	Borrow Area #1, offshore Golden Beach	0.2
Local	1994	Renourishment	Mid Beach	R-54 to R-59	30,000	Truck Haul from upland source	1.0
Local	1996	Renourishment	Mid Beach	R-54 to R-60	8,000	Truck Haul from South Beach	1.2
Local	Feb. 1997	Renourishment	Mid Beach	R-54 to R-56 R-57 to R-59	35,000 50,000	Truck Haul from CSR Rinker laker fill material & Truck Haul from upland Borrow Area	0.8
USACE	Jul. 1997	Renourishment	Mid Beach	R-53 to R-58	478,938	Borrow Area #1, offshore Golden Beach	1.0
Local	1998	Renourishment	North Beach	R-44 to R-45	18,000	Truck Haul from upland source	0.2
USACE	1997	Emergency Fill at Hotspots	Sunny Isles Beach	R-7 to R-8 R-10 R-16	9,000	Truck Haul from Upland Sand Source	0.4
USACE	1997	Renourishment	Sunny Isles Beach	R-7 to R-10	80,130	Offshore Borrow Area #1	0.6
USACE	1998	Maintenance Disposal	Bal Harbour Beach	R-28 to R-31	35,000	Bakers Haulover Inlet & Flood Shoal & AIWW	0.6

Project Type	Construction Date	Event Type	Location		Volume (cy)	Activity/Borrow Source	Length (miles)
			Name	R-mons			
USACE	1999	Renourishment	South Beach	R-73 to R-74	132,000	South of Government Cut Offshore Borrow Area	0.3
USACE	1999	Renourishment	Surfside Beach	R-32 to R-36	590,000	South of Government Cut Offshore Borrow Area	0.8
USACE	2001	Renourishment	North Beach	R-44 to R-46.5	167,662	South of Government Cut Offshore Borrow Area	0.5
USACE	2001/2002	Renourishment	Sunny Isles Beach	R-7 to R-19.3	874,814	South of Government Cut Offshore Borrow Area	2.4
Local	2002	Breakwater Construction	Mid Beach	R-57 to R-60	125,000	Truck Haul from South Beach to Backfill construction of 32nd St. Breakwaters	0.5
USACE	2003	Renourishment	Bal Harbour Beach	R-27 to R-31.5	188,000	Bakers Haulover Ebb Shoal	0.85
USACE	2007	Maintenance Disposal	Bal Harbour Beach	R-27 to R-31	30,000	AIWW	0.8
Local	Summer 2007	Renourishment	Mid Beach	R-53.5 to R-56	70,000	Truck Haul from South Beach	0.5
Local	Dec. 2007	Renourishment	Mid Beach	R-60 to R-61	30,000	Truck Haul from upland source	0.2
Local	2009	Renourishment	Sunny Isles Beach	R-7 to R-10.5	10,000	Truck Haul Ortona Mines	0.7
Local	2009	Renourishment	Bal Harbour Beach	R-27 to R-28.8	15,000	Truck Haul Ortona Mine	0.35
Local	2009	Renourishment	North and Mid Beach	R-43 to R-44.5 R-48.7 to R-50.7 R-53.7 to R-55.5	10,000 10,000 3,000	Truck Haul from upland source	0.9
USACE	2010	Maintenance Disposal	Bal Harbour Beach	R-28 to R-29	33,080	Bakers Haulover Flood Shoal & AIWW	0.2

Project Type	Construction Date	Event Type	Location		Volume (cy)	Activity/Borrow Source	Length (miles)
			Name	R-mons			
USACE	2012	Renourishment	North Beach	R-41.5 to R-46.5 R-53.7 to R-54.7 R-60 to R-61.1	206,402 122,237 18,922	South of Government Cut Offshore Borrow Area & Truck Haul from South Beach	1.5
Local	2013	Renourishment	Mid Beach	Unknown	6,296	Truck Haul from upland source	Unknown
USACE	Jan-14	Renourishment	Bal Harbour Beach	R-27 to R-31.5	235,733	Bakers Haulover Ebb Shoal	0.85
USACE	Mar-14	Maintenance Disposal	Bal Harbour Beach	R-28 to R-29	49,592	AIWW Cut DA-9	0.2
Local	2014	Renourishment	Surfside Beach	R-32 to R-36	12,800	Truck Haul from nearby construction excavation	0.8
Local	2014	Renourishment	Mid Beach	Unknown	31,365	Truck Haul from upland source	Unknown
Local	2015	Renourishment	Mid Beach	R-53.7 to R-55.5	19,259	Truck Haul from upland source	0.3
USACE	2017	Maintenance Disposal	Bal Harbour Beach	R-28 to R-29	37,000	AIWW	0.2
USACE	2017	Renourishment	Mid Beach	R-49 to R-50 R-53 to R-55.5	83,665 149,665	Truck Haul from Ortona Mine	0.7
USACE	2017	Renourishment	Sunny Isles Beach	R-7 to R-10 R-15.5 to R-17	122,324	Truck Haul Ortona Mines	1.0
Local	2018	Renourishment	North Beach	R-43 to R-44 R-45 to R-46	12,500 14,400	Truck Haul from upland source	0.4
USACE	2020	Renourishment	Surfside Beach	R-31 to R-36.5	325,000	Truck Haul from Vulcan Witherspoon Mine	1.1

Project Type	Construction Date	Event Type	Location		Volume (cy)	Activity/Borrow Source	Length (miles)
			Name	R-mons			
USACE	2020	Renourishment	Mid Beach	R-43 to R-46.5 R-49.5 to R-50.5 R-53.5 to R-55.5 R-60 to R-61	25,000 78,800 68,400 100,900	Truck Haul from Garcia Mine	1.5
USACE	2021	Renourishment	Sunny Isles Beach	R-7 to R-19.3	280,000	Truck Haul Garcia Mines	2.4

The period of Federal participation for the existing project is limited to 50-years from initial construction. **Figure 1-5** shows the timeline for Federal participation in the Main Segment and Sunny Isles Segments.

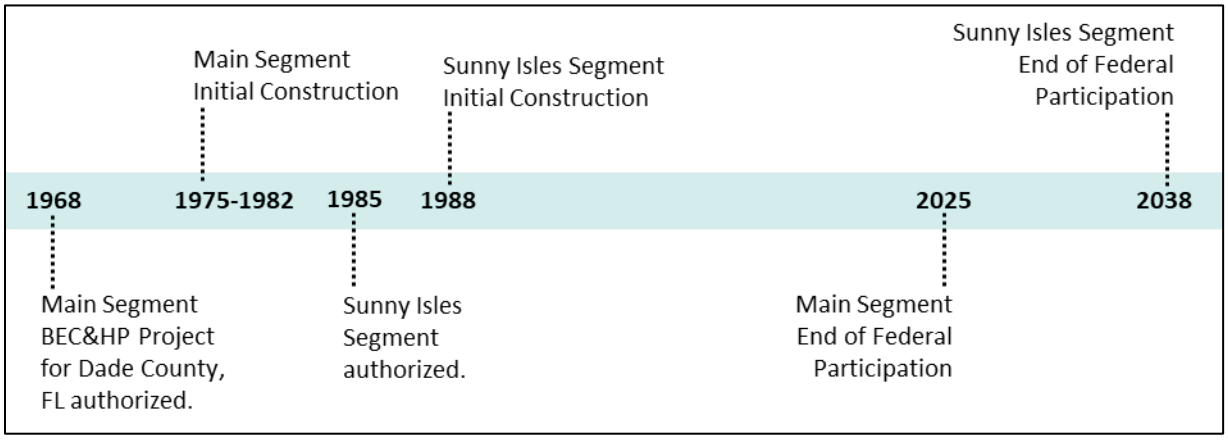


Figure 1-5. Timeline of Federal participation in the existing project in Miami-Dade County, FL.

1.6 Scoping

1.6.1 Agency and Public Feedback*

By letter dated November 3, 2020 pursuant to 36 C.F.R. § 800.3, USACE initiated NHPA consultation with the Florida State Historic Preservation Office (SHPO) and federally recognized tribes including the Miccosukee Tribe of Indians of Florida, the Seminole Tribe of Florida, the Thlopthlocco Tribal Town, the Seminole Nation of Oklahoma, and the Muscogee Creek Nation of Oklahoma.

SAJ mailed a public scoping letter on November 16, 2018, which outlined the intent to gather information evaluating the feasibility of providing CSRM measures to the Miami-Dade County shoreline. A scoping meeting was held on December 5, 2018, in Miami-Dade County, Florida, to provide information on the study and to solicit comments from local, state, and government personnel and from the public. The public comment period closed on January 9, 2019. During this scoping period, comments were received from the EPA, the Village of Key Biscayne, and Miami-Dade County. EPA provided a wide variety of technical comments and recommendations. The remainder of the comments received were focused on the request to include the Village of Key Biscayne in the study. Comments can be found in this report's Appendix J "Pertinent Correspondence".

1.6.2 Focused Study Area

The initial study area considered included the entire Atlantic Ocean shoreline of Miami-Dade County. This initial area was screened down to focus on the areas with the greatest potential for Federal interest in managing coastal storm risks.

Although a protective beach at Haulover Beach Park is included in the existing Main Segment project, this area is generally accretional and has not needed nourishment of the beach since 1987. It is anticipated

that this stretch of shoreline will remain stable into the future and the structures and infrastructure in this area are currently not threatened by coastal storm damages. For these reasons, the need for Federal participation in a CSRM project for Haulover Beach Park was determined to be unnecessary at this time and was screened from the review conducted in the current study.

The existing Federal project at Sunny Isles was authorized in 1985 and initial construction was initiated in 1988; therefore, Federal participation in the Sunny Isles Segment extends through 2038. USACE and the non-Federal sponsor are satisfied with the existing project at Sunny Isles, which is successful at reducing risk from coastal storms in this segment. Due to the considerable amount of time remaining in the existing authorization and to the success of the existing project at Sunny Isles, it is not evaluated in the current study. The current study effort is not intended to alter the existing authorization for the Sunny Isles Segment.

Golden Beach, Fischer Island, and Virginia Key are not expected to experience damages related to coastal storms to an order of magnitude that would warrant Federal interest as compared to the cost of implementing a project; additionally, the non-Federal sponsor has not expressed interest in including these areas in the current study. These areas have been screened from the review conducted in the current study.

The period of Federal participation for the Main Segment of the existing BEC&HP project will expire in 2025. The portion of the Main Segment project between Bakers Haulover Inlet and Government Cut (R-27 to R-74) continues to experience problems related to coastal storms; therefore, the current study focuses on solutions to the problems related to coastal storms in this area. The current study also focuses on the Atlantic Ocean shoreline in the Village of Key Biscayne (R-101 to R-108) which was identified as an area where potential Federal interest exists to address problems related to coastal storms that are being experienced. **Figure 1-6** shows the location of the Focused Study Area.

Figure 1-6. Location of the Focused Study Area.

Back bay flooding has increasingly become a concern throughout the project area due to the low-lying elevations of these barrier islands. Local interests are planning for future SLC and a separate USACE study focusing on back bay coastal flooding in Miami-Dade County is underway.

The current study has been scoped to focus on addressing the coastal storm risks that threaten structures and infrastructure from the Atlantic Ocean shoreline. Alternatives to address back bay coastal flooding will not be evaluated as part of this study. Back bay flooding analysis for this study will be limited to discussion on the residual risk associated within the study area.

1.7 Related Documents

Documents and reports relevant to the focused study area described in **Section 1.6.2** are listed in the below sections (Note: these lists are not all-encompassing).

1.7.1 Existing Project Documents

This report builds upon previous NEPA analyses conducted for the existing Dade County, Florida BEC&HP project in the focused study area. These documents, included in the list below, are incorporated by reference and available upon request.

1967. Report of the Chief of Engineers, Department of the Army for Dade County, Florida, including the reports of the District and Division Engineers and the Board of Engineers for Rivers and Harbors (30 March 1967). This report to congress recommended, "artificial placement of a protective beach and dune and periodic nourishment for beach erosion control and hurricane protection between Government Cut and Bakers Haulover Inlet, a protective beach and periodic nourishment at Haulover Beach Park, and credit to local interests in accordance with Section 103 of Public Law 87-874, for pre-project costs of works previously provided which are to become a part of the recommended project." The proposed plan would provide "an opportunity to restore and preserve the beaches for the intensive present and continued future use and to reduce the possibility of a major flood disaster."

1975. General Design Memorandum (GDM) (September 1975). This report presented an updated detailed design for initial construction of the Federal project through the communities of Miami Beach, Surfside, and Bal Harbour.

1975. Final Environmental Impact Statement (EIS), Beach Erosion Control and Hurricane Surge Protection Project, Dade County, Florida (December 1975). This EIS describes the environmental impacts and adverse effects associated with action proposed by the 1975 GDM to provide a recreational and protective each using offshore borrow areas.

1984. General Design Memorandum, Addendum II (First Renourishment) (June 1984). The purpose of this addendum to the 1975 GDM was to examine the performance of the Dade County BEC&HP project to date, and to develop an effective plan for renourishment and other related work for the various project reaches.

1986. General Design Memorandum, Addendum III (September 1986). The purpose of this third addendum to the 1975 GDM was to examine the performance of the Federal project in the vicinity of 20th

to 38th streets (corresponding to R-Monuments R-58 through R-64) in Miami Beach, and to develop an effective plan for renourishment of this area.

1987. General Design Memorandum, Addendum IV (Nourishment of Beach Segment Between 96th Street to Haulover Inlet) (September 1987). The purpose of this fourth addendum to the 1975 GDM was to examine the performance of the Federal project along the community of Bal Harbour, and to develop an effective plan for renourishment of this area.

2001. Evaluation Report (October 2001). The purpose of this report was to evaluate project performance in the post-construction era, from completion of the last segment of the project in 1988 to the present time, and to examine methods of maintaining the Federal project in the most efficient manner possible. A secondary purpose of this report was to examine alternative sources of borrow material for the long-term maintenance of the Federal project.

2016. Limited Reevaluation Report (March 2016). The purpose of the Limited Reevaluation Report (LRR) was to evaluate potential sand sources for future renourishments throughout the remaining period of Federal participation in the Dade County, FL, BEC&HP) Project. The report also confirmed the economic justification and environmental acceptability of the project.

2016. Environmental Assessment, Identification of Alternative Sand Sources for the Remaining Period of Federal Participation (March 2016). The purpose of this EA was to review the environmental effects of utilizing sand source alternatives which have been determined to meet the requirements for future renourishments throughout the remaining period of Federal participation in the Dade County, BEC&HP. This environmental effects analysis goes along with the economic analysis in the 2016 Limited Reevaluation Report prepared by the USACE to recommend a sand source plan for the project.

2020. Environmental Assessment for Bal Harbour Reach Renourishment (August 2020). The purpose of this EA was to evaluate the use of the following additional sand sources for renourishment of Bal Harbour Beach: dredged material from the BHI Channel, BHI Flood Shoal, upland sand mine Garcia Family Farm, LLC in Hendry County (Garcia Mine), and upland sand mine Cemex Construction Material Florida, LLC in Polk County (Cemex Mine).

2021. Finding of No Significant Impact for Federally Authorized Civil Works Shore Protection, Storm Risk Management, Beach Erosion Control and Hurricane Protection Projects in Miami-Dade, Broward, Palm Beach, and Brevard Counties, Florida (April 2021.) The purpose of this Finding of No Significant Impact (FONSI) is to include Garcia Mine and Cemex Mine as viable sand sources for ongoing Federal beach nourishment shore protection, storm risk management, beach erosion control and hurricane protection projects in Miami-Dade, Broward, Palm Beach and Brevard counties in Florida.

1.7.2 Other Related Documents

2010. Miami-Dade County Beach Erosion Control Master Plan (2010). This document provides a comprehensive summary of past and planned beach erosion control activities for the segment of shoreline extending from Government Cut through Sunny Isles Beach.

2018. Key Biscayne Beach Management Feasibility Study (February 2018). The Village of Key Biscayne retained Moffatt & Nichol (M&N) and EAC Consulting, Inc. to provide this beach management feasibility study along with conceptual engineering designs of beach nourishment and submerged breakwaters for the beach along Key Biscayne.

2020. Strategic Beach Management Plan: Southeast Atlantic Coast Region, Office of Resilience and Coastal Protection, Florida Department of Environmental Protection (April 2020). This document provides an inventory of the beach restoration/nourishment project information and the strategies to address critically eroded beaches. Also included is an inventory of the region's coastal barrier inlets or passes and associated strategies.

2021. Bakers Haulover Inlet Management Plan, Office of Resilience and Coastal Protection, Florida Department of Environmental Protection (August 2021). This plan establishes strategies to best manage sand by-passing activities for placement of beach quality sand on adjacent eroding beaches of inlet or pass. The intent of the Inlet Management Plan (IMP) strategies is to replicate the natural drift of sand that is interrupted or altered by an inlet so that each level of government can take all reasonable efforts to maximize inlet sand by-passing that will be designed to balance the sediment budget of an inlet and to be consistent with Section 161.142, Florida Statutes.

Ongoing. Miami-Dade Back Bay Coastal Storm Risk Management Feasibility Study (Ongoing). This study examines the impacts of and potential responses to storm-surge damage in Miami-Dade County. The study area includes coastal and inland areas that are at risk from coastal-storm flooding and sea level rise (SLR). This study includes two focus areas along the back bay shoreline of the Main Segment barrier island where non-structural alternatives are being recommended. Additional information on this back bay study is available at https://www.saj.usace.army.mil/MiamiDadeBackBayCSRMFeasibilityStudy/.

Ongoing. South Atlantic Coastal Study (SACS) (Ongoing). The SACS' vision is to provide a common understanding of risk from coastal storms and SLR to support resilient communities and habitats. This collaborative effort will leverage stakeholders' actions to plan and implement cohesive coastal storm risk management strategies along the South Atlantic and Gulf Coast shorelines, including the territories of Puerto Rico and the U.S. Virgin Islands. This study is scheduled to be completed in August 2022. Additional information on the SACS is available at https://www.sad.usace.army.mil/SACS/.

1.8 Related Coastal Storm Risk Management and Navigation Projects

1.8.1 Coastal Storm Risk Management Projects

The Main Segment and Sunny Isles Segments of the Dade County, Florida, BEC&HP Federal project are described in Section 1.5.

Miami-Dade County has implemented several small beach nourishment events within the limits of the existing Federal BEC&HP project. These small nourishment events are listed in **Table 1-1**. In 2002 Miami-Dade County constructed a series of three breakwaters at an erosional hot spot in the vicinity of 32nd Street (R-59 to R-60) in Miami Beach.

Key Biscayne has periodically received beach nourishments since 1969 through both Federal and local efforts. Section 101 of the River and Harbor Act of 1962 (Public Law 87-874) authorized the Beach Erosion Control Project on Virginia and Biscayne Keys, Florida (House Document Number 561, 87th Congress, Second Session), federal participation in a beach nourishment project on portions of Virginia Key and Key

Biscayne. In 1969, a 50-foot-wide berm at 7 feet NGVD was restored along R-92.5 to R-96 and R-99 to R-101 on Key Biscayne. In 1985, a small beach erosion control project for Key Biscayne was approved under Section 103 of the River and Harbor Act 1962. The project was a Section 103 project through the Continuing Authorities Program (CAP) that provided for a one-time restoration along portions of Key Biscayne. The CAP project restored 2.4 miles (excluding R-111 to R-112.3) with 420,000 cubic yards (cy) of sand from an offshore borrow area located one mile southeast of Cape Florida. The CAP project restored a 25-foot-wide berm at Key Biscayne and a 20-foot-wide berm at Cape Florida State Park, both at elevation 7 feet-MLW, and provided seven years of advance nourishment. Local interests have maintained the beach along the developed stretch of shoreline on Key Biscayne between R-101 and R-108 with beach nourishment events in 2002 (121,00 cy), 2008 (2,400 cy), 2012 (37,500 cy), and 2017 (27,000cy).

Additional information on previous coastal projects in the vicinity of the focused study area can be found in the Engineering Appendix.

1.8.2 Navigation Projects

Bakers Haulover Inlet (BHI) is a man-made cut through the barrier island between the present-day locations of Bal Harbour and Haulover Beach Park. It was constructed by local interests in 1925. The Federal project provided for rebuilding the north jetty and constructing a revetment along the north bank of the inlet which was completed November 1963, and for constructing the south jetty and the revetment along the south bank of the inlet which was completed July 1974. The Federally-authorized channel has a depth of 11 feet MLW and is 200 feet wide through the ocean entrance, a depth of 8 feet MLW and is 100 feet wide from the entrance channel to the Intracoastal Waterway.

The ocean entrance channel to Miami Harbor passes through Government Cut, which is another man-made inlet located at the southern end of Miami Beach. Miami Harbor has been a Federal navigation project since 1902. The initial project provided for construction of several navigation channels across Biscayne Bay and up the Miami River, for the ocean entrance channel through Government Cut, and for the north jetty at Government Cut. The project was modified in 1907 to include construction of a south jetty at Government Cut. The jetties were extended in 1922 and again to their present lengths between 1926 and 1929. Currently the north jetty is about 3,000 feet long, and the south jetty is about 2,200 feet long. The jetties are about 700 feet apart and the ocean entrance channel which lies between them has a depth of 38 feet MLW. In 1983 the landward portion of the north jetty was sand-tightened in order to reduce the littoral transport of sediment through the jetty. A second sand-tightening project landward of the original project was completed in 1999.

The Intracoastal Waterway (IWW) channel runs through Biscayne Bay, to the west of the barrier islands in the study area, between BHI and Government Cut. Occasionally sand that is dredged from the IWW in the vicinity of Bakers Haulover inlet has been placed on the beach in Bal Harbour.

CHAPTER 2

PLAN FORMULATION

2 PLAN FORMULATION

Plan formulation is the process of developing alternative plans that meet the project-specific objectives while avoiding constraints. USACE uses a six-step planning process for all civil works projects, which are summarized below.

(1) *Specify Problems and Opportunities*. Specification of water and related land resources problems and opportunities (relevant to the planning setting) associated with the federal objective and specific state and local concerns. This is also known as the "scoping period."
(2) *Inventory and Forecast Conditions.* Inventory, forecast, and analysis of water and related land resource conditions within the planning area relevant to the identified problems and opportunities. This is an ongoing process that extends throughout the planning process.
(3) *Formulate Alternative Plans.*
(4) *Evaluate Alternative Plans.*
(5) *Comparison of Alternative Plans.*
(6) *Select Recommended Plan.* Selection of a recommended plan based upon the comparison of alternative plans.

Plan formulation was conducted with a focus on achieving the federal objective of water and related land resources project planning, which is to contribute to NED consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders, and other federal planning requirements. Plan formulation also considers all effects, beneficial or adverse, to each of the four evaluation accounts identified in the 1983 *Economic and Environmental Principles and Guidelines for Water and Related Land Resource Implementation Studies* (Principles and Guidelines) which are National Economic Development, Environmental Quality, Regional Economic Development, and Other Social Effects.

This chapter describes how the Tentatively Selected Plan (TSP) was formulated.

2.1 Problems and Opportunities

The first step in the planning process is specifying problems and opportunities. A problem is an existing undesirable condition to be changed. An opportunity is a chance to create a future condition that is desirable. The difference between problems and opportunities is often indistinct, but in both cases a changed future condition is preferred. The purpose of this feasibility study is to develop an implementable and acceptable plan to improve the future condition and address specific problems and opportunities in the study area. Problems and opportunities to be addressed were identified in several ways. The study team reviewed previous studies by USACE and other agencies and groups, as well as comments received from the sponsor and during the scoping meeting on November 15, 2018, to identify current coastal risk related problems affecting the study area.

2.1.1 Problems

Problems within the study area include:

- Storm damages due to erosion, inundation, and waves threaten structures and infrastructure
- Loss of natural habitat due to beach erosion
- Loss of recreational opportunities due to beach erosion
- Loss of national and regional income associated with tourism due to beach erosion

Erosion, wave attack, and inundation are all problems in the study area and are expected to be exacerbated by SLC. As erosion causes the loss of the protective beach and dunes, structures and infrastructure become more vulnerable to damages being caused by erosion, wave attack, and inundation. Persistent erosion in the absence of beach nourishment would also reduce the habitat available for shorebirds and sea turtles, and would threaten recreational opportunities. The study area experiences some natural beach recovery following storm events, but the long-term trend throughout most of the focused study area is erosional.

A Federal beach nourishment project for the purposes of beach erosion control and hurricane storm surge protection has existed in the Main Segment since 1975, protecting structures and infrastructure. When the existing Federal project reaches the end of its period of Federal participation, the project area is expected to remain in an erosive state where properties are susceptible to storm damages and individual property owners will likely seek to protect their property using erosion control measures such as seawalls on a property by property basis. These hard structures limit or eliminate the natural function where dunes feed sand to the eroded beach berms during storm events. Limiting this natural protective function makes infrastructure and the environment adjacent to protected properties more susceptible to storm damages.

2.1.2 Opportunities

Opportunities exist to:

- Reduce economic loss due to coastal storm damages
- Maintain coastal habitat, the character of coastal beach communities, and other cultural resources
- Maintain existing recreation opportunities (beach and nearshore)
- Support the local and national tourism industry through the maintenance of stable beaches and healthy coastal ecosystems
- Implement a regional approach to sediment management by utilizing material from nearby accretional areas as a sand source
- Increase community understanding of coastal resilience
- Maintain current life safety or reduce risk to life safety

There is an opportunity to reduce storm damage to structures and infrastructure by implementing measures which control development in the project area and/or by engineering features which protect infrastructure. These are "management measures" and will be discussed in detail later in this chapter. There is also the opportunity to maintain recreational opportunities that the current beach and dune systems provide in all reaches such as beach access, surfing, fishing, and wildlife viewing.

Coincident with some management measures like beach nourishment and dune creation are opportunities to protect and enhance habitat for sea turtles, etc., as well as protecting or enhancing the beach/dune interaction. In areas where infrastructure has prevented landward migration of coastal beaches and dunes, engineered beaches provide habitat for protected species such as sea turtles and shorebirds that utilize these habitats for nesting and foraging. Management measures requiring sand for construction provide an opportunity to implement a Regional Sediment Management (RSM) strategy where maintenance of inlets can be combined with a Federal CSRM project to realize significant cost savings to the Federal government and to the non-Federal project sponsors.

2.2 Objectives

2.2.1 Federal Objectives

The Federal objective as stated in the *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies*, established by the U.S. Water Resources Council on March 10, 1983 (P&G) is to contribute to NED consistent with protecting the Nation's environment, consistent with national environmental statutes, applicable executive orders, and other Federal planning requirements. Contributions to NED are increases in the net value of the national output of goods and services, expressed in monetary units. Contributions to NED are the direct net economic benefits that accrue in the study area and the rest of the nation.

As the Federal objective is to maximize net benefits to the nation, it does not seek to identify specific targets within objectives. Rather, the planning process includes the formulation of alternative plans to maximize benefits relative to costs. The Federal objective to maximize net benefits would supersede any project-specific target output.

2.2.2 Planning Objectives

The planning objectives are statements of the study purpose. Planning objectives are more specific than the Federal and non-Federal objectives, and they reflect the problems and opportunities in the study area. An objective is developed to address each of the identified problems and opportunities while being consistent with the study authority and the USACE mission of CSRM. Planning objectives represent desired positive changes. All of the objectives focus on activity within the focused study area. The planning objectives are:

1. Reduce coastal storm damage to structures and infrastructure within the study area for the 50-year planning horizon.
2. Maintain environmental quality for human and natural use within the study area through the 50-year planning horizon.
3. Maintain existing recreation (beach and nearshore) and tourism opportunities within the study area for economic benefit over the 50-year planning horizon.

The goal of the feasibility study is to develop a range of alternative plans that balance the objectives and avoid conflicts or, where necessary, demonstrate the trade-offs between conflicting objectives, enabling decisions to be made. While the project purpose is for CSRM, including other objectives such as maintaining environmental quality, recreation, and tourism allows for the consideration of these during plan formulation. However, the plan that is selected must maximize NED benefits based on storm damage reduction.

2.2.3 Campaign Plan of the U.S. Army Corps of Engineers

The USACE Campaign Plan goals and objectives are derived, in part, from the Commander's intent, the Army Campaign Plan, and the Office of Management and Budget. The four goals and their associated objectives also build on prior strategic planning efforts. Each goal and objective is led by a USACE senior leader who manages and oversees actions to reach the goal and objectives.

The successful achievement of the goals and objectives contained in the Campaign Plan are dependent on actions implemented by the entire USACE team. The implementing actions supporting each goal and objective are contained in the headquarters staff and Major Subordinate Command (MSC) implementation guidance for the Campaign Plan. The four goals of the FY18-22 USACE Campaign Plan are:

Goal 1 – Support National Security: Deliver innovative, resilient, and sustainable solutions to the Department of Defense (DoD) and the nation.

Goal 2 – Deliver Integrated Water Resource Solutions: Deliver enduring and essential water resource solutions using effective strategies.

Goal 3 – Reduce Disaster Risks: Deliver support that responds to, recovers from, and mitigates disaster impacts to the nation while ensuring sustainable operations.

Goal 4 – Prepare for Tomorrow: Build resilient People, Teams, Systems, and Processes to sustain a diverse culture of collaboration, innovation, and participation to shape and deliver strategic solutions.

These Campaign Plan goals and associated objectives will be addressed through the course of this feasibility study.

2.3 Constraints

A constraint is a restriction that limits the extent of the planning process; it is a statement of effects that alternative plans should avoid. Identifying constraints avoids undesirable changes between without and with-project future conditions.

2.3.1 Planning Constraints

The planning constraints for this study area are to avoid conflict with Federal laws and regulations, USACE regulations and policies, and executive orders. Specific planning constraints are

1. Avoid/minimize adverse effects to the coastal ecosystem (including sediment quality) for protected species.
2. Avoid/minimize adverse effects to water quality.
3. Avoid/minimize adverse effects to coastal cultural resources and historic properties.

2.3.2 Local Constraints

Local and state laws, such as Florida State Statutes, are not a constraint to NED plan formulation.

2.4 Environmental Operating Principles

The USACE Environmental Operating Principles (EOPs) were developed to ensure that USACE missions include totally integrated sustainable environmental practices. The EOPs provided corporate direction to ensure the workforce recognized USACE's role in, and responsibility for, sustainable use, stewardship, and restoration of natural resources across the Nation and through the international reach of its support missions.

Since the EOPs were introduced in 2002, they have instilled environmental stewardship across business practices from recycling and reduced energy use at USACE and customer facilities, to a fuller consideration of the environmental impacts of USACE actions and meaningful collaboration within the larger environmental community.

The USACE Environmental Operating Principles are:

1. Foster sustainability as a way of life throughout the organization.
2. Proactively consider environmental consequences of all USACE activities and act accordingly.
3. Create mutually supporting economic and environmentally sustainable solutions.
4. Continue to meet our corporate responsibility and accountability under the law for activities undertaken by USACE, which may impact human and natural environments.
5. Consider the environment in employing a risk management and systems approach throughout the life cycles of projects and programs.
6. Leverage scientific, economic, and social knowledge to understand the environmental context and effects of USACE actions in a collaborative manner.

7. Employ an open, transparent process that respects views of individuals and groups interested in USACE activities.

Sustainability can only be achieved by the combined efforts of Federal agencies, tribal, state, and local governments. These principles help USACE define its role in that endeavor.

2.5 P&G Accounts

Four accounts, making up the Federal objectives, are established in the P&G, to facilitate the evaluation of management measures and display the effects of alternative plans:

1. *National Economic Development (NED):* The national economic development account displays changes in the economic value of the national output of goods and services. The NED account describes the plan with the greatest net economic benefit consistent with protecting the nation's environment.

2. *Environmental Quality (EQ):* The EQ account displays non-monetary effects on ecological, cultural, and aesthetic resources including the positive and adverse effects of alternative plans. Resources under consideration are identified early in the planning process. The environmental impacts and benefits of each management measure, and of the alternatives developed, were fully considered during plan formulation. The existing conditions of the study area are described in Chapters 2 and 4. Environmental effects of the management measures evaluated during preliminary screening are briefly discussed in Section 2.7. Although a separate EQ analysis was not conducted as the EQ account did not drive the plan selection for this project, these effects were fully considered during plan formulation. All plans are formulated to avoid to the fullest extent practicable any adverse impact. Chapter 5 describes the environmental effects of the TSP. This report includes all required components of an EA pursuant to NEPA regulations.

3. *Regional Economic Development (RED):* The RED account displays changes in the distribution of regional economic activity (e.g., income and employment). The RED is not the primary account considered in plan selection; however, the results can be useful for the sponsor and local stakeholders. Discussion of the RED results can be found in the Economics Appendix.

4. *Other Social Effects (OSE):* The OSE account includes the plan's effects on social aspects such as community impacts, health and safety, displacement, energy conservation and others. The effects of management measures on this account are briefly discussed in Section 2.7. Risks to life safety are also evaluated under this account, especially as related to hurricanes and other significant storm events. Structural measures could minimally improve life safety risk as a result of protecting hurricane evacuation routes from ocean side impacts. However, this analysis assumes that the majority of the population evacuates damage prone areas in adequate time to effectively reduce life safety risk.

The Federal P&G require that the NED plan is selected for CSRM projects unless an exception is granted. The NED plan must also be evaluated in consideration of the P & G criteria of completeness, effectiveness, efficiency, and acceptability. Completeness is satisfied by ensuring that the alternatives include all activities to implement the plan. Effectiveness is determined by how the alternatives address the project problems. Efficiency is indicated by the cost effectiveness of a plan, which will be determined through the cost and benefit analysis. Acceptability is determined by evaluating the plan against applicable laws, regulations, and public policies. Each alternative plan is formulated in consideration of these four criteria.

2.6 Inventory & Forecast of Conditions

The second step of the planning process is to develop an inventory and forecast of resources and factors relevant to the problems and opportunities under consideration in the study area. This information is used to further define and characterize the problems and opportunities. A quantitative and qualitative description of this information is made, for both current and future conditions, and is used to define existing and FWOP conditions. Existing conditions are those at the time the study is conducted. The FWOP condition, or No-Action Alternative, is the most likely condition of the project area without construction of a Federal project. The evaluation covered a 50-year period of analysis from 2026 through 2075.The forecast of the FWOP condition reflects the conditions expected during the period of analysis without the implementation of a Federal Project. The FWOP condition provides the basis from which alternative plans are formulated and impacts are assessed. Since impact assessment is the basis for plan evaluation, comparison and selection, clear definition and full documentation of the FWOP conditions are essential.

2.6.1 Inventory of Existing Conditions

2.6.1.1 Physical Environment

This section describes the natural coastal forces and processes that make up the physical environment as it relates to the problems and opportunities under consideration in the study area. Additional details on the physical environment can be found in the Engineering Appendix.

Winds. Local winds are the primary means of generating the small-amplitude, short-period waves that are an important mechanism of sand transport along the Florida shoreline. Typical prevailing winds in the study area are from the east with the strongest winds typically. From November through March, frontal weather patterns driven by cold Arctic air masses can extend as far as South Florida. These events (referred to as “Nor’easters”) generate winds that are predominantly from the east or northeast quadrant. During late spring, summer, and early fall months (April through October) the predominant trade winds lead to winds of lesser strength coming from the east and southeast. Tropical storms and hurricanes can generate devastating winds in the study area.

