INTEGRATED
FEASIBILITY REPORT AND
ENVIRONMENTAL ASSESSMENT
FOR
COASTAL STORM RISK MANAGEMENT

FOLLY BEACH, CHARLESTON COUNTY,

SOUTH CAROLINA

SEPTEMBER 2021

US Army Corps of Engineers
Wilmington District

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Executive Summary
Folly Beach Coastal Storm Risk Management Integrated Feasibility Report and Environmental Assessment, Charleston County, SC

The purpose of this study is to evaluate Coastal Storm Risk Management along Folly Beach, a barrier island approximately 5.9 miles long located on South Carolina's central coast in Charleston County. The Coastal Storm Risk Management study is a 100% federally-funded effort, with the City of Folly Beach as the non-Federal study partner. The City of Folly Beach would be the project sponsor. Project Delivery Team (PDT) representatives included participants of federal and local governments in the effort to identify the most cost-effective, publicly acceptable, environmentally acceptable, and technically sound alternative to reduce storm damage and associated risks along the project shoreline. This study identified coastal storm risks on Folly Beach, inventoried opportunities for addressing these problems, assessed planning constraints that could impact plan formulation, and analyzed alternatives. This analysis identified the National Economic Development (NED) plan, which is the plan that maximizes net benefits to the nation through reduction of future storm damages. Additionally, a prior United States Army Corps of Engineers (USACE) study—completed pursuant to Section 111 of the River and Harbor Act of 1968 (Section 111)—determined that federal navigation works at Charleston Harbor are responsible for much of the erosion along Folly Beach. As a result, Section 111 mitigation measures are included within this study's Recommended Plan.

The U.S. Army Corps of Engineers Wilmington District (USACE) is lead federal agency under the National Environmental Policy Act (NEPA) process and associated environmental compliance activities. Pursuant to 40 CFR 1501, the Bureau of Ocean Energy Management (BOEM) is serving as a cooperating agency as the project proposes to utilize a series of potential borrow areas in federal waters adjacent to the project site. Since BOEM has jurisdiction by law over mineral leasing in the Outer Continental Shelf (OCS) beyond three miles, this EA will support BOEM's decision regarding issuance of leases for those portions of the proposed borrow areas outside the three-mile limit. BOEM will also serve as a cooperating agency for consultation requirements related to ESA Section 7 (50 CFR 402), NHPA Section 106 (36 CFR 800), Subpart C Consistency (15 CFR 930), Magnusson-Stevens Section 305 (50 CFR 600), Endangered Species Act (ESA) and National Historic Preservation Act (NHPA). To ensure the EA included an assessment of impacts on all significant resources in the project area, the Wilmington District circulated a scoping letter January 2019, to state and federal resource agencies for a 30-day comment period. A public scoping meeting was held on February 19, 2019. The draft feasibility study and EA were sent out to the public and resources agencies for a 30-day review on November 10, 2020. In addition, a virtual public information meeting was conducted on December 1, 2020.

Folly Beach is located on Folly Island, a 5.9 mile-long barrier island in Charleston County along South Carolina's central coast. Folly Island is located approximately 12 miles south of Charleston, South Carolina. Kiawah Island lays to the south of Folly Island and Morris Island is to the north. The south end of Folly Island and Kiawah Island are separated by Stono Inlet. The north end of Folly Island and Morris Island are separated by Lighthouse Inlet. The barrier island is separated from the mainland by the Folly River, with the ocean beaches facing southeast. Folly Beach is developed and can be accessed by one causeway and bridges across the marsh behind it. Folly Beach includes some hotels but is dominated by private homes. Folly Beach also contains areas of maritime forest. Stores and other commercial properties are found in the community. The footprint of the study area includes the marine environment offshore of Folly Beach, the barrier island, and the sub-aerial terrestrial beach.

In all cases where technically sound and environmentally feasible, both structural and non-structural measures were considered in the development of alternative solutions to the ongoing Coastal Storm Risk Management problems along the project area. The non-structural measures analyzed included: demolition and relocation; retreat; floodplain and regulatory restrictions; community education; updating of evacuation plans; and floodplain and building code updating. Demolition and relocation were found to have much greater costs than benefits, and therefore, were not recommended for implementation. Retreat was not considered a practicable alternative given the narrow width of the barrier island; and regulatory restrictions, evacuation, and community education are assumed to be continued in perpetuity as an integral part of any alternative. Of the structural measures analyzed, which included breakwaters, seawalls, groins, revetments, and berm and dune construction, only berms and dunes were shown to have an economically-justified, environmentally-sound solution, and provided the greatest potential for an implementable risk reduction solution. Revetments, while economically- justified in the northern reaches, would not be implementable due to their negative impacts to Critical Habitat for loggerhead sea turtles and loss of recreation area.

The Recommended Plan consists of a 5.85 mile (30,890 linear foot) main dune and berm combination beach fill. The southwest portion of the project includes a 35 ft wide berm between reaches 1 to 17 for 19,170 feet (ft), see Figure ES-1. This includes the 2,200 ft Folly Beach County Park portion of the Recommended Plan plus the 16,970 ft portion of the Recommended Plan between reaches 2-17. The northeast portion includes a 50 ft wide berm between reaches 18 to 26 for 9,720 ft, plus a 50 ft wide berm in the 2,000 ft portion of the Recommended Plan which includes the County-administered Lighthouse Inlet Heritage Preserve. The berm is at elevation 8.0 ft North American Vertical Datum 88 (NAVD88). The Plan includes constructing a new dune or raising the existing dune to a uniform elevation of 15 ft NAVD88 with a minimum top width of 5 ft between reaches 2-26. Neither the County Park in the southern end of the Recommended Plan nor the Lighthouse Inlet Heritage Preserve at the northern end of the Recommended Plan would feature a dune. The beach fill includes a 750-foot tapered transition at the ends of the project and a 500 ft transition between the 35 ft and

50 ft wide berm. During the 50-Year period of recommended federal participation in the Recommended Plan, material for the beach fill would be dredged from proposed borrow sources and transported to the beach by pipeline for the beach fill construction and all renourishments. Implementation of the Recommended Plan would place approximately 2,169,000 cubic yards of beach quality sand from the borrow areas on the beach for initial construction and approximately 2,106,000 cubic yards thereafter for each of the three nourishments resulting in a total of approximately 8,488,000 cubic yards over the 50-year life of the project. The renourishment interval for the project is approximately twelve years.

Table ES-1 provides the details of the Recommended Plan dimensions expressed relative to the 26 economic study area reaches utilized in the analysis for plan formulation purposes. All elevations for the current project in the main report and appendices are referenced in feet, vertical datum NAVD 88.

Reaches	Length (ft)	Landward Dune Slope (X:1)	Max Dune Elevation (ft, NAVD88)	Dune Base Width (ft)	Seaward Dune Slope (X:1)	Berm Elevation (ft, NAVD88)	Berm Width (ft)	Berm Seaward Slope (X:1)
1 (County Park)	2,200	None	None	None	None	8.0	35	-15
2 - 17	16,970	3	15	47	-3	8.0	35	-15
18 - 26	9,720	3	15	47	-3	8.0	50	-15
Heritage Preserve	2,000	None	None	None	None	8.0	50	-15

Table ES-1. Details of the Recommended Plan dimensions expressed relative to the 26 economic study area reaches utilized in the analysis for plan formulation purposes.

The Recommended Plan is environmentally acceptable. Coordination with resource agency representatives was initiated early in the study and appropriate avoidance and minimization measures were developed and integrated into project alternatives during the plan formulation process in order to reduce project impacts. These measures reduced significant direct impacts; however, incidental impacts were still documented with respect to specific species and their associated habitat requirements, including listed species such as piping plovers and sea turtles.

The analysis and design of the Recommended Plan contained in this report complies with the National Environmental Policy Act (NEPA). A separate Environmental Assessment (EA) will not be provided because the document is a fully integrated report that complies with both NEPA requirements and the USACE water resources planning process and its requirements. Formal consultation was completed for the recent nourishment of the current Folly Beach Coastal Storm Risk Management Project upon issuance of the USFWS Biological Opinion (BiOp) dated July 11, 2018. USFWS agreed that this

Biological Opinion is sufficient for the Recommended Plan. However, USFWS has requested consultation be reevaluated prior to initial construction to ensure an up-to-date BiOp reflecting updated conditions. The USFWS request was based on the upcoming critical habitat designation for red knots and updated information on construction details. Dredging operations for the project will be performed in accordance with the 2020 National Marine Fisheries Service (NMFS) South Atlantic Regional Biological Opinion (SARBO) for Dredging and Material Placement Activities in the Southeast United States or any superseding SARBO that is prepared by NMFS. The USFWS and the NMFS have been actively involved throughout the formulation of this project. The South Carolina Department of Health and Environmental Control has issued a blanket waiver for all beach nourishment projects in South Carolina; therefore, an individual Section 401 Water Quality Certification will not be required for the proposed project. A copy of the SCDHEC waiver can be found in Appendix I. The project will also be in compliance with Section 404 of the Clean Water Act.

The estimated First Cost of the Recommended Plan is $241,735,000 in fiscal year (FY) 2022 price levels, which would be cost-shared approximately 87% federal ($209,914,000) and 13% non-Federal ($31,821,000), in accordance with the cost-sharing exclusive to the project, as discussed in the Section 111 Appendix. Operations and maintenance costs are estimated at $101,000 a year and would be a 100% non-Federal responsibility. The project includes an approximate 12-year renourishment cycle (initial construction, plus three renourishments) with an estimated cost of $50,544,000 for initial construction and $191,191,000 over three renourishments (approximately $63,730,000 per renourishment). Initial construction would be cost-shared around 90% federal and 10% non-Federal basis. Renourishments would be cost-shared on an approximately 86% federal and 14% non-Federal basis. [1] The benefit cost ratio is 9.5 to 1 (including Recreational Benefits). The total cost for initial construction and the three renourishments is $241,735,000 ($54,544,000 for initial construction plus $63,730,000 on average per renourishment, for the three renourishments).

[1] The precise cost share will be determined in PED once USACE generates the exact sand volume required for the Recommended Plan. The cost sharing identified here is an estimate and subject to vary slightly. See the Section 111 Appendix for further details.

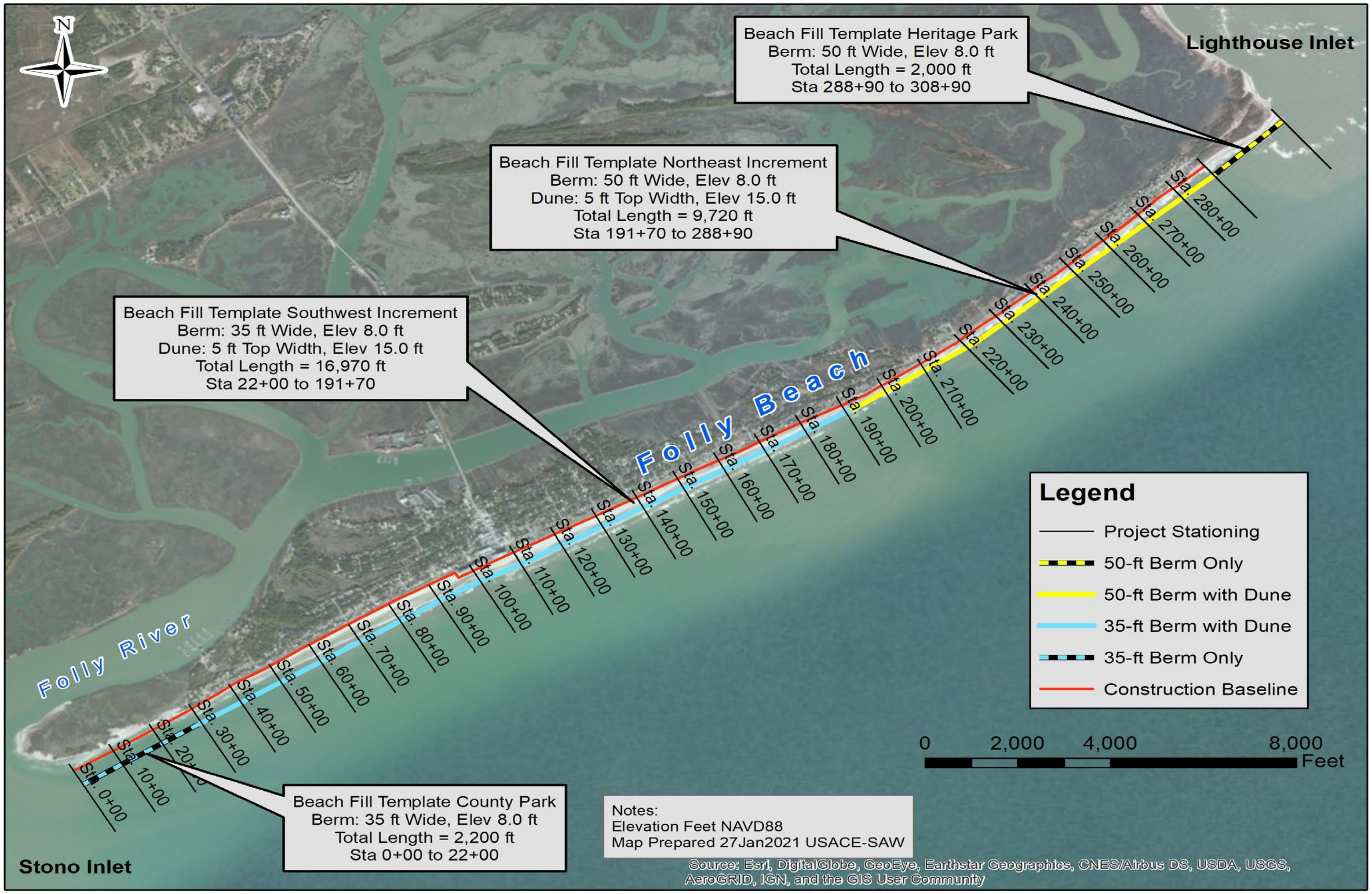

Figure ES-1. Recommended Plan

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NOTE: Sections containing an asterisk (*) refer to requirements of the NEPA process.

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List of Acronyms and Abbreviations

μPa/m	Micro Pascal per Meter
AA	Average Annual
ASA-CW	Assistant Secretary of the Army - Civil Works
BCR	Benefit-to-Cost Ratio
BiOp	Biological Opinion
BOEM	Bureau of Ocean Energy Management
°C	Degrees Celsius
CBRA	Coastal Barrier Resources Act
CBRS	Coastal Barrier Resources System
CEM	Corps of Engineers Manual
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CH_4	Methane
cm/s	Centimeters Per Second
CSRM	Coastal Storm Risk Management
CWE	Current Working Estimate
cy	Cubic Yard
dB	Decibel
DE	Damage Element
DPS	Distinct Population Segment
EA	Environmental Assessment
EC	Engineer Circular
EFH	Essential Fish Habitat
EPA	Environmental Protection Agency
EQ	Environmental Quality
EP	Engineer Pamphlet
ER	Engineer Regulation
ERDC	Engineer Research & Development Center
ESA	Endangered Species Act
ºF	Degrees Fahrenheit
FEMA	Federal Emergency Management Agency
FMC	Regional Fisheries Management Councils
FMP	Fisheries Management Plan
ft	Feet
FWOP	Future Without Project
FWP	Future With Project
FY	Fiscal Year
HAPC	Habitat Areas of Particular Concern
HTRW	Hazardous, Toxic and Radioactive Wastes

Hz	Hertz
IDC	Interest During Construction
IFR	Integrated Feasibility Report
LERRD	Lands, Easements, Right-of-Ways, Relocations, and Disposal Areas
LPP	Locally Preferred Plan
m	Meter
mg/l	Milligram Per Liter
MHW	Mean High Water
MLLW	Mean Lower Low Water
mm	Millimeter
MMT	Million metric tons
MOU	Memorandum of Understanding
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act
MSL	Mean Sea Level
N_2O	Nitrous Oxide
NAAQS	National Ambient Air Quality Standards
NARW	North Atlantic Right Whale
NAVD88	North American Vertical Datum 1988
NED	National Economic Development
NEPA	National Environmental Policy Act of 1969, as amended
NGVD 29	National Geodetic Vertical Datum of 1929
nm^2	Squared Nautical Miles
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NTU	Nephelometric Turbidity Units
O&M	Operations and Maintenance
OCS	Outer Continental Shelf
OCRM	SC DHEC's Office of Ocean and Coastal Resource Management
OMRR&R	Operation, Maintenance, Repair, Replacement, and Rehabilitation
OSE	Other Social Effects
P&G	Principles and Guidelines
PBF	Physical Biological Features
PCE	Primary Constituent Elements
PED	Preconstruction Engineering and Design
PPA	Project Partnership Agreement
ppt	Parts Per Thousand
RED	Regional Economic Development
ROI	Region of Influence
SAC	South Atlantic Division, Charleston District
SAD	South Atlantic Division
SAFMC	South Atlantic Fishery Management Council

SARBO	South Atlantic Regional Biological Opinion
SAW	South Atlantic Division,Wilmington District
SBEACH	Storm-Induced BEAch CHange
SCDHEC	South Carolina Department of Health and Environmental Control
SCDOT	South Carolina Department of Transportation
SCIAA	South Carolina Institute for Archaeology and Anthropology
SHPO	State Historic Preservation Office
SLC	Sea Level Change
SLR	Sea Level Rise
T&E	Threatened and Endangered
TCM	Travel Cost Method
TPCS	Total Project Cost Summary
UDV	Unit Day Value
USACE	United States Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
WRDA	Water Resources Development Act
yr	Year

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1. STUDY OVERVIEW*

This Integrated Feasibility Report and Environmental Assessment (EA) examines the feasibility and continued federal interest in a project providing Coastal Storm Risk Management along Folly Beach, in Charleston County, South Carolina. Folly Beach consists of a barrier island 5.9 miles long located on South Carolina's central coast, about 8 miles southeast of the city of Charleston, South Carolina. The island of Folly Beach is host to an existing project 5.47 miles long, sponsored by the City of Folly Beach, as discussed later in the report. The City of Folly Beach is the non-Federal sponsor on this study, which was conducted as a 100% federally-funded effort between the City of Folly Beach and the US Army Corps of Engineers, Charleston and Wilmington Districts. The City of Folly Beach would be the project sponsor. The location of the study area is shown in Figure 1-1.