Waves. Energy dissipation that occurs as waves enter the nearshore zone and break is the principal method of sediment transport. Wave height and period, in combination with tides and storm surge, are the most important factors influencing the behavior of the shoreline. The Miami-Dade County study area

is exposed to both short period wind-waves and to longer period open-ocean storm swells (Nor'easters and tropical storm events). The Bahamas islands and Bahama Banks limit some of the exposure of the area to long period waves from distant storms. However, due to the steepness of the continental shelf in the area, long-period waves that reach the area can hold significant height close to shore. Average wave heights range from 1.0 foot to 2.3 feet, indicating a generally mild wave climate year-round. Higher wave heights are more frequent in the fall and winter months (November through March) and tend to originate from the northeast. Spring, summer, and early fall waves (April through October) are smaller and originate predominantly from the east and southeast.

Tides. The gravitational pull of the moon and sun create astronomical tides which are predictable in magnitude and timing. Tidal datums for the Main Segment were obtained from NOAA tide stations 8723080 Haulover Pier which is just north of Bakers Haulover Inlet and 8723170 Miami Beach near the southern terminus of the Main Segment. For Key Biscayne, tidal datums were obtained from NOAA tide station 8723214 Virginia Key which is north of the Key Biscayne study area. **Table 2-1** summarizes the tidal datums. The tide range between Mean High Water and Mean Low Water is 2.47 feet at the north end of the Main Segment, 2.46 feet at the southern end of the Main Segment, and 2.03 feet near Key Biscayne.

Table 2-1. Tidal Datums

Tidal Datum	Elevation (feet) Relative to NAVD88		
	Station 8723080 (Haulover Pier)	Station 8723170 (Miami Beach)	Station 8723214 (Virginia Key)
Mean Higher High Water (MHHW)	0.43	0.33	0.23
Mean High Water (MHW)	0.36	0.25	0.15
North American Vertical Datum (NAVD88)	0.00	0.00	0.00
Mean Sea Level (MSL)	-0.86	-0.96	-0.89
Mean Low Water (MLW)	-2.11	-2.21	-1.88
Mean Lower Low Water (MLLW)	-2.25	-2.37	-2.02

Storm Effects. Tropical systems influence the shoreline of Miami-Dade County during the summer and early fall, and Nor'easters influence the shoreline during the late fall into the early spring. Nor'easter events are frequent throughout the winter, whereas tropical events are more sporadic. Although hurricanes typically generate larger waves and storm surge, winter storms may have a greater impact on the shoreline because of their longer duration and higher frequency. During intense storm activity, the shoreline is expected to naturally modify its beach profile. Storms erode and transport sediment from the beach into the active zone of storm waves. Once caught in the waves, this sediment is carried along the shore and redeposited farther down the beach or is carried offshore and stored temporarily in submerged sand bars. Periodic and unpredictable hurricanes and coastal storms, with their intense breaking waves and elevated water levels, can change the width and elevation of beaches and accelerate erosion. After storms pass, gentle waves usually return sediment from the sand bars to the beach, which

is restored gradually to its natural shape. While the beach profile typically recovers from storm energy as described, extreme storm events may cause sediment to leave the beach system entirely, sweeping it into inlets or far offshore into deep water where waves cannot return it to the beach. Therefore, a portion of shoreline recession due to intense storms may never fully recover.

Storm Surge. Storm surge is defined as the rise of the ocean surface above its astronomical tide level due to storm forces. Surges occur primarily because of atmospheric pressure gradients and surface stresses created by wind blowing over a water surface. Strong onshore winds pile up water near the shoreline, resulting in super-elevated water levels along the coastal region and inland waterways. In addition, the lower atmospheric pressure which accompanies storms also contributes to a rise in water surface elevation. Storm surge increases the potential for coastal flooding and allows larger storm waves to attack the shore.

Seal Level Change. Relative sea-level change (RSLC) was calculated using the USACE sea level change curve calculator which is available at: http://www.corpsclimate.us/ccaceslcurves.cfm. Relative sea level (RSL) refers to local elevation of the sea with respect to land, including the lowering or rising of land through geologic processes such as subsidence and glacial rebound. It is anticipated that sea level will rise within the next 100 years. To incorporate the direct and indirect physical effects of projected future sea-level change on design, construction, operation, and maintenance of coastal projects, USACE has provided guidance in ER 1100-2-8162, *Incorporating Seal Level Change in Civil Works Programs*, dated June 15, 2019 and Engineer Pamphlet (EP) 1100-2-1, *Procedures to Evaluate Sea Level Change: Impacts, Responses, and Adaptation*, dated June 30, 2019. Three estimates are required by the guidance, a Low (Baseline) estimate representing the minimum expected sea level change, an Intermediate estimate, and a High estimate representing the maximum expected sea level change. The observed sea level trends at the Vaca Key NOAA tide gage were used as the basis for calculating the three SLC curves used in this study. **Figure 2-1** shows RSLC from 1992 through 2100 for all three USACE curves. **Figure 2-2** shows the USACE SLC Curves along with the NOAA high curve and the 19 year and 5 year moving average of MSL at Vaca Key. **Figure 2-3** shows the results of the SACS Coastal Flood Hazards Analysis with present day sea levels and with 3 feet of sea level rise. It can be seen that the focused study area is already vulnerable to coastal flooding hazards during storms and will only become more vulnerable as sea levels continue to rise.

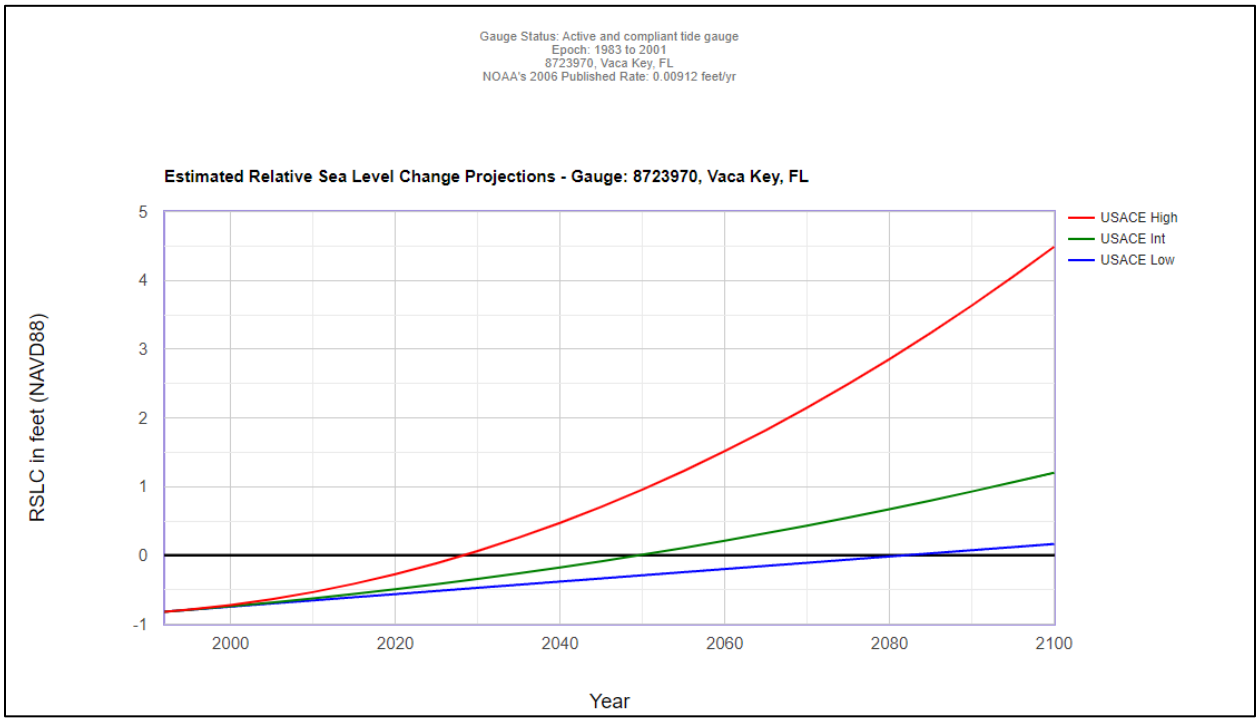


Figure 2-1. USACE SLC Curves.

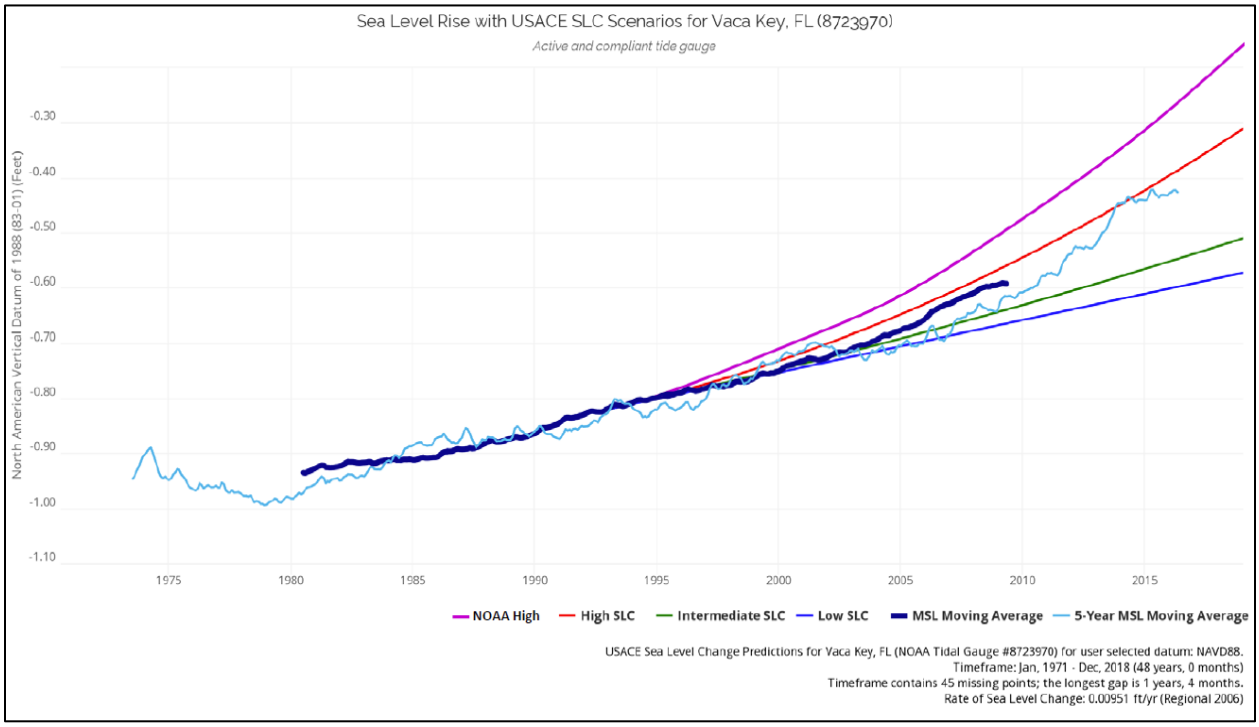


Figure 2-2. USACE SLC Curves along with the NOAA high curve and the 19 year and 5 year moving average of MSL at Vaca Key.

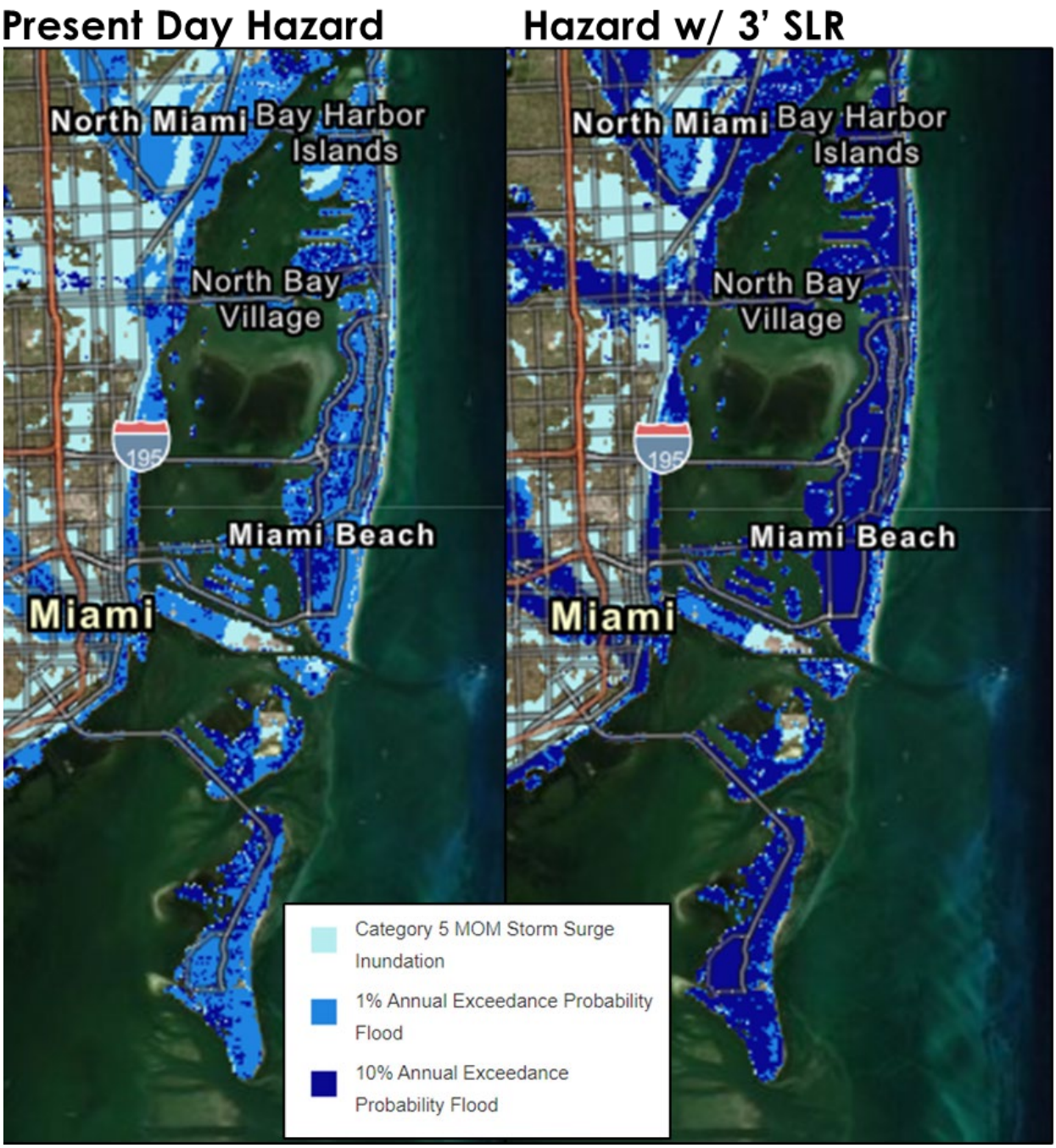


Figure 2-3. Coastal Flood Vulnerability from the SACS Coastal Flood Hazards Analysis.

2.6.1.2 Built Environment

This section describes the structures and infrastructure that make up the built environment as it relates to the problems and opportunities under consideration in the study area. Additional details on the built environment can be found in the Economics Appendix.

The structure inventory evaluated in the Main Segment extends from the Atlantic Ocean shoreline landward to Collins Avenue. In the Key Biscayne Segment the structure inventory extends from the Atlantic Ocean shoreline landward to Crandon Boulevard. The structure inventory includes high-rise buildings, single family residences, roads, parking lots, pools, decks, tennis courts, cabanas, and gazebos. There are over 1,200 damage elements in the focused study area that have an estimated depreciated replacement value of over $20 billion.

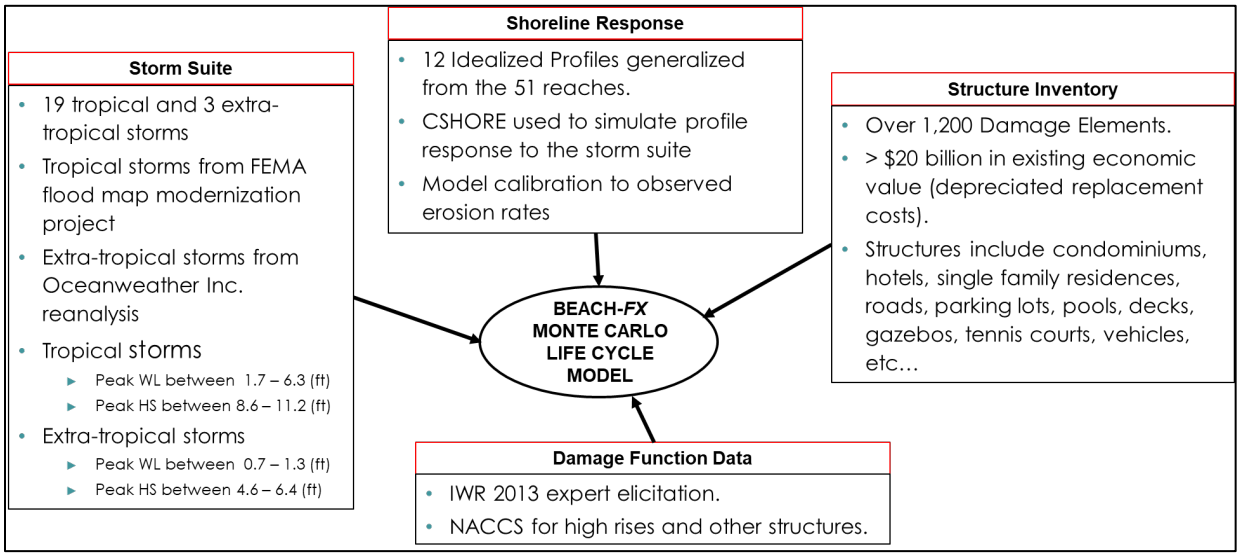
There is not any critical Infrastructure located along the oceanfront shoreline in the focused study area. Critical buildings such as police and fire stations located on the barrier islands in the focused study area are located back from the ocean front and generally are more vulnerable to back bay flooding which was not analyzed as part of this study.

2.6.1.3 Natural Environment

The natural resources in the study area, including species of concern and their habitat, are described in detail in **Chapter 4**.

2.6.2 Forecast of FWOP Conditions

Beach-fx is an engineering-economic life-cycle planning model that provides an analytical framework for evaluating the physical performance and economic benefits and costs of shore CSRM projects, particularly beach nourishment along sandy shorelines. **Figure 2-4** provides and overview of the key inputs used for Beach-fx modeling. Additional details on the application of Beach-fx for this study and FWOP model results can be found in the Engineering Appendix and Economic Appendix.



Note: FEMA = Federal Emergency Management Agency, WL = Water Level, HS = Significant Wave Height, CSHORE = Cross-Shore Numerical Model , IWR = Institute for Water Resources, NACCS = North Atlantic Comprehensive Coastal Study

Figure 2-4. Beach-fx Model Inputs

Beach-fx was used to model FWOP erosion, wave attack, and flood damages associated with coastal storms in the focus study area. For plan formulation the USACE high SLC curve was used as the study area is vulnerable to sea level change. The final plan will also be evaluated against the intermediate and low USACE SLC curves. The back bay flooding flag in Beach-fx was turned on for all model runs in both the Main Segment and Key Biscayne Segment in order to help assess the potential for back bay flooding impacts to the structure inventory in the focused study area. The beach-fx model simulations for evaluating and comparing alternatives used a start year of 2025 in order to ensure a consistent evaluation between alternatives with and without erosion control structures. Shoreline erosion between 2021 and 2025 was simulated using Beach-fx and the average 2025 profiles were used with a 2025 start year for the FWOP modeling. The 2021 starting shoreline position had dune dimensions based on the 2018 beach monitoring survey and berm widths based on the estimated equilibrated supplemental post-nourishment berm widths expected to be present in 2021. The performance of alternatives was evaluated over the 50-year period from 2026-2075.

Actions that would be taken by local interests in the absence of a Federal project are important considerations for modeling and forecasting the FWOP conditions.

For the Main Segment it was assumed that local interests would not be able to continue with any large-scale beach nourishment projects similar to the existing Federal beach nourishment project, and that when erosion eventually encroached on the ECL, private property owners would construct seawalls to protect their property from further erosion. This assumption is based on discussions with Miami-Dade County indicating that they do not anticipate being able to conduct large-scale beach nourishments after Federal participation in the existing project expires. Also, in other erosional parts of southeast Florida,

where a Federal beach nourishment projects do not exist, private property owners have resorted to armoring with individual seawalls to protect their property. This situation is similar to what existed in the Main Segment prior to the existing Federal beach nourishment project.

In the Key Biscayne Segment it was assumed that small scale beach nourishment would continue to occur on an emergency basis, similar to what has been done in this area in recent years. This assumption is based on discussions with the Village of Key Biscayne and supported by the recent history of small emergency nourishment events in the Key Biscayne Segment.

In the Main Segment there is a correlation between shoreline erosion and FWOP damages. The Main Segment shoreline currently has a healthy dune and berm that is at least 100 feet wide with an average dune crest elevation between 10-11 feet NAVD 88 because of the current Federal project. Without continued beach nourishment the existing shoreline will erode landward, and the subsequent result of that erosion will likely be private property owners constructing armoring and increased vulnerability of upland structures and infrastructure to direct erosion, wave attack, and flooding. The total average present value of FWOP damages and costs in the Main Segment from 2026 through 2075 are estimated at $130M.

In the Key Biscayne Segment, most of the FWOP damages are associated with flooding. The shoreline erosion rates in Key Biscayne are not as high as in the Main Segment, however the existing dune and beach berm is much narrower and lower. The upland area in Key Biscayne is also very low and flat making the structures and infrastructure, especially single-family homes constructed with slab on grade foundations, vulnerable to flooding from both the Atlantic Ocean and the back bay sides of the island. The total present value FWOP damages and costs from 2026 through 2075 in the Key Biscayne Segment are estimated at $527M.

The existing physical conditions in the study area and FWOP Beach-fx model results were used to inform management measures that were considered and development of alternatives.

2.7 Alternative Development

The third, fourth, and fifth steps of the planning process, involving the formulation, evaluation, and comparison of alternatives, are described in this section.

An alternative plan is a set of one or more management measures functioning to address one or more objectives. Sometimes a plan consists of only one measure, but more often it is a combination of measures. Different alternative plans can consist of different measures, or they can combine the same measures in different ways, such as different dimensions, quantities, materials, locations or implementation time frames. As the study evolves, favorable alternative plans are reformulated to devise the most efficient, effective, complete, and acceptable plan.

2.7.1 Management Measures

Following study scoping, identification of problems and opportunities, and inventory and forecasting, management measures were identified.

Management measures are specific structural or nonstructural actions that would take place at geographical locations within the project areas. There are three general categories of nonstructural measures: 1) land management; 2) acquisition and relocation; and 3) building retrofits (elevating and flood-proofing). Structural measures are those that change the movement of the water with relation to buildings and infrastructure, and can be both soft structural measures (e.g., beach fill) or hard structural measures (e.g., seawalls). Management measures were selected to accomplish at least one planning objective. Several of the structural measures are also considered to be Natural and Nature-Based Features (NNBF) in compliance with Section 1184 of the WRDA of 2016. All possible measures are considered, including those beyond USACE's authority to implement.

For this study the following list of management measures were considered. Nonstructural measures are indicated with "NS", structural measures are indicated with "S", and structural measures that are also considered to be a NNBF are indicated with "S/NNBF".

NS-1: Coastal Construction Control Line. A coastal construction control line (CCCL) that does not prohibit construction, but does provide stringent structural restrictions, has already been established by the State of Florida for the Miami-Dade County study area. This management measure provides for potential changes to the CCCL or building regulations that could be implemented by the State of Florida. Such changes could include moving the CCCL landward, increasing the setback for construction, or increasing the standards for construction to reduce storm damages.

NS-2: Moratorium on Construction. This management measure would not permit new construction in the area vulnerable to storm damages within the study area. As properties are damaged, reconstruction would not be permitted.

NS-3: Establish a No-Growth Program. This management measure would allow for existing structures and limited reconstruction following storm damage, but would not allow for an increased number of structures within the area vulnerable to storm damages.

NS-4: Relocation or Elevation of Structures. Relocation involves identifying structures vulnerable to storm damage in the study area, and where feasible, such structures would be moved further landward on their parcels to escape damage. Asset elevation involves raising the assets in place so that the structure sees a reduction in frequency and/or depth of flooding during high-water events. Elevation can be done on fill, foundation walls, piers, piles, posts, or columns. Selection of proper elevation method depends on flood characteristics such as flood depth or velocity.

NS-5: Flood Proofing of Structures. Dry Flood Proofing involves sealing building walls with waterproofing compounds, impermeable sheeting, or other materials to prevent the entry of floodwaters into

damageable structures. Dry flood proofing is applicable in areas of shallow, low velocity flooding. Wet flood proofing measures allows floodwater to enter the structure, vulnerable items such as utilities appliances and furnaces are waterproofed or elevated to higher locations. Allowing floodwater to enter the structure equalizes the hydrostatic forces inside and outside of the structure, reducing the risk of structural damage.

NS-6: Buyout and Land Acquisition. Buyout/land Acquisition involves purchase and elimination of flood damageable structures, allowing for inhabitants to relocate to areas away from flood hazards. This measure is the most dependable method of protection and provides the benefit of use of the evacuated floodplain. These structures would be demolished, and natural areas would be restored. Such parcels would become public property and would reduce the number of structures vulnerable to storm damages.

S-1: Seawalls. Seawalls would be constructed at the landward edge of the existing dune line. Old buried seawalls may be demolished in favor of a new seawall to provide a seamless wall over the entire study area or sub-reaches. This measure would stabilize the shoreline at the location of the wall, allowing erosion to continue until the seawall meets the water line. A concrete or steel sheet pile wall would be used due to its stability in the salt environment and ability to withstand wave action. Construction would entail excavation into the existing dune. The seawall must be of sufficient depth underground to withstand projected scour by erosion and wave action and may require rock toe protection.

S-2: Revetments. This measure would involve placement of large rock designed to withstand the wave environment along the existing dune line. The engineered structure would start at the elevation of the dune crest, to tie into existing elevations, and include a sloped profile. The structure would be imbedded under the beach elevation to a depth below expected scour and future erosion. In-place materials from the excavation would be used for backfill behind the structure. Along the shoreline, the revetment should be continuous to avoid erosional features at gaps and should include tie back features at the ends.

S-3: Sand-Covered Soft Structure. This management measure includes construction of a dune composed of geotextile sand-filled forms (typically tubes or bags) covered with sand. This forms a sand dune with a structured core. Sand depth over the geotextile core would be maintained to an adequate depth to allow the dune to function as habitat and not inhibit sea turtle nesting.

S-4: Reinforced Dune. This management measure includes construction of a buried wall within the footprint of a dune. The dune and beach covering the wall would be maintained to an adequate level to avoid the negative impacts associated with having an exposed seawall. The reinforcing wall would create a last line of defense against storm impacts.

S/NNBF-5: Beach Nourishment. This management measure includes initial construction of a beach fill and future nourishments at regular intervals. Beach-compatible sediments would be placed on the beach and graded to match the engineered profile. Dunes are an important component of a healthy beach system to help the beach remain stable and accommodate stress from unpredictable storms and extreme conditions of wind, wave, and elevated sea surfaces. During storms, dunes maintain a sand repository

that provides sacrificial sand before structures would be damaged. Where appropriate, dunes would be incorporated into the beach nourishment template. It would be standard practice to vegetate dune features when they are incorporated into beach nourishment.

S/NNBF-6: Nearshore Berm Placement. Dredged sand would be placed in the nearshore to provide wave attenuation benefits, passive nourishment of the active profile, or a combination of both. This management measure assumes that a portion of the sand placed in shallow water will move towards the beach under normal wave conditions. Over time following construction, the sand bar could migrate towards the beach through natural sediment transport processes, become transported onto the beach, and shaped into the natural equilibrium profile of the beach, thus enlarging the beach.

S/NNBF-7: Dune Vegetation. Proper vegetation on dunes increases sand erosion resistance by binding the sand together via extensive root masses penetrating deep into the sand. Further, such vegetation promotes dune growth through its sand trapping action when significant wind action transports substantial quantities of sand.

S-8: Groins. A series of groins in high erosion areas could help hold sand in front of existing development, preventing further losses of land, and reduce periodic nourishment requirements. Groins would be constructed of large size rock, designed to interlock together and with a foundation to avoid subsidence. The groins would be placed perpendicular to the shoreline and would extend from above the mean high water line (MHWL) out into shallow water. The length, orientation, and head of the structure would be designed based on wave conditions, storms and sediment transport.

S/NNBF-9: Submerged Artificial Reefs. Submerged, artificial multi-purpose reefs are designed to prevent shoreline erosion through wave energy dissipation, similar to how a breakwater functions, in a way that could enhance wave breaking for surfing and/or provides additional nearshore habitat. These submerged reefs would be located in the nearshore area outside of the footprint of typical beach fill and would typically be constructed using pre-fabricated concrete units placed on top of an engineered mat to prevent settlement.

S-10: Breakwaters. The construction of offshore breakwaters is considered as a management measure to stabilize the existing beach. Such structures reduce the amount of wave energy reaching the shoreline behind them. As a result, the rate of annual erosion could decrease. The breakwaters would be constructed of large size rock with foundation materials to prevent subsidence. The breakwaters would be trapezoidal in profile and would be placed parallel to the shoreline in shallow water. The breakwaters would be constructed in segments separated from each other to prevent infilling between the existing beach and the breakwaters. The elevation and length of each breakwater segment and the distance between segments would be designed using the wave and sediment transport characteristics of the reach.

The four P&G accounts (NED, EQ, RED, OSE) were used as criteria for evaluating the initial list of management measures. The measures were also evaluated on their ability to meet the study objectives while avoiding constraints. This evaluation resulted in the following measures being screened at this point

in the study. These measures could be re-considered later in the study process if it is warranted by new information.

- *Seawalls* could provide storm damage reduction but would have negative impacts on the EQ, OSE, and RED accounts unless a beach/dune is maintained in conjunction with the measure which would likely make this measure cost prohibitive.
- *Revetments* could provide storm damage reduction but would have negative impacts on the EQ, OSE, and RED accounts unless a beach/dune is maintained in conjunction with the measure which would likely make this measure cost prohibitive.
- *Sand Covered Soft Structures*, such as geo-tubes, could provide storm damage reduction, but would have negative impacts on the EQ, OSE, and RED accounts unless a beach/dune is maintained in conjunction with the measure which would likely make this measure cost prohibitive.
- *Nearshore Berm Placement* could possibly reduce damages; however, it is not likely to work as well as direct beach placement as there is a possibility that the sand may never migrate onto the beach. There could be negative impacts under the EQ account for this measure associated with potential impacts to nearshore resources in the area.
- *Coastal Construction Control Line* changes would likely be ineffective at meeting objectives because the study area is essentially fully developed other than park areas which are not expected to be developed in the future. This measure could achieve NED benefits, but benefits would not be realized under the EQ, OSE, or RED accounts.
- *Moratorium On Construction* would likely be ineffective at meeting objectives because the study area is essentially fully developed other than park areas which are not expected to be developed in the future. This measure would not be likely to achieve benefits under any of the four P&G accounts.
- *No-Growth Programs* would likely be ineffective at meeting objectives because the study area is essentially fully developed other than park areas which are not expected to be developed in the future. This measure would not be likely to achieve benefits under any of the four P&G accounts.
- *Relocation or Elevation of Structures* would likely be ineffective at meeting objectives because existing development in the area is so dense that there is no room to relocate structures and most of the existing structures are large high rise type structures that would be cost prohibitive to relocate or elevate. This measure could achieve NED benefits, but benefits would not be realized under the EQ, OSE, or RED accounts.
- *Flood Proofing of Structures* would likely be ineffective at meeting objectives because most of the existing structures are large high-rise type structures that would be cost prohibitive to flood proof. This measure would also not address the problems of erosion and wave attack. This measure could achieve NED benefits, but benefits would not be realized under the EQ, OSE, or RED accounts.
- *Buy-out and Relocation* would likely be ineffective at meeting objectives because most of the existing structures are multi-family structures with a high volume of people living in them which would make this alternative cost prohibitive.

The measures that would best address the problems in the study area, the four P&G accounts, and study objectives were grouped based on how they function. Beach nourishment, erosion control structures, and reinforced dune as described below were carried forward.

- Beach nourishment has been successfully implemented in the Main Segment of the study area to meet the study objectives over the past 45 years. Dunes with vegetation will be part of the beach nourishment measure moving forward as dunes are an integral feature of beach systems.
- Groins, submerged artificial reefs, and breakwaters are all types of erosion control structures that may be implemented in certain erosional areas in either as stand-alone feature or in conjunction with beach nourishment.
- A reinforced dune is considered for the Key Biscayne Segment where a Seawall would be buried within the dune portion of a beach nourishment template to maximize storm damage reduction while minimizing the project footprint to minimize or avoid impacts to nearshore seagrass in this area.

The measures carried forward were developed into the following focused array of alternatives.

- No Action
- Beach Nourishment
- Erosion Control Structures
- Beach Nourishment with Erosion Control Structures
- Reinforced Dune with Beach Nourishment (Key Biscayne Segment Only)

2.7.2 Screening Level Costs

Screening level costs were developed for all of the potential features and options that would potentially be implemented as part of the focused array of alternatives. For beach nourishment, costs were developed for various sand sources and construction options. For erosion control structures, costs were developed for various types of structures and materials that could be used. The screening level costs for all of these features and options are summarized in **Table 2-1**.

Table 2-2. Screening Level Costs for Alternative Feature Options

Feature Description	Unit of Measure	Unit Cost ($/Unit)	Mob/Demob Cost ($)
MS Beach Fill, Truck Haul from Upland Mine	cy	$82	$-
MS Beach Fill, Truck Haul from Stockpile @ Haulover Park (2 miles)	cy	$42	$600,000
MS Beach Fill, Truck Haul from Stockpile @ South Beach (5 miles)	cy	$47	$600,000
MS Beach Fill, Dredging by Cutter Suction @ BHI Complex (2 miles)	cy	$23	$5,087,958
MS Beach Fill, Dredging by Cutter Suction @ South Beach (5 miles)	cy	$19	$7,475,000
MS Beach Fill, Dredging by Hopper (105 miles)	cy	$79	$5,792,475
MS Beach Fill, Dredging by Hopper @ New Offshore Areas (Sand Study)	cy	$31	$6,540,625
KB Beach Fill, Truck Haul from Upland Mine	cy	$82	$-
KB Beach Fill, Truck Haul from Stockpile @ South Beach	cy	$50	$600,000
KB Beach Fill, Dredging by Cutter Section (Small), South of KB (2.5 miles)	cy	$18	$3,847,900

KB Beach Fill, Dredging by Hopper @ New Offshore Areas (Sand Study)	cy	$30	$4,025,000
Breakwater - Submerged (Granite)	lf	$8,296	$1,798,703
Breakwater - Emergent (Granite)	lf	$12,919	$1,798,703
Breakwater - Submerged (Reef Balls)	lf	$2,181	$857,500
Breakwater - Emerged (Core-Loc)	lf	$25,218	$2,632,000
Groins (Granite)	lf	$8,428	$1,050,000
Jetty Extension	lf	$29,011	$2,632,000
Fixed Sand Transfer Plant		$8,079,925	$-
Additional $500,000 Annual Operating Costs, $1,056,000 for pipeline replacement every 1mcy, $1,000,000 OMRRR Costs every 5-years			
> 24" Cutter Suction Dredge		$18,000,000	$1,000,000
Additional $19/cy Operating Cost, $2,640,000 for pipeline replacement every 1mcy, $500,000 Annual OMRRR Costs			
Steel Sheet Pile Seawall w/ Concrete Cover	lf	$3,139	$719,909

Note: MS = Main Segment, KB = Key Biscayne, BHI = Bakers Haulover Inlet cy = cubic yards, lf = linear feet
Note: All costs in this table include contingency, Preconstruction Engineering and Design (PED), and Construction Management (S&A) costs.

2.7.3 Alternative Feature Options

In order to streamline alternative development, several analyses were conducted and assumptions were made based on engineering judgement and input from the local sponsor and stakeholders to prioritize the various options that could be used for implementing the features making up the focused array of alternatives. The considerations described in this section would support the forward progress of plan formulation with a refined scope of alternatives to be covered in more detail.

2.7.3.1 Sand By-Passing from the Bakers Haulover Inlet (BHI) Complex

Options for by-passing sand from the BHI Complex sand source include:

- Contract dredging (status quo for the existing Federal beach nourishment Project)
- Truck hauling sand from Haulover Park with an extension of the BHI North Jetty
- Fixed sand by-pass plant with an extension of the BHI North Jetty
- Project specific dredge

The costs to implement these options were evaluated and compared over 50-year life-cycle scenarios assuming alternatives requiring 35,000 cy/yr (roughly the annual volume that has historically been used from the BHI complex for the existing beach nourishment project) and 70,000 cy/yr (to represent the potential needs for future beach nourishment project). For the 35,000 cy/yr scenario all sand could come from the BHI complex, and in the 70,000 cy/yr scenario sand from the BHI complex would be supplemented with sand from an offshore source. In order for the truck haul and fixed plant options to be able to by-pass 35,000 cy/yr the BHI North Jetty would need to be extended. The length of jetty extension needed was based on the Bakers Haulover Inlet Feasibility Study conducted by Moffat and Nichol in 2019 to support the updated FDEP IMP. A six-year nourishment interval was assumed for all options except for the fixed sand by-pass plant which would operate on a continuous basis. The estimated

50-year costs for these options shown in **Table 2-2** are based on the screening level costs described in **Section 2.7.2**.

Table 2-3. Cost Comparison for Bakers Haulover Inlet Sand By-Passing Options

Estimated BHI Bypass Option Life Cycle Costs	210,000 cy @ 6yr (35 kcy/yr) Project	420,000 cy @ 6yr (70 kcy/yr) Project
Contract Dredging (Status Quo)	$ 50,765,476	$ 117,568,061
Haulover Park Truck Haul + North Jetty Extension	$ 58,098,052	$ 127,891,312
Bypass Plant + North Jetty Extension	$ 44,931,067	$ 114,724,327
Project Dredge	$ 58,252,099	$ 125,054,684

The by-passing option with the fixed plant is slightly less expensive than the contract dredging option based on this analysis. However, there were concerns expressed by the local sponsor and stakeholders that the option for a fixed sand by-pass plant may not be acceptable due to the structure and equipment needed for continuous operation having negative impacts on aesthetics and recreation for oceanfront residents and visitors as well as concerns associated with the non-Federal operations and maintenance requirements associated with this type of feature. There is also uncertainty and risks associated with the extension of the BHI North Jetty and potential impacts to the physical coastal processes and environmental resources in the vicinity of the inlet. Similar concerns would also apply to the Haulover Beach Park Truck Haul and Project dredge options. Therefore, the team decided to move forward with plan formulation assuming that contract dredging would be used for by-passing sand from the BHI Complex sand source.

2.7.3.2 Sand Back-Passing from South Beach

Options for back-passing sand from the accretional areas of South Beach include, but is not limited to, truck hauling sand from mechanically dredged stockpiles on the beach, mechanically dredging then loading in a hopper and pumping, or hydraulically dredging sand from the submerged portion of the beach slope and nearshore area to the placement site with a cutter suction dredge. The area and volumes being considered for back-passing are much larger than the areas and volumes associated with the back-passing events that were conducted in 1996, 2002, 2007, and 2012. Recent surveys of the South Beach area indicated that significantly more volume could be hydraulically dredged from the submerged portion of the beach profile and nearshore areas than could be mechanically dredged from the dry beach without having a significant impact on beach recreation and nearby environmental resources[1]. Therefore, the team decided to move forward with plan formulation assuming that a cutter suction dredge would be used for back-passing sand from the South Beach sand source. It was conservatively estimated that approximately 900,000 cy of sand could be back-passed in addition to the 50,000 cy/yr estimated to be accreting annually without having a significant impact on the existing beach in this area. It was estimated

[1] Additional information on existing conditions and potential effects to the human environment are discussed in detail in Chapters 4 and 5 of this report.

that with this volume of back-passing a 200 foot beach berm seaward of the existing vegetation line would remain in place in this area.

2.7.3.3 Sand Source Options

The sand source options considered for the Main Segment include upland sand mines, by-passing from the BHI Complex, back-passing from South Beach, newly identified offshore borrow areas, and Treasure Coast offshore borrow areas. **Table 2-3** includes the costs for using these sand sources and the estimated quantities available. **Figure 2-2** shows a comparison of sand source costs by event volume from 200,000 cy to 1,600,000 cy. The information presented in **Table 2-3** was used as the basis for selecting the sand sources that could most cost effectively meet the volume needs of the beach nourishment alternatives that would be modeled in Beach-fx. The BHI Complex and South Beach sand sources are the most cost efficient sand sources followed by the newly identified offshore sand sources. The upland and Treasure Coast sand sources are the most expensive, with the upland truck haul sand being slightly less expensive than the Treasure Coast offshore sand. The Treasure Coast Offshore borrow areas were not considered further in the plan formulation process, and upland mines could supply unlimited volume at a lower cost with much less risk and uncertainty.

Table 2-4. Main Segment Sand Source Volumes and Costs

Sand Source Volume Availability & Costs	BHI Complex (Cutter Suction)	South Beach (Cutter Suction)	Upland Mines (Truck Haul)	Treasure Coast Ofshore (Hopper)	New Offshore (Hopper)
Annual Shoaling (cy/yr)	36,800	50,000	-	-	-
Additional Usable Volume (cy)	-	900,000	-	-	-
Total 50 yr Volume (cy)	1,840,000	3,400,000	unlimited	5,200,000	6,600,000
Max Event Volume	336,000	900,000	unlimited	5,200,000	6,600,000
Unit Cost	$23	$19	$82	$79	$31
Mob Cost	$5,087,598	$7,475,000	$-	$5,792,475	$6,540,625

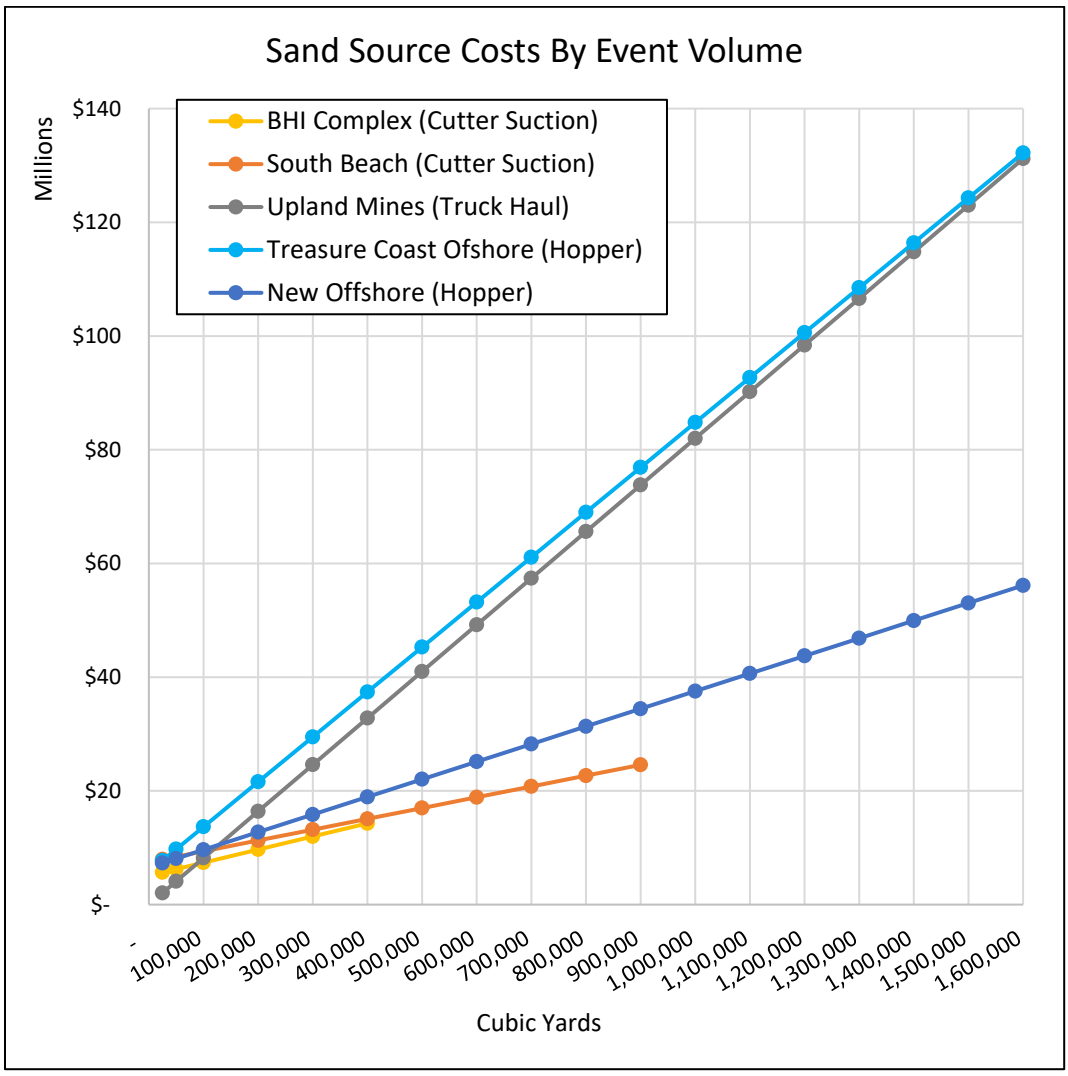


Figure 2-5. Main Segment Sand Source Costs By Event Volume

The sand source options for Key Biscayne include upland sand mines, truck haul from South Beach, newly identified offshore borrow areas, and a nearshore sand source located approximately 2.5 miles south of the focused study area in Key Biscayne which had been used for a local beach nourishment in 2002. **Table 2-4** includes the costs for using these sand sources and the estimated quantities available. **Figure 2-3** shows a comparison of sand source costs by event volume from 25,000 cy to 400,000 cy. Despite the upland truck haul sand source being the most expensive for events requiring more than 50,000 cy, the decision was made to assume that all beach nourishment alternatives in the Key Biscayne Segment would use upland sand sources. This assumption was made due to the uncertainty with seagrass impacts associated with using the nearshore or offshore sand sources, and the potential for all available sand from the South Beach sand source needing to be used in the Main Segment.

Table 2-5. Key Biscayne Segment Sand Source Volumes and Costs

Sand Source Volume Availability & Costs	South Key Biscayne (Small Cutter Suction)	New Offshore (Hopper)	Upland Mines (Truck Haul)	South Beah (Truck Haul)
Annual Shoaling (cy/yr)	unknown	-	-	50,000
Additional Usable Volume (cy)	unknown	-	-	900,000
Total 50 yr Volume (cy)	unknown	6,600,000	unlimited	3,400,000
Max Event Volume	300,000	6,600,000	unlimited	900,000
Unit Cost	$18	$30	$82	$50
Mob Cost	$3,847,900	$4,025,000	$-	$600,000

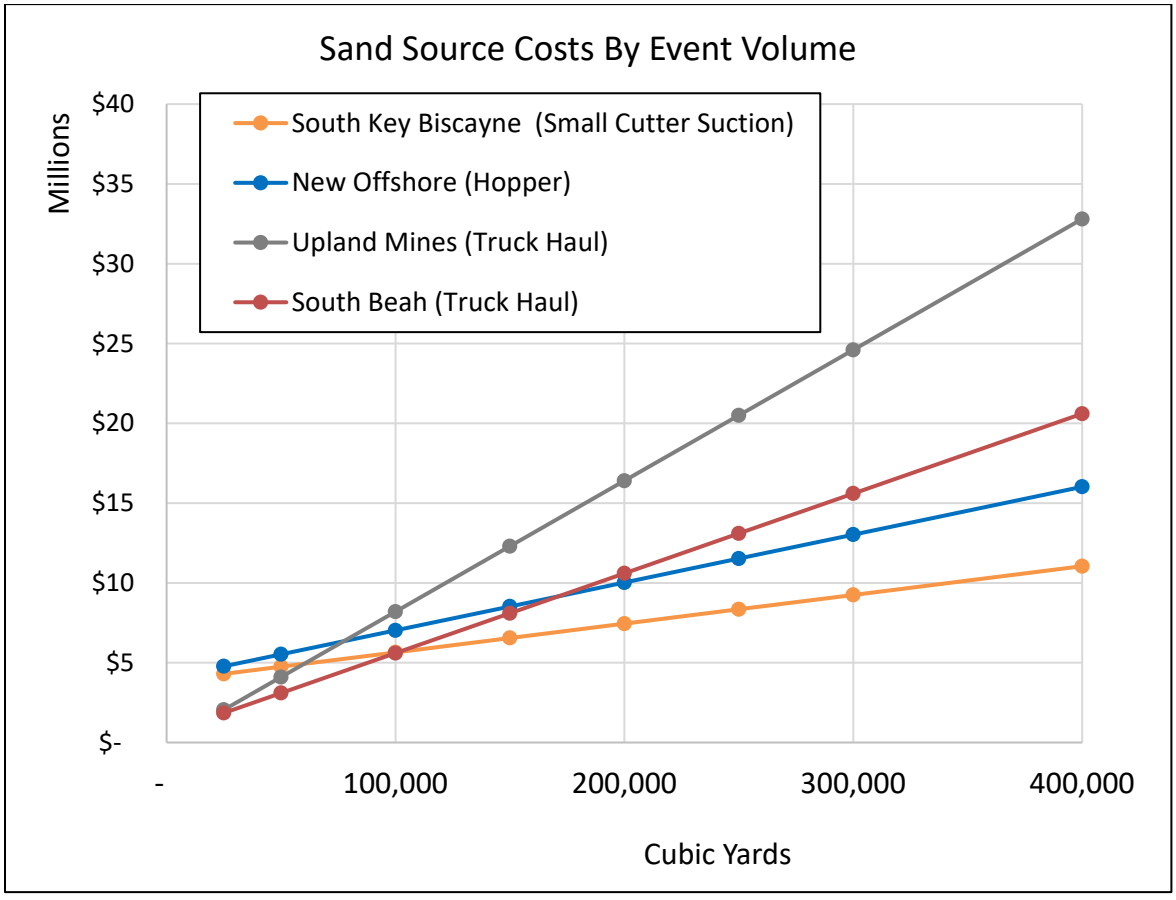


Figure 2-6. Key Biscayne Segment Sand Source Costs By Event Volume

2.7.3.4 Erosion Control Structures

Erosion control structures to be used in the focused study area could be implemented in a variety of configurations using a variety of materials. For plan formulation purposes, engineering judgment regarding structure performance, along with considerations for costs, downdrift impacts, and potential environmental impacts was used to assume the most appropriate type of erosion control structures to be used in certain locations throughout the focused study area.

At the erosional hot spot in Bal Harbour, between R- 28 and R-31.5, a series of groins similar to a design that was analyzed by the Jacksonville District in a 2003 Draft Design Memorandum was considered.

At the erosional hot spot in the vicinity of R-46 in Miami Beach a series of reef balls similar to a design that was developed by the Jacksonville District under an innovative technology program authorized by Section 227 of WRDA 1996 and section 2038 of WRDA 2007. A permit for this design was issued by the FDEP to SAJ in 2012 (Permit Number: 02 19 199-002- JC), however the project has never been constructed due to a lack of funding for Section 227 and 2038 projects.

At the erosional hot spots in the vicinity of R-50 and R-55 in Miami Beach a series of submerged granite rubble mound breakwaters similar to the design of the Sunny Isles breakwaters were considered.

At the erosional hot spot in the vicinity of R-61 in Miami Beach modifications to the existing breakwaters at 32nd Street (R-59 to R-60), installed by Miami-Dade County in 2002, along with extending a series of submerged breakwaters to the south from the existing structures was considered.

In Key Biscayne a series of groins were considered that would be similar to the groins that exist on Virginia Key.

Any erosion control structures carried forward through the planning phase of the project would require additional modeling and design refinements during the Pre-construction Engineering and Design (PED) phase. However, for plan formulation purposes the design assumptions described above are reasonable for determining the feasibility of erosion control structures.

2.7.4 Planning Reaches

The focused study area was divided into planning reaches. These planning reaches were established based on existing physical conditions and the FWOP damages to reflect areas where alternatives could be implemented, and benefits could be achieved independently. The Main Segment was divided into three planning reaches. Planning Reach 1 extends 2.5 miles from Bakers Haulover Inlet to R-39.3. In the FWOP condition, erosion is the primary damage driver in Planning Reach 1, with the greatest damages expected to occur in the areas of highest erosion between R-27 and R-34.5. The breakpoint between Planning Reaches 1 and 2 is the relatively stable stretch of shoreline at the southern portion of Planning Reach 1 where erosion rates are relatively low and minimal FWOP damages are expected. Planning Reach 2 extends 3.4 miles from R-39.3 to R-56.5. In the FWOP condition, erosion is the primary damage driver in Planning Reach 2, with the damages expected to occur along the length of the reach. The breakpoint

between Planning Reaches 2 and 3 is the relatively stable stretch of shoreline at the northern portion of Planning Reach 3 where erosion rates are relatively low and minimal FWOP damages are expected. Planning Reach 3 extends 3.5 miles from R-56.5 to Government Cut. In the FWOP condition, erosion is the primary damage driver in Planning Reach 3, with the damages expected to occur in the small area located immediately to the south of the existing breakwaters at 32nd Street (R-59 to R-60). The Key Biscayne Segment consists of a single planning reach, Planning Reach 4. The primary damage driver in Planning Reach 4 is flooding. The delineation of planning reaches is shown in **Figure 2-4**. While Planning Reaches 1, 2, and 3 are physically connected, they are also considered to be separable elements where alternatives could be implemented separately and benefits could be achieved regardless of the implementation of alternatives in the other Planning Reaches.

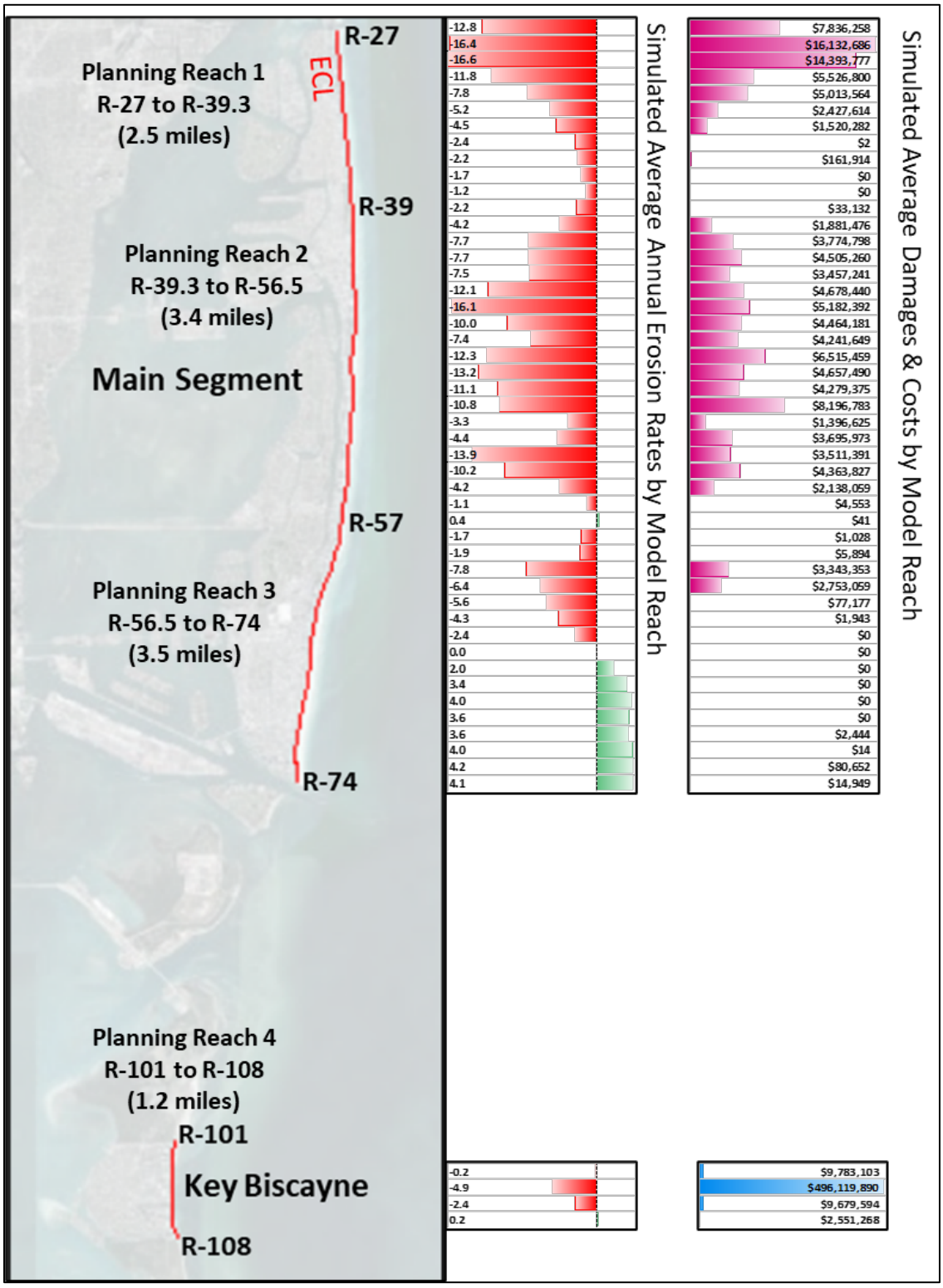


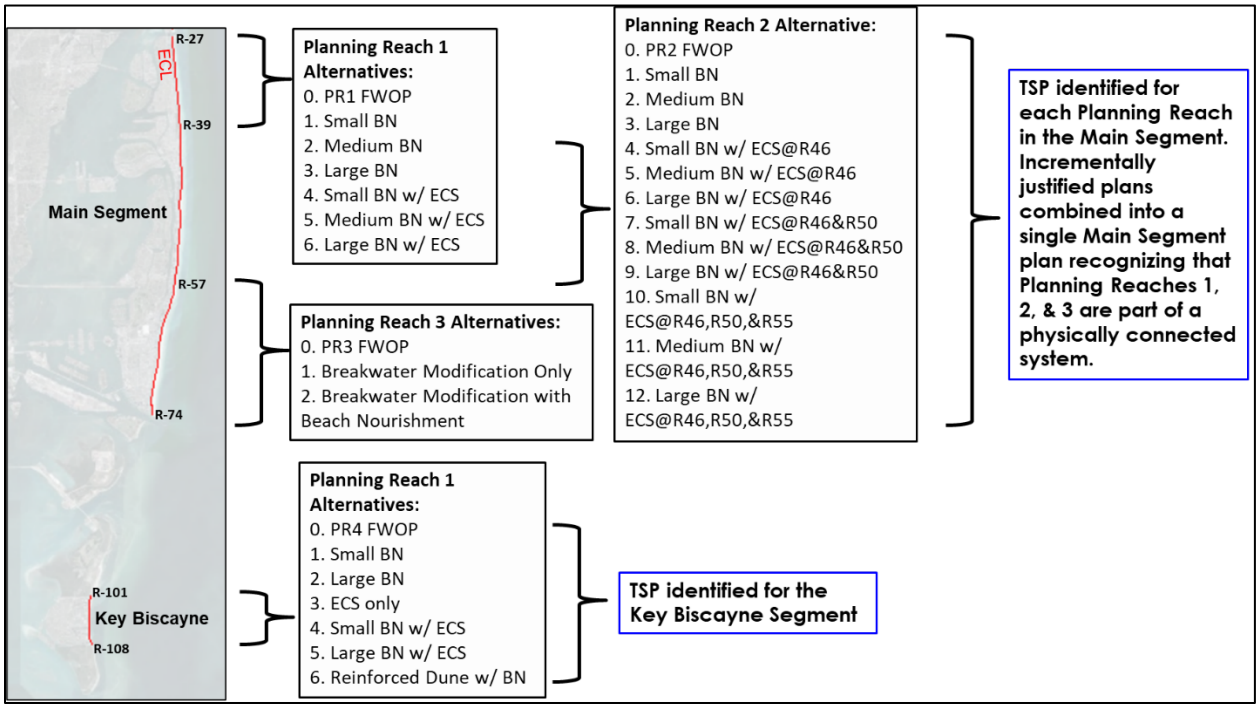
Figure 2-7. Planning Reach Delineation.

2.7.5 Alternative Modeling and TSP Identification Strategy*

For Planning Reaches 1, 2, and 3 in the Main Segment, various scales of beach nourishment were considered along with erosion control structures at select locations that experience the greatest erosion. Beach-fx was set up to simulate the performance of each alternative within its respective planning reach. The planning strategy for the Main Segment was to determine the TSP for planning reaches 1, 2, and 3 individually and then combine the plan that maximizes net NED benefits based on storm damage reduction for each planning reach into a single TSP for the Main Segment.

For Planning Reach 4 in the Key Biscayne Segment, various scales of beach nourishment were considered along with erosion control structures and a reinforced dune. The planning strategy was to determine a separate TSP for the Key Biscayne Segment that is physically separate from the Main Segment.

The overall TSP would include the combined features from the TSPs identified for the Main Segment and Key Biscayne Segment. **Figure 2-5** shows the alternatives modeled for each Planning Reach and the strategy for determining the TSP.



Notes: BN = beach nourishment, ECS = erosion control structures

Figure 2-8. Final Array of Alternatives for each Planning Reach and TSP Identification Strategy.

2.7.6 Evaluation and Comparison of Alternatives*

The final array of alternatives for each planning reach were set up and modeled using Beach-fx to determine the life-cycle damage reduction benefits provided. Screening level cost estimates for the alternative features were used to develop life-cycle costs for each alternative that could be compared to

the benefits. **Table 2-5**, **Table 2-6**, **Table 2-7**, and **Table 2-8** summarize the key information describing the performance of alternatives evaluated in each of the planning reaches with the NED plan for each planning reach that maximized net benefits highlighted. The costs presented in **Table 2-5**, **Table 2-6**, **Table 2-7**, and **Table 2-8** reflect the initial Class 4 estimates developed for alternative evaluation which include construction, PED, S&A, and contingency. For beach nourishment alternatives, costs were based on sand sources that would have enough volume for the alternatives needs over the 50-year period of analysis. For most alternatives this required various sand sources to be used over the period of analysis which required costs to be calculated outside of Beach-fx based on the volume needs simulated by the model. For alternatives with erosion control structures, it was assumed that the structures would be constructed and effective at the start of the period of analysis. The performance of erosion control structures was modeled in Beach-fx by adjustments to the applied erosion rate values that would reflect the structures influence on the shoreline in the vicinity of the structures. The benefits presented in **Table 2-5**, **Table 2-6**, **Table 2-7**, and **Table 2-8** include only primary storm damage reduction benefits. Additional costs (real estate and OMRR&R) and benefits (incidental recreation and income loss) would not influence plan selection and will be calculated for the NED plan identified for each Planning Reach. Benefits are the difference between FWOP and FWP damages, net benefits are the benefits minus costs, and the benefit to cost ratio (BCR) is the benefits divided by costs. The highlighted alternative in each of the following tables is the alternative that has the highest net benefits and is the NED plan for that planning reach.

Table 2-6. Planning Reach 1 Alternative Evaluation and Comparison.

Alternative	Description	AAEQ Damages	AAEQ Cost	AAEQ Benefits	AAEQ Net Benefits	BCR	% of Damages Reduced
PR1_Alt0	PR1 FWOP	$1,870,000					
PR1_Alt1	Small BN	$813,000	$2,473,000	$1,058,000	-$1,415,000	0.43	57%
PR1_Alt2	Medium BN	$366,000	$2,836,000	$1,504,000	-$1,332,000	0.53	80%
PR1_Alt3	Large BN	$96,000	$3,596,000	$1,774,000	-$1,822,000	0.49	95%
PR1_Alt4	ECS + Small BN	$637,000	$2,167,000	$1,233,000	-$934,000	0.57	66%
PR1_Alt5	ECS + Medium BN	$145,000	$2,546,000	$1,725,000	-$821,000	0.68	92%
PR1_Alt6	ECS + Large BN	$21,000	$3,340,000	$1,849,000	-$1,491,000	0.55	99%

Table 2-7. Planning Reach 2 Alternative Evaluation and Comparison.

Alternative	Description	AAEQ Damages	AAEQ Cost	AAEQ Benefits	AAEQ Net Benefits	BCR	% of Damages Reduced
PR2_Alt0	PR2 FWOP	$2,501,000					
PR2_Alt1	Small BN	$492,000	$3,763,000	$2,010,000	-$1,753,000	0.53	80%
PR2_Alt2	Medium BN	$189,000	$4,266,000	$2,312,000	-$1,954,000	0.54	92%
PR2_Alt3	Large BN	$44,000	$5,572,000	$2,458,000	-$3,114,000	0.44	98%
PR2_Alt4	ECS at R046 + Small BN	$465,000	$4,748,000	$2,036,000	-$2,712,000	0.43	81%
PR2_Alt5	ECS at R046 + Medium BN	$222,000	$4,710,000	$2,279,000	-$2,431,000	0.48	91%
PR2_Alt6	ECS at R046 + Large BN	$358,000	$4,817,000	$2,143,000	-$2,674,000	0.44	86%
PR2_Alt7	ECS at R046 & R050 + Small BN	$447,000	$4,729,000	$2,054,000	-$2,675,000	0.43	82%
PR2_Alt8	ECS at R046 & R050 + Medium BN	$205,000	$4,745,000	$2,296,000	-$2,449,000	0.48	92%
PR2_Alt9	ECS at R046 & R050 + Large BN	$128,000	$5,007,000	$2,373,000	-$2,634,000	0.47	95%
PR2_Alt10	ECS at R046, R050 & R055 + Small BN	$424,000	$4,453,000	$2,077,000	-$2,376,000	0.47	83%
PR2_Alt11	ECS at R046, R050 & R055 + Medium BN	$186,000	$4,887,000	$2,315,000	-$2,572,000	0.47	93%
PR2_Alt12	ECS at R046, R050 & R055 + Large BN	$154,000	$5,015,000	$2,347,000	-$2,668,000	0.47	94%

Table 2-8. Planning Reach 3 Alternative Evaluation and Comparison.

Alternative	Description	AAEQ Damages	AAEQ Cost	AAEQ Benefits	AAEQ Net Benefits	BCR	% of Damages Reduced
PR3_Alt0	PR3 FWOP	$222,000					
PR3_Alt1	BW Mod + BW Extension	$7,000	$422,000	$215,000	-$207,000	0.51	97%
PR3_Alt2	BW Mod + BN	$56,000	$1,344,000	$166,000	-$1,178,000	0.12	75%

Table 2-9. Planning Reach 4 Alternative Evaluation and Comparison.

Alternative	Description	AAEQ Damages	AAEQ Cost	AAEQ Benefits	AAEQ Net Benefits	BCR	% of Damages Reduced
PR4_Alt0	PR4 FWOP	$18,568,000					
PR4_Alt1	Small BN	$17,292,000	$2,116,000	$1,275,000	-$841,000	0.60	7%
PR4_Alt2	Large BN + Tieback Walls	$11,805,000	$3,801,000	$6,762,000	$2,961,000	1.78	36%
PR4_Alt3	ECS	$17,926,000	$694,000	$642,000	-$52,000	0.93	3%
PR4_Alt4	ECS + Small BN	$17,524,000	$1,954,000	$1,043,000	-$911,000	0.53	6%
PR4_Alt5	ECS + Large BN + Tieback Walls	$11,827,000	$3,914,000	$6,741,000	$2,827,000	1.72	36%
PR4_Alt6	Reinforced Dune + BN + Tieback Walls	$10,921,000	$2,128,000	$7,646,000	$5,518,000	3.59	41%

For alternative PR4_Alt6 a proxy simulation in Beach-fx needed to be used because Beach-fx cannot simulate the performance of a wall to prevent flood damage. To simulate the performance of a reinforced dune with a buried flood wall a simulation was set up with an "impenetrable dune" by adjusting the alternative template dimensions and nourishment triggers to estimate benefits. A separate simulation was run to estimate the volume of sand needed to keep the reinforcing dune wall buried over the project life cycle.

The incidental recreation benefits calculated for the NED plans identified for each planning reach are shown in **Table 2-9**. In Planning Reaches 1, 2, and 4 the inclusion of incidental recreation benefits resulted in economically justified plans. Planning Reach 3 does not have the incidental recreation benefits needed to be economically justified. In Planning Reach 3 there is only a small area (approximately ½ mile) where

the beach is erosional with stable or accretional beaches to the north and south where recreation benefits would transfer to.

Table 2-10. Incremental Justification with Incidental Recreation Benefits

Planning Reach	Alternative	Description	AAEQ CSRM Benefits	AAEQ Recreation Benefits	AAEQ Benefits	AAEQ Cost	AAEQ Net Benefits	BCR
1	PR1_Alt5	ECS + Medium BN	$1,725,000	$10,681,000	$12,406,000	$2,546,000	$9,860,000	4.9
2	PR2_Alt1	Small BN	$2,010,000	$26,136,000	$28,146,000	$3,763,000	$24,383,000	7.5
3	PR3_Alt1	BW Mod + BW Extension	$215,000	$0	$215,000	$422,000	-$207,000	0.5
4	PR4_Alt6	Reinforced Dune + BN + Tieback Walls	$7,646,000	$102,000	$7,748,000	$2,128,000	$5,620,000	3.6

Note: Real estate and OMRR&R costs not included.