1.01 Report Organization

This report is an Integrated Feasibility Report and Environmental Assessment (EA), containing elements that are required for both a U.S. Army Corps of Engineers (USACE) Feasibility Report as well as an EA, per the National Environmental Policy Act (NEPA). This report applies the 2020 Council on Environmental Quality NEPA regulations published in the Federal Register at 85 FR 43304. Sections that integrate both NEPA and Feasibility Report elements and requirements are denoted with an asterisk ("*") at the end of the section title. Section 2* contains background information on the environment that could be affected by a USACE project resulting from the study. Section 3* discusses the primary coastal storm damage problems and opportunities at Folly Beach. Section 4* details the existing and future without-project conditions of the study area and identifies the Recommended Plan. Section 5* describes the affected environment and environmental impacts. Section 6* is a detailed description of the Recommended Plan. Section 7* contains information on plan implementation such as schedule, project cost, and implementation cost-sharing. Section 8* lists the study's compliance with all applicable environmental laws and Executive Orders. Section 9* is a summary of agency and public involvement that has been undertaken throughout the course of the study. Sections 10*, 11*, 12*, and 13*contain, respectively, the report conclusions, recommendations, project point of contact, and literature references. Supporting Appendices are also included as part of this report.

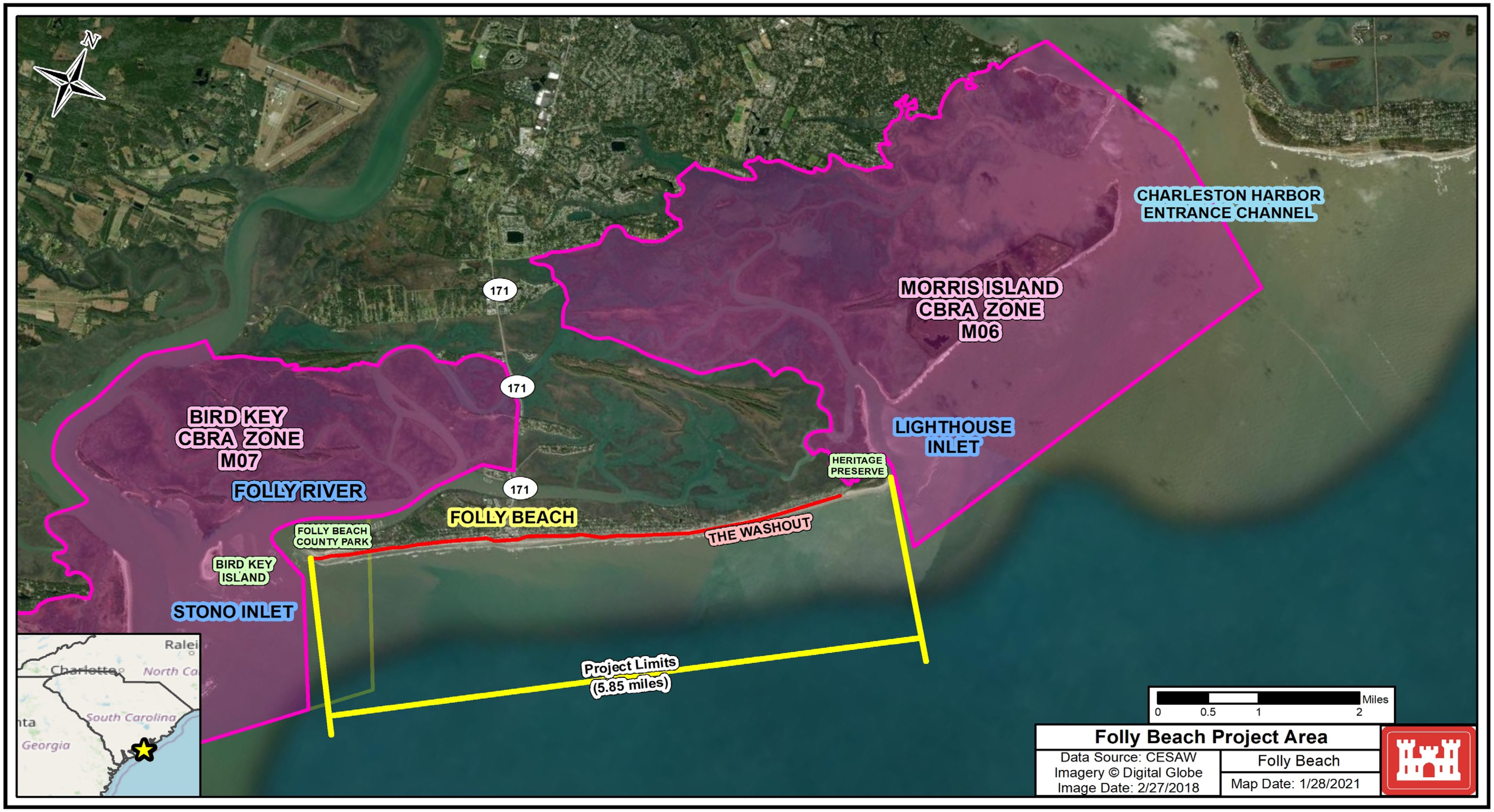

Figure 1-1. The location of the study area in relation to the adjacent Coastal Barrier Resources Act (CBRA) units and Charleston Harbor Entrance Channel.

1.02 Study Authority

The Folly Beach Shore Protection Project was authorized by Section 501 of the Water Resources Development Act of 1986 (WRDA 1986) Public Law (PL) 99-662, as amended, and modified by the Energy and Water Development Appropriations Act of 1992, Public Law 102-104.

The original authorizing language, as presented in PL 99-662 is as follows: "SEC. 501(a). The project for shoreline protection, Folly Beach, South Carolina: Report of the Chief of Engineers, dated March 17, 1981, at a total cost of $7,040,000, with an estimate first federal cost of $3,870,000 and an estimated non-Federal cost of $3,170,000."

The amended authorizing language, as presented in PL 102-104 is as follows: "SEC. 108. The project for shoreline protection for Folly Beach, South Carolina, authorized by section 501(a) of the Water Resources Development Act of 1986 (Public Law 99-662; 100 Stat. 4136), is modified to authorize the Secretary to construct hurricane and storm protection measures based on the Charleston District Engineer's Post Authorization Change Report dated May 1991, at an estimated total cost of $15,283,000, with an estimated federal cost of $12,990,000 and an estimated non-Federal cost of $2,293,000, and an annual cost of $647,000 for periodic beach nourishment over the life of the project, with an estimated annual federal cost of $550,000 and an estimated non-Federal cost of $97,000."

This study is authorized by Section 216 of the Flood Control Act of 1970, Public Law 91-611 (33 U.S.C. § 549a). Section 216 authorizes the Chief of Engineers to review the operation of projects constructed by the U.S. Army Corps of Engineers 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 operations, and for improving the quality of the environment in the overall public interest. This study is funded through the Bipartisan Budget Act 2018. The Feasibility Cost Share Agreement was signed with the local project sponsor, the City of Folly Beach, on October 12, 2018.

Section 111 mitigation measures are also integrated into this study. These mitigation measures, discussed in further detail in the Section 111 Appendix, are authorized by the River and Harbor Act of 1968 (33 U.S.C. § 426i). This Act authorizes USACE to "plan . . . and implement structural and nonstructural measures for the . . . mitigation of shore damages attributable to Federal navigation works."

1.03 Study Area

Folly Beach is located on Folly Island, a barrier island in Charleston County along South Carolina's central coast (Figure 1-1). The island faces the Atlantic Ocean on the southeast and extends approximately 5.9 miles from Stono Inlet on the southwest to Lighthouse Inlet on the northeast. The Folly River separates Folly Beach from James Island to the north and west.

Over the past 25 years, Folly Beach has developed rapidly as a tourist-oriented ocean resort community for outdoor recreation, vacationing fishing, and entertainment. Land use is primarily recreational, residential, and commercial properties, with the highest density along the oceanfront. Based on the 2010 census, the permanent, off-season population is 2,617 residents, but increases vastly in the summer. During the summer months a large portion of the homes within the study area are available as summer rentals to vacationers primarily from inland South Carolina and other locations around the Eastern United States. Tourist-associated income is critical to the region's economic vitality and growth. Except for some higher elevation areas, the entire island is subject to hurricane storm surge flooding.

1.04 Purpose and Need for Action

The purpose and need for Coastal Storm Risk Management along Folly Beach is the reduction in storm damages and land loss resulting from beach erosion, wave attack, and flooding along the ocean shoreline, and associated risks to life and safety. There is also a need to reduce erosion of the shoreline as an environmental resource itself, in its protection to the terrestrial environment inland, and as a recreational resource to the public. A wide variety of possible measures would reduce the impacts of erosion, waves, and flooding on commercial and residential property and infrastructure within the study area. Some of the measures would also provide incidental environmental and recreational benefits.

1.05 Scope of Study

This study consists of the problem identification and plan formulation addressing Coastal Storm Risk Management issues along Folly Beach. This study provides the analysis of measures and plans determining whether there is continued federal interest in project participation, and, if so, the identification of the NED plan with the highest net benefits to the Nation. This study also identifies and incorporates into the Recommended Plan Section 111 mitigation measures to address the federal Charleston Harbor navigation jetties' impact along the Atlantic frontage of Folly Island and ensure a comprehensive shoreline protection solution.

1.06 Study Process

U.S. Army Corps of Engineers (USACE) studies for water and related land resources follow detailed guidance provided in the *Planning Guidance Notebook* (Engineer Regulation 1105-2-100). This guidance is based on the *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies* that were developed pursuant to Section 103 of the Water Resources Planning Act (P.L. 89-80) and Executive Order 11747, which were approved by the U.S. Water Resources Council in 1982 and by the President in 1983. A defined six-step process is used to identify and respond to problems and opportunities associated with the federal objective and specific State and local concerns. The six steps are as follows:

Step 1: Identify Problems and Opportunities
Step 2: Inventory and Forecast Conditions
Step 3: Formulate Alternative Plans
Step 4: Evaluate Alternative Plans
Step 5: Compare Alternative Plans
Step 6: Select Recommended Plan

The process involves an orderly and systematic approach to making evaluations and decisions at each step so that the public and the decision makers can be informed of basic assumptions made, the data and information analyzed, risks and uncertainty, the reasons and rationales used as decision-making criteria, and the effectiveness and impacts of each alternative plan. Subject to positive economic justification, this process concludes with the selection of a Recommended Plan. Specific aspects of this planning process are described in more detail in other sections of this document.

1.07 Cooperating Agencies

Pursuant to Section 1501.8 of the Council on Environmental Quality (CEQ) NEPA Regulations, the Bureau of Ocean Energy Management (BOEM) agreed to participate as a cooperating agency during the preparation of the Integrated Feasibility Report and Environmental Assessment. BOEM has assisted and will continue to assist in developing information and preparing environmental analyses in areas which the BOEM has special expertise. This assistance enhances the interdisciplinary capability of the study team.

1.08 Prior Studies and Reports

- U.S. Army Corps of Engineers, Charleston District. 1979. Folly Beach, South Carolina, Survey Report on Beach Erosion Control and Hurricane Protection. This report recommended restoration of 16,860 linear ft of beachfront with periodic nourishment.
- U.S. Army Corps of Engineers, Charleston District. 1987. Detailed Project Report, Charleston Harbor, South Carolina, Folly Beach. This report was prepared under the authority contained in Section 111 of the 1968 River and Harbor Act, as amended. This report established a direct relationship between the construction of the Charleston Harbor jetties and the erosion at Folly Beach. The report concluded that approximately 57 % of the erosion at folly Beach is attributable to the effects of the federal navigation project at Charleston Harbor.
- U.S. Army Corps of Engineers, Charleston District. 1988. Folly Beach, South Carolina, Special PED Report to Re-evaluate Federal Justification for Storm Damage Reduction. This report recommended that PED studies be continued and that the authorized project is still eligible for federal participation in compliance with current policy.
- U.S. Army Corps of Engineers, Charleston District. 1991. General Design Memorandum, Folly Beach, South Carolina Shore Protection Project. This report recommended that the previously authorized project be modified from a length of 16,860 feet to a length of 28,200 ft. The report also recommended that the cost share should be 85% federal and 15% non-Federal.
- U.S. Army Corps of Engineers, Charleston District. 2005. Project Information Report Rehabilitation Effort for the Folly Beach Shore Protection Project. This report was prepared under the authority of Public Law 84-99 in response to damages to the federal project during the 2004 hurricane season. The report recommended partial restoration of

the project at 100% federal cost along with a full renourishment of the rest of the project at 85% federal cost and 15% non-Federal cost.

- U.S. Army Corps of Engineers, Charleston District. 2006. Folly Beach, South Carolina Shore Protection Project - Project Information Report for the Hurricane Rehabilitation Effort. This report was prepared under the authority of Public Law 84-99 in response to damages to the federal project during the 2005 hurricane season. The report recommended partial restoration of the project at 100% federal cost.
- U.S. Army Corps of Engineers, Charleston District. 2017. Project Information Report Rehabilitation Effort for the Charleston County Coastal Storm Risk Management Project Folly Beach, South Carolina. This report was prepared under the authority of Public Law 84-99 in response to damages to the federal project during the 2015 and 2016 hurricane seasons. The report recommended partial restoration of the project at 100% federal cost.
- U.S. Army Corps of Engineers, Charleston District. 2017. Addendum (To the 2016 Hurricane Season) Project Information Report Folly Beach Coastal Storm Risk Management Project Folly Beach, South Carolina. This report was prepared under the authority of Public Law 84-99 in response to damages to the federal project during the 2017 hurricane season. The report recommended partial restoration of the project at 100% federal cost.
- U.S. Army Corps of Engineers, Charleston District. 2017. Addendum Report for Economic Justification of the Full Construction Template (Per 2018 Supplemental Bill) Associated with: Project Information Report for the Rehabilitation Effort Folly Beach, South Carolina Coastal Storm Risk Management Project. This report was prepared under the authority of Public Law 84-99 in response to damages to the federal project during the 2018 hurricane season. The report recommended partial restoration of the project at 100% federal cost.

1.09 Existing Federal and Non-Federal Projects

Existing Federal Project:

- The currently authorized Folly Beach Shoreline Protection Project has a length of 28,890 ft, which includes a 670 ft transition zone on the north end of the project. The project extends from just southwest of the Heritage Preserve (former Coast Guard Station) on the northeast end of the island through the County Park on the southwest end. The project provided a protective berm with a top width of 15 ft and elevation of 9.0 ft NGVD. In 1993, USACE placed an initial 738,500 cubic yards in the protective berm and 1,742,700 cubic yards advanced nourishment plus overfill. Sand for this initial construction was removed from the lower Folly River landward of Stono Inlet and Folly Beach County Park. Subsequent renourishments occurred in 2005 and 2014, and two partial emergency renourishments in 2007 and 2018. Also included in the authorized project was groin rehabilitation. The USACE rehabilitated nine deteriorated groins north of the Holiday Inn (Station 0+00). These groins, made of wood or large rocks, were initially constructed by the South Carolina Department of Transportation. The USACE has completed rehabilitation of these groins; therefore, per the 1992 Local Cooperation Agreement, the City of Folly Beach is now the owner and responsible entity for operating, maintaining, repairing, and rehabilitating these groins.

Other Federal Projects: There are two federal projects in the vicinity of Folly Beach, which are briefly described below (see Figure 1-1).

- Folly River Federal Navigation Project: The Folly River navigation project is located immediately south and west of Folly Beach. The Folly River project was authorized under Section 107 of the 1960 Rivers and Harbor Act, as amended. It includes an approximate 3 nautical mile long 11-foot deep by 100-foot wide entrance channel beginning at the ocean bar and extending into Stono Inlet at the junction of the Stono River and Folly River; an approximate 3 nautical mile long 9-foot deep by 80-foot wide channel in Folly River; and an approximate 3 nautical mile long 9-foot deep by 80-foot wide channel in Folly Creek. Dredging of this project occurs on an intermittent, as needed basis when funding is available. Dredged material from Folly River is placed on both Folly Beach and a bird nesting island in Stono Inlet known as Bird Key Island. Dredged material from the entrance channel is sidecast into ocean alongside the channel. Dredging of Folly Creek is not required.

- Charleston Harbor: The Charleston Harbor navigation project is located approximately 7-1/2 miles north of Folly Beach. The Charleston Harbor project is a deep-draft navigation project that was originally authorized in 1878. It has been deepened and expanded many times since its original authorization and is currently undergoing an additional deepening project. Once completed, the Charleston Harbor project will consist of an approximately 20-1/2 mile long 54-foot deep by 800-foot wide entrance channel that extends from the 54-foot depth ocean contour to the mouth of the harbor; a 52-foot deep inner harbor channel that extends from the mouth of the harbor to approximately 2-1/2 miles up the Cooper River; a 52-foot deep channel in the Wando River that extends from the junction of the Cooper and Wando Rivers to approximately 2-1/2 miles up the Wando River; and a 48-foot deep upper harbor channel that extends approximately 6 miles further up the Cooper River from the end of the 52-foot deep channel. Dredging of this project occurs on an annual basis in different parts of the approximately 38-1/2 mile long navigation channel. Dredged material is placed either in the Ocean Dredged Material Disposal Site (ODMDS) or in various upland, confined dredged material placement areas.

Non-Federal Projects: There are no significant non-Federal projects in the vicinity of Folly Beach.

Placement of Dredged Material on Folly Beach**:**

- Historically, the placement of dredged material from the Folly River navigation project has intermittently occurred at the southwest end of the Folly Beach shoreline at the

Charleston County Park. It should be noted that the purpose of these actions is beneficial use of dredged material, not Coastal Storm Risk Management. These navigation related placement activities could occur in the future; however, given funding uncertainties and the uncertainties related to any specific determination of placement locations, these potential future events are not included as an element of the Future Without-project Condition in this feasibility study.