In Planning Reach 4, where most of the FWOP damages and future with project (FWP) benefits are associated with flooding, the Beach-fx model results indicated that back bay flooding could have an impact on the structure inventory being protected by the ocean shoreline alternative. The back bay flooding damages simulated in Beach-fx cannot be clearly delineated from the ocean side flooding in the outputs produced by Beach-fx. Information from the National Oceanic and Atmospheric Administration (NOAA) and the SACS study hazards analysis also indicated that even if structures in the Key Biscayne structure inventory are protected along the ocean shoreline there is still a good chance that flooding would occur from the back bay. Impacts from the back bay would have an equal effect on all alternatives so PR4_Alt6 remains the best plan for the ocean shoreline. To have a complete plan in Planning Reach 4, back bay flooding risks must be addressed. It is assumed that the Village of Key Biscayne and Miami-Dade County will implement projects to address back bay flooding to a consistent level that will be provided by the alternative for the ocean shoreline. Additionally, the alternatives considered in Planning Reach 4 would require lands extending up to 30-feet landward of the ECL, except for PR4_Alt3 which is not considered to be an effective plan. A gross appraisal was conducted to estimate the costs to obtain the easements required to construct the Key Biscayne Segment TSP; it is estimated to cost $61M. These additional considerations for back bay flood risks and real estate costs in Planning Reach 4 do not affect the plan selection for the alternative that best addresses the coastal storm risks along the ocean shoreline. **Table 2-10** shows the updated economic summary for the NED plan in Planning Reach 4 assuming that back bay flooding would be addressed by local interests.

Table 2-11. Updated Planning Reach 4 Economic Summary.

AAEQ CSRM Benefits	$9,872,000
AAEQ Rec Benefits	$102,000
AAEQ Total Benefits	$9,974,000
AAEQ Costs	$4,279,000
AAEQ Net Benefits	$5,695,000
BCR	2.3

The incrementally justified plans that maximized NED benefits in Planning Reaches 1, 2, and 4 were carried forward as the TSP. No action is proposed for Planning Reach 3 where no economically justified alternative could be identified.

CHAPTER 3

TENTATIVELY SELECTED PLAN

3 TENTATIVELY SELECTED PLAN

The TSP for the Main Segment is the combination of Alternatives "PR1_Alt5" and "PR2_Alt1". The TSP for the Key Biscayne Segment is Alternative "PR4_Alt6". The key features of the TSP are listed below and shown in **Figure 3-1**.

Main Segment TSP Features

- Beach Nourishment (all beach nourishment will include a dune feature)
  - Full template from R-27 to R-34.5 with taper to R-36.5 (1.9 miles)
  - Full template from R-39.5 to R-56.5 with tapers to R-38.5 and R-57.5 (3.8 miles)
- Sand Sources
  - BHI Complex By-passing
  - South Miami Beach Back-passing
  - Offshore Borrow Areas
- Erosion Control Structures
  - Five Groins from R-28 to R-31.5

Key Biscayne Segment TSP Features

- Beach Nourishment (all beach nourishment will include a dune feature)
  - R-101.3 to R-107.8 (1.2 miles)
- Sand Sources
  - Upland Truck Haul (upland sand mines not shown in **Figure 3-1**)
- Reinforced Dune
  - Steel Sheet Pile Dune Core Wall from R101.3 to R107.8 (6,560 feet)
  - Northern Tieback Wall (1,800 feet)
  - Southern Tieback Wall (700 feet)

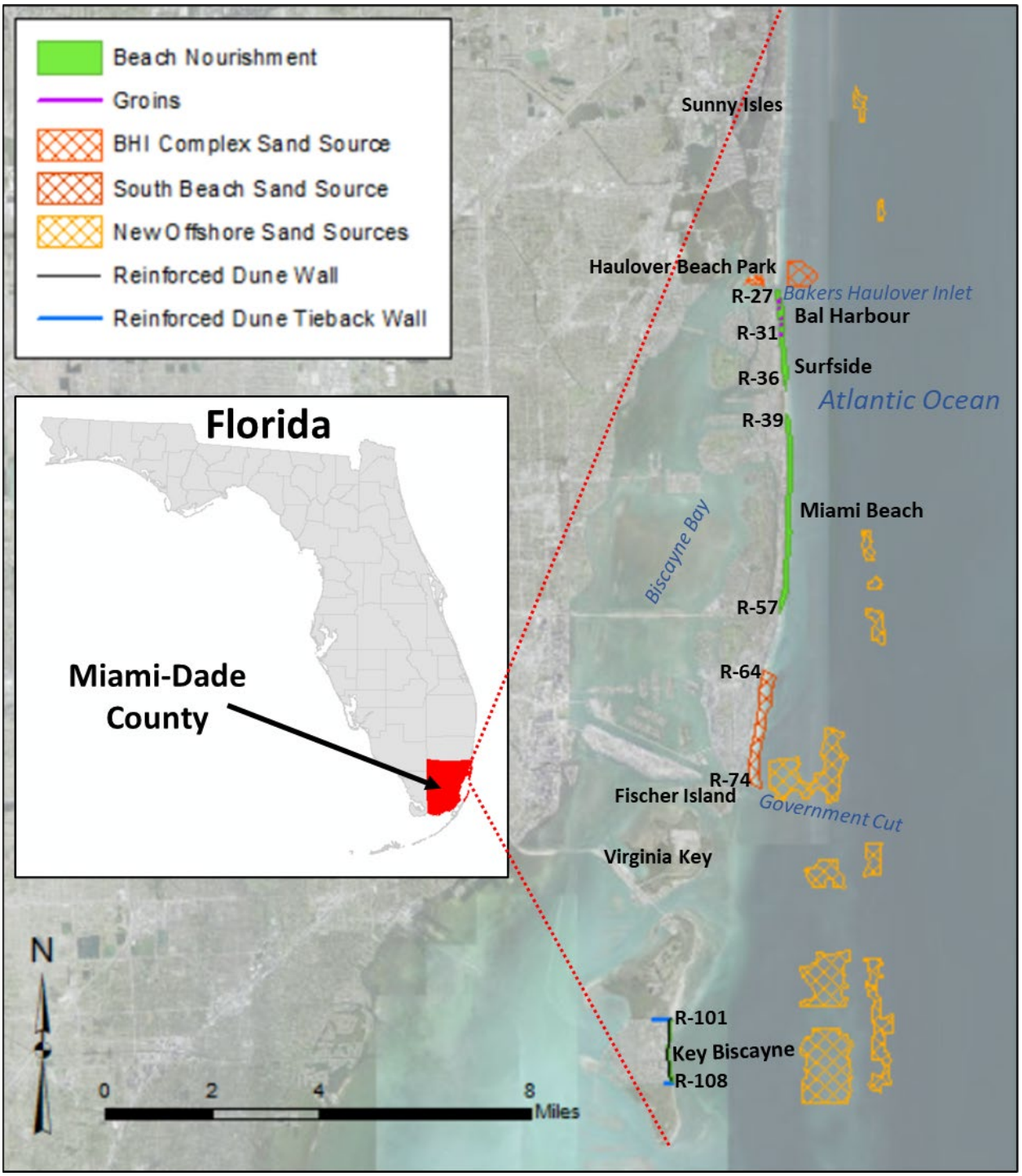


Figure 3-1. Map showing the key features associated with the Tentatively Selected Plan.

3.1 Project Design

The following sections describe the general features associated with the TSP. More detailed descriptions and information can be found in the Engineering Appendix.

3.1.1 Main Segment Project Design*

The TSP for the Main Segment includes periodic beach nourishment and groins in select locations along the shoreline to achieve the study objectives. Beach nourishment is a NNBF. The TSP features, as described below, function to reduce economic damages to structures and infrastructure while maintaining opportunities for recreation, tourism, and environmental resources in the study area.

Beach Nourishment

Beach nourishment would be implemented periodically along 4.8 miles of shoreline (5.7 miles including maximum tapers) over the 50-year period of Federal participation using various sand sources. A full nourishment template for the northern portion of the Main Segment (Planning Reach 1) would extend from the south jetty at Bakers Haulover Inlet at R-27 to R-34.5 with a maximum southern taper extending to R-36.5 as needed to reduce beach fill end losses and transition the beach fill into the adjacent shoreline. A full nourishment template for the southern portion of the Main Segment (Planning Reach 2) would extend from R-39.5 to R-56.5 with a maximum northern and southern taper extending to R-38.5 and R-57.5 respectively as needed to reduce beach fill end losses and transition the beach fill into the adjacent shoreline.

The beach nourishment volumes to be placed, as described in the following paragraph, are considered to be the governing factor with respect to project functional performance and cost. The exact beach nourishment template dimensions will be determined as the design is optimized and will be refined based on existing shoreline conditions at the time of construction. The established ECL will delineate the landward limit of the beach fill footprint and the seaward extent of equilibrated toe of fill (ETOF) will not extend beyond that of the existing project. The nourishment template will have a maximum dune crest elevation of 13 feet NAVD88 and a berm elevation matching the natural berm elevation which is currently approximately 7 feet NAVD88. **Figure 3-2** shows the Main Segment beach nourishment areas and typical cross sections for the maximum construction template dimensions.

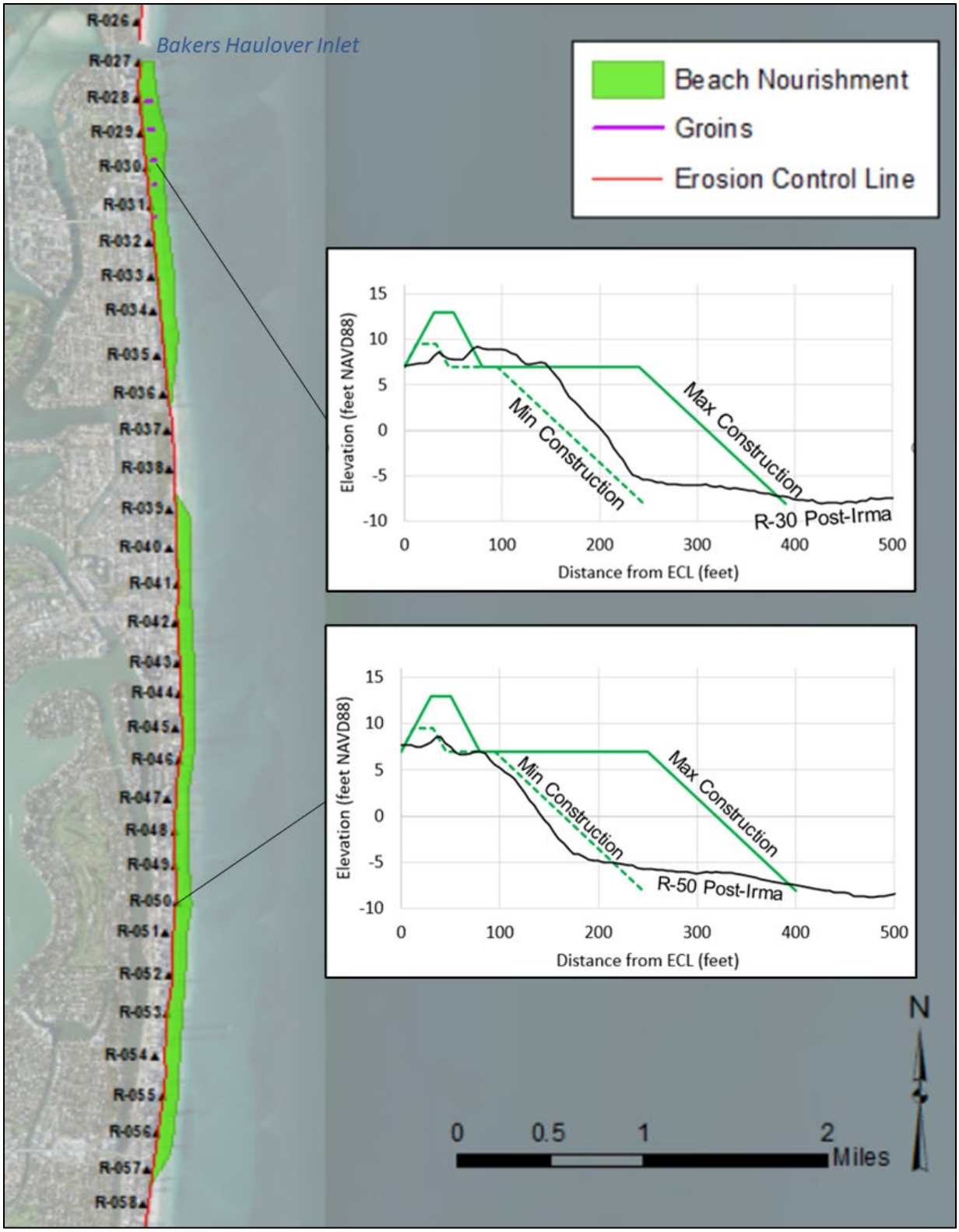


Figure 3-2. Main Segment Beach Nourishment Areas and Typical Maximum Construction Template

Beach nourishment in the Main Segment will require a total of approximately 8 million cubic yards (mcy) over the 50-year period of analysis. Various sand sources will be used including by-passing from the BHI Complex, back-passing from the beach and nearshore areas of South Beach, offshore sand sources, and upland mines if needed. The BHI Complex includes the ebb shoal, inlet channel, flood shoal, segment of the IWW in the vicinity of the flood shoal, and the nearshore area of Haulover Beach Park. Only previously used sites (i.e., ebb shoal, flood shoal, navigation channels) will be used as sand sources for the TSP. Most of the sediment available from the BHI Complex will come from the ebb shoal. The South Beach sand source includes the dry beach as well as the submerged beach profile out to approximately the -15-feet NAVD88 contour (approximately 800 to 1200 feet seaward from the ECL) between R-64 and Government Cut. Most of the sediment available in the South Beach borrow area is expected to come from the submerged portion of the beach profile between R-64 and R-69. There are 15 potential new offshore sand sources that have recently been identified on the inner continental shelf based on the results of geophysical and geotechnical investigations. Truck haul sand from upland mines is not anticipated to be needed for the Main Segment but may be used in certain situations over the project life cycle if needed and economically justified. The upland mines that would be used if needed include the Garcia Sand Mine, Davenport Sand Mine, Ortona Sand Mine, and Witherspoon Sand Mine. Additional detail on all of these sand sources can be found in Appendix D, Geotechnical Analysis.

The general strategy for implementation will be to alternate between use of the BHI Complex and South Beach sand sources and the offshore sand sources. The BHI Complex would be used for initial construction in Planning Reach 1 and South Beach would be used for initial construction of Planning Reach 2. The new offshore sand sources would be used for the first periodic nourishment in both planning reaches 1 and 2. Subsequent periodic nourishment events would then alternate between the BHI Complex/South Beach sand sources and the new offshore sand sources. The average periodic nourishment interval is currently estimated at 4-years. The specific areas to be dredged will be determined during PED. Considerations for the sequencing of specific areas for use include the capacity of the available borrow areas versus the volumes needed at the time of construction, borrow material characteristics (grain size, color, percent fines), proximity of the borrow area to the placement area (closer is better), and dredging efficiencies.

A cutter suction dredge would most likely be used to by-pass and back-pass sand from the BHI Complex and South Beach sand sources. The location and footprints of these sand sources are shown in **Figure 3-3** and **Figure 3-4**. By-passing refers to the moving of sand past an inlet in the direction of net sediment transport while back-passing refers to the moving of sand from an accretional area in the opposite direction of net sediment transport. The back-passing of sand from the submerged nearshore areas of South Miami Beach could require the use of a booster pump to accommodate the distance that sand would need to be transported and the pipeline would run to the placement location either along the dry beach or in the water. For the BHI Complex bypassing previously used borrow areas in the ebb shoal and flood shoal will be used. Pipeline for the cutter suction dredging from South Beach would run either along the dry beach or nearshore areas, either submerged or floating, landward of any hardbottom resources to avoid any potential impacts. USACE anticipates using the existing pipeline corridors to transport sand dredged from the back-passing and bypassing areas to the beach placement sites. Establishing additional

pipeline corridors could be beneficial to the construction schedule, cost, and productivity; therefore, the potential need and opportunity for additional corridors would be investigated further during the PED phase. If additional pipeline corridors are needed and identified, supplemental NEPA would be conducted at that time. Mechanical equipment may also be used to dredge smaller quantities of sand to be back-passed from the dry beach portion of the South Beach sand source. Mechanical dredging from the dry beach could entail, but is not limited to, excavating material and truck hauling it to the placement areas or using mechanical equipment to load up a hopper that would pump material to the placement areas. Dredging will generally occur at least 400 feet away from hardbottom except for a portion of the borrow area located between R-67 to R-72. This portion of the South Beach sand source located within 400 feet of hardbottom would be completed in less than 18 days in compliance with the *2020 South Atlantic Regional Biological Opinion for Dredging and Material Placement Activities in the Southeast United States (SARBO)*[2]coral hardbottom project design criteria (PDCs). All of the material to be by-passed or back-passed will have less than 5% fine material.

A hopper dredge would be used for the new offshore sand sources due to the water depths that they are located in. The location and footprints of the new offshore sand sources are shown in **Figure 3-5**. USACE anticipates using the existing pipeline corridors to transport sand dredged from offshore borrow sites to the beach placement area. Establishing additional pipeline corridors could be beneficial to the construction schedule, cost, and productivity; therefore, the potential need and opportunity for additional corridors would be investigated further during the PED phase. If additional pipeline corridors are needed and identified, supplemental NEPA would be conducted at that time. A 400 foot hardbottom buffer will be applied to all of the new offshore borrow areas. Portions of these sand sources located within 400 to 1,000 feet of hardbottom would be completed in less than 18 days in compliance with the SARBO coral hardbottom PDCs. All of the material to be used from the new off shore sand sources will have less than 5% fine material.

The analysis to determine the TSP assumes that the beach nourishment areas in Planning Reaches 1 and 2 would be constructed separately. The Planning Reach 1 beach fill area (R-27 to R- 34.5) is estimated to need 247,000 cy in 2035 and then eight subsequent nourishment events through 2075 (average interval of 4-years) needing an average of 289,500 cy per event. The TSP analysis for this beach fill area prioritized the use of sand from the BHI Complex for the initial beach nourishment event and subsequent nourishment cycles would alternate between offshore sand sources and the BHI Complex. The Planning Reach 2 beach fill area (R-39.5 to R- 56.5) is estimated to need 386,500 cy in 2035 and then 9 subsequent nourishment events through 2075 (average interval of 4 years) needing an average of 564,600 cy per event. The TSP analysis for this beach fill area prioritized the use of sand from the South Miami Beach for

[2] The 2020 SARBO is the biological opinion issued by National Marine Fisheries Service (NMFS). The SARBO considers dredging, material placement activities, and sand mining in borrow sites in federal waters in the Southeast United States (from the North Carolina/Virginia border through and including Key West, Florida and the islands of Puerto Rico and U.S. Virgin Islands). More information on the types of projects, activities, and species covered by the SARBO are included in Chapters 5 and 6 of this report.

the initial nourishment and subsequent nourishment cycles would alternate between offshore sand sources and the back-passing from South Beach.

The exact strategy for beach nourishment implementation will consider efficiencies that could be realized by combining the construction of the two beach fill areas as the design is optimized prior to the final report and will be refined based on existing shoreline conditions at the time of construction.

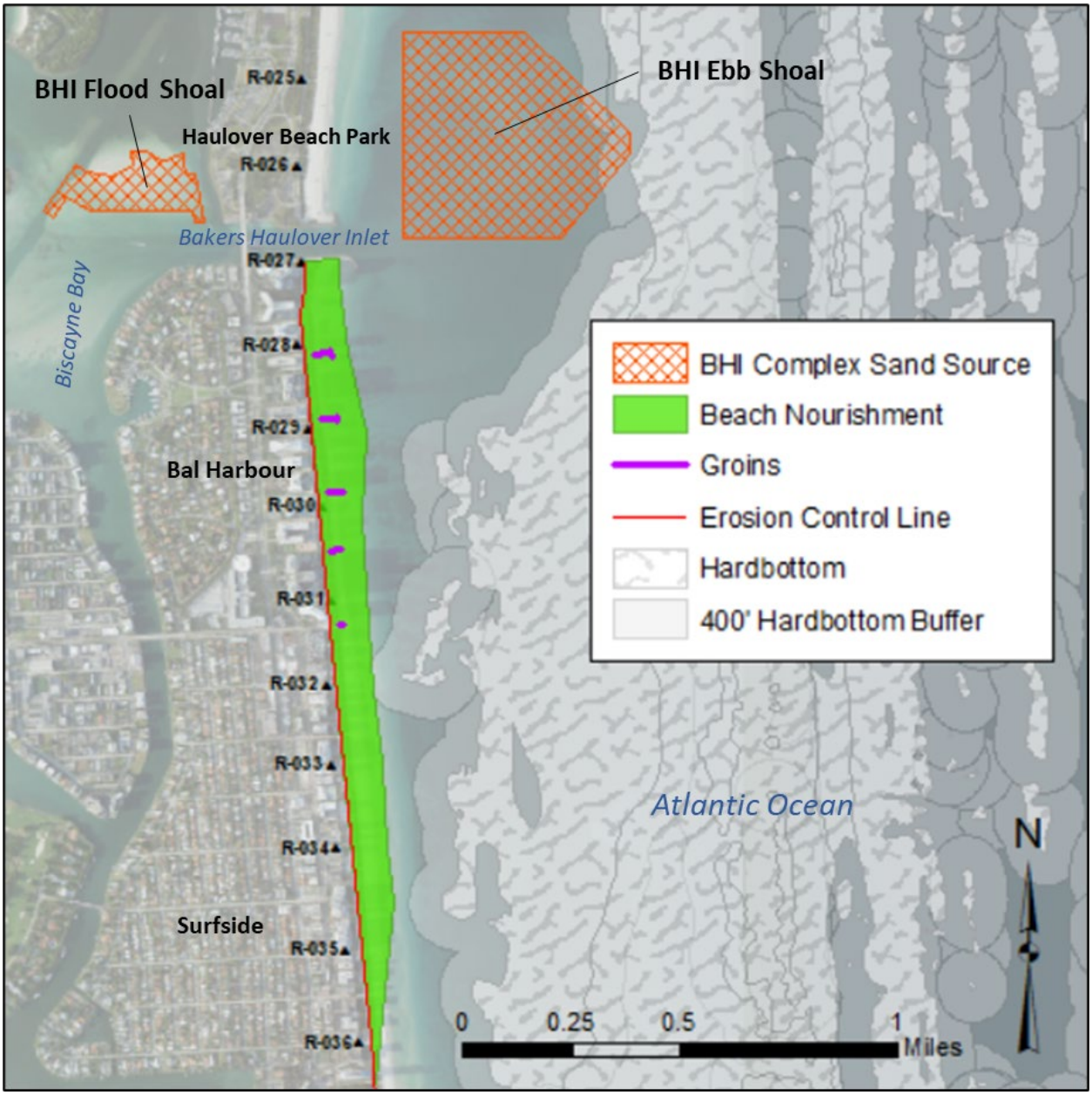


Figure 3-3. BHI Complex by-passing sand source

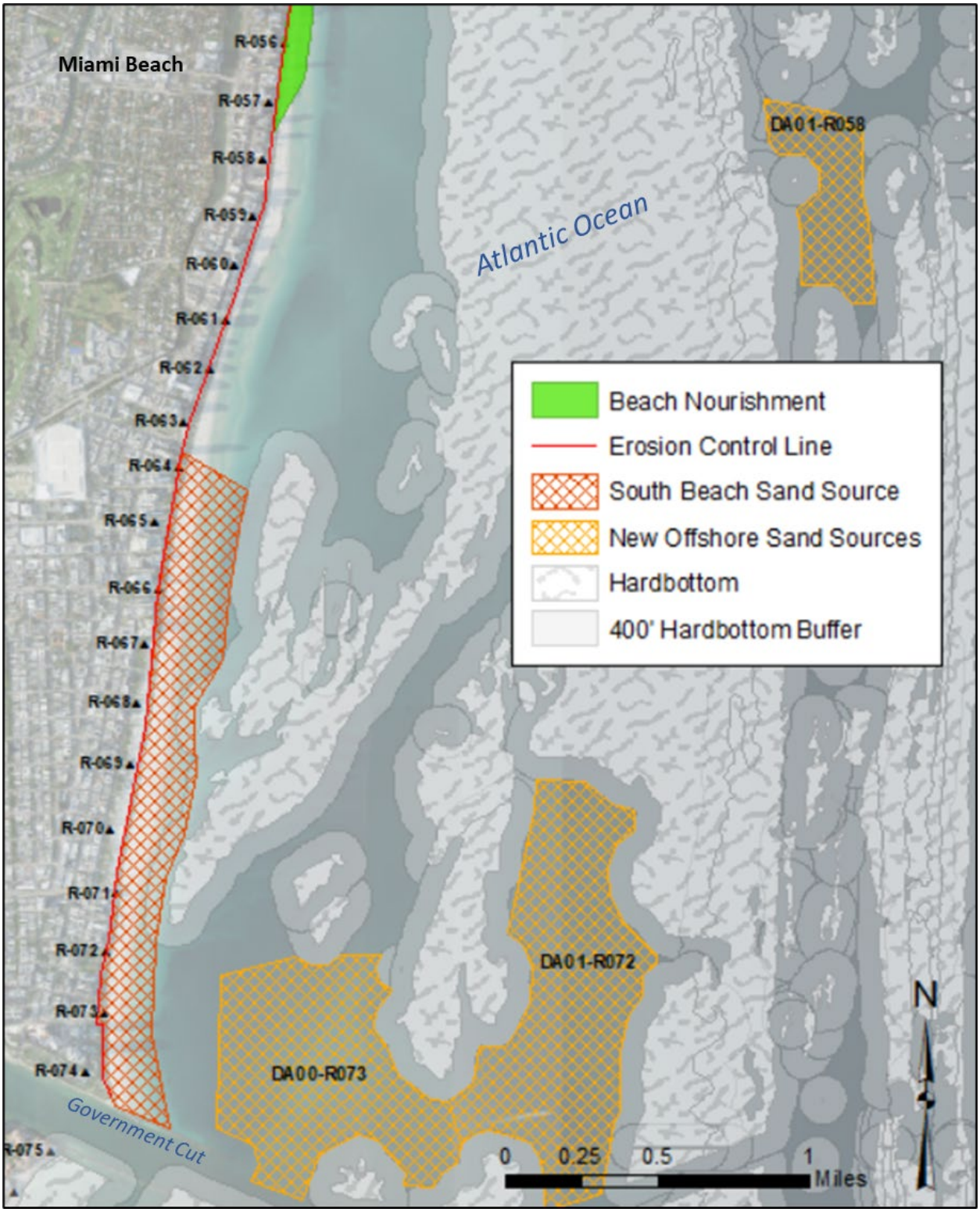


Figure 3-4. South Beach back-passing sand source

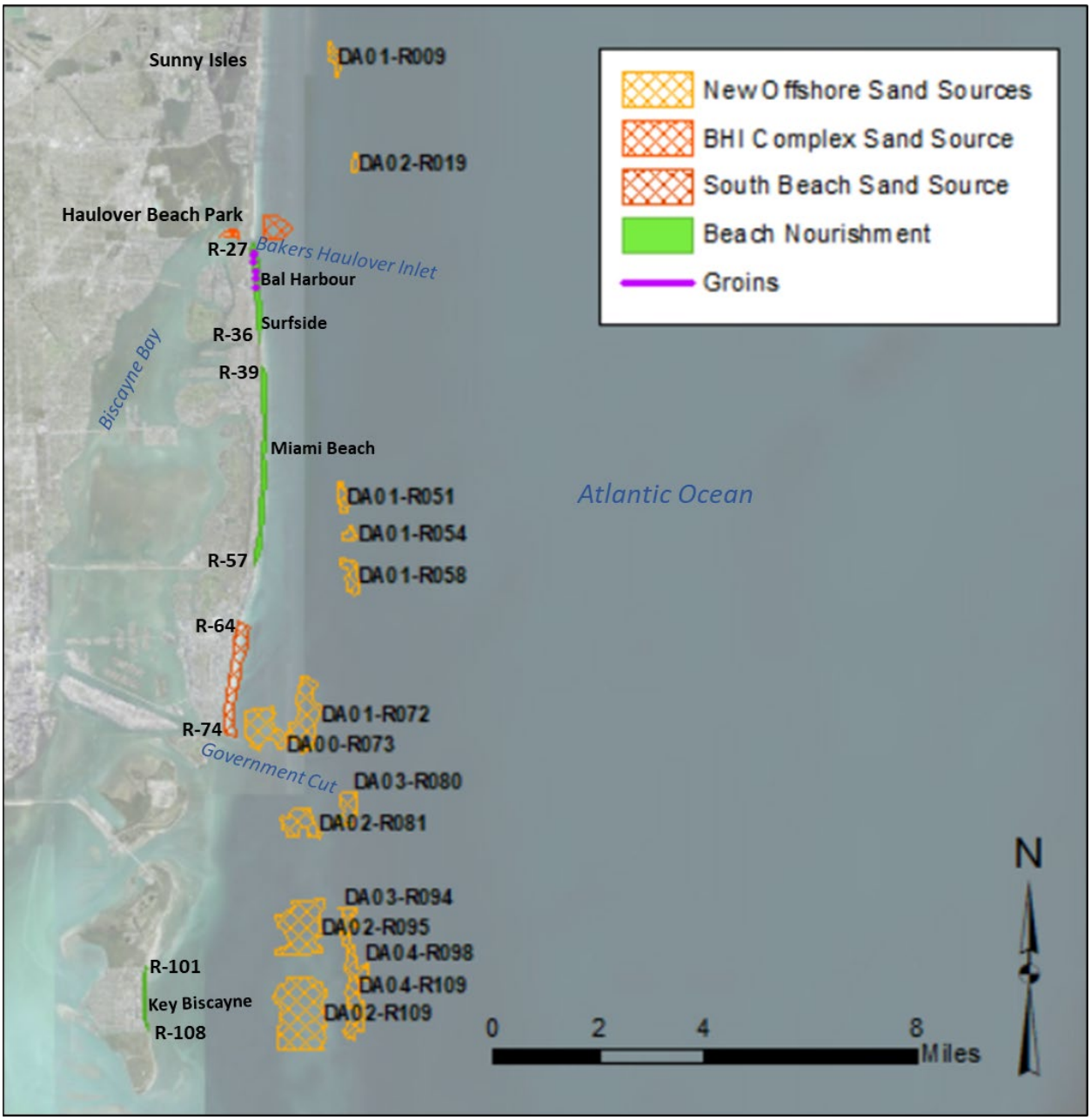


Figure 3-5. New Offshore Sand Sources

Groins

A series of groins will be constructed between R-28 and R-31.5. The preliminary design includes 5 granite rubble mound groins that would taper off in length from 220-feet down to 60 feet from north to south. The five structures would have a total combined length of approximately 915 feet. The northern two groins would include T-head features. The exact design will be determined as the design is optimized and will be refined based on existing shoreline conditions at the time of construction. The granite armor stone would be trucked to the project area. Groin construction would be land-based and would involve excavation into portions of the beach to allow for stone placement. **Figure 3-4** shows the conceptual design for the groins.

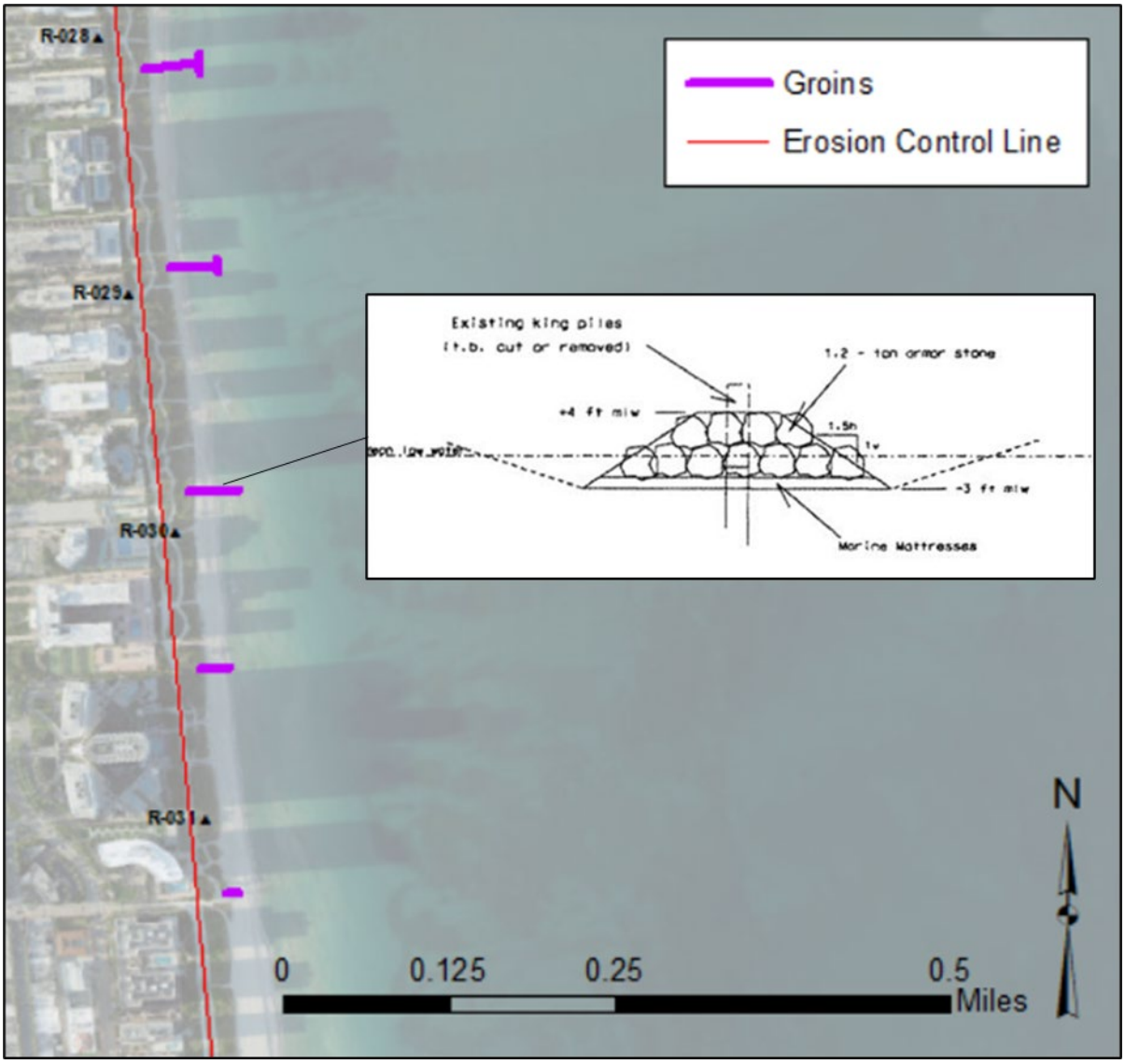


Figure 3-6. Conceptual Groin Design

3.1.2 Key Biscayne Segment Project Design*

The TSP for the Key Biscayne Segment includes a reinforced dune with tieback walls and beach nourishment to achieve the study objectives. Beach nourishment is a NNBF. These features, as described below, function to reduce economic damages to structures and infrastructure from inundation while maintaining opportunities for recreation, tourism, and environmental resources in the study area. The footprint of these features along the Atlantic Ocean shoreline would extend up to 30-feet landward of the ECL and would only extend seaward approximately 150-200 feet from the ECL to avoid impacts to seagrass. **Figure 3-5** shows the Key Biscayne TSP in plan view and **Figure 3-6** provides a typical cross section.

Reinforced Dune

A steel sheet pile dune core seawall with a concrete cap having an 11 feet NAVD88 crest elevation would be constructed as far landward as possible within the dune template. Tieback walls constructed of steel sheet pile would extend landward to Crandon Boulevard at the north and south ends of the developed shoreline. The tie back walls would function to prevent flood waters from flanking around the north and south ends of the reinforced dune. The exact design will be determined as the design is optimized and will be refined based on existing shoreline conditions at the time of construction.

Beach Nourishment

Beach nourishment would build up the existing dune up to cover the reinforced dune wall and fill the beach nourishment template along the length of developed shoreline (R-101.3 to R-107.8). The initial beach fill is estimated to be 26,200 cy in 2026 and then 27 subsequent nourishment events through 2075 (average interval of 2-years) needing an average volume of 24,500 cy per event. The sand source for beach nourishment will be truck hauled from upland sand mines. The exact beach nourishment template dimensions will be determined as the design is optimized and will be refined based on existing shoreline conditions at the time of construction. The landward extent of the dune footprint will extend up to 30-feet landward of the ECL along the length of the project and the seaward extent of the beach fill will occur within the currently permitted footprint of the local beach nourishment project in order to avoid potential impacts to seagrasses. Additionally, a monitoring and adaptive management plan is included as Appendix I to this report and describes how potential impacts to seagrasses off the beach in Key Biscayne will be minimized.

Figure 3-7. Plan View of the TSP for Key Biscayne

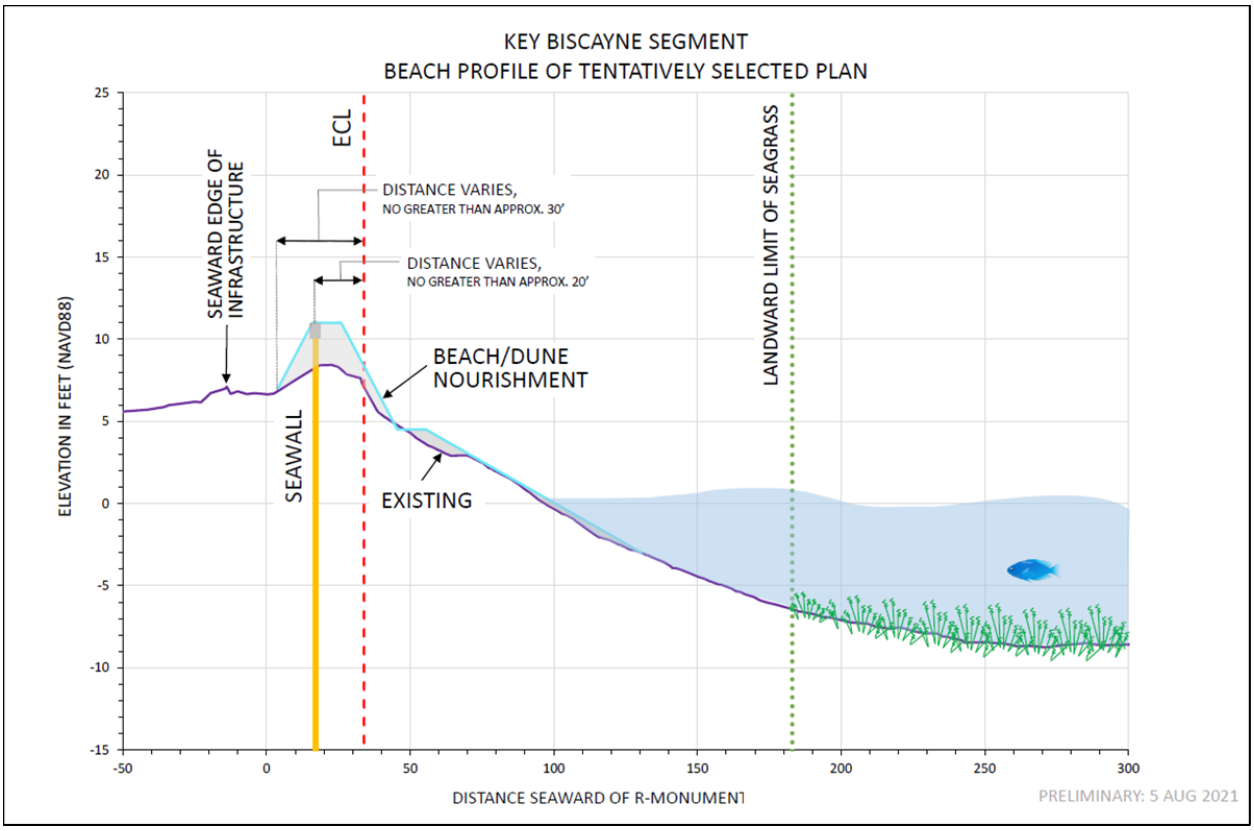


Figure 3-8. Typical Key Biscayne TSP Cross-Section

3.1.3 Pre-construction Engineering and Design Considerations

During PED, design refinements will be conducted for project elements based on new information and analyses. The new information and analyses needed to refine the project design during PED include:

- Additional topographic and bathymetric surveys
- Detailed modeling of the groins in Bal Harbour
- Additional modeling for use of the BHI Complex and South Beach sand sources
- Additional analysis on the newly identified offshore sand sources
- Risk assessment for the Reach 4 reinforced dune

3.1.4 Project Monitoring

Physical monitoring of the project is necessary to assess project performance and to ensure that project functionality is maintained throughout the 50-year project life. Profile surveys provide assessments of dune and beach fill volumes, a basis for assessing post-construction dune and beach fill adjustments, as well as variation in the profile shape due to seasonal changes and storms. Post-construction monitoring activities include annual topographic and bathymetric surveys of the beach placement areas and adjacent shorelines. A monitoring report is required on an annual basis for 3 years following construction and then biannually until the next construction event. Bathymetric mapping of the borrow sites to ensure sand

availability will be done as part of the PED phase prior to each nourishment. Measured wind, wave, and water level information will be obtained from the best available existing data sources to periodically assess the sea level and other physical conditions in the project area and to reassess the project performance.

3.1.5 Operations and Maintenance Considerations

Federal law (33 U.S. Code § 426e(c), Federal aid in protection of shores) states, "When in the opinion of the Chief of Engineers the most suitable and economical remedial measures would be provided by periodic beach nourishment, the term "construction" may be construed for the purposes of sections 426e to 426h–1 of this title to include the deposit of sand fill at suitable intervals of time to furnish sand supply to project shores for a length of time specified by the Chief of Engineers." By this provision, periodic nourishment is considered construction and not maintenance, and therefore is cost shared. Physical (topographic and bathymetric) and environmental surveys supporting beach nourishment are cost-shared activities included in the total project cost.

The OMRR&R anticipated for beach nourishment components of this project are the local sponsor's responsibility and include any necessary long-term topographic and bathymetric surveys (different from those supporting beach nourishment activities described in the paragraph above) of the placement area and adjacent areas. OMRR&R also includes surveillance of the project annually and following storm events to determine losses of material. Other OMRR&R items may include revegetating the dune as needed between nourishment activities (per Policy Guidance Letter No. 27 (PGL 27, 11/17/92)), scarp repair, and beach tilling.

The OMRR&R anticipated for the structural components of the project includes the inspection of structures and maintenance of structures as described in ER 1110-2-2902, *Prescribed Procedures for the Maintenance and Operation of Shore Protection Works*, dated June 30, 1989.

The items listed in **Section 7.1** are the items of local cooperation. They involve publicizing floodplain information, ensuring continued conditions of public ownership and use of the shore, performing surveillance of the beach, and any specific directions prescribed by the government.

OMRR&R is borne 100% by the non-federal sponsor and is detailed in the Project Partnership Agreement (PPA). An Operations and Maintenance Manual will be completed by USACE and provided to the sponsor following completion of initial construction.

For the TSP, average annual OMRR&R costs are estimated to be $35,000 for the Main Segment and $21,500 for the Key Biscayne Segment.

3.1.6 Real Estate Considerations

The Main Segment lands required for nourishment, dunes, and the five groins are located seaward of the ECL. Lands seaward of the ECL are in the jurisdiction of the State of Florida and require a Sovereign Submerged Lands Authorization (SSLA), as contained within the Joint Coastal Permit (JCP), for placement areas. The

SSLA is normally issued for 15 or more years in connection with use of the project lands. In addition to the SSLA, Miami-Dade County, the non-Federal sponsor (NFS), will obtain Sovereign Submerged Lands Easement (SSLE) for the groin areas from FDEP. Construction staging and access areas will be identified during the PED phase and will require temporary work area easements. Past areas used for construction purposes were in local public ownership and may be used again for future nourishments. The borrow areas located within the State of Florida submerged lands require the appropriate State documents in accordance with State of Florida Administrative Code (FAC) Rule, Chapter 18-21 entitled Sovereignty Submerged Lands Management. Material from approved upland sand mines are purchased and do not require a real estate interest.

The Key Biscayne Segment lands required for nourishment, dunes, a reinforced dune wall and dune tieback walls are located both seaward and landward of the ECL. Lands seaward of the ECL are in the jurisdiction of the State of Florida and require a SSLA. Approximately ten acres are located landward of the ECL, consisting of 17 parcels. The parcels include 14 private landowners and three public owners (Miami-Dade County, Village of Key Biscayne, and the State of Florida). Perpetual Beach Storm Damage Reduction Easements for the beach nourishment and dune features and Perpetual Flood Protection Easement for the tie back walls are the required estates for the properties in accordance with USACE policy. Construction staging and access areas will be identified during the PED phase and will require temporary work area easements. Borrow areas identified include truck haul from approved upland sand mines. Real estate is not required for upland sand mines as the material is purchased as part of the construction contract.

3.2 Tentatively Selected Plan Costs

The Main Segment TSP total project first cost (constant dollar basis in October 2022 price levels), including contingency, is $267.6 million. The Key Biscayne Segment TSP total project first cost (constant dollar basis in October 2022 price levels), including contingency, is $176.2 million. The Cost Engineering Appendix provides additional cost details.

The total project cost summary for the Main Segment currently assumes that Planning Reach 1 and 2 would be constructed separately. As the design is optimized for the main segment, cost savings could be realized by implementing the beach nourishment features in Planning Reaches 1 and 2 together.

3.3 Economic Benefits of the Tentatively Selected Plan

The TSP generates primary CSRM benefits and incidental recreation benefits. The benefits are summarized in **Table 3-1**, in average annual terms.

Primary CSRM benefits are based on reducing structure and content damages and coastal armor construction costs along the ocean facing side of the barrier islands in the focused study area.

Incidental recreation benefits are based on reducing unmet demand and enhancing willingness to pay between the future without project and future with project conditions.

Table 3-1. Summary of the Benefits associated with the TSP.

Main Segment	
AAEQ Coastal Storm Damage Reduction Benefits	$3,735,000
AAEQ Recreation Benefits	$36,817,000
AAEQ Total Benefits	$40,552,000
Key Biscayne Segment	
AAEQ Coastal Storm Damage Reduction Benefits	$9,872,000
AAEQ Recreation Benefits	$102,000
AAEQ Total Benefits	$9,974,000

Note: AAEQ Benefits use the FY21 water resources discount rate (2.5%).

The TSP has a total estimated BCR including CSRM and incidental recreation benefits of 6.4 for the Main Segment and 2.3 for the Key Biscayne Segment. Costs and benefits are further summarized in **Table 3-2**.

Table 3-2. Economic summary of the TSP.

Segment	**Main Segment**		**Key Biscayne Segment**	
Benefits	CSRM Only	With Incidental Recreation	CSRM Only	With Incidental Recreation
Total AAEQ Cost	$6,309,000	$6,309,000	$4,279,000	$4,279,000
AAEQ Damage Reduction Benefits	$3,735,000	$3,735,000	$9,872,000	$9,872,000
AAEQ Recreation Benefits		$36,817,000		$102,000
AAEQ Total Benefits	$3,735,000	$40,552,000	$9,872,000	$9,974,000
AAEQ Net Benefits	$-2,574,000	$34,243,000	$5,593,000	$5,695,000
Benefit-Cost Ratio (BCR)	0.6	6.4	2.3	2.3

Note: AAEQ Costs and Benefits use the FY21 water resources discount rate (2.5%).

In additional to the NED benefits quantified above, the TSP is expected to provide benefits under the EQ, OSE, and RED accounts. The benefits under the other three accounts have not been quantified, but can be described qualitatively. Under the EQ account, the TSP would maintain beach habitat along 10.6 miles of Atlantic Ocean shoreline. Under the OSE account, the TSP would improve coastal resiliency, reduces risk of damages to roadways, and maintains or improve recreation opportunities. Under the RED account, the TSP would maintain opportunities for recreation and tourism.

3.4 Cost Sharing of the Tentatively Selected Plan

The cost share estimates are based on policy guidance provided by ER 1105-2-100, Appendix E, and ER 1165-2-130. The non-Federal cost share for a CSRM project is set forth in Section 103 of WRDA 1986 (Public Law 99-662), as amended by Section 215 of the WRDA 1999 (Public Law 106-53)(33 U.S.C. § 2213(d)). The non-Federal cost share of initial construction is 35%, as adjusted upward for costs assigned to benefits to privately owned shores, and 50% for periodic nourishment of projects authorized for

construction after December 31, 1999 and carried out after January 1, 2003. Appendix K, Public Access and Cost Sharing, provides additional information on property ownership, public access, and developed lands in the project area and their use in calculating the estimated cost share amount for the project.

Table 3-3 provides a summary of the ownership for the shoreline included in the Main Segment TSP and the associated cost share percentages. The cost share for the Main Segment TSP is 57% Federal, 43% non-Federal for initial construction. Periodic nourishment events will be cost shared at 44% Federal and 56% non-Federal expense. The cost share can be updated throughout the 50-year period of Federal participation if conditions in the project area change.

Table 3-4 provides a summary of the ownership for the shoreline included in the Key Biscayne Segment TSP and the associated cost share percentages. The Village of Key Biscayne is currently working on adding new public beach access points in the project area. Assuming that these new access points are created prior to initial construction, the cost share for the Key Biscayne TSP is 65% Federal, 35% non-Federal for initial construction. Periodic nourishment events will be cost shared at 50% Federal and 50% non-Federal expense. The cost share can be updated throughout the 50-year period of Federal participation if conditions in the project area change.

Table 3-3. Main Segment TSP Cost Share Percentages Based on Shoreline Ownership.

	INITIAL CONSTRUCTION				PERIODIC NOURISHMENT		
Shore Ownership (as defined in ER 1105-2-100)	**% of Federal Participation for Initial Construction**	**Shoreline Length (feet)**	**Shoreline Length x Federal Participation %**	**Shoreline Length x non-Federal Participation %**	**% of Federal Participation for Periodic Nourishment**	**Shoreline Length x Federal Participation %**	**Shoreline Length x non-Federal Participation %**
I. Federally Owned	100%	0	0	0	100%	0	0
II. Publicly and Privately Owned, Protection Results in Public Benefits							
A. Coastal Storm Risk Management (CSRM) on Developed Lands (Public/Private)	65%	24,572	15,972	8,600	50%	12,286	12,286
B. CSRM on Undeveloped Public Lands	65%	2,435	1,583	852	50%	1,218	1,218
C. CSRM on Undeveloped Private Lands	0%	185	0	185	0%	0	185
III. Privately Owned, Use Limited to Private Interests (No public access within 1/4 mile)	0%	3,571	0	3,571	0%	0	3,571
IV. Coastal Barrier Resource Act (CBRA) Zone (Privately Owned)	0%	0	0	0	0%	0	0
	Total Distance:	30,763	17,555	13,208	Total Distance:	13,504	17,260
	Cost Shares:		**57%**	**43%**	**Cost Shares:**	**44%**	**56%**

Table 3-4. Key Biscayne Segment TSP Cost Share Percentages Based on Shoreline Ownership.

	INITIAL CONSTRUCTION				PERIODIC NOURISHMENT		
Shore Ownership (as defined in ER 1105-2-100)	**% of Federal Participation for Initial Construction**	**Shoreline Length (feet)**	**Shoreline Length x Federal Participation %**	**Shoreline Length x non-Federal Participation %**	**% of Federal Participation for Periodic Nourishment**	**Shoreline Length x Federal Participation %**	**Shoreline Length x non-Federal Participation %**
I. Federally Owned	100%	0	0	0	100%	0	0
II. Publicly and Privately Owned, Protection Results in Public Benefits							
A. Coastal Storm Risk Management (CSRM) on Developed Lands (Public/Private)	65%	6,388	4,152	2,236	50%	3,194	3,194
B. CSRM on Undeveloped Public Lands	65%	0	0	0	50%	0	0
C. CSRM on Undeveloped Private Lands	0%	0	0	0	0%	0	0
III. Privately Owned, Use Limited to Private Interests (No public access within 1/4 mile)	0%	0	0	0	0%	0	0
IV. Coastal Barrier Resource Act (CBRA) Zone (Privately Owned)	0%	0	0	0	0%	0	0
	Total Distance:	6,388	4,152	2,236	Total Distance:	3,194	3,194
	Cost Shares:		**65%**	**35%**	**Cost Shares:**	**50%**	**50%**

Table 3-5 and **Table 3-6** provide the Federal and non-Federal costs associated with the TSP based on the cost share identified in the analysis summarized above and detailed in Appendix K. As discussed in Section 3.1.5, OMRR&R activities are the responsibility of the non-Federal sponsor and are not cost-shared.

Table 3-5. Main Segment TSP Cost Sharing (Project First Cost; October 2022 Price Levels).

Initial Construction					
Item	**Federal Cost Share**	**Federal Cost**	**Non-Federal Cost Share**	**Non-Federal Cost**	**Project First Cost**
Coastal Storm Risk Management Costs	57%	$19,041,420	43%	$14,364,580	$33,406,000
Non-federal LERRD Contribution	0%	$0	100%	$607,000	$607,000
Periodic Nourishment					
Periodic Nourishment	44%	$102,789,280	56%	$130,822,720	$233,612,000
Final Project Cost (50 years)		**$121,830,700**		**$145,794,300**	**$267,625,000**

Table 3-6. Key Biscayne Segment TSP Cost Sharing (Project First Cost; October 2022 Price Levels).

Initial Construction					
Item	**Federal Cost Share**	**Federal Cost**	**Non-Federal Cost Share**	**Non-Federal Cost**	**Project First Cost**
Coastal Storm Risk Management Costs	65%	$9,440,600	35%	$5,083,400	$14,524,000
Non-federal LERRD Contribution	0%	$0	100%	$83,943,000	$83,943,000
Periodic Nourishment					
Periodic Nourishment	50%	$38,878,000	50%	$38,878,000	$77,756,000
Final Project Cost (50 years)		**$48,318,600**		**$127,904,400**	**$176,223,000**

3.5 Sea Level Change Considerations

The SLC predicted by the three USACE SLC scenarios (low, intermediate, and high) will have a significant impact on the project area. The USACE high SLC scenario was selected as a basis for plan formulation and

the feasibility level of design. All proposed project features have currently been designed to account for an increase in sea levels of approximately 2.64 feet by the year 2075, which is the end of the period of analysis for economic considerations.

Additional analysis to be completed prior to the Final Report will evaluate the sensitivity of the TSP performance under the USACE intermediate and low SLC scenarios.

3.6 Resiliency of the TSP

Engineering and Construction Bulletin (ECB) 2020-6 (Implementation of Resilience Principles in the Engineering & Construction Community of Practice) provides the policy and guidance for applying the USACE principles of resilience – Prepare, Absorb, Recover, and Adapt (PARA). In general, USACE defines resilience as the ability to anticipate, prepare for, and adapt to changing conditions; in addition, it is the ability to withstand, respond to, and recover from disruptions. ECB 2020-6 reflects this general definition and supports the application of a more project-specific definition of resilience as the capacity of a component, unit, or system to withstand occasional large overloads (for a definite duration of time) that cause minimal permanent deformation, damage, or cumulative degradation and then recover (within a specified time) its original state and function after the overloading event.

The *2016 Resilience Initiative Roadmap* establishes that resilience thinking will be implemented USACE-wide through the application of the PARA principles and in support of risk-informed decision making. To apply resilience thinking at the project or system level, an evaluation should be performed using the PARA principles during pre-construction designs, engineering during construction designs, and/or during repair/rehabilitation designs as frequently as needed based on engineering judgment and reflective of project complexity and assessed risk.

As the design of the TSP is optimized prior to the final report and during PED, resilience thinking will be applied using the PARA principles to increase resilience at the project level as well as for the overall community. The 100-year adaptation horizon will be considered as the design is optimized.

3.7 Risk and Uncertainty

As an event-based, Monte Carlo life-cycle simulation, Beach-fx fully incorporates risk and uncertainty to evaluate plans under many future scenarios. The Monte-Carlo simulation capability within Beach-fx allows the user to account for uncertainty based in variability in the model results. Each Beach-fx iteration represents a distinct life cycle, with its own simulated storms and unique estimated damages. The distribution of damages and benefits (over the various iterations) can be compared to estimated costs, which provides a picture of uncertainty with regard to net benefits. The selection of the TSP was based on average results from 50 iteration model simulations. Prior to the final report additional iterations will be simulated and additional analysis will be conducted in order to quantify the uncertainty associated with the performance and benefits of the TSP.

An abbreviated Cost Schedule Risk Analysis (CSRA) was completed to address the risks to project implementation and construction (see the Cost Engineering Appendix for additional information). Based

on the results of the analysis, the Jacksonville District identified a recommended contingency value of 31%. This contingency includes risks related to costs for the effect of schedule delay on overall project cost. The project team does not anticipate any high risks associated with the costs of the TSP, and the remaining risks are anticipated to be typical of civil works projects (such as those related to quantity estimates or unforeseen environmental risks). A full CSRA will be conducted prior to the final report and risks will continue to be assessed and managed in the design and construction phases of the project.

Additional risks and uncertainties associated with the implementation of the TSP include:

- The use of new sand sources for the Main Segment TSP that have not previously been used. Additional surveys and analysis to the extent required by applicable laws will be conducted prior to project implementation.
- Local projects to address back bay flooding in the Key Biscayne Segment will need to be implemented in order for the benefits of the TSP to be achieved.
- Public beach access will need to be established in the Key Biscayne Segment for Federal participation in the TSP.
- Easements for the Key Biscayne Segment TSP as described in Section 3.1.6 will need to be obtained in order for the project to be implemented.

3.7.1 Residual Risk

The TSP does not have a specific design level. In other words, the project is not designed to fully withstand a certain category of hurricane or a certain frequency storm event. The proposed project would greatly reduce, but not completely eliminate, future coastal storm risk and damages over the 50-year period of analysis.

In the Main Segment, the TSP is estimated to reduce FWOP damages by 86% based on Beach-fx modeling results. The 14% of residual damage risks will be further analyzed as the TSP design is optimized to reduce residual risks. In the Main Segment, where most of the damages are associated with erosion and the oceanfront structures and infrastructure being protected are located at some of the higher elevations on the barrier island, back bay flooding is not expected to impact the benefits to be achieved by protecting against the ocean side coastal storm risks.

In the Key Biscayne Segment, the TSP is estimated to reduce FWOP damages by 47% based on Beach-fx modeling results. The 53% of residual damage risks will be further analyzed as the TSP design is optimized to reduce residual risks. The Key Biscayne Segment is particularly vulnerable to back bay flooding. The TSP identified for Key Biscayne does not represent a complete plan to reduce coastal flood risks. A plan to reduce back bay flood risks needs to be implemented for the benefits associated with the TSP to be realized. The benefits in this segment are contingent on back bay flood risks being addressed by local interests.

Implementation of the plan for the Key Biscayne Segment is contingent upon local efforts to address back bay flooding such that the benefits for the Key Biscayne Segment are realized; therefore, USACE will

evaluate the engineering and environmental sufficiency of those efforts to determine whether to proceed with construction of this project and whether supplemental NEPA is required. This review will be appropriately documented (Design Documentation Report, Engineering Documentation Report, Letter Report, or Memorandum for Record, etc.) and approved prior to construction of the Key Biscayne Segment. USACE will not construct the Key Biscayne Segment until USACE has determined that the back bay efforts constructed by local interests are constructed in a manner that will allow for achievements of the benefits. NEPA will be updated as appropriate.

In addition to the residual risk for erosion, inundation, and wave attack damages within the focused study area, additional residual risks exist in the vicinity of the project including the following:

- Structures and infrastructure on the backside of the barrier island on which the study area is located, although outside of the focused study area, are susceptible to impacts from storm surge and sea level rise in the future.
- Structures and infrastructure within the project area would continue to be subject to damage from hurricane winds and windblown debris. Even new construction is not immune to damage, especially from these processes.
- Structures and infrastructure within the project area would continue to be subject to damage from rainfall.
- The project purpose is CSRM, and the TSP is not designed to prevent loss of life. Public safety risks can be reduced by actions taken at the local, state, and Federal levels, including established procedures for evacuating prior to significant storm events.

CHAPTER 4:

AFFECTED ENVIRONMENT

4 AFFECTED ENVIRONMENT*

This chapter provides a description of different aspects of the human environment that may be affected by the TSP. Consistent with Council on Environmental Quality (CEQ) Regulation, 40 C.F.R. §1502.15, this chapter focuses on the resource topics most relevant to the TSP under evaluation. This chapter is organized by resource topic and describes both the Main Segment and Key Biscayne reaches. This section is the scientific and analytic basis for the comparisons of the alternatives. Information gathered in this step helps to describe the problems and opportunities, and to forecast future conditions, as discussed in Chapters 2 and 3.

4.1 General Physical Setting

The project area consists of an open sandy coast subject to frequent storm events. Adjacent properties to the shoreline can be categorized as urban and include residential, commercial, and recreational properties. Many factors influence the coastal processes characteristic to the Miami-Dade County, Florida shoreline. Natural factors include winds, tides, currents, waves, storm effects, and SLC. Human-related (anthropogenic) factors include the existing Miami-Dade BEC&HP Project, navigation projects, and development. Detailed information on the physical characteristics and coastal processes in the project area are found in the Engineering Appendix A.

4.2 Natural Environment

4.2.1 Dune and Upland Vegetation

The dune system in south Florida is limited due primarily to the encroachment of development. Much of the dune system in Miami-Dade County is largely artificial, meaning that sand is brought in to the dune system and typically bulldozed to replicate the form of a natural dune system. Dominant plant species in the dune communities include sea grapes, beach morning glory, beach bean, sea oats, dune panicgrass, bay bean, inkberry, sea lavender, spider lily, beach star, and coconut palm.

4.2.2 Fish and Wildlife Resources (Other Than Threatened and Endangered Species)

Wildlife typically seen in the project area includes small mammals and reptiles; migratory and shorebirds; invertebrates, fish, and infaunal and epifaunal species. Coastal shoreline habitats can have low species diversity due to the harshness of the environmental conditions and heavy disturbance and development of the area. However, animals that are able to successfully adapt to these dynamic conditions on coastal shorelines are faced with very little competition from other organisms.

More than 70 species of birds have been observed in the coastal regions of southeast Florida during studies from 1996 to 2005 (Davis et al. 2000; Russell 2005). Bird species observed in the southeast Atlantic Coast are predominantly trans-migrant shorebirds, wading birds, and waterfowl. Federal regulatory protection of most birds falls under the Migratory Bird Treaty Act (MBTA; 16 U.S.C. §§703-712) and the Endangered Species Act (ESA; 16 U.S.C. §1531 et seq.). Birds protected under the MBTA include members

of the seabird guild, which represents a wide range of coastal species. Much of their time is spent in or over water and they are capable of staying far from land for long periods. Most species in this guild are colonial nesters that leave the nest to venture far from natal areas. Some seabirds spend significant portions of their life cycle offshore and may occur in the project area, such as the magnificent frigatebird (*Fregata magnificens*), greater shearwater (*Puffinus gravis*), sooty shearwater (*P. grisseus*), Audubon's shearwater (*P. lherminieri*), manx shearwater (*P. puffiinus*), masked booby (*Sula dactylatra*), northern gannet (*Morus bassanus*), Wilson's storm-petrel (*Oceanites oceanicus*), and band-rumped storm-petrel (*Oceanodrama castro*). Gulls and terns, pelicans, and cormorants divide their time more or less equally between offshore and coastal waters (Ehrlich *et al.* 1988) and may occur in the project area.

Shorebirds nest in the focused project area in significant numbers. These nesting shorebirds lay their eggs in bare sand or shelly areas. Shorebirds sighted in the project area include the Wilson's plover (*Charadrius wilsonia*), sanderling (*Calidris alba*), willet (*Tringa semipalmata*), dunlin (*Calidris alpine*), short-billed dowitcher (*Limnodromus gniseus*), marbled godwit (*Limosa fedoa*), ruddy turnstone (*Arenaria interpres*), black skimmer (*Ranchops niger*), and American oystercatcher (*Haematopus palliates*) (eBird 2021). On beaches, most shorebirds feed on marine worms, insects, mollusks, and crustaceans in tidal sand and mud flats (Sibley 2000; Ehrlich et al 1988).

The fish species most frequently observed while diving in the project area were sheepshead *(Archosargus probatocephalus)*, gag grouper *(Mycteroperca microlepus)*, and sand perch *(Diplectrum formosum)*. Grey snapper *(Lutjanus griseus)* and spottail pinfish *(Diplodus holbrooki)* were also frequently seen (CPE 2004). Other species observed included belted sand fish *(Serranus subligarius)*, black seabass *(Centropristis striata)*, hogfish *(Lachnolaimus maximus)*, lined seahorse *(Hippocampus erectus)*, and snook *(Centropomus undecimalis)*.

Typical beach fauna in the project area includes the mole crab (*Emerita talpoida*), surf clam (*Donax variabilis*) and ghost crab (*Ocypode quadrata*). These and other beach infauna provide food for a wide variety of shorebirds such as plovers (*Charadrius spp.),* willets *(Catoptrophorous semipalmatus*), and ruddy turnstones (*Arenaria interpres*). Drift algae and *Sargassum* stranded on the beach may support large numbers of insects and other invertebrate life. Beyond the beach, polychaetes, gastropods, portunid crabs, and burrowing shrimp are the most abundant fauna in shallow, softbottom habitats. As depth increases, these habitats are dominated by amphipods, polychaetes, and bivalves (*Donax* sp., *Tellina* sp.) (Dial Cordy 2002). The benthic communities that occur within the borrow areas are dominated by soft bottom organisms including lugworms and mollusks. Mobile fauna includes sand dollars, sea stars, and urchins (Dial Cordy 2009).

4.2.3 Threatened and Endangered Species

The list of threatened and endangered (T&E) species developed for this EA were compiled from the *2020 SARBO,* the *2015 Statewide Programmatic Biological Opinion for Shore Protection Activities along the Coast of Florida (SPBO),* the *2013 Programmatic Piping Plover Biological Opinion for Shore Protection Activities in the Geographical Region of the North and South Florida Ecological Services Field Offices*

(P3BO), as well as project specific biological assessments and biological opinions prepared for previous projects which have taken place in the vicinity of the proposed project.

T&E species protected under the ESA that may occur in the focused project area and potentially be affected by the proposed work are found in **Table 4-1**.

Table 4-1. ESA listed species potentially present in the study area. Species previously consulted on in the 2016 LRR/EA are highlighted in bold.

Common Name	Scientific Name	Coordinating Agency	Federal Status
Green sea turtle[1]	***Chelonia mydas***	**NMFS / USFWS**	**Threatened**
Hawksbill sea turtle	***Eretmochelys imbricata***	**NMFS / USFWS**	**Endangered**
Leatherback sea turtle	***Dermochelys coriacea***	**NMFS / USFWS**	**Endangered**
Loggerhead sea turtle	***Caretta caretta***	**NMFS / USFWS**	**Threatened**
Kemp's ridley sea turtle	***Lepidochelys kempii***	**NMFS**	**Endangered**
American crocodile	*Crocodylus acutus*	USFWS	Threatened
Florida manatee	***Trichechus manatus latirostris***	**USFWS**	**Threatened**
Blue whale	***Balaenoptera musculus***	**NMFS**	**Endangered**
Fin whale	***Balaenoptera physalus***	**NMFS**	**Endangered**
Humpback whale	***Megaptera novaeangliae***	**NMFS**	**Endangered**
North Atlantic right whale[D]	***Eubalaena glacialis***	**NMFS**	**Endangered**
Sei whale	***Balaenoptera borealis***	**NMFS**	**Endangered**
Sperm whale	***Physeter macrocephalus***	**NMFS**	**Endangered**
Johnson's seagrass	*Halophila johnsonii*	NMFS	Threatened
Beach jacquemontia	*Jacquemontia reclinata*	USFWS	Endangered
Piping plover	*Charadrius melodus*	USFWS	Threatened
Rufa red knot	*Calidris canutus rufa*	USFWS	Threatened
Least tern	**Sterna antillarum**	**USFWS**	**Threatened**
Smalltooth sawfish	***Pristis pectinata***	**NMFS**	**Endangered**
Nassau grouper	*Epinephelus striatus*	NMFS	Threatened
Oceanic whitetip shark	*Carcharhinus longimanus*	NMFS	Threatened
Giant manta ray	*Manta birostris*	NMFS	Threatened
Pillar coral	***Dendrogyra cylindrus***	**NMFS**	**Threatened**
Rough cactus coral	***Mycetophyllia ferox***	**NMFS**	**Threatened**
Lobed star coral	***Orbicella annularis***	**NMFS**	**Threatened**
Mountainous star coral	***Orbicella faveolata***	**NMFS**	**Threatened**
Boulder star coral	***Orbicella franksi***	**NMFS**	**Threatened**
Elkhorn coral[D]	***Acropora palmata***	**NMFS**	**Threatened**

Common Name	Scientific Name	Coordinating Agency	Federal Status
Staghorn coral[D]	***Acropora cervicornis***	**NMFS**	**Threatened**

[1] North Atlantic distinct population segment (DPS); [2] South Atlantic DPS; [D] Designated Critical Habitat (DCH)

Information on presence and biology of the listed species under USFWS jurisdiction that were previously consulted on can be found in the 2016 LRR/EA and this project's consultation documents. Information on the presence and biology of the listed species under NMFS jurisdiction that were previously consulted on can be found in the 2016 LRR/EA and the 2020 SARBO.