2. PROBLEMS AND OPPORTUNITIES*

The primary concerns identified in the study area by the non-Federal sponsor and the general public are potential economic losses resulting from (1) damages to structures and their contents due to hurricane and storm activity, and (2) the loss of beachfront land due to progressive and long-term shoreline erosion. The loss of the beachfront threatens not only the local economy, visitation, and tourist-related commercial enterprises, but has National Economic Development impacts as well, when resources that could be used elsewhere are devoted to storm recovery and rebuilding efforts. There are also on-going threats to life and safety during large coastal storm events. In addition, periods of severe shoreline recession can adversely affect nesting habitat for endangered and threatened sea turtles and shorebirds, and beach width available for recreational opportunities. This section describes these problems, and opportunities for improvement, in more detail.

2.01 Long-Term Erosion

"Long-term erosion" as used in this report refers to long-term shore processes that reduce the width of the shoreline. These processes include longshore and cross-shore sediment transport resulting from both tropical and storm induced wave conditions. Without-project shoreline changes can be assessed by extrapolating historic shoreline erosion/accretion rates out into the future, thereby identifying areas likely to be problematic and prone to storm damage. The South Carolina Department of Health and Environmental Control's (SCDHEC) Office of Ocean and Coastal Resource Management (OCRM) has established 31 permanent beach profile monuments along Folly Beach with surveys from 1988 to present.

The results of the historic shoreline analysis at Folly Beach revealed recession and accretion rates that varied both in time and in location along the shoreline. Influences include the Charleston Harbor navigation jetties, groin fields and armoring of the beachfront with bulkheads and revetments. Folly Beach is bounded by Stono Inlet on the southwest end of the island and Lighthouse Inlet on northeast end with tidal shoals continually evolving over time. Terminal groins at ends of the island complicates the dynamics. Morris Island is located north of Folly Beach and has a history of high erosion also related to the navigation jetties. The retreat of Morris Island has likely accelerated recent erosion rates on the northeast end of Folly Beach. The northeast end was relatively stable in the 1990's but is now an erosional hot spot with rates exceeding 20 ft/yr at several OCRM profiles since 2008. The location known as the "Washout" includes a rock revetment constructed by the South Carolina Department of Transportation (SCDOT) and has a long-term erosion rate of 7 ft/yr. The middle section of the island has had more consistent erosion rates through time with rates between 3 ft/yr to 6 ft/yr. The southwest end of Folly Beach experienced erosion rates exceeding 15 ft/yr. A terminal groin was built in 2013 to stabilize the reach.

2.01.1. Charleston Harbor Jetties

The 1987 USACE Section 111 report "Evaluation of the Impacts of Charleston Harbor Jetties on Folly Island, South Carolina" addressed the issue of shoreline damage attributable to a federal navigation project (USACE, 1987). A sediment budget analysis was used to determine the impact of the jetties on the sub-aerial beach at Folly Island. The report states that littoral sediment transport from the north has been blocked by the jetties causing a decreased sediment supply to Folly Island and to offshore areas. Morris Island is to the north of Folly Island and is also impacted by loss of sediment. The reduced sediment to the ebb-tide shoals and the steepening offshore profile have increased the wave energy along Folly Island and resulted in the landward migration of the ebb-tide shoals at Lighthouse Inlet. Figure 1 from the original Section 111 Report is included in Appendix G and shows the overall area evaluated for these erosion impacts.

2.02 Coastal Storm Damage

"Coastal storm damage," as used in this report, refers to damages incurred to property and infrastructure due to flooding and wave impact during hurricanes and other extratropical events, as well as short-term erosion that occurs during these events. These short-term effects can be exacerbated in areas that are also experiencing long-term erosion. When the island is under storm attack, the full force of the waves is felt along the immediate ocean shoreline; as the waves break and spill over the ocean edge of the island, development in upland areas is subject to the force of the waves.

Devastating hurricanes and other extratropical events periodically strike coastal South Carolina. Storms occur in cycles with the recent years being fairly active. Folly Beach suffered the effects of many of these storms. Hurricane Hugo made landfall north of Charleston on September 22, 1989 as a Category 4 and was the costliest storm event in South Carolina history. Folly Beach experienced sustained winds of 85 mph and gust of 107 mph and with combined surge and peak wave elevations of 13 to 14 ft NAVD88 resulting in major structural damage to homes and businesses and beach erosion. Other hurricanes of significance include Gracie (1959), Ophelia (2005), Sandy and Beryl (2012), Joaquin (2015) Matthew (2016) and Florence (2018). Although hurricanes typically generate larger waves and storm surge, northeasters also impact the Folly Beach shoreline because of their longer duration and higher frequency of occurrence. A detailed history of the hurricane and tropical storm events impacting southeast South Carolina is provided by the National Weather Service at the link below.

https://www.weather.gov/chs/TChistory

2.03 Loss of Beach Recreation Usage

All reaches in the study area are available for a multitude of beach recreation activities—swimming, surfing, wading, walking, sightseeing, picnicking, sunbathing, surf fishing, and jogging. As the State population increases, the number of visitors to these beaches is expected to increase as well. The concern for beach recreation is that long term shore erosion will continue to narrow the amount of beach available for recreational use. As the available width decreases, some of those recreational opportunities are reduced and eventually lost altogether. Maintaining or expanding the current beach width would increase recreational opportunities and benefits in the study area.

2.04 Impacts to Sea Turtle and Shorebird Habitat

A shoreface composed of beach, berm, and dune components can provide valuable nesting habitat for sea turtles, and beaches and inlets in the project vicinity are heavily used by migrating shorebirds. These areas offer high value habitat for breeding birds including terns, skimmers, piping plovers, Wilson's plovers, and American oystercatchers. However, long-term shoreline erosion coupled with historical short-term storm events have led to substantial sediment losses from the shoreface. As a result, of those existing erosional trends, substantial portions of the berm and dune system have historically been lost in areas where the shoreline is being squeezed between the ocean and adjacent development. Limited, high-quality turtle nesting habitat along the shoreline is consequently impacted, placing the sea turtle nests at risk in the eroded areas.

Reestablishing a berm and dune system with a gradual slope can enhance nesting success of sea turtles by providing suitable nest sites without escarpment obstacles and away from tidal inundation. Additional information can be found in Section 5 below and specific protection measures can be found in Section 5.05 and Appendix I Environmental Coordination.

2.05 Opportunities

There are potential opportunities to address these problems described above through structural and non-structural, including nature- and nature-based coastal storm risk management measures that could be implemented as part of a cost-shared federal project. Measures taken to reduce long term erosion and coastal storm damages can also incidentally benefit recreation and the environment.

3. EXISTING AND FUTURE WITHOUT-PROJECT CONDITIONS*

The existing condition of significant resources in the area was described briefly in Section 2 of this report. This section focuses on further quantifying the existing and future without-project (FWOP) physical shoreline and economic conditions that form the primary basis for the comparison of benefits of project alternatives. The future without-project condition refers to the most likely future that would occur without a Federal Coastal Storm Risk Management project or other federal actions, in place.

3.01 Without-Project Analysis – Key General Assumptions

The key assumptions made for this study are:

- Current physical and social trends occurring from the recent past until the present will continue into the future for the 50-year period of analysis. The period of analysis for this study is from 2025 to 2075. Period of analysis and project life are considered to be the same in this study.

- Damaging storms will continue to occur with comparable strength and frequency as have occurred in the past

- There will continue to be a demand for residential structures in the study area

- Existing structures will be rebuilt as before after experiencing minor storm damage. Existing structures will be rebuilt to be more resilient after suffering major damage events, consistent with floodplain standards per local regulations and 33 USC 2318

- No new structures will be built on currently undeveloped lots. This is a conservative approach with regards to benefits since additional structures would result in additional FWOP damages, hence increased benefits.

- No other Coastal Storm Risk Management project in the study area will be constructed over the period of analysis. The FWOP analysis in this study assumed no local project implementation beyond repair of small individual property revetments. This assumption was deemed valid for several reasons: 1) the high level of uncertainty about any actions regarding the timing, location, and quantities of any future placement make it impossible to accurately model the effects; consequently development of any specific FWOP condition that included local nourishment would potentially be less accurate than a FWOP that assumed no nourishment at all; 2) Any non-project related beach fill placements that occur in the future would reduce the cost of the federal project by reducing required nourishment volumes; and; 3) Assuming no new beach placement in the FWOP minimizes the risk of exceeding the Section 902 limit (the risk is that the total project cost would be underestimated if non-Federal beach placement predicted for a FWOP did not actually occur), and better ensures that storm damage reduction benefits will be realized with a federal project in place. Section 902 is a cost limit policy established in the Water Resources Development Act of 1986 as amended. All project authorized in or after 1986 are subject to Section 902 unless otherwise authorized.

Violation of the Section 902 limit occurs when the cost appears to exceed 120% of the amount authorized.

- Placement of dredged material is not factored into analysis of future shoreline change owing to uncertainties related to funding and potential placement. Historically, material from federal maintenance dredging activities of the Folly River navigation project has been placed on the west end of Folly Beach at the Charleston County Park. These placements occurred on an intermittent, as needed basis when funding was available. However, future placement is not guaranteed and would depend on funding, navigation needs, and other potential factors. As an example, material dredged from local navigation channels could be placed in more cost-effective offshore locations, rather than on the beach. In addition, these placements are not designed for Coastal Storm Risk Management purposes. Incorporating these future placement activities into the without-project condition is difficult from a modeling perspective, and made even more so because of uncertainties surrounding the frequency, location, and amount of future placement.

- The FWOP does not attempt to model the potential reaction of individual homeowners to worsening erosion, or the effect of FEMA response to disaster declarations. In the absence of a large-scale protective feature, in the future, individual private property owners may undertake some of their own measures to protect their homes and business as they become increasingly threatened. None of these measures would be substantial enough to prevent damage from large events, as their size limitations would not prevent substantial surge and wave attack. Some minor emergency beach nourishment may be accomplished after declared disasters when Federal Emergency Management Agency (FEMA) funding is available, if a Federal project is still in place. However, the scope and extent of these activities are difficult to predict, and most likely would not significantly alter the relative comparison of alternatives, the feasibility of a large-scale federal Coastal Storm Risk Management project, or its costs and benefits. As such, these activities are not being modeled in the future without-project condition. Under any FWOP condition, there would be substantial loss of recreation and environmental habitat benefits.

3.02 Without-Project Analysis – Sea Level Change Assumptions

USACE Engineer Pamphlet (EP) 1100-2-1, Engineering Regulation (ER) 1100-2-8162 and Engineer Pamphlet (EP) 1100-2-1 provide both a methodology and a procedure for evaluating sea level change (SLC). This guidance is used for incorporating the potential direct and indirect physical effects of projected future sea level change in the engineering, planning, design and management of USACE projects. Three estimates are required by the guidance, a Low (Baseline or historic rate) estimate representing the minimum expected sea level change, an Intermediate estimate, and a High estimate representing the maximum expected sea level change. These

estimates are referenced to the midpoint of the latest National Tidal Datum epoch, 1992.
The guidance was used to evaluate the future sea levels, the impacts to the Folly Beach project during the 50-Year period of analysis and to assess the risk associated with the SLC estimates. Details of the SLC analysis can be reviewed in Appendix A.

This analysis was based on the NOAA tide gauge located in Charleston, South Carolina (Station #8665530), approximately 8 miles north of Folly Beach (Figure 3-1). The gauge is active and compliant with data from 1905 to present. The linear relative sea level trend for this gauge is 3.26 mm/year (0.01070 ft/year) with a 95% confidence interval of +/- 0.19 mm/year (0.00062 ft/year) based on monthly mean sea level data, see Figure 3-1. For the 50-year period of analysis of 2025 to 2075 this is equivalent to an increase of 0.54 ft in sea level.

The USACE online tool *Sea Level Tracker* was used to determine the current rate of SLC observed and the projected future trends in the rate of SLC, a link to the tool is provided below. The *Sea Level Tracker* is used to compare actual mean sea level (MSL) values and trends for specific NOAA tide gauges with the USACE SLC scenarios as described in ER 1100-2-8162 and Engineer Pamphlet (EP) 1100-2-1. The Sea Level Tracker tool calculates the USACE Low, Intermediate and High sea level change scenarios based on global and local change effects. Historical MSL can be represented by either 19-year or 5-year midpoint moving averages. https://climate.sec.usace.army.mil/slr_app/

The Sea Level Tracker tool was used to evaluate the NOAA Charleston tide gauge data. The regionally corrected rate of 0.00965 ft/yr was used as the rate of SLC and was sourced from NOAA Technical Report NOS CO-OPS 065 and accounts for vertical land motion. This regional rate is also the Low USACE estimated SLC rate. Based on the regional rate only, the sea level increase was 0.48 ft during the 50-year period of analysis of 2025 to 2075. Figure 3-2 presents the results of the Tracker tool focused on trends between 1990 to 2020. The light blue line represents the 5-year moving average and the heavy dark blue line represents the 19-year moving average. The 19-year average is useful in that this represents the moon's Metonic cycle and the tidal datum epoch. These estimates are referenced to the midpoint of the latest National Tidal Datum epoch, 1992. The red line is the High SLC prediction, the green is the Intermediate and the blue is the Low rate prediction. From Figure 3-2 it can be noted that the 19-year moving average tracks well with the Intermediate rate. The 5-year rate is tracking upwards but is cyclical and does not match the tidal epoch period of 19-years.

The future USACE sea level predictions for the Folly Beach project based on the Charleston gauge are provided in Figure 3-3. For the 2025 to 2075 period of analysis the predicted Low rate sea level rise (regional rate) is 0.48 ft, the Intermediate SLC increase was 0.99 ft and the High SLC increase was 2.58 ft.

The USACE Intermediate SLC scenario was selected for the Folly Beach project because it tracked well with the 19-year moving average. The USACE predicted Intermediate rate was also selected for the Charleston Peninsula Coastal Storm Risk Management Feasibility Study. Similar SLC trends were noted at the near-by tide gauges in Tybee Island, GA and Myrtle Beach, SC. The Intermediate rate was also selected in coordination with the USACE Climate Preparedness and Resilience Community of Practice.

The sea-level rise used in the without-project condition is 0.0198 ft/yr for a total of 0.99 ft over 50-years. Relative vulnerability to flooding during extreme events and SLC is consistent between both the With and Without-project conditions. However, adaptation in the form of additional sand volume may be required to maintain project performance. For this analysis, the Intermediate sea level rise rate curve was used to compare with and without-project conditions.

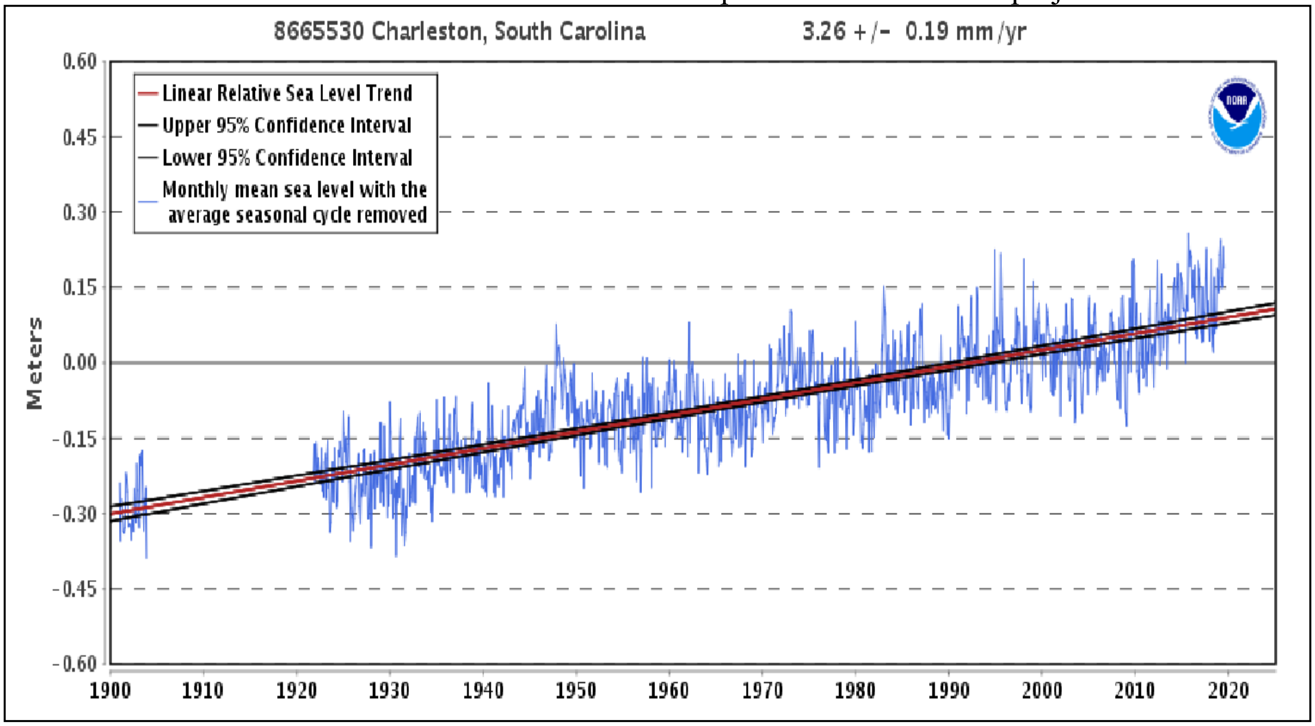

Figure 3-1. Relative Sea-Level Trend, NOAA Gauge 8665530.