Information on the presence and biology of the listed species under USFWS or NMFS jurisdiction that were not previously consulted on are provided below and in the SARBO:

USFWS

American Crocodile (Crocodylus acutus)

The American crocodile (*Crocodylus acustus*) is endemic to the United States and inhabits mostly low-energy bays, creeks, and inland swamps in extreme South Florida, the Caribbean, Mexico, Central America and northern South America. The species was listed as endangered by the USFWS in 1975 (40 FR 44151), and in March 2007, the USFWS reclassified the American crocodile from endangered to threatened. Although designated critical habitat (DCH) was identified in 1979 in the extreme southern portion of Florida (44 F.R. 75076), no DCH is present in the project area.

Feeding typically occurs shortly before sunset to just after sunrise and consists of opportunistic foraging for any animals they can catch and easily overpower. Nesting habitat includes sandy shorelines, creek banks adjacent to deep water, or manmade structures, such as canal berms. Males establish and defend breeding territory from late February through March. Females select a nest site and typically clutch size ranges from as few as eight to as many as 56 eggs. Hatchlings are about 10 inches and yellowish-tan in color with cross markings that fade as they grow. Adults are typically greenish-gray with black mottling and can be over 14 feet long.

Beach Jacquemontia (Jacquemontia reclinata)

Jacquemontia reclinata is commonly known as beach jacquemontia or beach clustervine. This species is a perennial vine with a woody base and non-woody, twining stems up to six feet long. Leaves are fleshy, rounded or egg-shaped and approximately 1-inch long with blunted or indented tips. Flowers are white or pinkish, 1-inch across, and deeply five-lobed with a short tube. *Jacquemontia reclinata* is endemic to the coastal barrier islands in southeast Florida from Palm Beach to Miami-Dade Counties (Johnson et al. 1992).

Jacquemontia reclinata was listed as federally endangered in 1993 (58 F.R. 62046). The majority of habitat, coastal beach strand, has been destroyed or lost due to residential and commercial construction, development of recreational areas, and beach erosion. This species is further threatened by invasion of exotic plant species including Australian pine, carrotwood, Brazilian pepper, and turf grass. All but one of

the wild populations in Florida exist on public lands in parks or conservation areas (USFWS 2007). Surveys indicate that studied populations were declining in total number of individuals; total area occupied and stem density (Maschinski et al. 2005; 2006). Protection and management of this species involves removal of exotics, protecting coastal habitats from development by conservation purchases or easements, and establishing new populations of this species in protected areas (Chafin et al. 2012). Reintroductions of *J. reclinata* have increased the number of plants in the wild, although survival after transplant is variable (2-98%) (Maschinski and Wright 2006) due to mortality caused by human and natural factors. Major threats to survival of this species include highly fragmented habitat due to coastal development and associated reproductive isolation that hinders genetic variability and reproduction (USFWS 2007).

Piping Plover (Charadrius melodus)

The piping plover (*Charadrius melodus*) Atlantic Coast and Northern Great Plains populations were listed as threatened in 1985 (50 FR 50726). Piping plovers are generally found on sandy beaches on the Atlantic Coast and Great Lakes as well as sandbars along major rivers on the northern Great Plains. While most shorebirds have a wide distribution, the piping plover barely extends into Mexico during the winter (Audubon, 2018). Piping plovers are foragers and feed on prey such as insects, marine worms, and crustaceans. Nests are shallow scrapes in open ground with no direct shelter or shade.

Although critical habitat was designated for the species in 2001 (66 FR 36038), there is no DCH in the project area. The project area includes habitat that could be suitable for use by piping plover but it is not considered optimal habitat due to the level of disturbance (i.e. beach access, recreation use, etc.) at the Main Segment's beaches. According to eBird.org (an online database launched by the Cornell Lab of Ornithology and National Audubon Society), piping plover were sighted in September 2021 at Crandon Park, which is located north of the Key Biscayne project area (eBird 2021).

Rufa Red Knot (Calidris canutus rufa)

The rufa subspecies of the red knot (*Calidris canutus rufa*) was listed as threatened in 2014 (79 FR 73705) and is a small shorebird that can occur along the Atlantic and Gulf coasts during its migration. It is also known to overwinter in low numbers along both coasts. Florida is home to the largest concentration of wintering rufa in the U.S. (Schwarzer et al. 2012). In migration and winter, it prefers coastal mudflats, tidal zones, and sometimes open sandy beaches where it feeds on small invertebrates such as small mollusks, marine worms, and crustaceans (Kaufman 1996).

Critical habitat has not been designated for this species. The project area includes habitat that could be suitable for use by rufa red knot, but it is not considered optimal habitat due to the level of disturbance (i.e. beach access, recreation use, etc.). According to eBird, two rufa red knots were sighted at Crandon Park in September 2021 (eBird 2021).

<u>NMFS</u>

Nassau Grouper (Epinephelus striatus)

Nassau grouper was listed as threatened in 2016 (81 FR 42268). It is a top predator in reef systems and is slow growing and long lived. Although considered a reef fish, it transitions through a series of ontogenetic

shifts of both habitat and diet. Juveniles are found in nearshore, shallow waters whereas adults are most abundant on high relief coral reefs or rocky substrate in clear water. Both adults and juveniles will use natural or artificial reefs. Nassau grouper reproduce during annual aggregations in which large numbers will collectively spawn (NMFS 2013).

Oceanic Whitetip Shark (Carcharhinus longimanus)
The oceanic whitetip shark, named for its distinctive pattern of mottled white markings on the tips of the dorsal, pectoral, and tail fins, was listed as threatened by NMFS in 2018 (81 FR 4153). DCH has not been designated for this species. A highly migratory species, the oceanic whitetip shark has a worldwide distribution and can be found in tropical and subtropical waters. Generally remaining offshore, oceanic whitetip sharks are considered surface-dwelling, preferring the surface mixed layer of warm waters, but can also be found offshore in the open ocean on the outer continental shelf (OCS) or around oceanic islands in deep water.

Considered a top predator, their diet is opportunistic and generally consists of cephalopods and ray-finned fish as well as sea birds, marine mammals, other sharks and rays, and crustaceans. The reproductive cycle is thought to be biennial, and females may give birth to litters ranging from 1-14 pups, depending on the female's size. Lifespan is thought to average approximately 19 years, but some individuals may live over 30 years.

Giant Manta Ray (Manta birostris)
Listed as threatened by NMFS in 2018 (83 FR 2916), the giant manta ray is the world's largest ray with a 29-foot wingspan. Easily recognizable by their large body and elongated wing-like pectoral fins, this species is a filter feeder and eats large amounts of zooplankton. Although migratory, this species has small, fragmented populations that are distributed sparely across the world and can be found in tropical, subtropical, and temperate waters, commonly offshore in oceanic waters or near productive coastlines.

This species uses a wide range of depths for feeding, from approximately 30 feet to over 3,000 feet deep. Generally solitary, giant manta rays will aggregate to feed and mate. Although these rays have been reported to live at least 40 years, this species has one of the lowest reproductive rates at one pup every two to three years.

4.2.4 Essential Fish Habitat

This section describes the existing conditions for the study area's Essential Fish Habitat (EFH), federally managed fisheries, and associated species such as major prey species, including affected life history stages. The Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA; 16 U.S.C. §1801 *et seq.*), as amended by the Sustainable Fisheries Act of 1996, requires Federal agencies to consult with NMFS for spawning, breeding, or growth to maturity (South Atlantic Fish Management Council (SAFMC) 1998).

The SAFMC designated seagrasses, corals, coral reefs, hardbottom, and unconsolidated sediments as EFH. Hardbottom habitats are EFH for coral, red grouper (*Epinephelus morio*), gag grouper (*Mycteroperca*

microlepis), gray snapper (*Lutjanus griseus*), mutton snapper (*L. analis*), white grunt (*Haemulon plumieri*), and spiny lobster (*Panulirus argus*). Unconsolidated habitats are EFH for cobia (*Rachycentron canadum*), black seabass (*Centropristis striata*), king mackerel (*Scomberomorus cavalla*), Spanish mackerel (*S. maculates), spiny lobster, and pink shrimp (Farfantepenaeus duorarum).*

Pursuant to the MSFCMA, as amended by the Sustainable Fisheries Act of 1996 (Public Law 104-297), the Integrated Feasibility Report and Environmental Assessment is prepared consistent with the Finding between USACE and NMFS Southeast Regional Office regarding the coordination of EFH consultation requirements with NEPA (NMFS, 1999 (revised 2000)). The 2016 LRR/EA analyzed the effects of dredging and beach placement on EFH in the Main Segment project area. That analysis is incorporated by reference.

All demersal fish species under SAFMC management that associate with coral habitats are addressed in the fishery management plan for snapper-grouper species and include some of the more commercially and recreationally valuable fish of the region. All of these species show an association with coral or hardbottom habitat during their life history. In groupers, the demersal life history of almost all *Epinephelus* species, several *Mycteroperca* species, and all *Centropristis* species, takes place in association with coral habitat (SAFMC 2009). Coral, coral reef and hardbottom habitats benefit fishery resources by providing food or shelter (SAFMC 1983).

Hardbottom Habitats and Coral Reefs

SAFMC also designated corals, coral reefs, hardbottom and seagrass, as Habitat Areas of Particular Concern (HAPCs). HAPCs are a subset of EFH that are either rare, particularly susceptible to human-induced degradation, important ecologically, or located in an environmentally stressed area. Hardbottoms provide substrate for benthic organisms, crevices where organisms can seek protection, and foraging habitat for a number of aquatic species. Hardbottoms can be of various types, artificial or natural, such as reefs, with high and/or low relief, and can be of any shape. In light of their designation as EFH-HAPC's and Executive Order (E.O.) 13089 (Coral Reef Protection), NMFS applies greater scrutiny to projects affecting corals, coral reefs, hardbottom, and seagrass to ensure practicable measures to avoid and minimize adverse effects to these habitats are fully explored.

Stony Coral Tissue Loss Disease (SCTLD) Outbreak

Since 2014, the Florida Reef Tract, which extends from Port St. Lucie to Key West, Florida, has been experiencing the most widespread and lethal coral disease outbreak in the world. While originally thought to be a white-plague-disease (Precht et al. 2016), the current case definition assigns the name *Stony Coral Tissue Loss Disease* (SCTLD)[3]. This disease outbreak is unprecedented in terms of the large geographic range, duration of the outbreak, number of species affected (22 species)[4], high rates of transmission and mortality, and considerably high prevalence, e.g., within certain species, disease is seen in 66 to 100 of every 100 colonies surveyed whereas background levels of disease in Florida is typically two to three of

[3] https://nmsfloridakeys.blob.core.windows.net/floridakeys-prod/media/docs/20181002-stony-coral-tissue-loss-disease-case-definition.pdf cited herein Case definition.

[4] https://floridadep.gov/sites/default/files/Coral-Disease-Outbreak-FAQ_v5.2.pdf

every 100 colonies (FDEP 2018). Hundreds of millions of corals have died from this outbreak so far, including all known colonies of pillar coral (*Dendrogyra cylindrus*), listed as threatened under the Endangered Species Act, in southeast Florida, Biscayne National Park, and the Upper Keys (FDEP 2018). The disease has since spread to other Caribbean reefs in Mexico, Jamaica, St. Maarten, Dominican Republic, and St. Thomas in the U.S. Virgin Islands[5]. It is likely that increases in coral disease incidence results from not a single abiotic or biotic factor, but rather the prolonged and multiplicative effect of simultaneous stressors (Vega-Thurber et al. 2009).

While SCTLD may not have reached outbreak status until the Fall of 2014, the disease was present in the Port of Miami area several months earlier. A knobby brain coral (*Pseudodiploria clivosa*), now known to be highly susceptible to SCTLD[6], was the first coral recorded to have SCTLD in the Miami area along the Nearshore Ridge Complex south of the federal channel (HBSC1, T3 C5)[7]. By fall of 2015 widespread disease had been confirmed across approximately 55 miles of reef, including locations as far north as Pompano Beach (Broward County) and as far south as Biscayne National Park. Disease continued to spread into the Florida Keys throughout 2016, and by summer of 2017 reports of widespread disease were confirmed as far north as St. Lucie Inlet (Martin County) and to the southern boundary of the upper Keys. By 2018 the disease had reached Looe Key in the lower Keys, and in 2019 it continued to spread southward into the Lower Keys. As of 2020, SCTLD continues to spread through the Florida Keys (**Figure 4-1**). For the most up to date information, refer to https://floridakeys.noaa.gov/coral-disease/disease.html

[5] http://www.agrra.org/where-is-this-occurring/
[6] Case definition
[7] DC&A response to Port of Miami Request for Information tracker item #64b

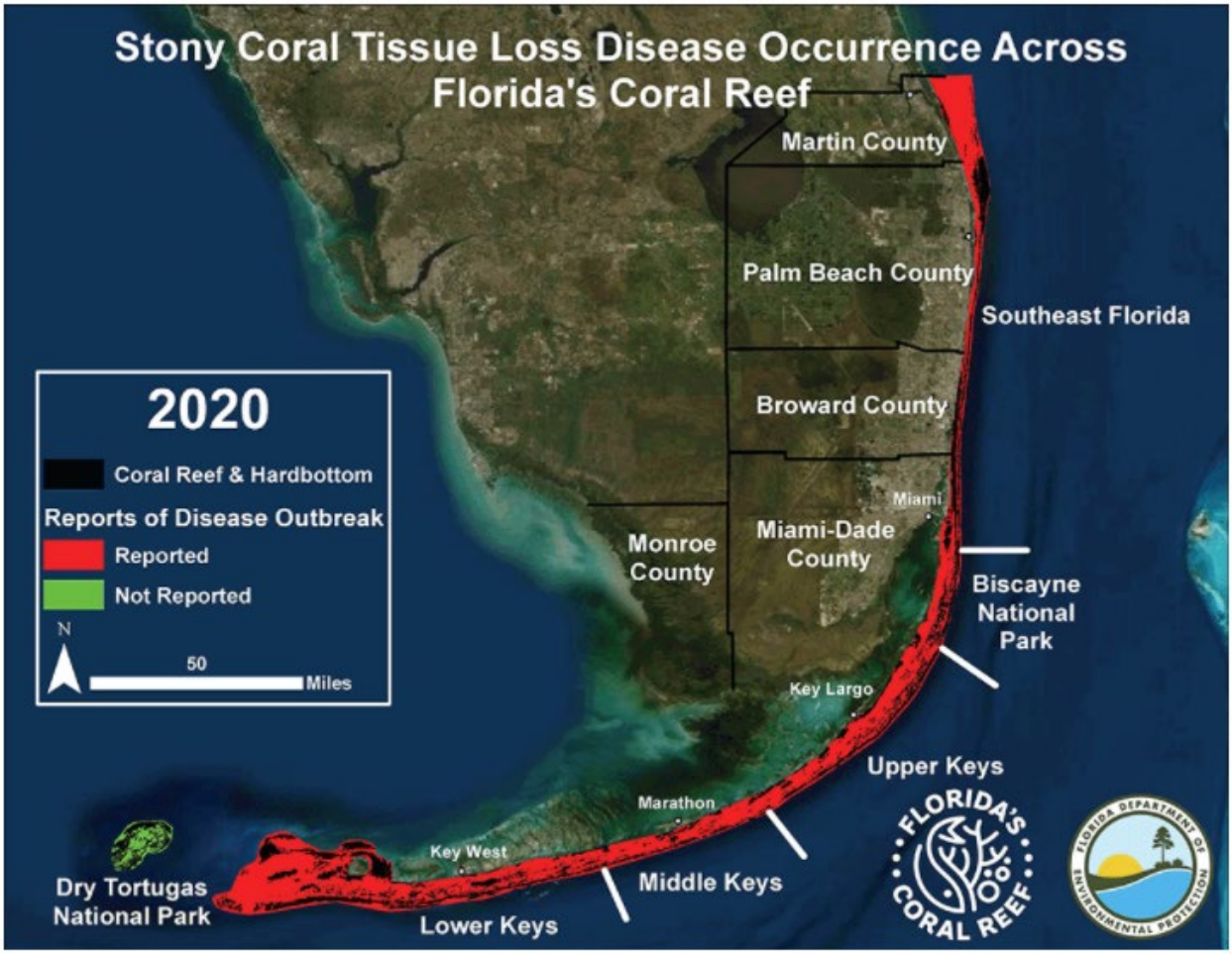


Figure 4-1. Extent of coral disease outbreak across the Florida reef tract, which includes Miami-Dade County, where the project is located. SOURCE: https://floridakeys.noaa.gov/coral-disease/disease.html

Recent Surveys

Miami-Dade County's DERM periodically conducts surveys to identify the location of hardbottom habitats in the Main Segment. Based on recent surveys, DERM identifies these areas as being exposed hardbottom, spoil rubble, and/or dense algae. In Reach 1, the nearshore edge between R-27 to R-32 was resurveyed in 2020 in anticipation of renourishment of Bal Harbour. R-32 to R-37 was surveyed in 2018. The closest hardbottom in Reach 1 is located as near as approximately 600 feet from the shoreline (**Figure 26**). Hardbottom is also present in the northern portion of Reach 2 (between approximately R-40 to R-45). R-40 to R-64 was surveyed by DERM in 2019. The closest hardbottom in Reach 2 is located as near as approximately 800 feet from the shoreline (**Figure 4-2**)**.** USACE conducted a geophysical survey of Key Biscayne in May 2021. This survey did not identify hardbottom within the Key Biscayne project area.

Figure 4-2. Hardbottom located in the vicinity of Planning Reach 1.

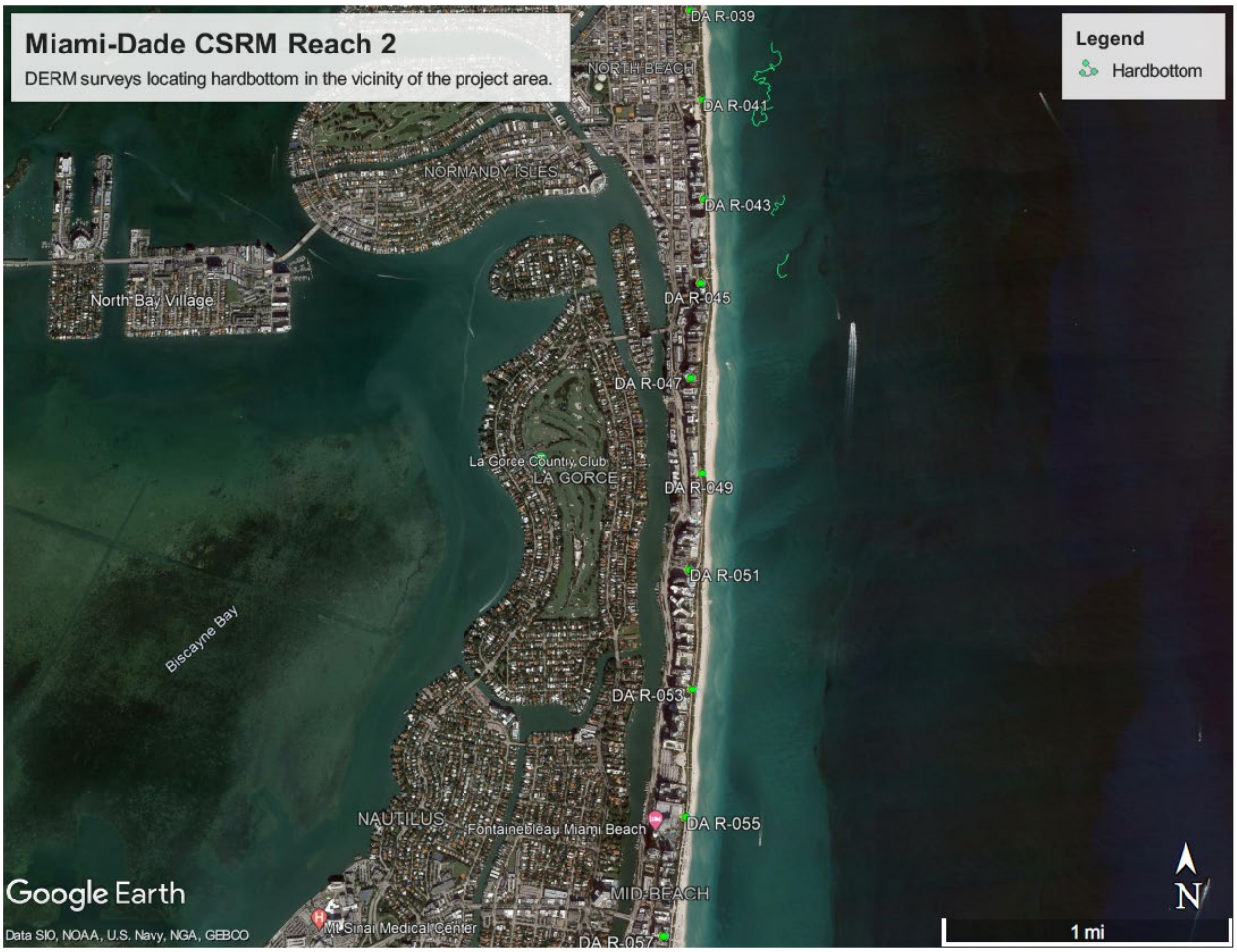


Figure 4-3. Hardbottom located within the vicinity of Planning Reach 2.

Seagrasses

The nearshore environment of the Main Segment is typically dynamic and does not support seagrass growth; however, seagrass habitat is located within the Key Biscayne reach. A survey was conducted in June 2021 to determine seagrass coverage and presence of species, especially Johnson's seagrass, in the project area. The Braun-Blanquet method was used to determine the average cover abundance score. Approximately 77% of the quadrats surveyed contained seagrass coverage. Seagrass species observed during the survey include *Thalassia testudinum, Halodule wrightii, Syringodium filiformii,* and *Halophila englemannii* (**Figure 4-4**)**.** Johnson's seagrass was not present in the survey area.

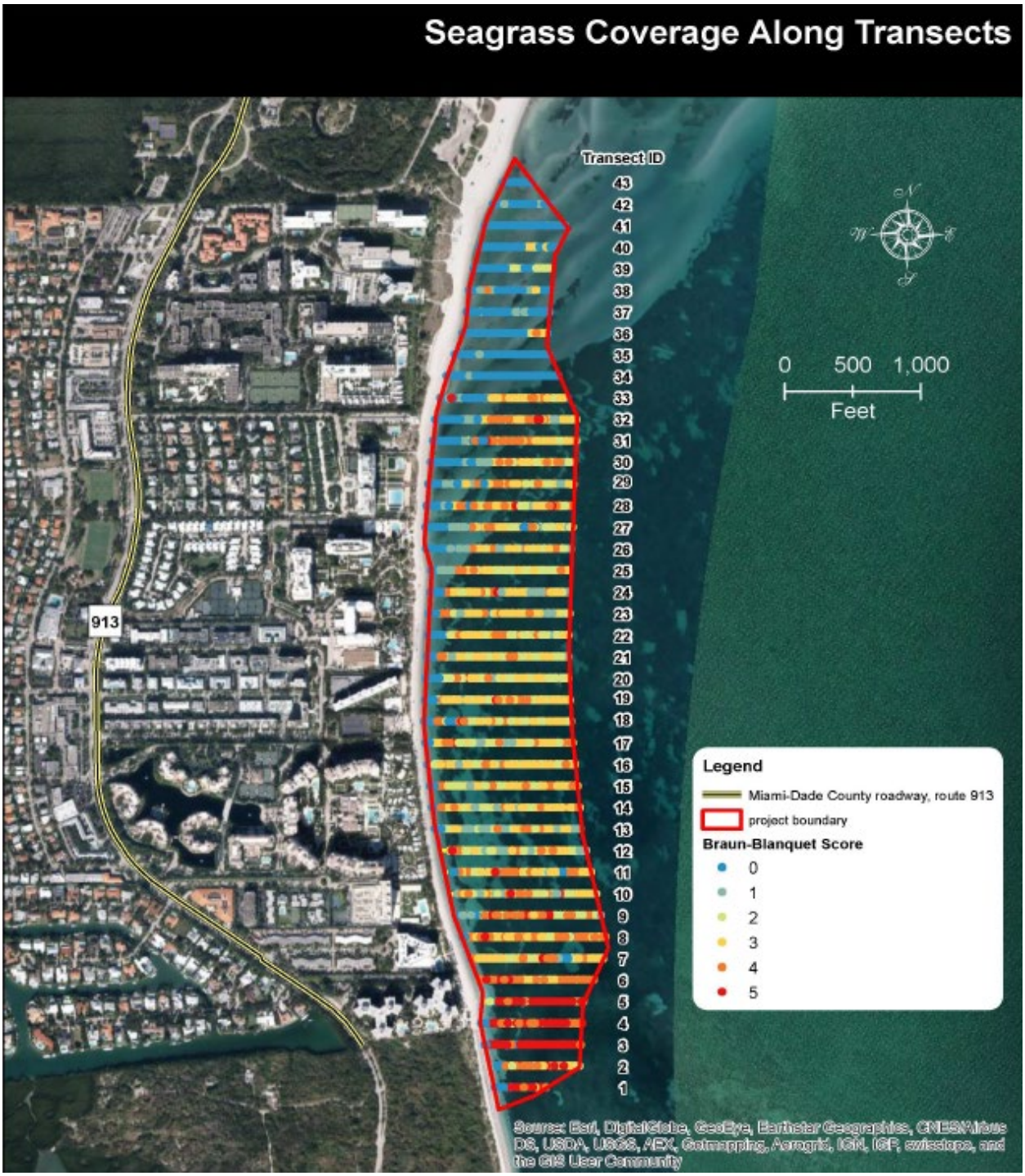


Figure 4-4. Seagrass coverage at Key Biscayne (Reach 4).

4.2.5 Coastal Barrier Resources

The Coastal Barrier Resources Act (CBRA) of 1982 (16 U.S.C. §3501 *et. seq.*) and the Coastal Barrier Improvement Act (CBIA) of 1990 (PL 101-591) limit Federally-subsidized development within the CBRA Units to limit the loss of human life by discouraging development in high risk areas, to reduce wasteful expenditures of Federal resources, and to protect the natural resources associated with coastal barriers. CBIA provides development goals for undeveloped coastal property held in public ownership, including wildlife refuges, parks, and other lands set aside for conservation ("otherwise protected areas," or OPAs). These public lands are excluded from most of the CBRA restrictions, although they are prohibited from receiving federal flood insurance for new structures.

Three Coastal Barrier Resource System (CBRS) Units classified as OPAs are located adjacent to the project area (**Figure 4-5** and **Figure 4-6**). Immediately north of Bakers Haulover Inlet is FL-21P (Haulover Beach). To the north of the Key Biscayne reach is FL-22P (Virginia Beach/Crandon Park) and to the south is FL-23P (Cape Florida).

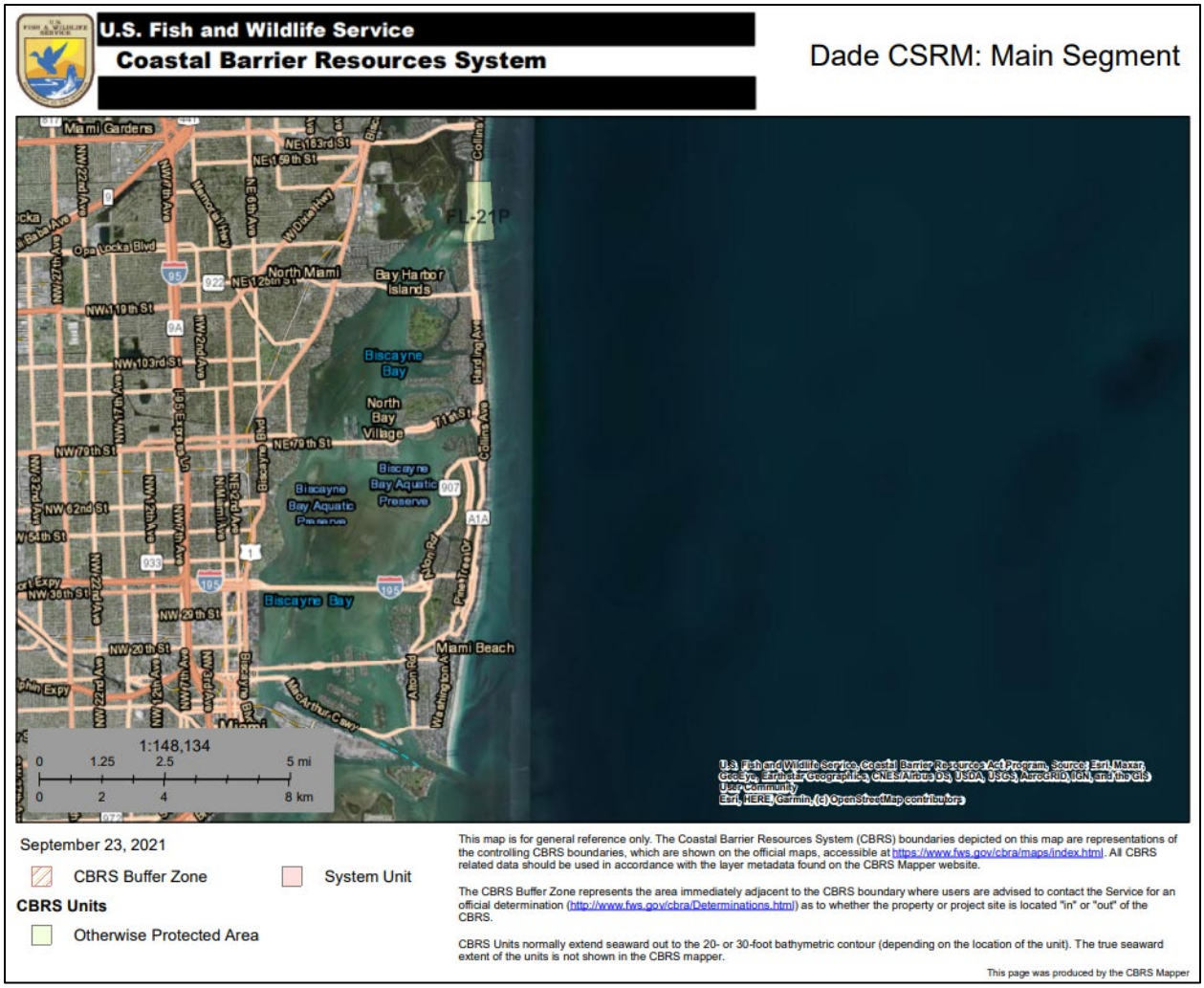


Figure 4-5. Location of CBRS Unit OPA FL-21P in the vicinity of the Main Segment Reach 1.

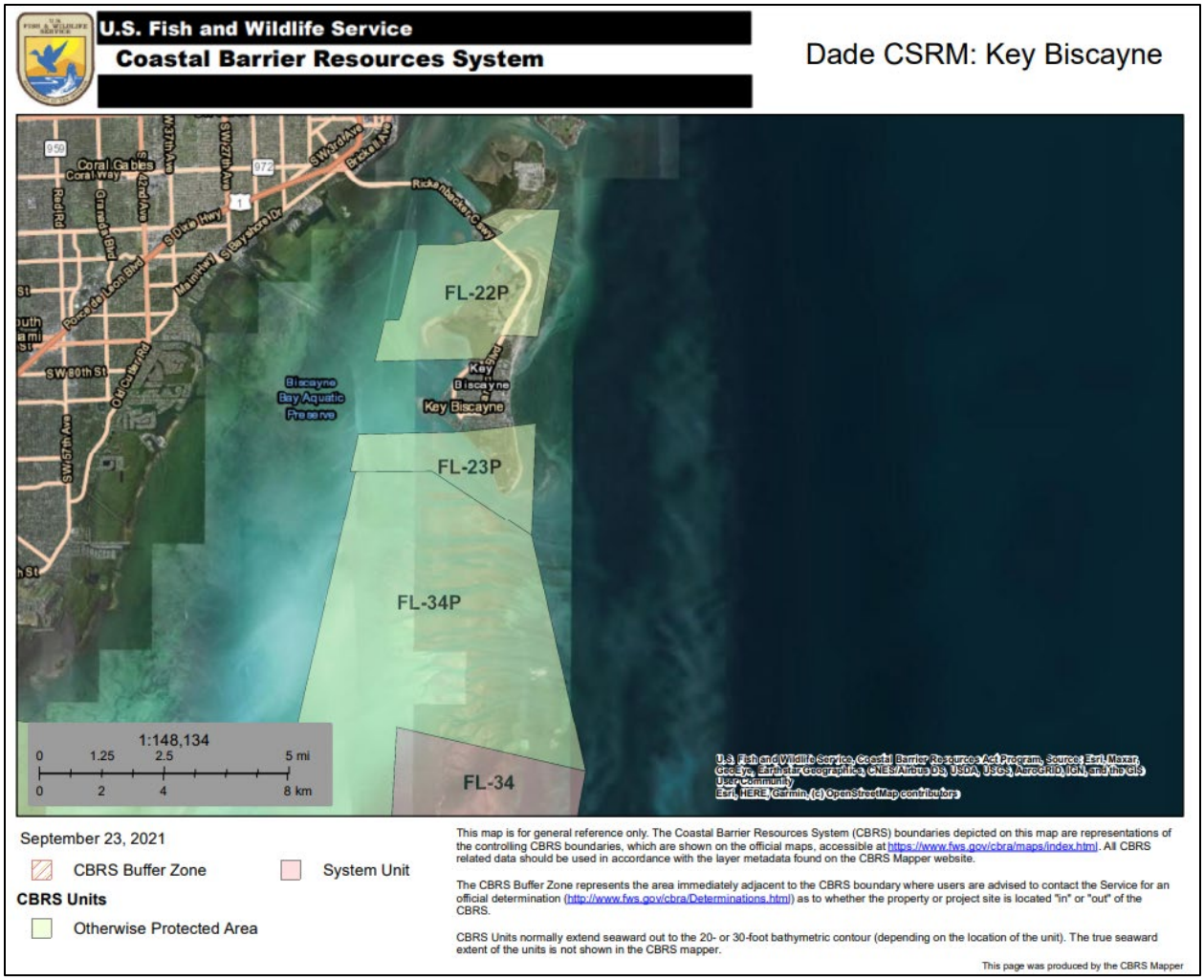


Figure 4-6. Location of CBRS Units OPAs FL-22P and FL-23P in the vicinity of the Key Biscayne reach.

4.2.6 Water Quality

The State of Florida lists the majority of the waters in the project area as Class III, which is suitable for recreation and the propagation and management of fish and wildlife. Portions of the project area are located within or near the Biscayne Bay Aquatic Preserve, which is state-designated as an Outstanding Florida Water (OFW)(**Figure 4-7**). An OFW is a water designated worthy of special protection because of its natural attributes and this designation is intended to protect existing good water quality. OFWs are managed by the state or federal government (FDEP, 2020).

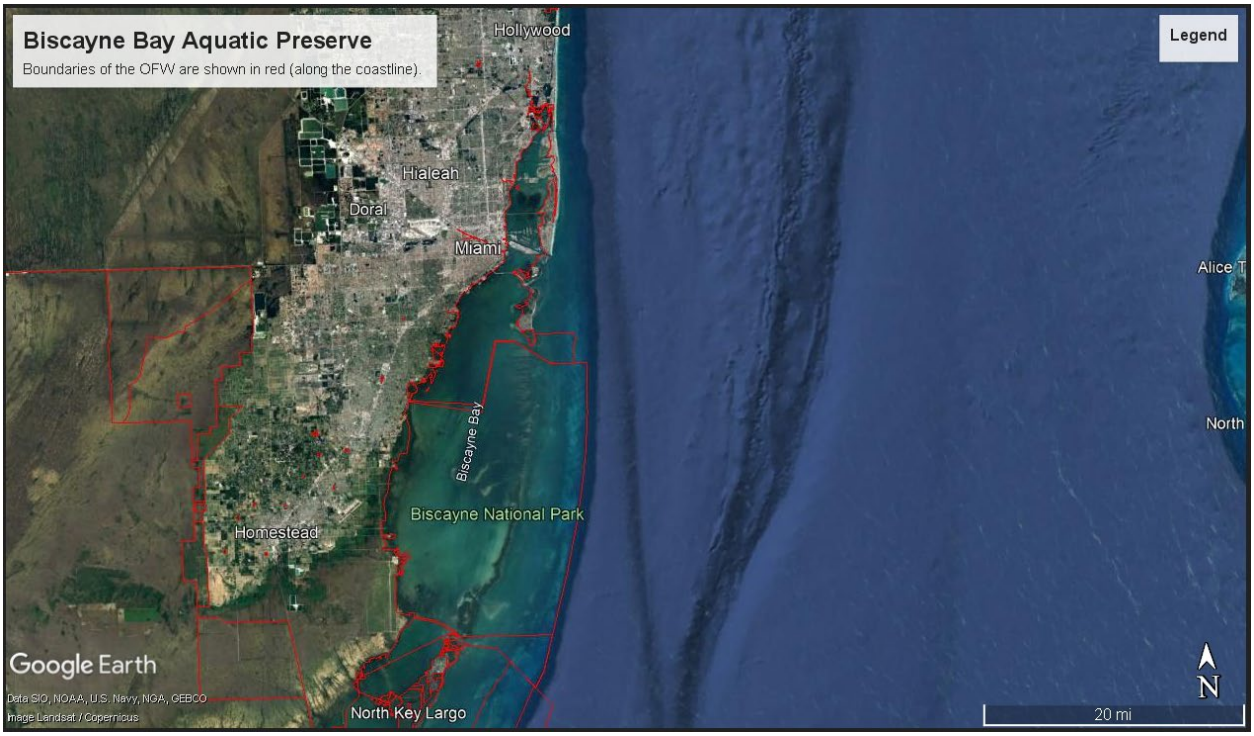


Figure 4-7. Location of Biscayne Bay Aquatic Preserve.

The project area is the east facing Atlantic Ocean shoreline with sandy beach, high energy wind and wave environment, a high salinity surf zone and no anoxic pits. Anoxic conditions are not created in the project area due to the high wave energy environment. The project area is a sandy, high energy coastline. The beach is predominantly poorly graded, fine-grained quartz and carbonate sand. Due to the high energy conditions found along the project area, sand is continuously re-suspended in the water column with each breaking wave. This re-suspension of sediment results in generally highly turbid conditions in the nearshore region of the project area. The FDEP regulates water quality in Florida, and requires stringent water quality monitoring during dredging and beach fill operations.

4.2.7 Hazardous, Toxic, and Radioactive Waste

The coastline within the project area is located adjacent to predominantly residential, commercial, and recreational areas. The project area contains high-energy littoral zones and the materials used for nourishment contain particles with large grain sizes that do not normally absorb contaminants. Additional information on Hazardous, Toxic, and Radioactive Waste (HTRW) is included in the Engineering Appendix.

4.2.8 Air Quality

The project area is in the Southeast Florida Intrastate Air Quality Control Region, as established by 40 CFR § 81.49. USEPA (40 CFR § 81.310) designates air quality compliance on a county level. A review of USEPA data indicates that the project area (Miami-Dade County) is in attainment status for all of the criteria pollutants. The two counties inshore of the OCS (Martin and St. Lucie) are both considered as being in

attainment with National Ambient Air Quality Standards for ozone, nitrogen dioxide, carbon monoxide; total suspended particulates, and sulfur dioxide. USEPA has not established air quality standards for Federal waters.

4.2.9 Noise

Ambient noise levels in the project area are low to moderate. The major noise producing sources are breaking surf and adjacent residential and resort areas. Ambient sources of noise within the project area are recreational activities (boating and fishing), commercial vessels transiting up and down the coast, and natural sounds from the physical and biological environment.

4.2.10 Aesthetic Resources

The aesthetics of an area are considered the visual resources in the area, in this case the open ocean and marine life in the vicinity. The project area possesses visually pleasing attributes, including the waters and beaches of the Atlantic Ocean The project area is developed along the majority of its length.

4.2.11 Recreation Resources

Recreational uses of the project area are for swimming, fishing, surfing, sun bathing, scuba diving, and boating. These recreational uses are used year round with an increase in tourism in the winter months. The project area has public access and receives heavy use by swimmers and sunbathers. Adjacent to these beaches are many condominiums and hotels used by long-term and short-term visitors and residents of the area. Commercial enterprises along the beach rent beach chairs, cushions, umbrellas, and jet skis. Food vendors can also be found along the beach areas. The revenue generated by beachgoers supports a strong business district in the project vicinity. The high diversity of fish species in this area supports sport and recreational fishing opportunities. Both offshore fishing and diving utilize the natural and artificial reefs located within and adjacent to the project area.

4.2.12 Safety and Navigation

Navigation in the project area is generally limited to watercraft used for commercial enterprises (e.g., fishing) and recreational activities (fishing, sailing, jet skiing, pleasure boating, etc.). A portion of the AIWW is located at the BHI Complex. Over time, the channels in this area shoal and require dredging to maintain safe vessel passage through Bakers Haulover Inlet.

4.2.13 Cultural Resources and Historic Properties

The coastal areas of Miami-Dade County, including the nearby Key Biscayne Bay, have been subject to nearly five centuries of European seafaring activity, and have accommodated prehistoric occupation supporting a rich diversity of cultures and environmentally adaptive settlement for over 10,000 years. This dynamic history is manifest in the material culture represented by the plethora of submerged and terrestrial archaeological sites that have already been discovered, or have yet to be discovered in the county. These cultural resources include shipwrecks, prehistoric camps and villages, historical buildings

and residences, and other anthropogenic modifications in the cultural landscape and environment that constitute the archaeological record of this coastal region of Florida.

The earliest prehistoric inhabitants in the area were Paleo-Indian hunters and gatherers. These were the earliest populations to inhabit the Americas from the terminal Pleistocene epoch to the early Holocene. These peoples were known to share a pan-hemispheric cultural system, exhibiting remarkable similarities in cultural traits with other groups of this period that appear throughout North and South America. The Paleo-Indians thrived in a climate significantly cooler and drier than the present. They are characterized as consisting of highly mobile bands of large-game hunters utilizing lanceolate projectiles ranging from skillfully fluted to unfluted varieties. The subsistence strategy of the Paleo-Indian Period gave way to new Archaic Period strategies that were increasingly dependent on agriculture. The Archaic traditions eventually developed into the unique cultural affiliations identified temporally as Orange, Manasota, Weeden Island, and Safety Harbor.

Paleoindian and early Archaic artifacts have been found across Miami-Dade County. Shell mounds, middens, and burial mounds indicate that many areas were used repeatedly (either seasonally or annually) and other areas were continuously inhabited by moderately sized populations of aboriginal inhabitants. The surrounding environment is rich in natural resources and is considered to have a high probability for containing prehistoric sites.

Juan Ponce de Leon made the first "authorized" discovery of Florida in 1513 (Griffen 1947; Turner 2013). Prior to this documented voyage, it is assumed that the Spanish used Florida as a staging ground to capture slaves and possibly provision their ships, as had been practiced extensively in the Bahamas for some time. The specific location of Ponce de Leon's initial landfall remains unknown but judging from the latitude recorded in his log the prior day, it would have been somewhere close to present-day Ponte Vedra north of St. Augustine. He claimed the land for Spain and named it *La Florida*. He then explored south along the coast, around the Florida Keys and north up the west coast of the Florida Peninsula before returning to Puerto Rico. Ponce de Leon, like other conquistadors in the Americas, was primarily searching for gold, Indians to enslave, and land to govern under the Spanish crown. After Ponce de Leon, a series of increasingly ambitious Spanish expeditions led by Panfilo de Narvaez (1528), Hernando de Soto (1539 - 1540), and finally Tristan de Luna (1559) explored Florida and parts of the southeastern United States (Meide et al 2010).

Throughout the past, many shipwrecks that have been known to have been lost in the vicinity of Miami-Dade County. Considering the extensive, maritime-related history of the Miami-Dade region, much attention has been given to the archaeological and historical resources of the coastal areas. Archival research and cultural resource surveys have been conducted off the Miami-Dade County shoreline, portions of the IWW, and within several coastal inlets. Many investigations were conducted specifically in the Miami-Dade Harbor region due to the extensive dredging and construction projects. The majority of the surveys were conducted for USACE-related projects. While the Miami-Dade region existed on the periphery of colonial activity for much of Florida's history, Miami Harbor as an inlet provided ships with access to the sheltered waters of Biscayne Bay since the dawn of European exploration and colonization.

While some distance from commonly used Key West Harbor, the inlet has always been repeatedly used for stray vessels seeking refuge from storms or needing access to the interior for taking on food or water or for other purposes. While ships can always be lost at sea due to a variety of reasons, Florida shipwrecks tend to be found in the vicinity of inlets for vessels seeking inland waters and typically feature sandbars, currents, and shallows that can prove treacherous for mariners unfamiliar with the local environment.

A search of the Florida Master Site File identified 1,433 historic structures, 13 bridges, 12 archaeological sites, 31 resource groups (districts, roads, railroads), 8 historic properties listed on the National Register of Historic Places within one mile of the Project area. A total of 69 cultural resources surveys have been conducted within this area. The twelve archaeological sites are identified as BD04775, BD04822, DA00005, DA00022, DA05248, DA05921, DA05922, DA06446, DA06447, DA06448, and DA06764. Of these resources, archaeological sites 8DA05921, 8DA05922, and 8DA05428 are plotted as being within a general vicinity location that may potentially be adversely impacted by construction of the northern tie-back wall. The North Shore Historic District (8DA11654) and the Collins Waterfront Architectural District (8DA11867) are listed on the National Register of Historic Places and located within 1,000 feet of the project beach nourishment. Archaeological site 8DA11417, a prehistoric campsite, is also located within 1,000 feet of the Project beach nourishment.

4.2.14 Native Americans

No portion of the proposed action is located within or adjacent to known Native American-owned lands, reservation lands, or Traditional Cultural Properties. However, Native American groups have lived throughout the region in the past and their descendants continue to live within the State of Florida and throughout the United States.

There are two federally recognized tribes within Florida: the Miccosukee Tribe of Indians of Florida and the Seminole Tribe of Florida. Both tribes share a long history of inhabiting the project area and maintain continued traditional and cultural practices in the region. These tribes regard the indigenous population of Florida as their ancestors. Readers should note that neither tribe has landholdings within the project area. Both tribes migrated into the region from Georgia and Alabama during the 18th and 19th centuries - fleeing the U.S. Army and evading the forced relocation policies of the Indian Removal Act (1830). Many of these groups moved into the swamp areas of southern Florida inhabiting the Everglades and remote areas of the region. The advent of the Civil War led to the abandonment of these removal efforts and the various Native American groups were largely left undisturbed. In 1928, the Tamiami Trail opened the Everglades to tourism and allowed access for Native American groups to share in the larger southern Florida economy.

The Seminole Tribe of Florida received federal recognition as a sovereign nation in 1957. In an effort to maintain their own unique cultural identity, independence, and heritage, other Native American groups, primarily located along Tamiami Trail, refused to join in tribal recognition with the Seminole Tribe of Florida. Through their continued persistence and resistance to join, these groups held out to establish their own governance resulting in their federal recognition as the Miccosukee Tribe of Indians of Florida in 1962.

Today the Miccosukee Tribe of Indians of Florida generally occupy reservations within two counties of southern Florida. The population primarily resides within the Tamiami Trail Reservation located 40 miles west of Miami, occupying a land area of 712.64 acres. The Miccosukee also maintain a perpetual lease within Water Conservation Area 3A on lands administered by the SFWMD. The tribe uses this lease to maintain their uniquely-adapted Everglades traditional and cultural lifeways including subsistence agriculture, medicinal practices, ceremonial activities, hunting, and fishing. Alligator Alley Reservation is the Miccosukee Tribe's largest reservation consisting of 74,812.37 acres, on the north and south sides of State Highway 84. Approximately 50,000 acres of this land is set aside for wetlands conservation, and the remaining is planned for development. Two additional smaller reservations are known as the Krome Avenue Reservations, located at the intersection of Krome Avenue and Tamiami Trail. These smaller reservations administer the Miccosukee Indian Resort and Gaming operations and the Miccosukee Tobacco Shop. The Miccosukee do not have landholdings in the project area.

The Seminole Tribal members reside on several reservations and properties, with the largest being those of Big Cypress, Hollywood, and Brighton Reservations. Hollywood is the headquarters location for the Seminole Tribe of Florida and the smaller reservations are Tampa, Fort Pierce, and Immokalee. As with the Miccosukee Indians of Florida, the Seminole Tribe of Florida practice traditional cultural activities uniquely adapted to the Everglades, including hunting, fishing, agriculture, medicinal, and ceremonial activities. They also engage in modern entrepreneurship through various enterprises including cattle ranching, gaming, and businesses centering on tourism. The Seminole Tribe of Florida don not have landholdings in the project area.

4.2.15 Socioeconomic Resources

With a total population of more than 2.7 million people, Miami-Dade County has the largest population of all Florida counties by a significant margin (the next largest, Broward County, has a total population of 1.9 million. It is a large, economically diverse county with a high population density. **Table 4-2** displays the population for the County for the years 1980, 1990, 2000 2010, and 2020 as well as a projection for 2040. As shown in **Table 4-2**, the County experienced relatively constant population growth between the years 1980 and 2020, and is expected to maintain this growth rate in the next 20 years.

Table 4-2. Miami-Dade County population growth over time

County	1980	1990	2000	2010	2020	2040
Miami-Dade, Florida	1,625,000	1,937,000	2,259,000	2,257,000	2,717,000	3,367,000

Source: US Census Bureau

Table 4-3 shows the median household income levels for Miami-Dade County for the years 1990, 2000, 2005, 2010, 2014, and 2018, the year with the latest available data. As shown in the table and based on Bureau of Economic Analysis data, Miami-Dade County experienced a steady increase in household income between 2000 and 2018. In 2010, 29% of households earned less than $25,000 annually, and 26% earned between $25,000 -$50,000. It is expected in the year 2040 for the annual household income of these two categories to be 31% and 26% respectively. (2040 Miami Transportation Plan)

Table 4-3. Miami-Dade County median household income over time

County	2000	2005	2010	2015	2020
Miami-Dade, Florida	33,228	37,142	40,145	43,687	51,347

Source: US Bureau of Economic Analysis

Table 4-4 shows the total number of employed civilians by industry in Miami-Dade County age 16 and up based on 2018 data. According to this data, approximately 58% of employed civilians in Miami-Dade are white collar workers, while 20% is considered blue collar and 22% is considered service and farm. (The most detailed breakdowns available are from 2018, these numbers will be updated when 2020 figures become available). The overall unemployment rate of Miami-Dade County in 2018 was 6.33%. As of July 2021, it was 6.5%.

Table 4-4. Employed civilians (16 years old +) by economic sector

Category		
Total Persons	**Total Persons**	**Percentage of Total**
Accommodation/Food Services	124,185	9.41%
Admin/Support/Waste Management	76,308	5.78%
Agriculture/Fishing/Hunting	9,888	0.75%
Entertainment/Recreation Services	28,568	2.16%
Construction	104,232	7.89%
Education Services	94,586	7.16%
Insurance/Real estate/Rent/Lease	98,501	7.46%
Health Care/Social Asst.	165,228	12.51%
Information	25,834	1.96%
Management of Companies	845	0.06%
Total Manufacturing	59,164	4.48%
Other Services	82,481	6.25%
Prof/Sci/Tech/Admin	89,784	6.80%
Public Administration	45,279	3.43%
Retail Trade	162,298	12.29%
Transport/Warehouse/Utils	104,523	7.92%
Wholesale Trade	48,629	3.68%
Total	**1,320,693**	**100.00%**

Source: US Bureau of Labor Statistics (BLS)

The County's economy is diverse and includes Federal government, higher education, manufacturing, port activity, residential construction, downtown business and residential development, and the medical and health professions. Economic growth within the county expected to continue due to proximity to major transportation routes such as Interstate 95, the Port of Miami, Miami International Terminal, and Miami International Airport. As with most of the country, the economy of Mami-Dade County was adversely

affected by the Covid-19 pandemic in 2020 and 2021. Economic growth was lower than it would have been in recent years without a pandemic and its socioeconomic effects.

In all portions of the study area, growth is highly dependent upon the major employment sectors. A steady pace in employment in Miami-Dade County is likely the result of the influx of population and businesses that support the Port of Miami and Miami International Airport. From the years 2010 to 2040, growth is expected in all employment industries excluding Agriculture, with the most growth of 68% expected in the health care and restaurant industries and the least growth in the utilities industry at 28%. Due to limited development outside the UDB, the agriculture industry is expected to decline approximately 33% between 2010 and 2040. Miami-Dade County has a gross domestic product (GDP) of approximately $111 billion, with the largest contributing sector being Finance, Insurance and Real Estate at 26%, followed by Wholesale and Retail Trade at 16%.

The project area retains its natural aesthetic value, which draws recreation and tourism; however, continued shoreline erosion in the Main Segment and flooding in Key Biscayne can adversely impact recreation and tourism. Recreational boating and other water-dependent activities are commonly seen in the surrounding waters. Port and navigation uses provide economic value to the project vicinity.

The project area was evaluated using USEPA's Environmental Justice Screening and Mapping Tool (ejscreen.epa.gov/mapper) tool to determine whether it contains a concentration of people of color and/or low- income populations. The study area which comprises the project does not constitute an Environmental Justice community because there is not a high concentration of people of color and low-income populations. Compliance with E.O. 12898 "Environmental Justice" and analysis are included in Appendix F. Detailed information on the economics of the project area can be found in Appendix B "Economic Analysis".

CHAPTER 5:

ENVIRONMENTAL EFFECTS

5 ENVIRONMENTAL EFFECTS*

This chapter discusses the potential effects to the affected environment described in Section 4. This section presents the effects analysis of the No Action alternative (or Future Without Project) and the Tentatively Selected Planas required by NEPA (40 CFR 1502.16). This chapter is organized by resource topic as described in Section 4 with the potential effects of each alternative described within each resource section for the Main Segment and Key Biscayne reaches. The effects of dredging or mining sand from the existing sources (e.g. upland mines, BHI complex, and existing in-water sand borrow areas) and associated sand placement have been discussed and disclosed in the referenced NEPA documents mentioned in this report's Section 1.7.1 (specifically the 2016 LRR, 2016 EA, 2020 EA, and 2021 FONSI). The effects of dredging from the newly proposed in-water borrow areas are similar in nature to effects of the other sources previously evaluated by the NEPA documents. Additionally, use of these sites would be conducted in compliance with the 2020 SARBO's applicable PDCs.

NEPA Implementing Regulations, 40 CFR 1508.1(g), define effects or impacts as changes to the human environment from the Proposed Action or alternatives that are reasonably foreseeable and have a reasonably close causal relationship to the TSP or alternatives, including those effects that occur at the same time and place as the TSP or alternatives and may include effects that are later in time or farther removed in distance from the TSP and alternatives. The potential impacts of the alternatives are described in this EA using the following terms:

- **Beneficial**: A positive change in the condition or appearance of the resource or a change that moves the resource toward a desired condition.
- **Adverse**: A change that moves the resource away from a desired condition or detracts from its appearance or condition.
- **Short-term**: impacts generally occur during construction or for a limited time thereafter, generally less than two years, by the end of which the resources recover their pre-construction conditions.
- **Long-term**: impacts last beyond the construction period, and the resources may not regain their preconstruction conditions for a longer period.

Past, present, and reasonably foreseeable actions and plans include beach nourishment projects, maintenance dredging of navigation channels, and general urbanization. Section 1.7 of this EA contains more details on environmental reports completed in/around the project's vicinity. In addition, it is expected that the public, State of Florida, and local governments could have permitted activities in or around the project area. Federal activities are evaluated under NEPA directly for each project. Other projects that take place in-water or would affect wetlands are evaluated under a permit issued by the Corps' Regulatory Division. Reasonably foreseeable future actions and plans could include continued port operations, freshwater inflow releases, Bakers Haulover Inlet sand bypass, planned flood control and coastal emergency beach renourishment, and future maintenance dredging of the Port Miami Harbor. Other proposed future actions and plans include Miami Harbor Improvements Study and the South

Atlantic Coastal Study; however, potential effects of these proposed future actions and plans are speculative and remote at this time. Preparation of a separate NEPA document, which would contain detailed analysis of potential effects, will be required during the development of the proposed future projects. Implementation of the plan for the Key Biscayne Segment is contingent upon local efforts to address back bay flooding such that the benefits for the Key Biscayne Segment are realized; therefore, USACE will evaluate the engineering and environmental sufficiency of those efforts to determine whether to proceed with construction of this project and whether supplemental NEPA is required. This review will be appropriately documented (Design Documentation Report, Engineering Documentation Report, Letter Report, or Memorandum for Record, etc.) and approved prior to construction of the Key Biscayne Segment. USACE will not construct the Key Biscayne Segment until USACE has determined that the back bay efforts constructed by local interests are constructed in a manner that will allow for achievements of the benefits. NEPA will be updated as appropriate.

5.1 Dune and Upland Vegetation

5.1.1 No Action Alternative

Without the proposed project, existing dune and vegetation will continue to erode and eventually be eliminated in the Main Segment and Key Biscayne shorelines.

5.1.2 TSP

Dune features in the Main Segment and Key Biscayne would be planted with native dune vegetation to help create and stabilize dune habitat. Beach nourishment would have no direct effect on vegetation; however, the placement of sand on the beach may also stabilize dune and beach habitat, which may result in increased available area for new vegetation to establish. Temporary impacts to available habitat and/or existing vegetation may occur from truck haul operations accessing the beach from the uplands. Any damaged vegetation would be replanted following completion of the project. The South Beach sand source includes the dry beach as well as the submerged beach profile (extending out to approximately the -15-feet NAVD88 contour) between R-64 and Government Cut. No effect to dune and upland vegetation is expected from using this sand source since most of the available sediment is expected to come from the submerged portion of the beach profile between R-64 and R-69.

5.2 Fish and Wildlife Resources (Other Than Threatened and Endangered Species)

5.2.1 No Action Alternative

Under the No Action Alternative, erosion of the beach would continue resulting in decreased habitat available for wildlife. Species that utilize the beach environment may decrease in number due to continued erosion of the beach and dune system as a result of lack of resources. These species may relocate to adjacent beaches in the FWOP Conditions. The diversity and abundance of shorebirds in the

project area is not expected to change in the future; however, erosion of the beach and dune system would limit the available foraging and roosting habitat for shorebirds and seabirds. The use of the sand source locations by migratory birds would not change in the future. Species habitat within the swash zone would continue to decrease due to continued erosion from potential increases in turbidity in the FWOP Conditions. No changes to fish and wildlife resources that reside below the swash zone are expected to occur in the FWOP Condition.

5.2.2 TSP

Beach nourishment and construction of the groins may result in temporary increases in turbidity and sedimentation as well as potential smothering and burial of non-mobile benthic species (i.e. worms, clams, etc.) within the construction footprint. Construction activities may also temporarily cause avoidance and/or displacement of fish and other mobile species in and around the construction area. Direct effects to birds and other wildlife as a result of any of the construction activities, including the reinforced dune, would be expected to be minimal as these animals are motile and can avoid construction activities. Presence of construction equipment and noise generated by the operations could disturb nesting and foraging birds and other wildlife (Speybroek et al. 2006). Some wildlife and birds may experience temporary adverse effects from a reduction in available food sources. These effects would be short-term and limited to the immediate area of placement and time of construction. There is sufficient area north and south of the construction zone that can be used by displaced birds and wildlife during construction.

The TSP would likely have an overall beneficial impact on wildlife resources. Increasing the size of the beach would benefit migratory birds as the additional beach area would result in more available nesting and foraging areas. Dredging sand may attract seabirds to both the dredge and the placement areas. Activities such as oil exploration have been shown to attract large numbers of seabirds, possibly because of an increase in food availability as bottom sediments are stirred up by drilling, potentially resulting in an algal bloom, and attracting species preyed on by seabirds (Tasker et al. 1986; Herron Baird 1990). Similar processes may occur during the initial stages of sand dredging. In addition, some species groups, notably gulls, are attracted by increases in shipping activity, especially at the low speeds associated with dredging (Garthe and Hüppop 1999; Skov and Durinck 2001; Christensen et al. 2003).

Vision has been shown to be an important component in the foraging activity of a number of seabird species (Essink 1999; Garthe et al. 2000; Gaston 2004; Thaxter et al. 2010). As a result, water clarity may play an important role in the foraging success of these, and other, species. Changes to water clarity resulting from the re-suspension of sediments during dredging operations would negatively affect the foraging capabilities of some species. However, turbidity would only be located in the vicinity of the dredging and placement operations. In addition, the impact of increases in turbidity is likely to be dependent (both in scale and spatial extent) on initial background levels (Cook 2010). Water quality would quickly return to pre-dredging conditions upon completion of construction. These impacts would occur whether sand were dredged from the passes or from the nearshore areas.

5.3 Threatened and Endangered Species

5.3.1 No Action Alternative

Under the No Action Alternative, beach renourishment of the reaches would not occur. Continued erosion could result in exposure of nearshore rock outcroppings which may serve as habitat for coral colonization. The increased turbidity associated with the continued erosion may also reduce recruitment due to the interference with coral spawning or coral health. Fragmentation would still be a potential. Additionally, the continued erosion of the beach could threaten the existence of the dune system. A decrease in available dune habitat would negatively affect beach jacquemontia as well as result in a loss of potential foraging habitat that will negatively affect piping plover, rufa red knot, and least terns. The continued shoreline recession will also reduce the amount of dry beach available for sea turtle nesting and may result in poor site selection by nesting females. As the beaches recede, nests become more susceptible to tidal inundation leading to an increase in hatchling mortality (Brock and Erhard 2008; Witherington et al. 2008). Other studies have documented an increase in the number of false crawls with increased erosion (Mosier and Witherington 2002). In the absence of renourishment, coastal property owners may turn to armoring measures, such as sea walls, groins and revetments, which severely decreases suitable nesting habitat and leads to an increase in false crawls and hatchling mortality due to wash out (Mosier and Witherington 2002; Brock and Erhart 2008; Witherington et al. 2008).

5.3.2 TSP

The USACE determined that implementation of the TSP may affect certain federally-listed species under NMFS and USFWS jurisdiction. USACE's effect determinations are described in **Table 5-1.** Details on the consultation with USFWS and NMFS for compliance with the ESA are included in Appendix F "Environmental Compliance". Consultation letters to USFWS and NMFS are included in Appendix J "Pertinent Correspondence".

Table 5-1. USACE effect determinations for Threatened and Endangered species listed under the ESA.

Common Name	Scientific Name	Coordinating Agency	USACE Effect Determination
Green sea turtle[1]	*Chelonia mydas*	NMFS / USFWS	May Affect
Hawksbill sea turtle	*Eretmochelys imbricata*	NMFS / USFWS	May Affect
Leatherback sea turtle	*Dermochelys coriacea*	NMFS / USFWS	May Affect
Loggerhead sea turtle	*Caretta caretta*	NMFS / USFWS	May Affect
Kemp's ridley sea turtle	*Lepidochelys kempii*	NMFS	May Affect
American crocodile	*Crocodylus acutus*	USFWS	MANLAA
Florida manatee	*Trichechus manatus latirostris*	USFWS	MANLAA
Blue whale	*Balaenoptera musculus*	NMFS	MANLAA
Fin whale	*Balaenoptera physalus*	NMFS	MANLAA
Humpback whale	*Megaptera novaeangliae*	NMFS	MANLAA
North Atlantic right whale[D]	*Eubalaena glacialis*	NMFS	MANLAA
Sei whale	*Balaenoptera borealis*	NMFS	MANLAA
Sperm whale	*Physeter macrocephalus*	NMFS	MANLAA
Johnson's seagrass	*Halophila johnsonii*	NMFS	MANLAA
Beach jacquemontia	*Jacquemontia reclinata*	USFWS	NE
Piping plover	*Charadrius melodus*	USFWS	MANLAA
Rufa red knot	*Calidris canutus rufa*	USFWS	MANLAA
Least tern	Sterna antillarum	USFWS	MANLAA
Smalltooth sawfish	*Pristis pectinata*	NMFS	MANLAA
Nassau grouper	*Epinephelus striatus*	NMFS	MANLAA
Oceanic whitetip shark	*Carcharhinus longimanus*	NMFS	NE
Giant manta ray	*Manta birostris*	NMFS	MANLAA
Pillar coral	*Dendrogyra cylindrus*	NMFS	MANLAA
Rough cactus coral	*Mycetophyllia ferox*	NMFS	MANLAA
Lobed star coral	*Orbicella annularis*	NMFS	MANLAA
Mountainous star coral	*Orbicella faveolata*	NMFS	MANLAA
Boulder star coral	*Orbicella franksi*	NMFS	MANLAA
Elkhorn coral[D]	*Acropora palmata*	NMFS	MANLAA
Staghorn coral[D]	*Acropora cervicornis*	NMFS	MANLAA

MANLAA: May Affect, Not Likely to Adversely Affect; NE: No Effect

[1] North Atlantic DPS; [2] South Atlantic DPS; [D] DCH

5.4 Essential Fish Habitat

5.4.1 No Action Alternative

EFH, federally managed fisheries, and associate species in the project area are not likely to be altered from the existing conditions if the proposed project were not constructed. However, any nearby hardbottoms in the Main Segment could be uncovered due to continued erosion of the beach if the project were not constructed. Within the Key Biscayne reach, seagrass habitat would likely continue to expand as the beach erodes.

5.4.2 TSP

Marine areas of unconsolidated substrate (e.g. beach placement areas below MHW, sand borrow sources, groin locations below MHW, etc.), hardbottoms, and water columns within the project area have been designated as EFH. The water column is used for foraging, spawning, and migration. Effects to the water column may have localized effects on marine species. Injury or entrainment due to dredging would most likely affect demersal species (those living close to the sea floor) and less mobile species, such as shellfish. Dredging may temporarily affect feeding success of managed species and their prey due to turbidity and loss of benthic organisms; however, adjacent similar habitat is available for feeding. Other potential adverse effects include: behavioral alterations due to sound, light, and structure; increased turbidity and sedimentation; changes to soft bottom bathymetry in the borrow area during dredging; and temporary loss of prey items and foraging habitat.

Non-motile infaunal invertebrates that inhabit the dredge areas and beach nourishment sites below MHW will unavoidably be lost during dredging and placement activities as well as groin construction. Species of motile epifaunal invertebrates also inhabit the proposed sand source, groins, and placement locations. Motile organisms such as fish and crabs should be able to escape the area during construction. Species that are not able to escape the construction area are expected to recolonize after project completion from adjacent similar habitat.

Water quality concerns are of particular importance in the maintenance of this habitat. During dredging, resuspended materials may interfere with the diversity and concentration of phytoplankton and zooplankton, and therefore could affect foraging success and patterns of schooling fishes and other grazers that comprise prey for managed species. Foraging patterns would be expected to return to normal at the end of dredging activities.

Effects to benthic infaunal and epifaunal communities would be considered relatively minimal when examined on a spatial scale. Infaunal communities in particular have very high reproductive potential and recruitment. Adjacent areas that have not been impacted would most likely be the primary source of recruitment to the impacted areas. Studies have shown a relatively short recovery time for infaunal communities following dredging. Succession of post-dredging infaunal communities should begin within days following dredging. This initial settlement usually consists of pelagic larval recruits settling within

the impact area. Later recruitment from adjacent non-impacted areas will be more gradual and involves species which are less opportunistic. It is highly likely that infaunal communities would most likely be re-established within one to two years after dredging ends (Vivan, Domenico, and Almeida, 2009).

Short-term effects of dredging and construction would affect populations of benthic organisms that serve as prey for EFH species and migratory species traveling through the area. Noise from the dredging activities may also cause fishes to move from the area. These temporary impacts may also alter the paths of migratory fishes and baitfish. Although this foraging and migratory habitat would not be available to these species, this effect would be minimal due to the relatively small size of the area involved in construction when compared to the total area available for foraging in the adjacent areas. These effects should not be significant and fishes should move back into the area shortly following the dredging activity.

Other impacts to EFH species within the area would include impact to larval fishes in the water column. These larval fishes may become entrained in the dredge during construction. The majority of larval fishes encountered would depend on the season and location of suction devices. In particular, those species that occur near the lower portions of the water column may be the most affected (Hammer and Zimmerman, 1979). However, given the very high reproductive capacity of these species, the small area in which the dredge would be used and the relatively short period of time that construction would occur, impacts to larval fishes should be very minor.

Hardbottom Habitats and Coral Reefs

Due to the known presence of hardbottom habitats in the Main Segment, hardbottom surveys will be conducted in accordance with the SARBO to confirm no impacts to hardbottom habitats and ESA-listed species will occur from beach nourishment activities and construction of the groins. Additionally, pre-, during, and post-construction pipeline surveys will be conducted along pipeline corridors in accordance with the SARBO project design criteria (PDCs). This will ensure potential impacts to nearshore hardbottom communities are avoided and that any ESA-listed corals are identified and relocated, if need be. Per the SARBO, any relocation of ESA-listed corals would be coordinated with NMFS through SAD.

Seagrasses

Beach renourishment in Key Biscayne will be limited to the existing permitted and previously filled footprint. No new effects to seagrasses are anticipated to occur; however, USACE has prepared a Monitoring and Adaptative Management Plan which is included as Appendix I to this report.

EFH Determination

USACE has determined that the proposed action would not have a long-term adverse impact on EFH or Federally-managed fisheries along Florida's eastern shorelines. In addition, it is important to note that the dredging area encompasses a fraction of the entire water body, and similar habitat occurs immediately adjacent to the proposed sand sources.

5.5 Coastal Barrier Resources

5.5.1 No Action Alternative

No changes to the OPAs would be expected to occur regardless of whether the project is constructed. The FWOP related to Coastal Barrier Resources in the project area are the same as described in the Existing Conditions section.

5.5.2 TSP

The TSP does not include the construction of structures that would require Federal flood insurance; therefore, Federal expenditures for the proposed project are not restricted. The groins proposed for construction in Reach 1 would alter local sediment transport processes, which does impact the natural movement of sediment; however, these erosion control structures are proposed in conjunction with beach nourishment to stabilize the eroding shoreline. The seawalls proposed for construction in Reach 4 would be constructed as far landward as possible within the dune template, in close proximity to existing structures, and would not further disrupt natural processes.