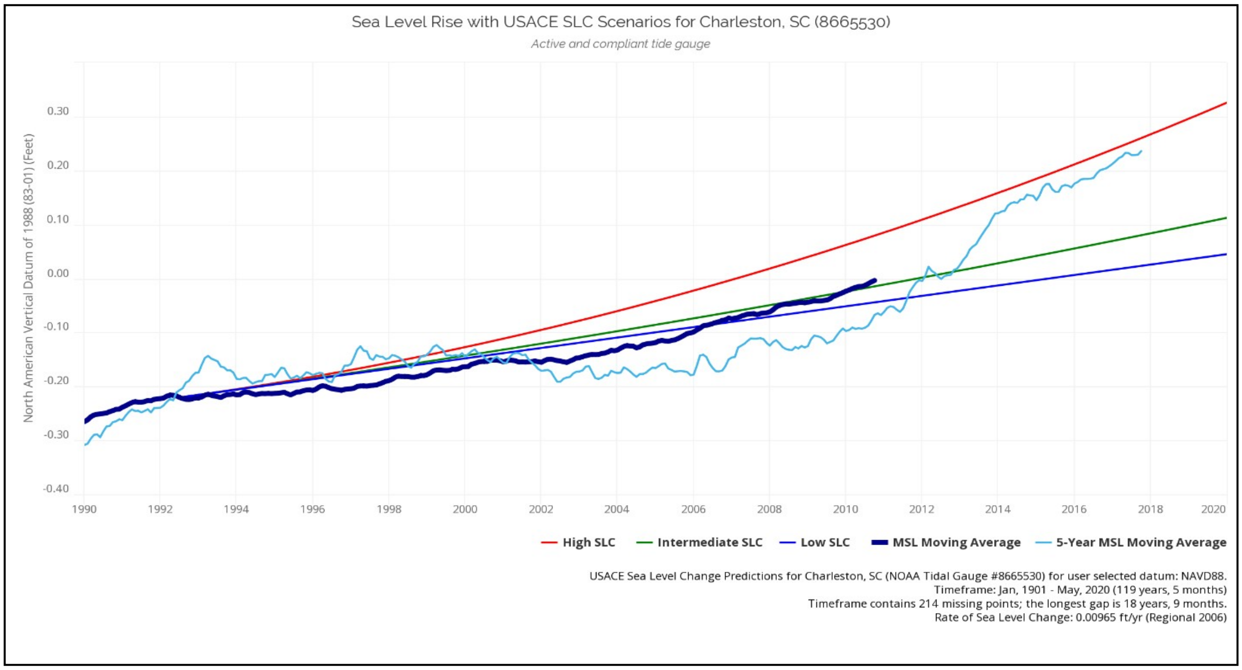

Figure 3-2. Charleston NOAA Gauge #865530 SLC with 19-year and 5-Year Moving Average.

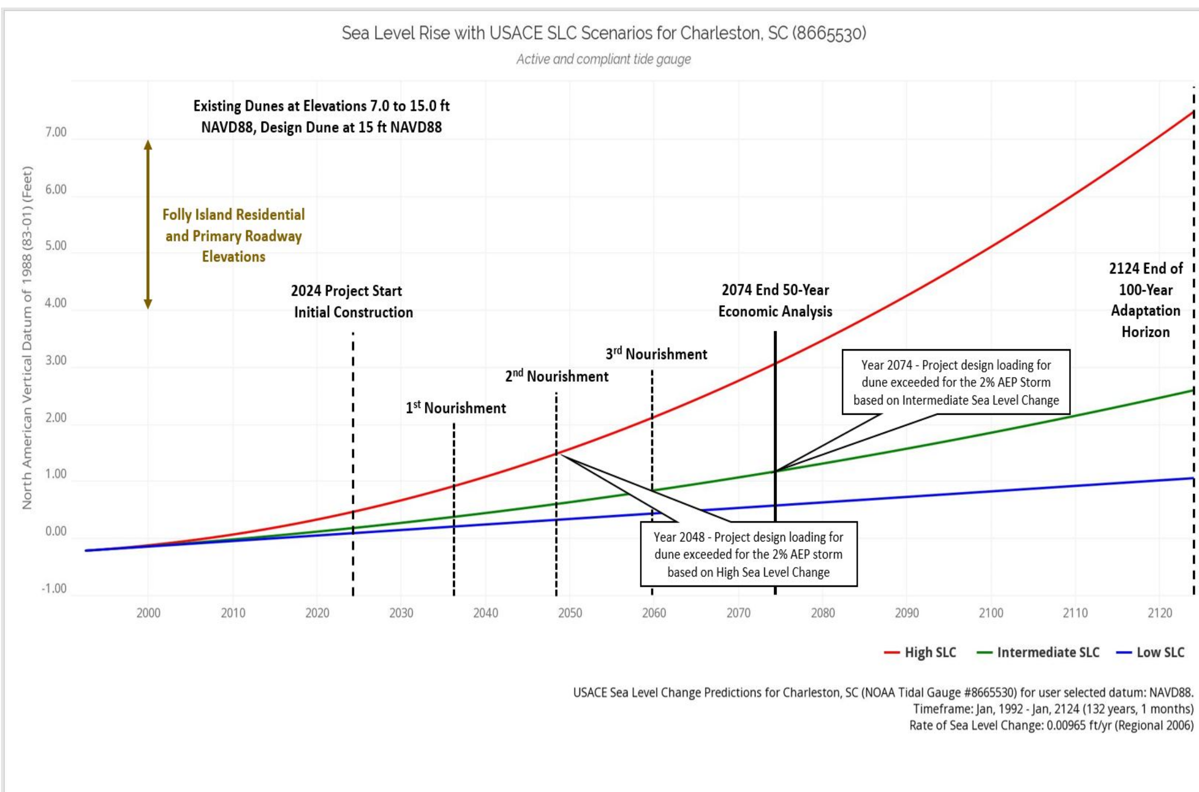

Figure 3-3. USACE Sea-Level Change Predictions.

The comparison of the final array indicated that berm and dune plans are the only plans that are economically justified. A non-structural plan, at over $407,000,000 for removal and relocation is not economically justified. Changes in RSLC would not change a plan from that of a berm and dune plan, just would make the dune and berm template larger and more expensive. Analysis indicates choice of a higher rate is not supported by evidence.

3.03 Existing and Future Without-Project Shoreline Conditions

For the purposes of the coastal analysis and characterizing the physical characteristics of the shoreline, the study area was divided into 9 Storm-Induced Beach Change (SBEACH) model coastal reaches and 26 project economic reaches. A coastal reach is an area where the beach profile is consistent enough that the entire reach can be adequately characterized through a single representative profile. Each coastal reach had similar erosion rates and physical morphology. Particular attention was paid to important profile features such as dune height, berm height and width, and offshore bar location. In addition, shoreline orientation was also taken into consideration. Additional details are provided in Appendix A, Section 4.1. Economic reaches are quadrilaterals with a seaward boundary that is parallel with the shoreline that contain the Lots and Damage elements, and that are used to incorporate coastal morphology changes for transfer to the lot level. Model reaches are also useful because they allow modelers to divide study reaches into more manageable segments for analysis.

This coastal reach characterization is necessary for the numerical modeling of the shoreline response to storms using the SBEACH model. The SBEACH model output of shoreline responses is then used as an input into the Beach-*fx* model, which uses a Monte Carlo simulation to track beach profile evolution over time and measure average economic damages over multiple project life cycles. The calibration of the SBEACH and Beach-*fx* models is discussed in detail in Appendix A. In the Beach-*fx* model, events of interest (storms, beach nourishment) take place at calculated times. As each event takes place, the model simulates the physical and economic responses associated with that event. A set of idealized beach profiles, as defined by key data points, is tracked by the simulation model as the beach profile evolves over time. Figure 3-4 depicts the features that are measured in an idealized profile,

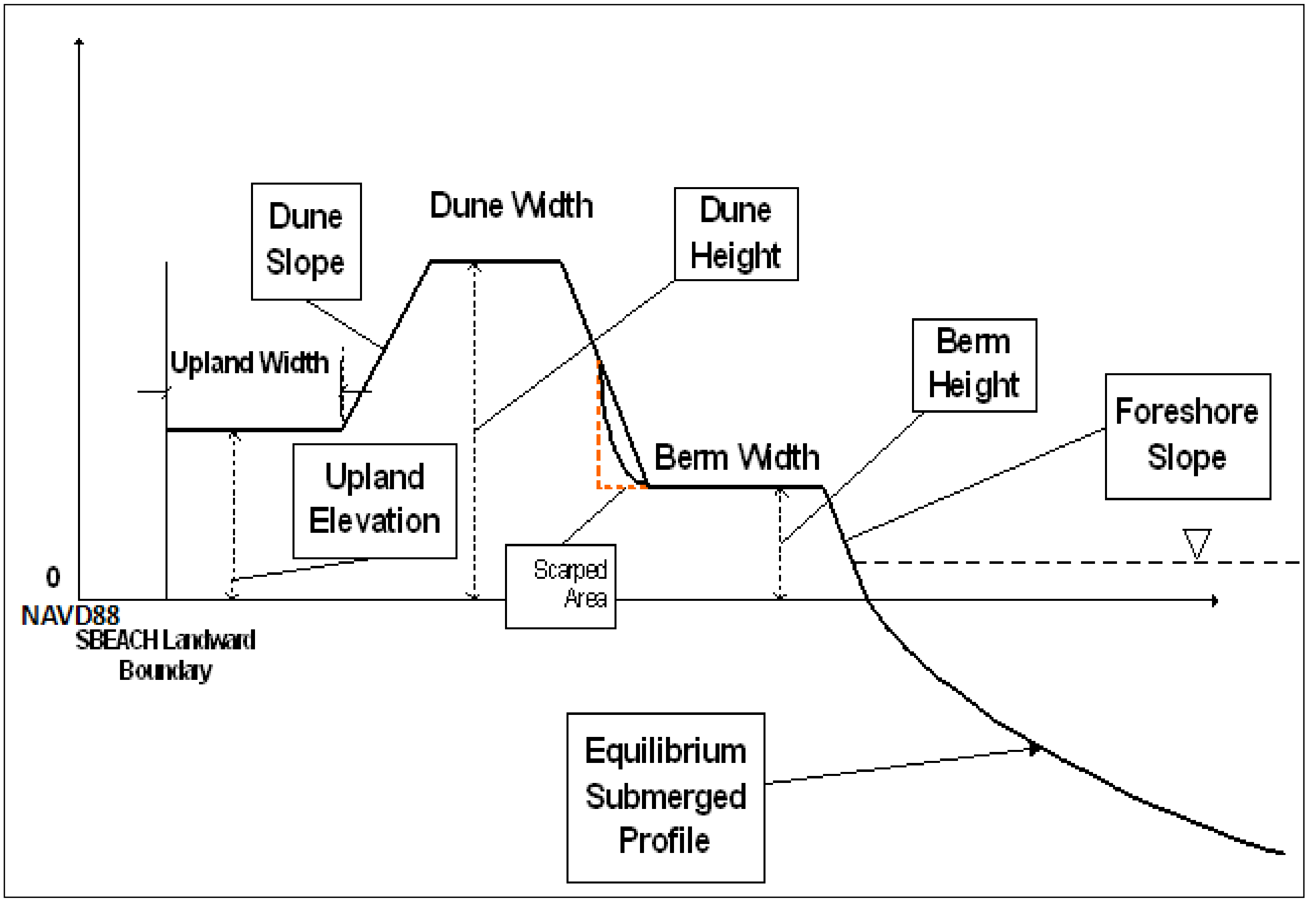

Figure 3-4. Features of an idealized shore profile cross-section.

Details on how these coastal reaches were determined are contained in Appendix A (Coastal Engineering). A map of these coastal reaches is shown in Figure 3-5 below.

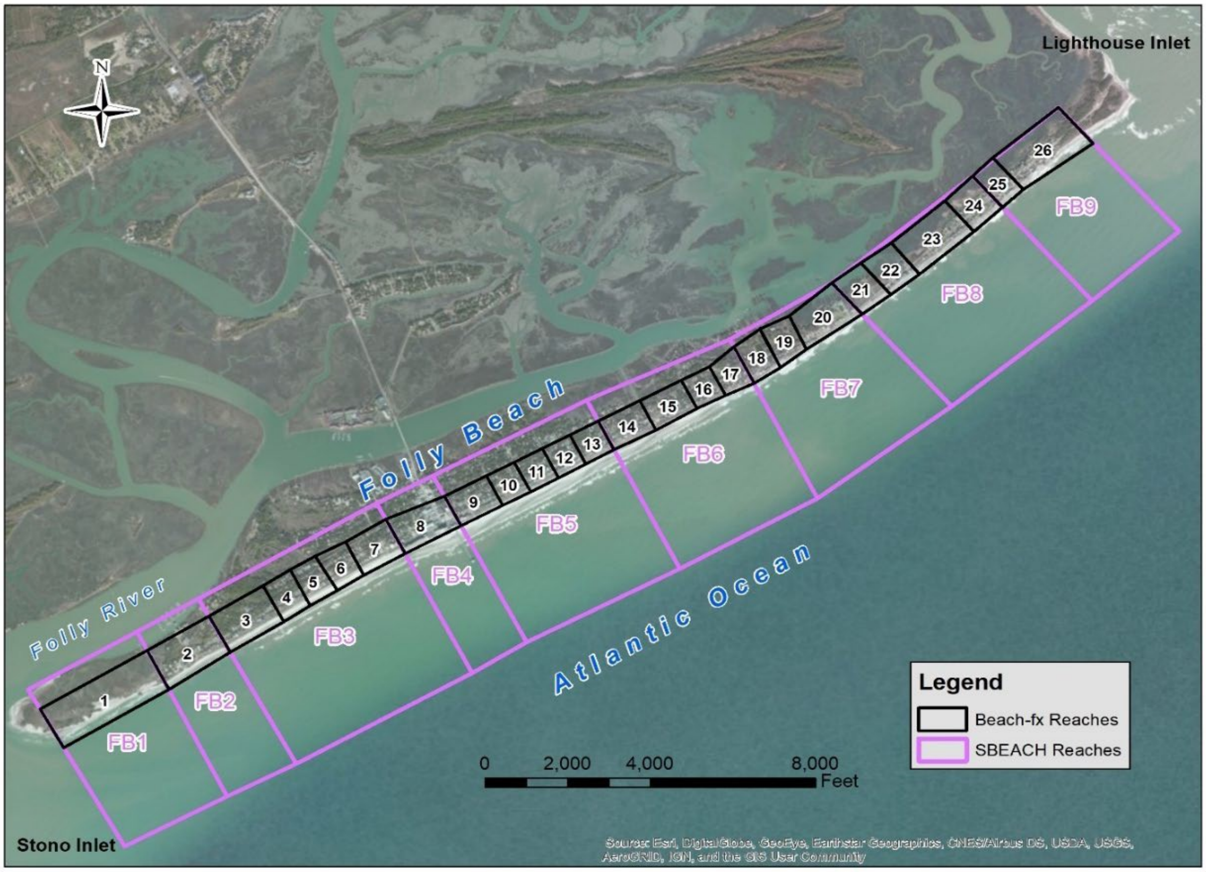

Figure 3-5. Delineation of coastal reaches along the study area.

The characteristics of the existing, idealized profile at each of the 9 SBEACH reaches are contained in Table 3-1. As shown in the table, the frontal dune system along Folly Beach is either non-existent or intermittent and includes reaches with armor revetments or bulkheads and no dune. The most established dune system is along the middle of the island.

SBEACH Reach	Beach-fx Economic Reach	Historic Background Change Rates	Upland Elevation	Dune Elevation	Dune Width	Dune Slope	Berm Elevation	Berm Width	Foreshore Slope
		(ft/yr)	(ft-NAVD88)	(ft-NAVD88)	(ft)	(H:1V)	(ft-NAVD88)	(ft)	(H:1V)
FB 01	R01	-2.0	10	10	0	0.333	8.0	125	0.033
FB 02	R02	-2.0	11	11	0	0.333	8.0	50	0.033
FB 03	R04 – R07	-5.4	11	14	25	0.333	8.0	25	0.033
FB 04	R08	-4.3	12	12	35	0.333	8.0	125	0.033
FB 05	R09 – R13	-3.3	10	12	45	0.333	8.0	50	0.033
FB 06	R14 – R17	-4.9	10	10	0	0.333	8.0	25	0.033
FB 07	R18 – R20	-7.7	10	10	0	0.333	8.0	0	0.033
FB 08	R21 – R24	-7.0	9	9	0	0.333	8.0	0	0.033
FB 09	R25- R26	-8.9	9	9	0	0.333	8.0	0	0.033

Table 3-1. Dimensions for existing condition idealized profiles.

Long-term historic shoreline change rates for the without-project condition were determined for the nine SBEACH study reaches and are shown in Table 3-1. The background shoreline change rates ranged from -2.0 to -8.9 ft/yr. It should be noted that the without-project conditions use the historic background erosion rates and reflect the effect of beach armoring and the new terminal groin on the southwest end of the island. The SBEACH reaches contain one to five Beach-fx economic reaches. Economic reaches in the study area vary in length from 680 to 2,950 ft and average approximately 1,000 ft long. The Beach-fx model is calibrated so that the applied erosion rates match the background rates in the without-project condition. The role of storm induced erosion only was first determined by setting the applied erosion rates for each reach to zero. A Beach-fx "Calibration Run" was created using the historic background erosion rates as continuous erosion through 100 iterations of the 50-year simulation. The erosion rates were calibrated within Beach-fx to ensure model reproduced the long-term background erosion rates. Planform erosion rates are used later in the Beach-fx analysis to evaluate the nourished beachfill in place. The planform erosion rates represent the annual erosion rate of the shoreline associated with the newly constructed beach nourishment project in place. The planform erosion rates are typically the highest the first one or two years after construction of the nourishment project. The rate of erosion with the beach nourishment project in place will be higher than the long-term erosion rates that have occurred in the past without any beach nourishment project and may exceed 20 ft/yr as the new shoreline adjusts to the wave climate. Longshore current may also result in accretion in downdrift reaches following a nourishment project. A detailed description of the SBEACH and Beach-fx model development and erosion rates is contained in Appendix A, Section 4.2.6.

3.04 Existing and Future Without-Project Coastal Storm Damages

For purposes of economic analysis, the study area was divided into 26 smaller economic reaches. An economic reach contains one or more similar, adjacent damageable elements. Economic reaches in the study area vary in length from 681 to 2,945 ft, but average approximately 1,000 ft long. Average annual coastal storm damages to the study area were estimated using the Beach-*fx* model.

The estimated average total without-project damages over 50 years for each of the 26 economic reaches, based on 100 life-cycles, are depicted in Figure 3-6. Due to the impact of erosion, damages are highly correlated with the erosion rate. The undeveloped "washout" area in reaches 20 and 21 are the exception. The total without-project damages in the study area over 50 years, in present value, are $163,198,000. At the FY2021 discount rate of 2.5%, total average annual without-project damages are estimated at $5,754,000 per year. Average annual without-project damages are broken into four parts, structure and content damages, armor costs, land loss, and property condemnation. Annually, structure and content damages result in $172,000, armor in $1,210,000, land loss in $2,973,000, and property condemnation in $1,399,000. Appendix E contains more details on the calculation of armor costs, land loss value, property condemnation and the determination of structure and content value.