5.6 Water Quality

5.6.1 No Action Alternative

Continued erosion of the OFW and water quality standards would likely be negatively affected from the Existing Conditions in the FWOP Conditions.

5.6.2 TSP

Construction operations would produce temporary minor changes in water quality at dredge sites and in the nearshore region of the placement sites. Turbidity levels would be elevated above normal during operations within the mixing zone. Visible plumes at the water surface are expected in the immediate vicinity of the operation. Elevated turbidity levels are expected to dissipate rapidly, returning to background levels in a short period. The USACE contractor would implement a spill contingency plan for hazardous, toxic, or petroleum material. No long-term adverse impact on water quality is expected to occur. Construction operations would be in compliance with the FDEP water quality certification to ensure compliance with Section 401 of the Clean Water Act.

Additionally, dredging and sand placement activities may temporarily increase turbidity by introducing additional fine material into the water column. The increased fines may increase biological oxygen demand, thus reducing water column oxygen levels. USACE ensures that sediments placed on the beach are very similar to existing beach sand to ensure minimization of turbidity during construction. Dredging and discharges from sand placement may also slightly alter water temperatures in the immediate dredging and sand placement areas, but any changes in temperature would be temporary and localized.

USACE will conduct daily monitoring of turbidity at dredging and sand placement locations during project operations. If the monitoring detects turbidity exceeding established levels, the construction activity will be halted until the contractor takes appropriate steps to reduce the turbidity to acceptable levels and the turbidity returns to those levels. Given the naturally dynamic waters of the Atlantic Ocean, organisms inhabiting the nearshore zone adapt to environmental changes such as moderate increases in turbidity. Fish and other mobile species may temporarily leave the dredging site or surf zone adjacent to the beach placement site if turbidity becomes too great. These effects should not be significant, and fishes and other mobile species should move back into the area shortly following the dredging activity.

In areas where only a dune is constructed (with no corresponding berm feature), the impacts to water quality would be less. Some turbidity in the nearshore would still be expected. Otherwise, impacts to water quality as a result of dune restoration and enhancement would not be noticeably increased over those anticipated as a result of berm construction.

Groin construction activities would temporarily impact water quality during construction due to localized disturbance and increases in turbidity similar to those described for dredging operations and berm construction. The impacts would not be significant on an incremental scale over those described for beach nourishment alone. No additional impacts over those anticipated with beach nourishment are anticipated associated with the construction of seawalls or floodwalls in the proposed reaches.

5.7 HTRW

5.7.1 No Action Alternative

The presence/absence of hazardous or toxic wastes in the project area is not likely to change from the Existing Conditions in the FWOP Conditions.

5.7.2 TSP

The nature of the work involved with the renourishment of beaches is such that contamination by hazardous and toxic wastes is very unlikely. No contamination due to hazardous and toxic waste spills is known to be in any of the in-water sand source locations. However, accidental spills and releases of waste/fuel, although remote, are possible. USACE will implement measures to prevent oil, fuel, or other hazardous substances from entering the air or water. All wastes and refuse generated by project construction would be removed and properly disposed. The USACE contractor will implement a spill contingency plan for hazardous, toxic, or petroleum material. Compliance with USEPA Vessel General Permits would be ensured, as applicable.

5.8 Air Quality

5.8.1 No Action Alternative

The air quality in the project area is not likely to change from the Existing Conditions in the FWOP Conditions.

5.8.2 TSP

Federal actions for the project are exempt from the Clean Air Act General Conformity Regulations because the project is not located in a designated nonattainment or maintenance area. The State of Florida does not regulate emissions from off-road equipment or marine vessels (FDEP, 2012); however, it can be assumed that insignificant emissions will be produced by the dredge and construction equipment during construction activities.

Implementation of the TSP would result in minor, temporary degradation of air quality due to emissions from dredging and placement operations and associated heavy equipment and machinery. Air quality is expected to revert to background levels following the completion of construction.

5.9 Noise

5.9.1 No Action Alternative

While the area may experience a slight decrease in tourist activity, noise levels in the project area are not likely to change significantly from the Existing Conditions in the FWOP Conditions.

5.9.2 TSP

Dredging noise can affect marine mammals, sea turtles, birds, and fishes. Possible effects of dredging noise can vary depending on a variety of internal and external factors, and can be divided into masking (obscuring of sounds of interest by interfering sounds, generally at similar frequencies), response, discomfort, hearing loss, and injury (MALSF, 2009). Deeper water operations may propagate sound over greater distances than those in confined nearshore areas (Hildebrandt, 2004).

Dredging to extract sand produces broadband and continuous sound, mainly at lower frequencies. Noise associated with dredging activities can be placed into five categories:

1. Collection noise – The noise generated from the collection of material from the sea-floor; for example, the scraping of the buckets on a bucket ladder dredge or the operation of the drag head. This noise is dependent on the structure of the sea floor and the type of dredge used.

2. Pump noise – The noise from the pump driving the suction through the pipe.

3. Transport noise – The noise of the material being lifted from the sea floor to the dredge and pumped through a pipeline to the beach. For trailing suction hopper and cutter suction dredges, this would be the noise of the material as it passes up the suction pipe. For clamshell dredges, it would be the sound of the crane dropping/lifting the bucket.

4. Deposition noise – This noise is associated with the placement of the material within the barge or hopper.

5. Ship/machinery noise – The noise associated with the dredging ship itself. For stationary dredges, the primary source will be the onboard machinery. Mobile dredges will also have propeller and thruster noise (MALSF, 2009).

Field investigations have been undertaken to characterize underwater sounds typical of bucket, hydraulic cutterhead, and hopper dredging operations (Dickerson *et al.,* 2001). Preliminary findings indicate that cutterhead dredging operations are relatively quiet as compared to other dredging operations in aquatic environments. Hopper dredges produce somewhat more intense sounds similar to those generated by vessels of comparable size. Bucket dredges create a more complex spectrum of sounds, very different than either cutterhead or hopper dredges. Hopper dredge noises consist of a combination of sounds emitted from two relatively continuous sources: engine and propeller noise similar to that of large commercial vessels, and sounds of dragheads moving in contact with the substrate. The intensity, periodicity, and spectra of emitted sounds differ greatly among dredge types. Components of underwater sounds produced by each type are influenced by a host of factors including substrate type, geomorphology of the waterway, site-specific hydrodynamic conditions, equipment maintenance status, and skill of the dredge plant operator (Dickerson *et al.,* 2001).

Noise generated by the dredge may minimally impact those living on the beaches during project construction, but will likely not be too noticeable over ambient noise of wind and waves. Noise generated on the beaches by equipment placing the dredged material will be relatively low level and will be of a short duration. Construction equipment such as booster pumps will be properly maintained to minimize effects of noise. Once dredging and beach placement have concluded, noise levels will drop back to background levels for the beach area. Since the increases to the current level of noise as a result of this project will be localized and minor, there will only be a temporary reduction in aesthetics and no expectation of adverse effects to the environment as a result of construction-related noise.

Noise during construction activities will likely be minor and short term with minimal impacts to fish and wildlife that use the project area. Species with sufficient motility would avoid the project area during construction and return after completion of construction activities. Dredging and beach placement of sand would disrupt organisms living in the dredged sediments and bury those organisms at the beach placement site.

5.10 Aesthetic Resources

5.10.1 No Action Alternative

The aesthetics of the project area are anticipated to decline in the FWOP Condition due to increased erosion and the continued narrowing of the beach. Coastal armoring such as seawalls and revetments would likely become exposed or constructed.

5.10.2 TSP

The proposed project for the Main Segment includes periodic beach nourishment in Reaches 1 and 2 and erosion control structures (e.g. groins) in Reach 1. Short term adverse aesthetic impacts would occur during construction due to the presence of construction equipment and the impacts to the staging area. In the long-term, there would be a more permanent change to the aesthetics of the shoreline. Dune features could have a max crest elevation of 13 feet NAVD88, which could be up to 3 feet higher than the existing dune in certain locations. The existing dune in the Main Segment are generally at an elevation of 8 to 9 feet NAVD88. The granite rubble mound groins would initially be covered with sand except for the seaward ends of the groins, and would become more exposed as the beach erodes. The proposed project for the Key Biscayne Segment includes a reinforced dune with a crest elevation of 11' NAVD88, which could be up to 3' higher than the existing dune crest in certain locations. The existing dune in the Key Biscayne Segment are generally at an elevation of 10 to 11 feet NAVD88. These features would be high enough to partially visually block the viewshed in certain areas, and would require modifications to access to the beach in certain locations. The exact design will be determined as the design is optimized and will be refined based on existing shoreline conditions at the time of construction. Beach placement of sand would result in a long-term improvement in aesthetics due to restoration of the beach and removal of erosional scarps.

5.11 Recreation Resources

5.11.1 No Action Alternative

It is anticipated that the recreational usage of the project area would decline in the FWOP Condition due to increased erosion and the continued narrowing of the beach, which will make it less suitable for recreating.

5.11.2 TSP

Construction of the TSP would temporarily impact recreation during beach nourishment due to the equipment located on the beach. Temporary impacts to the area used to stage the shore-based equipment would also occur. However, the long-term recreational resources of the area would be generally improved due to the beach habitat that would be maintained. Groins could decrease the beach berm available for recreating, and could cause an impediment for those enjoying swimming, kayaking, and water-based activities in the nearshore region.

5.12 Safety and Navigation

5.12.1 No Action Alternative

The BHI federal navigation channels are currently dredged on an occasional basis as part of the existing AIWW federal navigation program. In the FWOP Condition, these areas would continue to be dredged on an as-needed basis as the flood and ebb shoals would accrete sand and potentially impede navigation.

5.12.2 TSP

Implementation of the TSP includes beneficial use of the sand from the BHI Complex and sand by-passing. Navigation in the channels adjacent to the BHI Complex would be improved when sand is obtained from this area. Removal of shoaled material that poses an impediment to vessel traffic would decrease life-safety risks.

Groins constructed in Reach 1 could impact nearshore navigation of small vessels such as kayaks and jet skis. These activities should not be significantly affected as they generally occur further offshore, and these small vessels can easily navigate around the groins.

5.13 Cultural Resources and Historic Properties

5.13.1 No Action Alternative

The future without project condition will allow for continued erosion that will eventually threaten these cultural resources identified within the Miami-Dade CSRM Project area. As the shoreline recedes without a project, resources will either be destroyed or hard structures will need to be constructed for their protection. As noted above, increased hardening is detrimental to the environment as a whole. Thus, continued shoreline erosion will create a cumulative negative effect on the cultural and historic resources.

5.13.2 TSP

The APE of the TSP consists of beach nourishment at three locations: Planning Reach 1, Planning Reach 2, and the Key Biscayne Segment.

Based on a search at the Florida Master Site File (FMSF), one archaeological site (8DA11417) is located within 1,000 feet of the beach nourishment from FDEP Monuments R-27 to R-36.5, and two historic districts (8DA11654 and 8DA11867) listed in the National Register of Historic Places (NRHP) are located within 1,000 feet of the beach nourishment from FDEP Monuments R-38.5 to R57.5. No archaeological sites are recorded for the Key Biscayne Segment of the beach nourishment extending from FDEP Monuments R-101.3 to 107.8. Archaeological site 8DA11417 is recorded by Archaeological and Historical Conservancy, Inc. as a prehistoric campsite recorded as having insufficient information to make a

determination of eligibility for the NRHP. The Florida State Historic Preservation Office (SHPO) did not evaluate the site.

On September 3, 2021, USACE awarded Panamerican Consultants, Inc. a contract to conduct a terrestrial and submerged nearshore cultural resources assessment survey along 9.4 miles of shoreline between FDEP range monuments R-27 to R-74 (Bakers Haulover Inlet to Government Cut) and 1.2 miles of restoration between R-101 to R-108 (Village of Key Biscayne). No archaeological sites were identified as a result of these investigations and a draft report is currently in preparation. Based on this information, USACE determined archaeological site 8DA11417 will not be adversely impacted by construction of the project. The USACE also determined the North Shore Historic District (8DA11654) and the Collins Waterfront Architectural District (8DA11867) will not be adversely impacted by construction of the project. These historic districts and archaeological site 8DA11867 will be protected from erosion by the addition of sand along the Project beachfront.

During their investigations, Panamerican Consultants also conducted subsurface shovel testing at 25-meter intervals along the northern and southern tie-back walls because these features extended inland in areas determined to have a high probability of containing cultural resources. Moreover, archaeological sites 8DA05921, 8DA05922, and 8DA05428 were plotted on the FMSF as general vicinity sites near the western terminus of the northern tie-back wall; however, no sites were identified within the footprints of the tie-back walls. Based on this information, USACE determined construction of the tie-back walls will have no effect on historic properties eligible for inclusion in the NRHP. Panamerican Consultants, Inc. also conducted a remote-sensing submerged cultural resources survey for 9.4 miles along the nearshore and within the Bal Harbor Inlet (BHI) Complex. No historic properties were identified during these submerged investigations; therefore, USACE determined construction activities within these areas will have no effect on historic properties eligible for inclusion in the NRHP.

The five erosion control structures (groins) are located between FDEP Monuments R-28 to R-31. In June 2018, pursuant to Florida Statutes § 161.101 and § 161.161, the Florida Department of Environmental Protection designated this area as Critically Eroded Shoreline (as defined in rule 62B-36.002(5) of the Florida Administrative Code. The current shape and extent of the coast in Planning Reaches 1 and 2 are largely a product of constructed projects and local non-federal construction efforts. Panamerican Consultants, Inc. did not identify cultural resources within the Project area of potential effect. Based on this information, the USACE has determined that construction of these groins will have no effect on historic properties eligible for inclusion in the NRHP.

Due to timing and funding constraints, and based on a lack of certainty of sand sources at this point in the feasibility study, the Corps cannot fully determine the effects of the Miami-Dade CSRM Study prior to completion of the NEPA documentation. Additionally, the unsurveyed offshore borrow areas are not needed for the initial beach nourishments of Planning Reaches 1 and 2, and will be utilized much later in the lifecycle of the project. Therefore, the Corps will utilize the Coastal Navigation Programmatic

Agreement (CNPA): *The Programmatic Agreement among the United States Army Corps of Engineers, the Florida State Historic Preservation Officer, the Bureau of Ocean Energy Management, and the Advisory Council on Historic Preservation regarding Compliance with Section 106 of the National Historic Preservation Act during Implementation of the United States Army Corps of Engineers, Jacksonville District Operations, Navigation, and Shore Protection Programs* consistent with Stipulation V. of the CNPA. The CNPA establishes the phased review process that the Corps will follow for compliance with the National Historic Preservation Act, (54 U.S.C. § 306108), when the constraints of individual undertakings preclude completion of the Section 106 review process prior to completing the appropriate NEPA documentation. Subsequent to the authorization of the Study by Congress and receipt of funding at the District level the Corps will follow the terms of the CNPA to investigate these offshore borrow areas as their construction designs are determined, refined, and prioritized during the pre-construction, engineering, and design (PED) phase of the project.

5.14 Native Americans

5.14.1 No Action Alternative

Selection of the No Action Alternative would have no effect on Native American groups. As discussed above, all portions of the project have been consulted upon with the interested, Federally recognized tribes living in the region.

5.14.2 TSP

As part of the development of this project, consultation is ongoing between USACE and the five Federally-recognized tribes within the immediate area of potential effect of the TSP. As discussed in Chapter 4, there are no known Native American properties within the project area and none of the Focused Array of Alternatives should have any foreseeable effects on Native Americans. Consultation with Native American tribes having ancestral ties to this region, including the Seminole Tribe of Florida, the Seminole Nation of Oklahoma, The Muscogee (Creek) Nation, the Thlopthlocco Tribal Town, and the Miccosukee Tribe of Indians of Florida was initiated by letter on November 3, 2020. The consultation letters are included in the Pertinent Correspondence Appendix J.

5.15 Socioeconomic Resources

5.15.1 No Action Alternative

It is anticipated that the tourism opportunities the project area would decline in the FWOP Condition due to increased erosion and the continued narrowing of the beach, which will make it less desirable for tourists. Continued erosion could eventually result in negative impacts to property values and the local economy.

5.15.2 TSP

The active construction areas would shift along the project area beach; recreational users could access areas already nourished. The temporary closure of the beach with active construction may result in potential loss of tourism during construction's increased traffic and road wear and tear; however, it is reasonable to assume implementation of the TSP may result in increases in property value, increased storm protection, and a boost to the local Economy through job creation and preservation that increases the tax base, which all contribute to sustaining Florida and Miami's tourist industry. Additional information on the economics and potential effects can be found in Appendix B "Economic Analysis".

5.16 Irreversible and Irretrievable Commitment of Resources

5.16.1 Irreversible

An irreversible commitment of resources is one in which the ability to use and/or enjoy the resource is lost forever. One example of an irreversible commitment might be the mining of a mineral resource. The use of fossil fuels to operate heavy equipment related to this project would result in an irreversible commitment of resources. Additionally, the use of sand from the proposed sand mine and offshore borrow sources would, for all practical purposes, irreversibly deplete the suitable sand reserves in the short-term.

5.16.2 Irretrevable

An irretrievable commitment of resources is one in which, due to decisions to mandate the resource for another purpose, opportunities to use or enjoy the resources as they presently exist are lost for a period of time. An example of an irretrievable loss might be where a type of vegetation is lost due to road construction. The TSP is not expected to result in an irretrievable commitment of resources.

5.16.3 Unavoidable Adverse Environmental Impacts

5.16.4 No Action Alternative

Under the No Action Alternative, erosion would continue, which adversely affects the area's recreation and aesthetics, reduces the shoreline protection against storm events, and reduces available beach and dune habitat for T&E species and other wildlife and vegetation.

5.16.5 TSP

Construction of the TSP will result in minor and temporary increases in turbidity of the surf zone, degradation of air quality, increases in the noise level, and reduction in the aesthetic values during construction. Mobile species are likely to leave the project area during construction to avoid the temporary increases in noise and turbidity. Adverse effects would be expected to occur to non-motile macrofaunal communities (i.e. worms, etc.) located within the construction footprint as a result of burial;

however, the effects are expected to be minor and temporary, given the expected immediate recolonization of the area from adjacent communities.

CHAPTER 6

COMPLIANCE WITH ENVIRONMENTAL REQUIREMENTS

6 COMPLIANCE WITH ENVIRONMENTAL REQUIREMENTS*

The status of coordination and compliance of the TSP with environmental requirements is shown in **Table 6-1**. Detailed information on environmental compliance can be found in Appendix F.

The status of environmental compliance is described as follows:

- Compliant: Meets all requirements of the statute for the current stage of planning (either preauthorization or post-authorization).
- In-Progress: Not having met some of the requirements that normally are met in the current stage of planning or pending due notice of availability and comment public/agency comment period.
- Not applicable: No requirements for the statute required for the planning/ construction.

Table 6-1. Status of environmental compliance.

Law, Policy, and Regulations	Status	Comments
National Environmental Policy Act of 1969 (42 U.S.C. §4321 *et seq*.)	Compliant	This EA has been prepared pursuant to NEPA and its implementing regulations. A Notice of Availability for the proposed FONSI, draft EA, and associated appendices was coordinated with pertinent agencies and interested stakeholders for 30 calendar days to allow for review and comment. USACE is complying with the NEPA process and will be in full compliance with the Act at the time of construction. Implementation of the plan for Key Biscayne is contingent upon local efforts to address back bay flooding; therefore, USACE will evaluate the engineering, economics, and environmental acceptability of those efforts and will complete supplemental NEPA. USACE will update this draft NEPA document as appropriate following public review/comment.
Anadromous Fish Conservation Act (16 U.S.C. §§757A-757G)	Compliant	The TSP would not adversely affect anadromous fish species.
Archaeological Resources Protection Act of 1979 (16 U.S.C. §§470aa *et seq.*)	Compliant	This act applies to federally owned and tribally owned lands, including Reservation lands. This Act is not applicable because the TSP does not occur on federally or tribally owned lands and will not affect such lands.
American Indian Religious Freedom Act (42 U.S.C. §1996 and 1996a)	Compliant	The policy of the U.S. is to protect and preserve for American Indians, Alaska Native Groups and Native Hawaiians, their inherent rights of Freedom to believe, express, and exercise traditional religions. These rights include, but are not limited to, access to sites, use and possession of sacred objects, and the freedom to worship through ceremony and traditional rites.
Clean Air Act of 1972 (42 U.S.C. §7401 *et seq*.)	Compliant	USACE's contractor will obtain any air quality permits, if required.

Law, Policy, and Regulations	Status	Comments
Clean Water Act of 1972, Section 401 and Section 404(B) (33 U.S.C. §1341 and 33 U.S.C. §1344(b))	In progress	In accordance with the Clean Water Act, a Section 404(b)(1) Evaluation has been completed and is included as Appendix H. USACE will obtain Water Quality Certification (WQC) from the State of Florida and any required National Pollutant Discharge Elimination System permits.
Coastal Barrier Resources Act and Coastal Barrier Improvement Act of 1990 (16 U.S.C. §3501 *et seq*.)	Compliant	The TSP will not affect the nearby OPAs.
Coastal Zone Management Act of 1972 (16 U.S.C. §1451 *et seq*.)	In progress	A Florida Coastal Zone Federal Consistency Determination (FCD) has been prepared in accordance with the provisions of 15 CFR 930 and is included as Appendix G. USACE has determined that the TSP is consistent to the maximum extent practicable with the enforceable policies of Florida's approved Coastal Zone management program. USACE will be in compliance with the Coastal Zone Management Act at the time of construction through issuance of the WQC.
Endangered Species Act of 1973 (16 U.S.C. §1531 *et seq*.)	Compliant	The TSP will comply with the Terms and Conditions of the SPBO and P3BO as well as the applicable PDCs of the SARBO. Detailed information on the consultation with NMFS and USFWS can be found in Appendix F.
Estuary Protection Act of 1968 (16 U.S.C. §§1221-26)	Not applicable	No estuaries of national significance exist in the project area.
Federal Water Project Recreation Act (16 U.S.C. §460l-12 *et seq*.)	Compliant	Recreational opportunities as well as the effects of the TSP on outdoor recreation have been described in Chapter 5.
Fish and Wildlife Coordination Act of 1958 (16 U.S.C. §661 *et seq*.)	In progress	The proposed action has been coordinated with USFWS. A Memorandum for the Record, signed by USFWS and USACE, will document an agreement between the agencies to use the NEPA review and ESA consultation processes to complete coordination responsibilities under the FWCA. USACE is complying with the Act through the NEPA review and ESA consultation processes and will be in full compliance with the Act.
Farmland Protection Policy Act of 1981 (7 U.S.C. §4201 *et seq*.)	Not applicable	No farmland would be impacted with the proposed project.

Law, Policy, and Regulations	Status	Comments
Magnuson-Stevens Fishery Conservation and Management Act of 1976, as amended (16 U.S.C. §1801 *et seq*.)	In progress	In accordance with the January 22, 2019 guidance from the USACE and the October 2, 2018 EFH Finding between the Southeast Regional Office of NMFS and the USACE South Atlantic Division, the EFH Assessment for the project is integrated within this report. EFH consultation is coordinated with the NMFS through the draft report's review period. USACE is complying with the Act through the NEPA review and EFH consultation processes and will be in full compliance with the Act.
Marine Mammal Protection Act of 1972 (16 U.S.C. §1361 *et seq*.)	Compliant	Project sites are accessible to marine mammals, such as the Florida manatee. Incorporation of safeguards to protect threatened and endangered species during construction would protect marine mammals in the area. No take [8] is anticipated.
Marine Protection, Research, and Sanctuaries Act of 1972 (16 U.S.C. §1431 *et seq*. and 33 U.S.C. §1401 *et seq*.)	Not applicable	The TSP does not include ocean disposal of dredged material.
Migratory Bird Treaty Act of 1918 (16 U.S.C. §§703-712) and Migratory Bird Conservation Act of 1929 (16 U.S.C. §§715-715D, 715E, 715F-715R)	Compliant	USACE will include standard migratory bird protection measures in the project plans and specifications and will require the Contractor to abide by those requirements.
National Historic Preservation Act of 1966 (54 U.S.C. §300101 *et seq.*)	Compliant	Cultural resources are known to exist within the vicinity of the project area. Once the project is authorized and PED is implemented, further investigations and consultation will be needed consistent with the CNPA.
Native American Graves Protection and Repatriation Act (25 U.S.C. §3001 *et seq*.)	Compliant	This Act applies to Federal owned lands, including Reservation lands. These lands are not located within the feasibility study area.
Rivers and Harbors Act of 1899, Section 10 (33 U.S.C. §403 et seq.)	Compliant	The TSP would not obstruct navigable waters of the United States. The groins proposed for construction in Reach 1 could impact nearshore navigation of small vessels such as kayaks and jet skis but should not significantly affect these activities as they generally occur further offshore and these small vessels can easily navigate around the groins.

[8] Take as defined under the Marine Mammal Protection Act means "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal" (16 U.S.C. 1362)

Law, Policy, and Regulations	Status	Comments
Submerged Lands Act of 1953 (43 U.S.C. § 1301 et seq.)	In progress	Some dredging activities will occur within the navigational servitude and on submerged lands of the State of Florida. Beach nourishment will occur on submerged lands of the State of Florida. USACE will coordinate the project with the State of Florida through the WQC process, FCD review, and the review process of this EA. USACE is complying with the Act through the state review processes and will be in full compliance with the Act at the time of construction.
Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 (42 U.S.C. §4601 et seq.)	Compliant	No homeowners would be displaced as part of the real estate acquisitions required for this project. The project will be in full compliance with the Act at the time of construction.
Wild and Scenic River Act of 1968 (16 U.S.C. §1271 et seq.)	Not applicable	No designated wild and scenic rivers are located within project area.
E.O. 11988 Flood Plain Management	Compliant	USACE concludes that the proposed project will not result in harm to people, property, and floodplain values; will not induce development in the floodplain; and the project is in the public interest. For the reasons stated above, the project complies with this E.O.
E.O. 11990 Protection of Wetlands	Compliant	No wetlands are within the proposed project footprint but are located within the project vicinity. USACE will include protection measures in the project plans and specifications and will require the Contractor to abide by those requirements.
E.O. 12898 Environmental Justice	Compliant	The proposed project does not present any environmental impacts that are high, adverse and disproportionate to low income and/or people of color populations. The EJ analysis can be found in Appendix F.
E.O 13007 Indian Sacred Sites	Not applicable	This E.O. is directed towards executive branch agencies with statutory or administrative responsibility for the management of Federal lands. The proposed action would not affect Department of Defense owned or USACE managed lands.
E.O. 13045 Protection of Children	Compliant	The proposed action does not affect children disproportionately from other members of the population and would not increase any environmental health or safety risks to children.
E.O. 13089 Coral Reef Protection	Compliant	The proposed action would occur in areas near coral reefs and hardbottom habitats. USACE remains committed to reviewing new information as it becomes available, as well as applying lessons learned to inform future construction to minimize potential adverse effects to corals and hardbottom habitats to the maximum extent practicable. Coordination with pertinent agencies and the implementation of protective measures during construction will avoid and/or minimize effects to these ecosystems.

Law, Policy, and Regulations	Status	Comments
E.O. 13112 Invasive Species	Compliant	The project's plans and specifications will include conditions to avoid the introduction and/or promotion of non-native species to the region. USACE will require the Contractor to abide by those requirements as well as submit a plan describing the protection measures to be implemented by the Contractor.
E.O. 1315 Consultation and Coordination with Indian Tribal Governments	Compliant	Consultation with members and representatives of the Seminole Tribe of Florida, the Miccosukee Tribe of Indians of Florida, the Seminole Nation of Oklahoma, the Thlopthlocco Tribal Town, and the Muscogee Creek Nation have been ongoing. Pursuant to E.O. 13175, HQUSACE developed the November 01, 2012 Tribal Policy Memorandum, which dictates Federal responsibilities, including Trust Responsibilities, to Federally recognized Tribes.
E.O. 13186, Responsibilities of Federal Agencies to Protect Migratory Birds	Compliant	The TSP is not expected to adversely affect migratory bird species. The proposed actions are expected to benefit species by improving habitat and increasing availability of foraging opportunities.

CHAPTER 7
RECOMMENDATIONS

7 RECOMMENDATIONS

The TSP is the NED plan. The Main Segment plan includes beach nourishment (including dune features) along 5.7 miles of shoreline along with a series of groins between R-28 and R-31.5. Sand sources to be used for beach nourishment in the Main Segment include the BHI Complex, South Beach, and offshore borrow areas. The Key Biscayne plan includes a reinforced dune with a steel sheet pile wall along 1.2 miles shoreline. Beach nourishment (including dune features) will use sand from upland mines to keep the wall buried and sheet pile tieback walls will be used at the north and south ends of the project.

Implementation of the plan for the Key Biscayne Segment is contingent upon local efforts to address back bay flooding such that the benefits for the Key Biscayne Segment are realized; therefore, USACE will evaluate the engineering and environmental sufficiency of those efforts to determine whether to proceed with construction of this project and whether supplemental NEPA is required. This review will be appropriately documented (Design Documentation Report, Engineering Documentation Report, Letter Report, or Memorandum for Record, etc.) and approved prior to construction of the Key Biscayne Segment. USACE will not construct the Key Biscayne Segment until USACE has determined that the back bay efforts constructed by local interests are constructed in a manner that will allow for achievements of the benefits. NEPA will be updated as appropriate.

The TSP contributes to the creation of beach and dune habitat. It is integrated with the community to allow continued public access to existing recreational opportunities that traditionally occur along the coastline. The TSP was formulated to avoid and minimize impacts to every extent possible; therefore, no mitigation is recommended as part of the project. It is recommended that the non-Federal sponsor and local communities pursue additional measures to further manage coastal storm risks, such as public outreach about coastal storm damage and future consideration of SLC impacts in local planning ordinances.

I have given consideration to all significant aspects in the overall public interest including engineering feasibility, economic, social, cost and risk analysis, and environmental effects. The TSP described in this draft report provides the optimum solution for CSRM benefits within the focused study area that can be developed within the framework of the formulation concepts.

The recommendations contained herein reflect the information available at this time and current Departmental policies governing formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of a national Civil Works construction program nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to the Congress as proposals for authorization and implementation funding. However, prior to transmittal to the Congress, the sponsor, the States, interested Federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

7.1 Draft Items of Local Cooperation

Recommendations for provision of Federal participation in the TSP described in this report would require the project sponsor to enter into a written PPA, as required by Section 221 of Public Law 91-611, as amended, to provide local cooperation satisfactory to the Secretary of the Army.

My recommendation is subject to cost sharing and other applicable requirements of Federal laws, regulations, and policies. Federal implementation of the project for coastal storm risk management includes, but is not limited to, the following required items of local cooperation to be undertaken by the non-Federal sponsor in accordance with applicable Federal laws, regulations, and policies:

a. Provide 35 percent of construction costs for initial construction of the project and 50 percent of construction costs for periodic nourishment allocated by the Federal government to coastal storm risk management; 100 percent of construction costs for initial construction and periodic nourishment allocated by the Federal government to beach improvements with exclusively private benefits; 100 percent of construction costs for initial construction and periodic nourishment allocated by the Federal government to improvements and other work located within the Coastal Barrier Resources System that the Federal government has determined are ineligible for Federal financial participation; and 100 percent of construction costs for initial construction and periodic nourishment allocated by the Federal government to the prevention of losses of undeveloped private lands, as further specified below:

1. Provide, during design, 35 percent of design costs in accordance with the terms of a design agreement entered into prior to commencement of design work for the project;

2. Provide all real property interests, including placement area improvements, and perform all relocations determined by the Federal government to be required for the project;

3. Provide, during construction, any additional contribution necessary to make its total contribution equal to at least 35 percent of construction costs for initial construction and 50 percent of construction costs for periodic nourishment;

b. Prevent obstructions or encroachments on the project (including prescribing and enforcing regulations to prevent such obstructions or encroachments) that might reduce the level of coastal storm risk reduction the project affords, hinder operation and maintenance of the project, or interfere with the project's proper function;

c. Inform affected interests, at least yearly, of the extent of risk reduction afforded by the project; participate in and comply with applicable Federal floodplain management and flood insurance programs; prepare a floodplain management plan for the project to be implemented not later than one year after completion of construction of the project; and publicize floodplain information in the area concerned and provide this information to zoning and other regulatory agencies for their use in adopting regulations, or taking other actions, to prevent unwise future development and to ensure compatibility with the project;

d. Operate, maintain, repair, rehabilitate, and replace the project or functional portion thereof at no cost to the Federal government, in a manner compatible with the project's authorized purposes and in accordance with applicable Federal laws and regulations and any specific directions prescribed by the Federal government;

e. At least annually and after storm events, at no cost to the Federal government, perform surveillance of the project to determine losses of material and provide results of such surveillance to the Federal government;

f. For shores, other than Federal shores, protected using Federal funds, ensure the continued public use of such shores compatible with the authorized purpose of the project;

g. Provide and maintain necessary access roads, parking areas, and other associated public use facilities, open and available to all on equal terms;

h. Give the Federal government a right to enter, at reasonable times and in a reasonable manner, upon property that the non-Federal sponsor owns or controls for access to the project to inspect the project, and, if necessary, to undertake work necessary to the proper functioning of the project for its authorized purpose;

i. Hold and save the Federal government free from all damages arising from design, construction, operation, maintenance, repair, rehabilitation, and replacement of the project, except for damages due to the fault or negligence of the Federal government or its contractors;

j. Perform, or ensure performance of, any investigations for hazardous, toxic, and radioactive wastes (HTRW) that are determined necessary to identify the existence and extent of any HTRW regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. 9601-9675, and any other applicable law, that may exist in, on, or under real property interests that the Federal government determines to be necessary for construction, operation and maintenance of the project;

k. Agree, as between the Federal government and the non-Federal sponsor, to be solely responsible for the performance and costs of cleanup and response of any HTRW regulated under applicable law that are located in, on, or under real property interests required for construction, operation, and maintenance of the project, including the costs of any studies and investigations necessary to determine an appropriate response to the contamination, without reimbursement or credit by the Federal government;

l. Agree, as between the Federal government and the non-Federal sponsor, that the non-Federal sponsor shall be considered the owner and operator of the project for the purpose of CERCLA liability or other applicable law, and to the maximum extent practicable shall carry out its responsibilities in a manner that will not cause HTRW liability to arise under applicable law; and

m. Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended, (42 U.S.C. 4630 and 4655) and the Uniform Regulations contained in 49 C.F.R Part 24, in acquiring real property interests necessary for construction, operation, and maintenance of the project including those necessary for relocations, and placement area improvements; and inform all affected persons of applicable benefits, policies, and procedures in connection with said act.

CHAPTER 8
LIST OF PREPARERS

8 LIST OF PREPARERS*

8.1 Preparers

This Feasibility Study with integrated Draft EA was prepared by the following USACE personnel:

Marty Durkin	Planner
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Gabe Todaro	Coastal Engineer
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8.2 Reviewers

This report was reviewed by the following USACE personnel:

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CHAPTER 9
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9 REFERENCES*

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