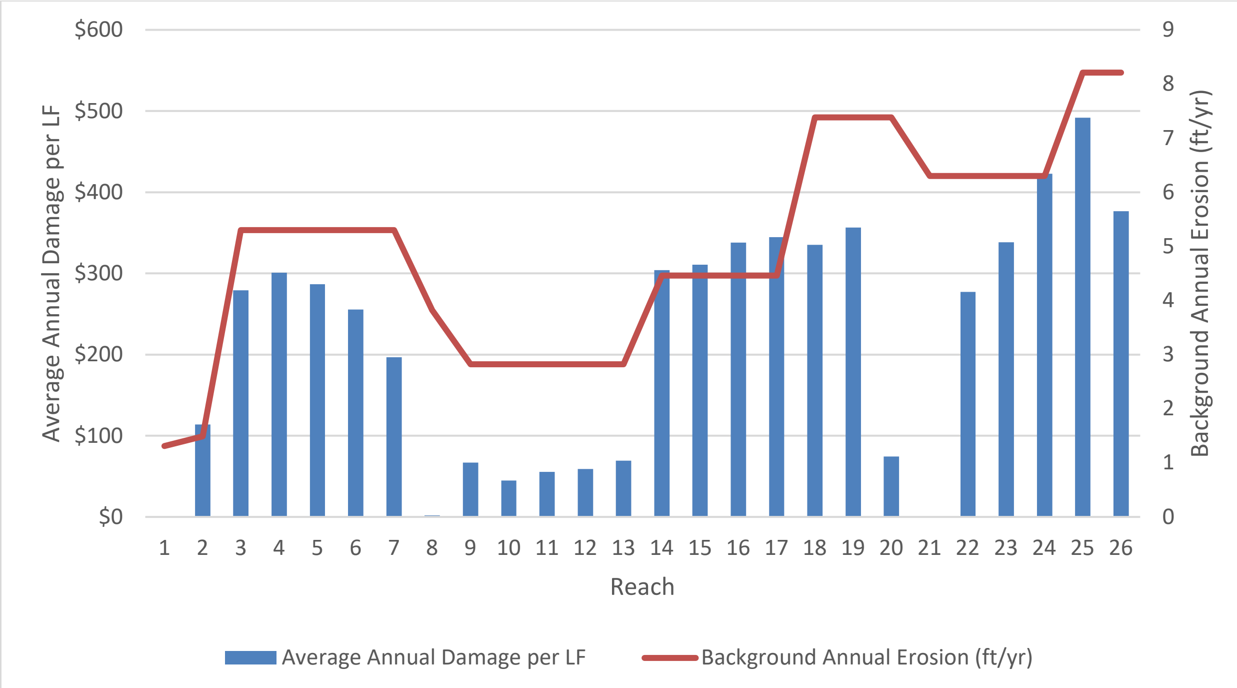

Figure 3-6. Average annual shoreline rates of change and FWOP damages at each of the 26 economic reaches in the study area.

3.05 Existing and Future Without-Project Recreation Conditions

The study area has a robust tourist-oriented commercial industry. Visitors come to enjoy both the developed beach areas and the Charleston County Park at the southwest end of the island to take advantage of ocean-based recreational opportunities. Folly Beach will continue to serve as a popular tourist destination in the future. However, in the without-project condition the recreational value of the area would decline as the beach eroded and the available beach width typical of beach-going activities narrowed.

3.06 Future Without-project Environmental Conditions

The existing environmental conditions of the area were briefly discussed in Section 2 of this report, and in more detail in Section 5 – Affected Environment and Environmental Consequences. The following subsections detail the future without-project conditions of several environmental resources that would be particularly impacted without a project.

3.06.1 Threatened and Endangered Species

Long-term shoreline erosion processes coupled with historical short-term storm events are expected to lead to substantial sediment losses from the shoreface. As a result of those losses, limited, high-quality turtle nesting, including loggerhead critical habitat, piping plover wintering habitat and red knot wintering and migrating habitat along the shoreline are likely to be negatively impacted, placing the sea turtles piping plover and red knot at risk in the eroded areas. In the past 10 years (i.e., 2010 to 2019), there has been an average of 78 sea turtle nests on Folly Beach annually (*http://www.seaturtle.org/nestdb/index.shtml?year=2020&view_beach=52*). Without beach renourishment actions to replace the eroded material, the number of sea turtle nest relocations necessitated from beach erosion would be expected to increase. In the longer term, persistent erosion would lead to loss of suitable sea turtle nesting, piping plover wintering and red knot wintering and migrating habitat resulting in almost total elimination of sea turtle nests, piping plover and red knot foraging, sheltering, and roosting habitat on Folly Beach.
Additionally, as short-term erosional processes scour the existing shoreface and the nesting beach environment slowly erodes away, large scarps are expected to form at the toe of the primary dune, preventing a turtle from encountering suitable nesting habitat above the mean high tide line.

3.06.2 Beach and Dune

Major erosion is caused by northeasters that frequently occur along Folly Beach during the colder months, as well as tropical cyclones occurring in the warmer months. Based on the calculated average erosion rate per year, it is anticipated that a good portion of the beach will continue to erode from the existing condition back into the dune. Once the beach has eroded back into the dune, escarpments will occur resulting in wave reflection off the escarpment with subsequent increased erosion, scouring, and loss of intertidal beach habitat. As the beach and dune complex erode, important habitat for a variety of plants and animals would be endangered including loss of the dune grasses and associated fauna. The intertidal beach habitat and benthic invertebrate community is a significant resource for feeding shorebirds and surf zone fishes. Additionally, beach habitat for loafing and nesting shorebirds as well as nesting sea turtles would be degraded or lost as the beach and dune are eroded into the coastal infrastructure.

3.06.3 Community Cohesion, Public Facilities and Services

Ongoing erosion of the beach and degradation of the dune system by coastal erosion and flooding would result in damage to public facilities, roads, and utilities. Population displacements would be anticipated in the wake of significant storm damage, and damages to the bridges connecting the island to the mainland would splinter the communities on the island, and potentially impact hurricane evacuation and recovery efforts before/after a large storm event. Hospital services must be obtained off the island, and the ability of the residents in this community to reach critical care facilities could significantly be impaired under the FWOP conditions. Fire and police service on the island could also be disrupted by coastal erosion and flooding.

3.06.4 Floodplains

The floodplain in the study area is being adversely affected by erosion and the continued deterioration of the beach and dune complex. Those effects would become more pronounced as the beach continues to erode and future storms encroach on the area.

3.07 Existing and Future Without-project Socioeconomic Conditions

Since 2010, the population of the Charleston/North Charleston metropolitan statistical area (MSA) has increased by almost 20%, and this population growth rate is predicted to continue to increase at a similar rate over the next 20 years (www.census.gov). The population of the City of Folly Beach has also increased, but at a slower rate. In a future without-project condition where the beach is allowed to erode, a significant economic impact would likely be felt by the City of Folly Beach since many commercial businesses are dependent on the income generated by tourists and others visiting the beach. Should beach utility drop below a critical level associated with shoreline erosion, these significant revenues gained from tourist-oriented business could be expected to markedly decrease as recreational opportunities and environmental quality diminish.

3.08 Existing and Future Without-project Condition – General Conclusions

Coastal storms will always be a threat to our national shorelines, including those in the Folly Beach area. Long term erosion will continue to reduce the amount of protective and recreational beach, resulting in increased vulnerabilities for structures and diminished recreational capabilities impacting local businesses. As the population of the State and the island continues to grow throughout the period of analysis, the associated impact to the region and the Nation in terms of loss of revenue and tax base will increase into the future as well. Under the FWOP conditions, national economic damages over $160 million dollars (present value) over the 50-year period of analysis will be incurred. There will also be high potential for additional impacts to the regional economy, recreational opportunities, and the local environment.

4. PLAN FORMULATION AND EVALUATION OF ALTERNATIVES*

The planning process applied to this study and detailed below followed the 6-step process indicated earlier in Section 1.06. After problem identification, opportunities for addressing those problems were developed; alternatives were formulated and then screened to a refined list; these final alternatives were evaluated, and then compared against one another in an iterative process aimed at identifying the National Economic Development (NED) Plan.

4.01 Goals and Objectives

As outlined in the 1983 *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies*, the federal objective in water resources planning is to contribute to national economic development (NED) consistent with protecting the Nation's environment. The federal objective leads to the general overall goal of this study:

Goal: Reduce the adverse economic effects of coastal storms and erosion at Folly Beach, while protecting the Nation's environment.

Identifying and considering the problems, needs, and opportunities of the study area in the context of federal authorities, policies, and guidelines resulted in the establishment of the following specific objective:

Objective: Over a 50-year period of analysis, reduce the risk of coastal storm damages (as measured by increases in NED benefits), to approximately 5.85 miles of shoreline at Folly Beach while minimizing or avoiding impacts to natural resources.

Achieving the study objective would likely have positive effects on the environment (such as the preservation of sea turtle and shorebird nesting and foraging habitat), as well as benefits associated with recreational use of the restored beach, and reduced damages to roads and utilities; however, those benefits are considered incidental to the objective of providing Coastal Storm Risk Management benefits. For example, the main evacuation route is located directly behind the barrier island, and somewhat protected from surge and wave attack by the island. The road and the main utility corridor have a low likelihood of significant damage due to erosion but would instead most often suffer damage from deposition of sediment due to tidal overwash, in very large events, and on a highly localized basis. Stub roads that access the beach would also have a low likelihood of erosional destruction but could also suffer from overwash deposition in some areas of the project. However, the specifics of such impacts are difficult to predict and quantify.

4.02 Constraints

The formulation of alternatives to address the study objective is limited by planning constraints. Specific to this project, the formulation of alternative plans is potentially constrained by:

a. Geographic limits of the study authority.

b. The amount of existing space on the island that is available for mass relocation of vulnerable structures.

c. Avoidance or minimization of impacts to threatened and endangered sea turtle and shorebird nesting habitat.

d. The only time the CBRA zone would create a constraint is if DOI/FWS interpretation of the exemption to use of federal funds created in that act were to be reinterpreted. USFWS has previously concurred with USACE's use of the Folly River borrow site in the CBRA zone for past nourishments. Likewise, the navigation channel does not create a constraint to plan formulation or implementation. Additionally, no constraints on Folly Island seem to currently exist.

4.03 Formulation and Evaluation Criteria

Alternative plans are evaluated by applying numerous, rigorous criteria. Four general criteria are considered during alternative plan screening: completeness, effectiveness, efficiency, and acceptability.

Completeness: Completeness is the extent to which the alternative plans provide and account for all necessary investments or other actions to ensure the realization of the planning objectives, including actions by other federal and non-Federal entities. Completeness also includes consideration of real estate issues, operations, and maintenance (O&M), monitoring, and sponsorship factors.

Effectiveness: Effectiveness is the extent to which the alternative plans contribute to achieve the planning objectives. The plan must make a significant contribution to the problem or opportunity being addressed.

Efficiency: Efficiency is the extent to which an alternative plan is the most cost-effective means of achieving the objectives. The plan outputs cannot be produced more cost-effectively by another plan.

Acceptability: Acceptability is the extent to which the alternative plans are acceptable in terms of applicable laws, regulations and public policies. Appropriate mitigation of adverse effects shall be an integral component of each alternative plan. The project should have evidence of broad-based public support and be acceptable to the non-Federal cost-sharing partner.

There are also specific technical criteria related to engineering, economics, and the environment, which also need to be considered in evaluating alternatives. These are:

Engineering Criteria:

- The plan must represent a sound, acceptable, and safe engineering solution.

Economic Criteria:

- The plan must contribute benefits to NED.
- Tangible benefits of a plan must exceed economic costs.
- Each separable unit of improvement must provide benefits at least equal to costs.

Benefit Cost Ratio (BCR) must be equal to or greater than 1.0 to 1 with at least 50 % of benefits coming from storm damage reduction.

Environmental Criteria:

- The plan would fully comply with all relevant environmental laws, regulations, policies, executive orders.
- The plan would represent an appropriate balance between economic benefits and environmental sustainability.
- The plan would be developed in a manner that is consistent with the USACE' Environmental Operating Principles.
- The plan would be formulated to avoid and/or minimize adverse impacts to the environment. In cases where adverse effects cannot be avoided, appropriate mitigation must be included as part of the alternative.

4.04 Environmental Operating Principles

The USACE Environmental Operating Principles (Principles) were developed to ensure that Corps of Engineers missions include totally integrated sustainable environmental practices. The Principles provided corporate direction to ensure the workforce recognized the Corps of Engineers 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. More information on the Principles can be found here:
http://www.usace.army.mil/Missions/Environmental/EnvironmentalOperatingPrinciples.aspx

Specifically, for this project, these Principles were adhered to during the entire planning process including the screening of potential borrow areas, beach placement and the proposed timing of construction activities to avoid impacts to listed species to the maximum extent practicable.

4.05 Identification, Examination, and Screening of Measures

A variety of potential measures can be considered and combined when formulating alternative plans for reducing coastal storm risk. These measures generally are categorized as either structural or non-structural. Structural measures are those that directly affect the conditions that cause storm damage – in this case erosion, wave attack and/or flooding. Non-structural measures are those taken to reduce damages without directly affecting those conditions driving project area damages. A No-Action Alternative, which is required by NEPA, is developed to provide a baseline condition against which to measure comparative plans. Under the No-Action alternative, the FWOP conditions (Section 3) remain in place without implementation of a federal project.

4.05.1. Structural Measures, including Nature-and Nature-Based Measures

Preliminary measures considered to address the coastal storm damage vulnerabilities along the project area include a variety of structural measures and non-structural measures for addressing Coastal Storm Risk Management exist. This includes "soft" structures such as beach fills, and "hard" structures such as breakwaters, seawalls, revetments, and groins. These structures and their associated characteristics are discussed below:

- ***Natural and Nature Based Features: Beach fill, Dunes***. Beach fill measures consist of berms, dunes, and terminal sections. Measures generally involve variations in dune width, dune height, and berm width. Beach fill measures are considered some of the most appropriate and effective measures, as they mimic the natural environment and can be designed to optimize storm damage reduction outputs. Although incidental to formulation efforts for this project, beach fill measures which widen the existing berm also provide more recreational benefits than hard structures and expand the area available for sea turtle nesting and shorebird nesting and foraging. Additionally, a beach fill alternative is naturally adaptable to various sea- level rise scenarios. However, in order to fully realize project outputs, the beach fill template may need to be periodically renourished throughout the life of the project. Figure 4-1 shows an example of a beach fill being constructed. This preliminary alternative was determined to have potential and was carried forward into detailed evaluation and analysis.

- ***Groins***. Groins can be made of wooden, rock, or concrete structures that can take the form of a terminal groin at the terminus of a shoreline littoral cell (e.g., near an inlet) or a groin field consisting of multiple groin structures parallel to one another along a project reach. Groin fields generally must be 'filled' with sand in the area between each structure, and they can be used to reduce the future renourishment requirements needed to maintain a given template. Groin fields can present a risk of potential adverse effects on adjacent shorelines due to trapping sand that would otherwise have naturally nourished downcoast beaches, or shunting sand offshore outside the limits of transport capabilities to return to the beach. Groins and groin fields often have high initial construction costs, and in most cases additions to the existing groins at Folly Beach would likely require extensive threatened and endangered species mitigation and monitoring. Nevertheless, the existing groins and groin fields were modeled to determine their contribution to erosion control and protection, and also to determine their potential incremental economic justification.

- ***Seawalls, bulkheads, and revetments***. Seawalls, bulkheads, and revetments can be effective for reducing structural damage due to wave and water level attack; however, in some cases they may induce beach erosion. Although these structures could have substantial adverse environmental effects regarding endangered sea turtle utilization of the beach, they were also evaluated to determine their potential contribution in reducing erosion and damage to structures, contents, and infrastructure.

- ***Breakwaters.*** Breakwaters can be used in erosional hotspots where it is difficult to maintain a beach fill. Although offshore breakwaters may reduce erosion in their lee, the benefits may be offset by accelerated erosion of the downdrift shoreline because of interruption of the littoral drift. Breakwaters were evaluated for their potential to reduce erosion.

- ***Vegetation and sand fencing.*** Vegetation and sand fencing help retain windblown sand, but do not provide adequate storm damage reduction for moderate to severe storms, and hence are not adequate as a stand-alone measure. However, any dune construction measure would also include appropriate vegetation planting; therefore, this measure was carried forward into detailed evaluation as part of the beach fill plans.

- ***Nature and Nature Based Features other than dune and berm plans.*** Analysis indicated that NNBFs other than dune and berm complexes were not technically supportable in this active coastal environment. Dune and berm plans which are also nature-based features are carried forward. Other NNBF measures were not carried forward for further analysis.

Based on preliminary cost-effectiveness analysis, and impact analysis, seawalls and breakwaters were screened out and not considered for further detailed analysis due to high cost and environmental impacts. Groins and revetments were carried forward for further analysis. These, and a variety of beach fill and dune configurations, were considered in the detailed evaluation of structural measures.

Figure 4-1. Example of beach fill construction (Folly Beach, SC).

4.05.2. Non-Structural Measures

Non-structural measures considered in this analysis included changes in regulations and physical modifications to reduce damage, but which do not affect depth or extent of flooding.

- ***Floodplain and Building Code Regulations.*** Regulatory measures include coastal building codes, building construction setbacks, and floodplain regulations. Most regulatory measures have already been instituted at the local level. These regulations provide indirect benefit to storm damage reduction, primarily to new and future construction. Although they are not carried into detailed evaluation as a stand-alone measure, they are considered as part of the existing and future without-project conditions and are an integral part of any final project alternatives.

- ***Retreat and Relocation.*** Another non-structural measure consists of reduction of the damage threat by removing beachfront structures from the immediacy of the threat and relocating farther landward of the area of greatest threat. Retreat would move the existing structure away from the shoreline within the same property parcel. Relocation may also be achieved by moving an existing structure away from the shoreline to a vacant property. As the Folly Beach area is already near full build-out, and most parcels do not have adequate depth to move a structure back a significant distance within a parcel, the retreat and relocation non-structural measure was determined to be impractical and screened from further consideration.

- ***Removal and Demolition.*** Removal measures involve acquisition of vulnerable properties and demolition and clean-up of the site. A provision of this is relocation of those parties involved to safe and sanitary housing elsewhere. Because this measure would effectively eliminate all future damage to structures, contents, and infrastructure, and most risk to life and safety, its further development is illustrative of what this potential alternative would entail. This measure was carried forward for additional analysis.

- ***Flood Proofing of Structures.*** Flood proofing of structures was evaluated in the first round of measure development, evaluation, and screening. Elements of this measure could include water-tight sealing of doors, windows, and other entry points, ensuring that utilities and infrastructure would not be damaged by floodwater, in some cases elevation of air conditioning units, or by elevation of entire structures. This measure (or group of measures) was determined to be technically infeasible due to the nature of much of the existing structure base. Most structures could not be flood proofed by these means due to the nature of materials used in construction, the lack of water-tight flooring and siding, and other issues; many other structures are already elevated above the level of the 1% chance event, and therefore, would not benefit from flood proofing except during very extreme storm or hurricane events. This measure was thus, screened from further consideration.

- ***Evacuation Planning and Maintenance of Evacuation Signage.*** This measure consists of local evaluation of the adequacy of existing evacuation planning, and measures to maintain signage to enhance coastal storm response by maintenance of hurricane evacuation signage. This measure was determined to have considerable value at a low cost and was carried forward.

- ***Community Education.*** This measure consists of evaluation of the adequacy of existing education directed toward understanding of the nature and degree of risks from coastal storms. This would be anticipated to include education in schools, as well as community education for both year-round residents, and visitors. This measure was determined to have considerable value at a low cost and was carried forward.

Based on the initial non-structural measures screening, only the No-Action, local actions to include floodplain and building code regulation, evacuation plans, signage maintenance, and storm education, and Removal/Demolition Measures, were carried forward into the following more detailed evaluation. Some structural and non-structural measures can be applied independently or in combination with each other as alternative plans.

4.06 Identification of Alternative Plans

4.06.1. Beach Fill Alternatives.

Beach fill plans were initially formulated to encompass the entire Folly Beach shoreline, with the exception of coastal reach 1, which is a County park and does not include any significant damageable elements. The two basic types of beach fills considered are a berm only and a berm and dune together. These beach fill plans will have tapered transition sections where needed, such as in Reach 1 and on the northern end of the project.

Dune and Berm Designs. For all plans, the berm elevation is at the elevation of the existing berm, which is either 5.5 ft or 7 ft (NAVD 88) depending on the location. All elevations for the current project in the main report and appendices reference NAVD 88. An artificially high berm would result in persistent scarping along the beach face and would not be environmentally desirable. The beach fill alternatives analyzed and modeled consisted of (1) alternatives containing combinations of different dune widths added to the front of the existing dune, coupled with different berm widths; and (2) berm-only plans that do not involve any dune construction.

Potential Borrow Areas. A total of nine borrow locations were initially analyzed for use in berm and dune construction. Of these, four were identified as suitable sources for providing enough compatible material for a 50-year beach fill project, estimated at approximately 10,058,000 cubic yards. These four areas are depicte2 and consist of Borrow Area F, also known as Lighthouse Inlet, (approximately 1 to 3 miles offshore of the northern end of Folly Beach), Borrow Area E and K, also known as Stono Ebb Shoal and Ebb Shoal 2 (approximately 4 to 7 miles offshore of the southern end of Folly Beach), and the Folly River borrow source, (approximately 0.5 miles behind and west of Folly Beach). The costs of the beach fill alternatives considered in this study are based on dredging material from these four locations and transporting it to the closest location onshore. The compatibility of the accumulated sediment north of the Charleston Harbor jetty was also analyzed, however the use of this source was considerably more expensive than other options and was not carried forward as a sand source.

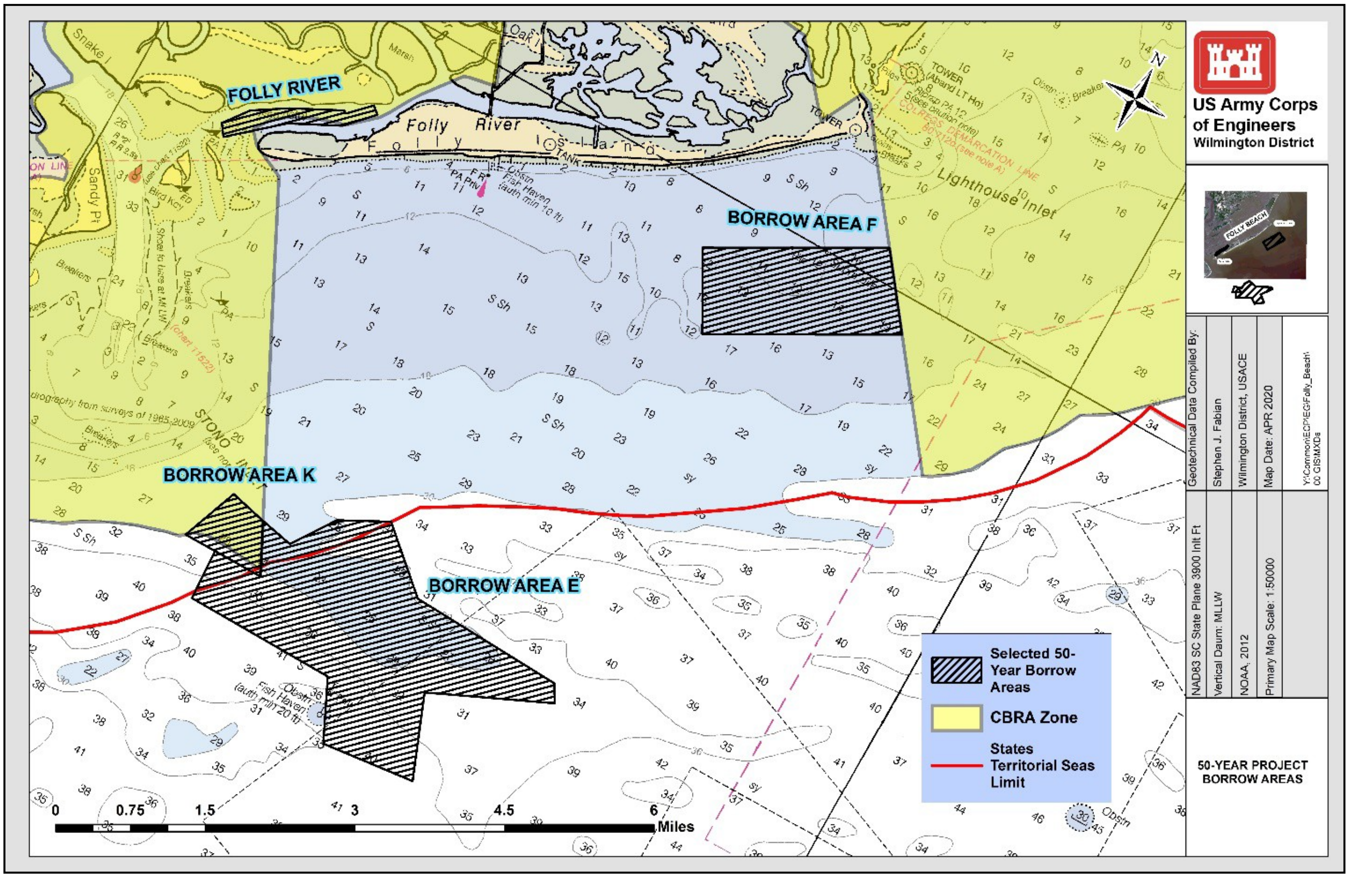

Figure 4-2. Borrow Area Locations

Detailed information regarding how these sites were characterized and their boundaries determined are contained in Appendix B (Geotechnical). A summary of the size and available borrow volumes for the four sites are shown in Table 4-1. These volumes account for the avoidance of any hardbottom areas. The available volume also incorporates a 1 to 2-foot vertical buffer. The vertical buffer may come into play if the bottom portions of useable material are being dredged. Additional geotechnical borings will be taken at these sites during the Preconstruction Engineering and Design (PED) phase of the study, prior to nourishment. Based on those results, the borrow area boundaries and available beach compatible volumes will likely be updated.

Borrow Area	Sand Thicknesses (feet)			Footprint Area (acres)	Volume (millions of cubic yards)
	Min.	Max.	Avg.		
Folly River	2.4	20.1	11.8	151	2.7
Borrow Area E	0.8	14.7	5.6	2,605	14.0
Borrow Area F	0.0	10.0	5.0	1,079	2.8
Borrow Area K	1.2	10.6	6.0	216	0.8

Table 4-1. Estimated usable sand thickness, footprint of borrow area, and volume of material at each of the four borrow sites.

The Folly River borrow area is a rechargeable borrow source. The one time use of this borrow area's volume is represented in Table 4-1.

Borrow areas E and K are adjacent to one another and were combined as a single borrow area, resulting in three final borrow areas. This combined borrow area is referred to in the report as Stono Ebb Shoal.

Beach Compatibility of Borrow Material. Historical performance in South Carolina and other states has shown that borrow areas containing no more than 10 % fines are generally compatible for placement on the beach. The State of South Carolina's Coastal Management Program does not include specific requirements for sand used for beach nourishment projects. The requirements are general in nature and require that the sand should be compatible with the native beach sand.

The sediment characterization of the borrow material, as compared to that of the native beach, is shown in Table 4-2. The amount of silt in the borrow areas (% passing #200) is under 10%, and generally only about 1-2% higher than that of the native beach. The percentage of shell in the borrow areas is also well under 15% and is also comparable to the percentage of shell on the native beach.

Borrow Area	Mean (mm)	Median (mm)	Std Dev (mm)	% Passing #200	Overfill Ratio
Folly River	0.16	0.16	0.70	2.21	1.31
Borrow Area E	0.23	0.19	0.81	3.80	1.17
Borrow Area F	0.26	0.20	0.42	5.31	1.35
Borrow Area K	0.23	0.17	0.43	6.23	1.32
Native Beach	0.17	N/A	0.79	<10%	N/A

Figure 4-3. Grain size comparison of native beach and borrow material. The native beach grain size information is from the general design memorandum from 1991.

4.06.2. Removal/Demolition.

A "non-structural-only" alternative, consisting of demolition of threatened structures across the entire study area, was also identified for further evaluation. This alternative included buyout and demolition of all 820 buildings in the structure inventory currently built in what are approximately the first three rows from the shoreline. Remaining inventory elements (dune walks, vehicles, etc.) were not considered for buyout and demolition.

4.06.3. Combination Plan/Structural and non-Structural.

A combination of structural and non-structural measures was evaluated, the latter consisting of buy-out and removal. This evaluation did not identify any combination that exceeded the benefits of a structural plan alone, due to the costs of removals, and were not carried forward for further analysis.

4.06.4. No-Action Alternative.

The No-Action Alternative remains in the list of final alternative plans. The No-Action Alternative would only be recommended if no other acceptable alternatives produced positive net economic benefits or if other alternatives had unacceptable and unmitigable environmental effects. Under this alternative, no federal shoreline protection projects will be constructed at Folly Beach between the years 2025 and 2075. This alternative assumes that the currently constructed template will be fully depleted, and no new renourishments will occur per the currently authorized Folly Beach project. It also assumes that local entities will continue to armor their properties, repairing existing armoring as needed.

4.06.5. Additional Non-Structural Alternatives.

The City of Folly Beach currently engages in a number of non-structural measures that aid in risk management. These include: coastal storm and flooding education, floodplain management, evacuation and evacuation route management, and building code upgrading. These were also evaluated.

4.07 Further Evaluation of Alternative Plans

This section discusses third-tier evaluation of alternative plans.

4.07.1. Beach Fill Alternatives Evaluation

Twenty-five beach fill alternatives were evaluated using the Beach-fx numerical model. The Beach-fx model was used to produce the benefits and borrow volumes needed for each alternative; however, it should be noted that the costs produced by the model and presented at this stage were for comparative purposes only. A fully detailed project cost was only developed for the NED/Recommended Plan. The fully detailed project cost includes line items not included in the Beach-*fx* cost. These costs would have been a part of any alternative, and thus would have affected net benefits similarly. Inclusion of associated costs is why the final cost is higher than the costs presented in the alternatives comparison.

Eleven (11) alternatives were analyzed initially with a ten-year renourishment cycle. These alternatives were chosen based on an assessment as regarding general dimensions of a beach fill plans that may be economically viable, based on previous experience with other Coastal Storm Risk Management studies. Based on analysis of the results from those eleven alternatives, nine alternatives were developed and run in order to better "bracket" the plan with the highest average annual net storm damage reduction benefits. Bracketing is done to determine whether a larger or smaller sized alternative would produce greater net benefits than the alternatives that were already run. During bracketing, the ten-year nourishment interval from the screening runs was expanded to seven, eight, ten, twelve, and seventeen year intervals, and an array of berm widths incorporated. It should be noted, all beach fill plans take into account large storm events that may require out-of-cycle emergency nourishments. The net benefits are the average annual reduction of structure, content, armor costs, land loss, and structure condemnation damages (as compared to the without-project condition), minus the average annual costs of the alternative.

Concern on project performance in reaches 18 through 21, which was initially formulated with a 35-foot berm, led to the conclusion that that portion of Alternatives Two and Four could become completely eroded during a ten-year or 12-year cycle, and due to the concerns of the coastal engineers and in recognition of a high level of risk, those alternatives were screened from further consideration. A narrower final array of three alternatives was further evaluated to incorporate planform rates and identify any effects that the planform rates would have on plan performance. For more information on the screenings and incremental analysis, see Section 3.4.2.1 of Appendix E Economics.

In some reaches, the highest net benefits were achieved for a revetment-only plan, and in others, for a berm plan that included dune construction, however, the revetment plan would preclude the addition of a berm seaward, and thus, have severe environmental impacts, including loss of critical habitat and loss of recreation acreage and associated benefits. A revetment-only plan was not considered for potential recommendation. A plan which included both revetments and beachfill was not economically justified. For greater detail on berm and dune combinations see Appendix A, Coastal Engineering, Figure 4-2.

It should be noted that the berm widths in the analyzed alternatives do not include advanced maintenance. Advanced maintenance was utilized on older USACE CSRM projects as a means to increase the probability that the design template was always in place prior to storm impacts. Advanced maintenance is no longer used on USACE CSRM projects by policy.

Table 4-2 summarizes the Final, Focused Array of Alternatives in comparative format. The study area's nine Coastal Reaches are based on coastal engineering modeling needs and criteria, while these are further sub-divided into 26 Economics Reaches based on like properties of the structures and properties involved. Figure 4-2 provides an aerial view of Folly Beach with the coastal SBEACH and economic reaches superimposed. Alternative 1: The No-Action Plan has been discussed earlier and is not included in this specific comparison.

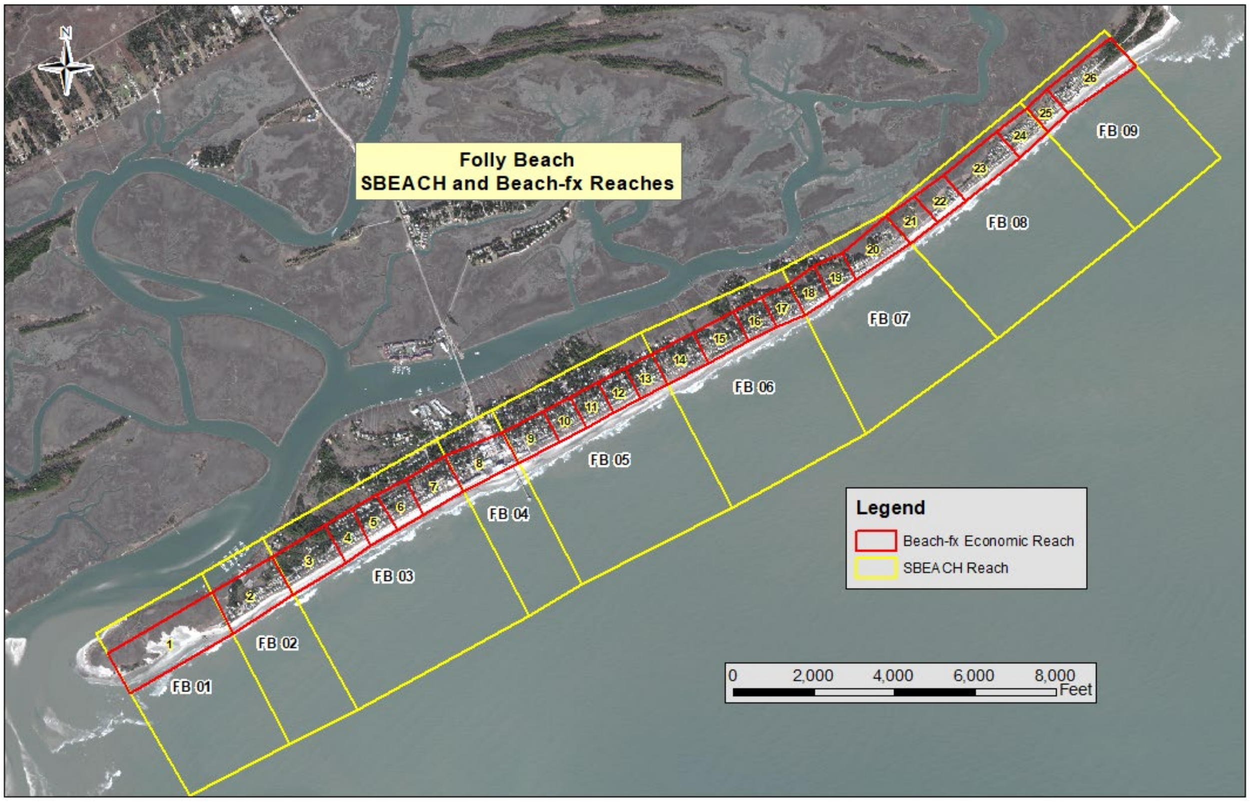

Figure 4-4. Folly Beach SBEACH and Beach-fx Economic Reaches

Nourishments/Renourishments include: a) Initial Construction, plus: b) following renourishments required, and are presented in sum in the table.

Alternatives Three, Five, and Six are the Structural Alternatives that remained in the Final Array. Alternative Three consists of a 35-foot berm width in reaches 2-17, plus a 50-foot berm width in reaches 18-26, plus a 15-foot-high, five-foot crest width dune the entire length of the project., with four nourishment events consisting of the initial (construction) and three additional periodic nourishments.

Alternative Five is a 35-foot berm width in reaches 2-17, plus a 50-foot berm width in reaches 18-26, plus a 15-foot-high, five-foot crest width dune the entire length of the project, and a ten year nourishment interval. Alternative Six is the Existing (authorized) Project, consisting of a 15-foot berm only, with no new additional dunes.

These do not include the additional non-structural measures considered as a necessary condition of a complete Coastal Storm Risk Management plan. Those are discussed in detail later in the report. Alternative Six is included to demonstrate the proposed project is expected to perform better than a potential reauthorization; and reauthorization of the previous project is not economically justified.

Alternative Feature	**Alternative 3:**	**Alternative 5:**	**Alternative 6:**
Dune	15' high dune for reaches 2-26	15' high dune for reaches 2-26	No dune
Berm	35' berm for reaches 2-17, 50' berm for reaches 18-26	35' berm for reaches 2-17, 50' berm for reaches 18-26	15' berm for reaches 2-26
Nourishment (Time Interval)	4 nourishments (12 years)	5 nourishments (10 years)	6 nourishments (8 years)

Note: Dune elevations are in feet NAVD88

Table 4-2. Final Focused Array of Alternatives

While Alternative Six has no new dune features, there is an existing dune between Reaches 3 and 13 (about 10,000 ft) and was included in the SBEACH storm response modeling. Most of the dune is naturally occurring but note that there are sections of armor (seawall and revetments) along the beach and the dune was likely bulldozed during construction. The dune line is not continuous and varies in both elevation and width. The majority of the existing dune line is landward of the project construction easement line. The dune is present in the FWOP analysis and all beach nourishment alternatives (including Alternative Six.) In the FWOP the dune erodes and is completely removed as the shoreline moves landward during significant storm events over the 50-year simulation. While the dune does not get rebuilt or maintained under Alternative Six, the proposed berm allows it to remain in place longer than in the FWOP. This process provides benefits that are captured in the economic analysis; however, the benefits are not enough to justify Alternative Six as seen in table 4-4 of the main report. Refer to Section 4.2.4, Table 4-4 in the Coastal Appendix for more information.

4.07.2. Non-structural Alternative Evaluation

One "non-structural only" alternative (alternative 7) was carried forward for additional detailed analysis. The screening process for other alternatives is described in Section 4.05. The non-structural alternative entailed the buyout and demolition of vulnerable properties. The structures included in the analysis are generally those in the first three rows from the ocean. Those structures farther landward from the shoreline are not likely to be as severely threatened for several decades and therefore are not included in the analysis. All 820 structures were considered for the non-structural alternative. Several broad assumptions were necessary to make a manageable evaluation of the plan. These assumptions include an identical demolition cost across all properties, 100% compliance by property owners, and immediate implementation at the start of the project. A "timed" implementation, where structures would only be removed as they became more vulnerable, would reduce the cost of the plan but would also reduce benefits. The goal of this screening level evaluation was to estimate if a non-structural measure or plan would a) be economically feasible and b) if it was economically feasible, determine if the magnitude of net benefits would be comparable to those derived from a structural plan. A more refined non-structural analysis would only be conducted if *a* and *b* were found to be true through the initial analysis.

The benefits of the non-structural plan were measured by removing the first three rows of structures from the structure file, then running the without-project condition again in Beach-*fx.* The difference in average annual damages between this run and the future without-project condition with all structures in place is the benefit of the non-structural plan.

The costs of the non-structural plan included structure acquisition cost, a land value acquisition cost, and a demolition/removal cost. These were the only costs used in the analysis. The replacement cost minus depreciation value of the structure from the structure database was also used as the structure acquisition cost. The replacement cost minus depreciation value likely underestimates the actual structure acquisition cost but was used because those numbers were readily available. For simplification, an identical demolition/removal and land value acquisition cost was used for every structure and lot. Based on the average costs of some demolition/removal activities that took place recently at North Topsail Beach, NC, a $100,000 per lot demolition/removal cost was used in this analysis. An average lot acquisition value of $650,000 was used, which was based on a survey of recent beachfront property real estate comparisons from the Folly Beach area.

4.08 Additional Coastal Storm Risk Management Alternatives

4.08.1 Coastal Storm Risk Education

Numerous people have died as a result of hurricanes and other coastal storms, primarily because of the failure to evacuate to an area of safety. Any loss of life is tragic, and any number of those deaths might have been prevented. Even one death prevented is sufficient reason to improve our methods of educating the public on hurricane and storm threats and to ensure that all is done to warn all those residents or visitors to the coastline of South Carolina as to the dual hazards of wind and surge/waves. It is particularly vital to inform the public as to the potential for hurricane occurrence, particularly in the dangerous hurricane season, so they pay continued attention to media reports on weather. Education needs to include articulation of effects related to the potential magnitude of the threat, the urgency to heed potential calls to evacuate, and providing the means by which to make wise choices on evacuation methods and route (see recommendations given below under Hurricane Evacuation Planning). The following are suggested guidelines for implementation by State and local government, in the interests of good education on hurricane storm threats:

- Provide good science and information to the residents and visitors to coastal South Carolina, so they can understand the nature of the threat, and its possibility of happening at any time, especially within the hurricane season. This information should be provided in both written form and as an initial graphic on televisions provided in visitor's housing, and also in a variety of venues, including the following:

- Posted and televised education in supermarkets, libraries, and public buildings
- Teacher-provided, posted, and televised education in schools and at public meetings and gatherings, at intervals not to exceed 1 year
- Publicly posted and visitor-housing-posted information on evacuation routes, and procedures, on publicly accessible Web sites, updated regularly (minimum 1 yr.)

It is not possible to maintain the lives and safety of coastal South Carolina residents and visitors if they do not have sufficient warning and if they then do not use that knowledge to evacuate in a timely manner.

Education regarding coastal storm risks is an ongoing effort of multiple agencies and educational institutions and not a funded program under existing USACE authorities. Updating Web sites containing evacuation routes and procedures should be done under existing programs implemented by State and local governments.

As an existing program in the City of Folly Beach, this program has an existing cost estimated at approximately $10,000 per year. As this is currently funded, this cost did not become an additional NED cost to the nation.

4.08.2. Hurricane and Storm Warning

Residents and visitors to the coast of South Carolina need to recognize that they live in, or visit, a high-hazard area. Although certain times of the year pose less risk than others, each year's hurricane season provides a strong possibility of hurricane impact somewhere along the coast of South Carolina. All residents and visitors need to be made aware of the current hurricane threat. But first, meteorological conditions must be evaluated, and any threat must be assessed and characterized by experts at NOAA's National Weather Service. That interpretation must then be passed to national and local media for dissemination. Continued support of NOAA's program, and the following supportive activities are critical to an adequate warning process:

- Ongoing efforts to upgrade the existing system of NOAA buoys, transmission capabilities, and advanced warning measures that provide data on the location and nature of weather conditions.
- Efforts directed at the interpretation of that data and its dissemination to the media and public, through the National Weather Service.
- Public appreciation for the need to be aware at all times of, and the need to listen to weather reports and advice given on various media. Television weather reports, radio, and the Internet all provide excellent, up-to-date information on weather conditions, and the development of threatening situations. Simply living in or visiting the barrier islands of South Carolina should be sufficient to create a consistent and ongoing process of being exceptionally aware of the weather and its potential consequences.
- The vital importance of heeding the advice of experts. One should know what needs to be done when a storm is approaching. Family members should conduct evacuation drills, keep needed phone numbers and travel supplies on hand, and be prepared to leave on short notice. One should be aware of evacuation routes, keep a full tank of gas during the hurricane season and have a plan for where one should go, how to maintain contact with other family members, and where one will relocate temporarily, particularly if the event turns out to be longer than expected.

As an existing program in the City of Folly Beach, this program has an existing cost estimated at approximately $10,000 per year. As this is currently funded, this cost did not become an additional NED cost to the nation.

4.08.3 Storm Evacuation Planning Upgrading

The critical need for adequate evacuation planning was borne out by Hurricanes Bertha, Fran, and Floyd, of the late 1990s, and brought even more to the forefront by the monumental impacts of Hurricane Katrina in 2005. An evacuation plan is an essential component of a comprehensive plan for ensuring the safety of residents of, and visitors, to the coast of South Carolina. The preservation of life is the single most important goal and objective of the recommendations. Joint FEMA/NOAA/USACE/South Carolina studies of evacuation routes and populations along the coastline has provided a tremendous amount of value to-date in aiding local government, individual, and family readiness in the face of approaching events. Support for that program is a critical element of the recommendations for the towns located on Folly Beach in support of its residents and visitors.

The following are some recommendations in support of efforts to support Hurricane Evacuation Planning:

- Update this ongoing effort and to provide new and more widely disseminated data and tools for evacuation planning by the State and the towns, and also for use by individuals and families in their preparation for an impending event.
- Evacuation route signage is an important part of a successful evacuation campaign. Maintenance of hurricane evacuation route signage is viewed as a vital link in ensuring the safety of residents and visitors alike.
- The provision of additional signage illustrating surge height achieved during past events would be an added and continual link to ongoing education efforts. That could take the form of signs placed in locations in which there is significant traffic, such as major thoroughfares, where pedestrians walk, and particularly in those highest hazard zones according to elevation/depth data.

Evacuation Planning is an ongoing effort of multiple agencies, including the USACE, but its implementation is not a funded program under existing USACE authorities. Updating Web sites containing evacuation routes and procedures should be periodically updated under existing programs implemented by South Carolina.

A recommendation is also made that the sponsor add to their public access signage that includes text to the following “Evidence of erosion or scarping does not mean that the project is not functioning as intended. Erosion is a natural process on all barrier islands. Evidence of erosion will periodically be visible on this beach.

As an existing program in the City of Folly Beach, this program has an existing cost estimated at approximately $10,000 per year. As this is currently funded, this cost did not become an additional NED cost to the nation.

4.08.4. NED Comparison of Alternatives

The average annual NED costs, benefits, and net benefits of each of the beach fill alternatives are shown in Table 4-4. A detailed breakdown of costs and benefits for each alternative is contained in Appendix E

Economics. This report ultimately recommends Alternative 3 as the Recommended Plan as the alternative which maximizes net benefits. Based on Table 4-3, the nonstructural buyout and relocation plan, Alternative 7 is economically unjustified with a BCR below 1.

Alternative	Average Annual Benefit	Average Annual Cost	BCR	Average Annual Net Benefit
1 (No-Action)	$0	$0	-	$0
2	$5,001,000	$3,891,000	1.29	$1,110,000
3	$5,039,000	$3,938,000	1.28	$1,100,000
4	$4,945,000	$4,476,000	1.10	$469,000
5	$4,971,000	$4,528,000	1.10	$444,000
6	$3,893,000	$4,173,000	0.93	-$280,000
7[1] (Non-Structural)	$5,754,000	$14,695,000	0.39	-$8,941,000

Table 4-3. Comparison of alternative average annual (AA) costs and benefits, October 2019 price level, FY 2020 interest rate (2.75%). Interest rate used was current at the time of analysis. [1]Values in FY21 price levels, 2.5% interest rate.

4.08.5. Incremental Plan Justification

According to ER-1105-2-100, plans should be incrementally justified, meaning that the benefits of each added increment of the plan should exceed the costs of that increment. In the case of this study, these increments are additional lengths of beach, as represented by the 26 economic reaches used in the analysis. It should be noted that with beach fill projects, small unjustified increments that are bordered by justified reaches on either side may still be included as part of the project, since having short gaps in the project is undesirable and unsustainable from a coastal engineering perspective. Benefits equal to or greater than 50% of those used to justify a reach needs to come from Coastal Storm Risk Management benefits. The remainder may come from any recreation benefits realized. Once a BCR equal to or greater than 1.0 to 1 is achieved, then all recreation benefits may be claimed, even if they exceed the storm damage reduction benefits.

The 26 economic reaches used in the alternatives analysis were used as the basis for demonstrating incremental justification. Reaches 20 and 21 were not demonstrated to be at least 50% justified based on damage reduction benefits; however, as these reaches are short in relation to their distance between adequate transition features, they were included in the Recommended Plan, to ensure no future areas of excessive erosion or the possibility of circumvention during larger surge events. The inclusion of short features in a largely justified proposed project is well-founded and has also been justified by other means on other CSRM projects. The conclusions of the Section 111 analysis also justify the USACE mitigating the impacts of the Charleston Harbor project, which affects the entire study area. Therefore, the entire length of beach analyzed (reaches 2-26) is incrementally justified and is included as part of the Recommended Plan.

4.08.6. Comparison of Alternatives by NED, RED, EQ, OSE Accounts and P&G criteria

In addition to the NED comparison shown in Section 4.08.5, alternative plans were also be compared based on potential impacts to Regional Economic Development (RED), Environmental Quality (EQ), Other Social Effects (OSE) and required Principles and Guidelines (P&G) criteria. Although there are some small differences among the various beach fill alternatives as they relate to RED, EQ, OSE, and P&G, these differences would be minor and would not affect plan selection. Thus, for the purposes of the RED, EQ, OSE and P&G evaluation, the beach fill alternatives were grouped together to be compared to the non-structural Removal/Demolition alternative and No-Action alternatives. These comparisons are contained in Table 4-5, Table 4-6, Table 4-7, Table 4-8, and Table 4-9, below.

Item	Alternative 1 – No-Action	Alternative 3 – Recommended	Alternative 7 – Buyout & Removal*
National Economic Development Account			
Average Annual Damage Prevented	$0	$4,765,000	$5,754,000
Average Annual Emergency Cost Avoided	$0	-	-
Average Annual Recreation Benefit	$0	$47,753,000	$0
Average Annual Total Benefit	$0	$52,518,000	$5,754,000
Total Project Cost Summary First Cost	$0	$241,735,000	-
Total Project Cost Summary Present Value	$0	$152,874,000	$407,000,000
Interest During Construction	$0	$254,000	$9,788,000
Economic Cost for BCR	$0	$153,127,000	$416,788,000
Average Annual Economic Cost	$0	$5,399,000	$14,695,000
Average Annual OMRR&R	$0	$101,000	-
Average Annual Total Cost	$0	$5,500,000	$14,695,000
Benefit-Cost Ratio	-	9.5	0.39
Average Annual Net Benefit	$0	$47,018,000	-$8,941,000

Table 4-4. NED comparison of alternatives.

Account: Regional Economic Development (RED)			
Item	**Alternative 1 (No-Action)**	**Alternative 3 (Recommended Plan)**	**Alternative 7 (Non-Structural)**
Sales Volume	Similar to non- structural; although, likely to occur at a slower pace.	Rental sales and tourism sales preserved or increased.	Reduced rental market and tourism.
Income	Similar to non- structural; although, likely to occur at a slower pace.	Increased recreation visitation may improve the income of service industries and rental properties.	Decreased recreation visitation may reduce the income of service industries and rental properties.
Employment	Season employment may decrease due to decreased recreation visitation.	Seasonal employment may increase due to increased recreation visitation. Temporary increase in employment related to construction activities.	Season employment may decrease due to decreased recreation visitation. Temporary increase in employment related to structure removals.
Tax Changes	Loss of tax base when houses are destroyed and cannot be rebuilt.	Tax base and property values preserved of increased.	Loss of tax base due to numerous structures being removed.

Table 4-5. Regional Economic Development (RED) Comparison of Alternatives

Account: Environmental Quality (EQ)				
Item	**Sub-Item**	**Alternative**		
		Alternative 1 (No-Action)	**Alternative 3 (Recommended Plan)**	**Alternative 7 (Non-Structural)**
Physical Resources	Geology and Sediments	Long-term erosion of Folly Beach shoreline.	No significant change to the natural geology. Short-term reduction of beach quality sediment in the Folly River borrow area, long-term reduction of sediment on the offshore borrow areas. Long-term addition of beach quality sediment along Folly Beach.	Long-term erosion of Folly Beach shoreline.
	Water Quality	No effect.	Short-term and localized elevated turbidity and suspended solid levels nearshore, offshore, in the Folly River and in the surf zone associated with dredging and beach placement.	No effect.
	Climate Change	No effect to climate change. Likely increased storm events and sea level rise would cause increased erosion rates.	No effect to climate change. Likely increased storm events and sea level rise would cause increased erosion rates.	No effect to climate change Likely increased storm events and sea level rise would cause increased erosion rates.
	Air Quality	No effect.	Temporary pollutant increase associated with dredging and heavy equipment during construction & renourishment events.	Temporary pollutant increase associated with heavy equipment during demolition and removal.

	Sea Level Change	No effect to sea level change. Accelerated sea level rise rates could lead to higher storm surges and increased erosion rates.	No effect to sea level change. Accelerated sea level rise rates could lead to higher storm surges and increased erosion rates.	No effect to sea level change. Accelerated sea level rise rates could lead to higher storm surges and increased erosion rates.
Marine Resources	Benthic Resources	Long term reduction in benthic macro-invertebrate abundance in the beach environment due to erosion of beach habitat.	Short-term and localized impact to benthic macro-invertebrate community from direct burial and turbidity associated with beach placement. Short-term and localized impact to macro- invertebrate community associated with dredging.	Long term reduction in benthic macro-invertebrate abundance in the beach environment due to erosion of beach habitat.
	Estuarine and Surf Zone Fishes and Nekton	No effect.	Short-term, recurring effects due to construction and renourishment turbidity. Negligible dredging entrainment impacts.	No effect.
	Hard Bottoms	No effect.	No effect.	No effect.
	EFH-HAPC	No effect.	No effect to HAPC. No significant adverse impacts to EFH. Physical and biological impacts to EFH would be short-term and localized on an individual effects basis.	No effect.

Wetlands and Floodplains	--	No changes to wetlands or hydrology, but the continued erosion would cause permanent loss of land area in the floodplain	No change to wetlands, insignificant change to the floodplain.	No changes to wetlands or hydrology, but the continued erosion would cause permanent loss of land area in the floodplain
Terrestrial Resources	Vegetation	Long term loss of vegetation habitat areas as beach erodes.	Disturbance of some existing vegetation, minimized by post-construction dune planting if the dune requires renourishment.	Long term loss of vegetation habitat areas as beach erodes.
	Wildlife	Long term loss of roosting, foraging, breeding and nesting habitat for mammals, reptiles, amphibians, and birds.	Short-term effects to transient species. Temporary effect to roosting and foraging shorebird habitat.	Long term loss of roosting, foraging, breeding and nesting habitat for mammals, reptiles, amphibians, and birds.
Threatened & Endangered Species	Whales	No effect.	Short-term impacts to foraging habitat and slight chance of vessel strikes to whales. Minor impact from dredging noise. No effect to NARW critical habitat.	No effect.
	Manatees	No effect.	Short-term impacts to foraging habitat and slight chance of vessel strikes to manatees.	No effect.

	Sea Turtles	Long term decrease in sea turtle nesting habitat success due to beach erosion, scarping and scouring of the dune.	Negligible risk to benthic oriented sea turtles due to entrainment. Long term sustainability of sea turtle nesting habitat due to preservation of the beach berm. Temporary adverse impacts to beach loggerhead critical habitat.	Long term decrease in sea turtle nesting habitat success due to beach erosion, scarping and scouring of the dune.
	Atlantic and Shortnose Sturgeon	No effect to sturgeon or critical habitat.	No effect to Shortnose Sturgeon. Minor risk of Atlantic sturgeon (AS) impacts from dredging. Short-term impacts to benthic foraging and refuge habitat and disruption of migratory pathway. No effect to AS critical habitat.	No effect.
	Seabeach Amaranth	No effect.	No effect.	No effect.
	Piping Plover and Red Knot	Long term loss of habitat areas as beach erodes.	Short-term impact to bird foraging, sheltering and roosting areas. Long term enhancement of these areas with beach renourishment.	Long term loss of habitat areas as beach erodes.

Socioeconomics	Demographics, Economics, and Income	Increased potential adverse impacts to the existing tax base and to commercial and public entities.	Continue economic growth. Minimized damages to residential, public, and commercial structures, as well as reduction of damages to critical infrastructure.	Increased potential adverse impacts to the existing tax base and to commercial and public entities.
	Aesthetic Recreational and Resources	Adverse long-term detrimental effect due to beach erosion.	Short-term minor adverse impacts due to beach placement activities. Short-term Folly River navigability. Long term benefits to beach renourishment and stabilization.	Adverse long- term detrimental effect due to beach erosion.
	Commercial and Recreational Fishing	No effect.	Potential temporary delays to boat traffic through the inlet during construction. Temporary impacts to fishing during dredging in offshore borrow areas and beach placement.	No effect.
Cultural Resources	--	No effect.	No significant impact with implementation of the programmatic agreement.	No effect.
Noise	--	No effect.	Minor short-term increase in noise on the beach and in the marine environment during construction and renourishment events.	Temporary short-term increase in noise on the beach during demolition and removal. No effect to noise in water.
HTRW	--	No effect.	No effect.	No effect.

CBRA	--	It is likely Bird Key Stono will continue to migrate southwestward until it is slowly eroded away by the ebb tidal channel resulting in a new predominant emergent sand bar/island in Stono Inlet.	Significantly more sand would be introduced into the littoral system and is believed to accelerate the cycle of Bird Key Stono's southwestward migration and its ultimate demise and replacement by a new emergent sand bar.	Same as Alternative 1.

Table 4-6. Environmental Quality (EQ) Comparison of Alternatives

Account: Other Social Effects (OSE)			
Item	Alternative		
	Alternative 1 (No Action)	Alternative 3 (Recommended Plan)	Alternative 7 (Non-Structural)
Life, Health, and Safety	No change. Continued stress during damaging storms. Evacuation would still be required before storm landfall.	Significant reduction in stress related to concern of amount of damage and recovery during and after storms. Evacuation would still be required before storm landfall.	Moderate reduction in stress related to concern of amount of damage and recovery during and after storms. Evacuation would still be required before storm landfall.
Community Cohesion	Periodic displacement of all permanent residents and visitors.	Reduces displacements of all permanent residents and visitors.	Permanently displaces oceanfront residents/visitors. Periodic displacement of other residents.
Community Growth	Recreation visitation would likely decrease as the beachfront erodes away. Permanent population would likely decrease as lots are abandoned.	Growth trends in population and recreation visitation would continue.	Permanent population will decrease once oceanfront lots are vacated. Overall recreation visitation would likely decrease as the beachfront erodes away.
Traffic and Transportation	Continued risks to streets and highways.	Reduces damages to streets and highways. Minor, short-term increase in boat traffic due to dredging operations during initial construction and renourishments.	Continued risks to streets and highways.
Environmental Justice	No effect.	No effect.	No effect.

Table 4-7. Other Social Effects (OSE) Comparison of Alternatives

Account: Principles and Guidelines (P&G) Criteria			
Item	**Alternative**		
	Alternative 1 (No Action)	**Alternative 3 (Recommended Plan)**	**Alternative 7 (Non-Structural)**
Acceptability	Would continue to be acceptable to state and local entities and is compliant with existing laws, regulations, and policies, but will not meet the planning objective.	Acceptable to state and local entities and is compliant with existing laws, regulations, and policies.	Acceptable to state and local entities and is compliant with existing laws, regulations, and policies, but is not feasible and will not meet the planning objective of reducing the risk of coastal storm damages.
Completeness	Not be a complete solution because it would not meet the planning objective.	Complete solution.	Alternative 7 is a complete solution in regard to coastal storm damage reduction for structures and contents; however, it would result in eventual loss of the beach as an environmental and recreational asset.
Effectiveness	Would have no effect on achieving the planning objective.	An effective solution because it meets the planning objective.	Alternative 7 would be effective in eliminating damage to structures and contents but would not be effective in reducing erosion of the beach and dune system.
Efficiency	Not efficient because it does not contribute to the planning objective.	Most cost-efficient alternative for meeting the planning objective.	Not an efficient solution because it has costs that exceed the existing benefits.

Table 4-8. Principles and Guidelines (P&G) Criteria Comparison of Alternatives

4.09 Plan Selection

4.09.1. Selection of the Recommended Plan

Based on the results of the analysis presented in Section 4.07, Alternative 3 in combination with berm-only Section 111 elements at the County Park and Heritage Preserve is identified as the Recommended Plan (see Figure 4-3). Alternative 3 was chosen out of the final array as the National Economic Plan and the Recommended Plan since it had the highest net remaining NED benefits. Inclusion of the County Park reach (Reach 1), and the Lighthouse Inlet Heritage Preserve (Reach 26+), were added to the project as a result of the Section 111 study outcomes, which justify the Federal government to address the effects of the Charleston Harbor project on the entirety of Folly Island. For more information on Section 111 findings see Appendix G Section 111. Table 4-4 illustrates alternative differences in terms of cost and benefit-to-cost ratio. Plan selection was also based on full consideration of all factors including potential environmental impacts and other social effects as illustrated in Tables 4-5 through 4-9. Alternative 3 includes a 50-ft wide berm in economic reaches 18 through 26, due to extremely high erosion rates in those reaches, and a 35-ft berm south of that in reaches 1-17. The shoreline along economic reaches 18 to 26 is aligned in a more east-facing direction and has experienced higher rates of erosion than reaches 1 to 17. The inflection point between reaches 17 and 18 makes a natural break-point in the change in the design berm width and results in a more resilient design and lower risk. The dimensions of Alternative 3 are summarized in Section 6.01 later in the report. Results of the Sea Level Change Analysis did not result in a different Recommended Plan.

To identify the quantity to be removed from the borrow areas as opposed to the volumes ultimately being placed on the beach, the required borrow area volumes include the associated overfill factor and mechanical losses. This resulted in the Recommended Plan requiring removal of 2.6 million cubic yards of material for initial beachfill, followed by three periodic nourishment totaling approximately 7.5 million cubic yards. The Recommended Plan differs from the existing project in that it does not include an advance nourishment berm. For the risk based CSRM approach at Folly Beach, the nourished shoreline is expected to slowly erode after initial construction similar to past beach nourishment projects. As the nourished beach berm and dune erodes towards the end of the nourishment cycle the potential risk for damage will increase. However, the dune and berm, in combination with existing armor, are expected to continue to provide protection to the end of the cycle period. The modeling used in the analysis (Beach-fx) uses a random event-based life cycle analysis with hundreds of 50-year simulations to essentially evaluate the inland damages, benefits, and the cost of nourishments. The model is not a frequency-based analysis and does not provide a defined shoreline position at a set time or at the end of the 50-year analysis. The most severe model simulations indicated that at locations along the heavily armored northeast end of Folly Beach the waterline may reach the base of the rock revetments and timber bulkheads at high tide. Along the southwest and middle sections of Folly Beach the waterline may reach the base of the frontal dune line along the less armored sections. As the waterline approaches either of these conditions a renourishment will be considered, triggering a budget cycle request for future renourishment. During the 50-year period of analysis, the four nourishment events would require a total volume of 10.1 million cubic yards of material from the borrow areas. Actual renourishment volumes may vary depending on the occurrence of large storm events, the severity of erosion, and continue to minimize storm risk through the period of analysis.

4.09.2. Folly River Borrow Area and Decision to Utilize Offshore Borrow Areas Only

During the course of this study, USACE studied the feasibility of utilizing areas in the Folly River and Stono Inlet (Borrow Area K), located within CBRS units M006 and M07/M07P, to provide sand for this project. Use of these two sites was determined to be feasible from an engineering perspective, economically justified, and environmentally acceptable. Utilization of sand from within a CBRS unit to nourish a beach outside the unit was determined by US Department of the Interior (USDoI) to be an acceptable action in a November 2019 Solicitor's opinion. However, on July 15, 2021, the US Department of the Interior reinstated its earlier interpretation under CBRA as it relates to certain federally-funded shoreline stabilization actions, vacating the 2019 opinion. On August 5, 2021, the USFWS notified USACE that, as it relates to this project, "the CBRA exception under 16 U.S.C. § 3505(a)(6)(G) for 'nonstructural projects for shoreline stabilization that are designed to mimic, enhance, or restore a natural stabilization system' cannot be applied to removal of sand from within the CBRS to support beach nourishment projects that occur outside of the CBRS." As a result, the Recommended Plan will not utilize borrow sites located within a CBRS Unit. Further changes to CBRA or unit maps may occur during the 50-year life of the project, environmental analysis of the utilization of these two borrow areas will remain in this EA in recognition that future conditions may change.

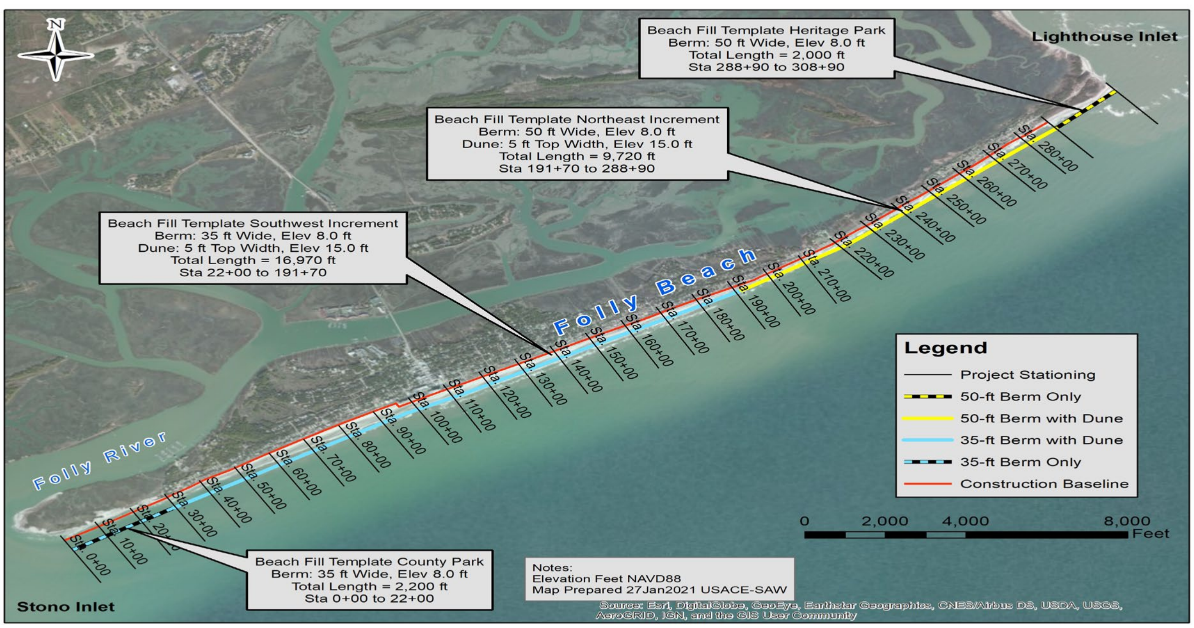

Figure 4-5. Recommended Plan

4.09.3. Identification of a Locally Preferred Plan (LPP)

No Locally Preferred Plan has been identified at this time, as the non-Federal sponsor is in support of moving forward with the NED Plan as the Recommended Plan.

4.10 Value Engineering

Value Engineering will not be addressed during this feasibility study. The entire project will be evaluated during individual construction contracts.

5. AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES*

This section describes the existing conditions of the human environment and environmental impacts within the proposed beach placement locations and within the borrow areas for Alternative 1 (No-Action), Alternative 3 (Recommended Plan) and Alternative 7 (Non-Structural). Alternatives 2, 4, 5 and 6 have similar environmental consequences as Alternative 3 and therefore are not discussed in this section.

Alternative 1 (No-Action)
The No-Action Plan is an alternative with no additional federal action undertaken to reduce coastal storm risk. Under this alternative, no federal shoreline protection projects will be constructed at Folly Beach—other than those in response to emergencies—between the years 2025 and 2075. This alternative assumes that the currently constructed template will be fully depleted, and no new renourishments will occur per the currently authorized Folly Beach project. It also assumes that local entities will continue to armor their properties, repairing existing armoring as needed, in an effort to stop the storm damage. Nor would non-structural measures, such as Building code re-evaluation, Floodplain Management re-evaluation, Community Education, and Re-evaluation of Evacuation Planning and Signage be recommended, although they are currently pursued by the City of Folly Beach. The period of analysis for this study is from 2025 to 2075.

Alternative 3 (Recommended Plan)
The Recommended Plan consists of a 5.8 mile (30,8690 linear foot) main dune and berm combination beach fill. The southwest portion of the project includes a 35 ft wide berm between reaches 1 to 17 for 19,170 feet (ft), see Figure ES-1. This includes the 2,200 ft Folly Beach County Park portion of the Recommended Plan plus the 16,970 ft portion of the Recommended Plan between reaches 2-17. The northeast portion includes a 50 ft wide berm between reaches 18 to 26 for 9,720 ft., plus a 50 ft wide berm in the 2,000 ft portion of the Recommended Plan which includes the County-administered Lighthouse Inlet Heritage Preserve. The berm is at elevation 8.0 ft North American Vertical Datum 88 (NAVD88). The Plan includes constructing a new dune or raising the existing dune to a uniform elevation of 15 ft NAVD88 with a minimum top width of 5 ft between reaches 2-26. Neither the County Park in the southern end of the Recommended Plan nor the Lighthouse Inlet Heritage Preserve at the northern end of the Recommended Plan would feature a dune. The beach fill includes a 750-foot tapered transition at the ends of the project and a 500 ft transition between the 35 ft and 50 ft wide berm. During the 50-Year period of recommended federal participation in the Recommended Plan, material for the beach fill would be dredged from two proposed offshore borrow sources and transported to the beach by pipeline for the beach fill construction and all renourishments. The renourishment interval for the project is approximately twelve years.

The location of Borrow Area F ranges from 1.0 to 2.5 miles offshore and is adjacent to Lighthouse Inlet (Figure 5-1). The Folly River borrow area is immediately behind Folly Beach (Figure 5-1). The Folly River federal navigation project transects the Folly River borrow area. Dredging of the borrow area is expected to be to about the same depth as the navigation channel (9-feet deep) but covers a much wider area. Borrow Area E is seaward of the state's territorial seas three nautical mile limit and ranges from approximately 4.0 to 6.0 miles from Folly Beach (Figure 5-1). Borrow Area K is associated with Stono Inlet's large ebb-tide delta and is about 4.0 miles from Folly Beach Figure 5-1).

Borrow Area K and the Folly River borrow area are located in the Bird Key Complex (CBRS Unit M07/M07P). The USACE initiated consultation with the USFWS under the Coastal Barrier Resources Act with the USFWS. The USACE determined utilization of the Folly River and Borrow Area K as borrow sites for the Folly Beach CSRM project would qualify under the exception to CBRA found at 16 U.S.C. 3505(a)(6)(G) for "non-structural projects for shoreline stabilization that are designed to mimic, enhance, or restore a natural stabilization system." The USFWS responded that they believe these borrow do not meet an exception to the CBRA and therefore, the USACE has removed them from the Recommended Plan (Appendix I). Nevertheless, both borrow areas have been included in the impacts analysis in the event they may meet any future exceptions.

The project includes an approximately 12-year renourishment cycle (initial construction, plus three renourishments). The borrow use plan involves placing material for initial construction in 2024. The first periodic nourishment that would be scheduled to occur in approximately 2036. The second periodic nourishment will be scheduled in approximately 2048. The third and last periodic nourishment will be scheduled in approximately 2060 (Figure 5-1). The Recommended Plan will require removal (including the associated overfill factor and mechanical losses) of 2.6 million cubic yards of material for initial beachfill, followed by a periodic nourishment removing 2.2 million cubic yards, then 2.4 million cubic yards, and finally 2.8 million cubic yards. The total amount removed from the borrow areas for the 50-year period of analysis is 10.1 million cubic yards. The final renourishment will contain sufficient volume to ensure the project is functional for the full period of analysis.

Each dredging and placement event will require approximately 180 days and may be working anytime throughout the year (year-round). The total maximum acreage and volumes of the borrow areas are:

- Borrow area F (Lighthouse), 1,079 acres, 2.8 million cubic yards
- Folly River, 151 acres, 2.7 million cubic yards
- Borrow area K/E (Stono Ebb), 2,821 acres, (borrow area E = 2,605 acres and borrow area K = 216 acres), 14.8 million cubic yards

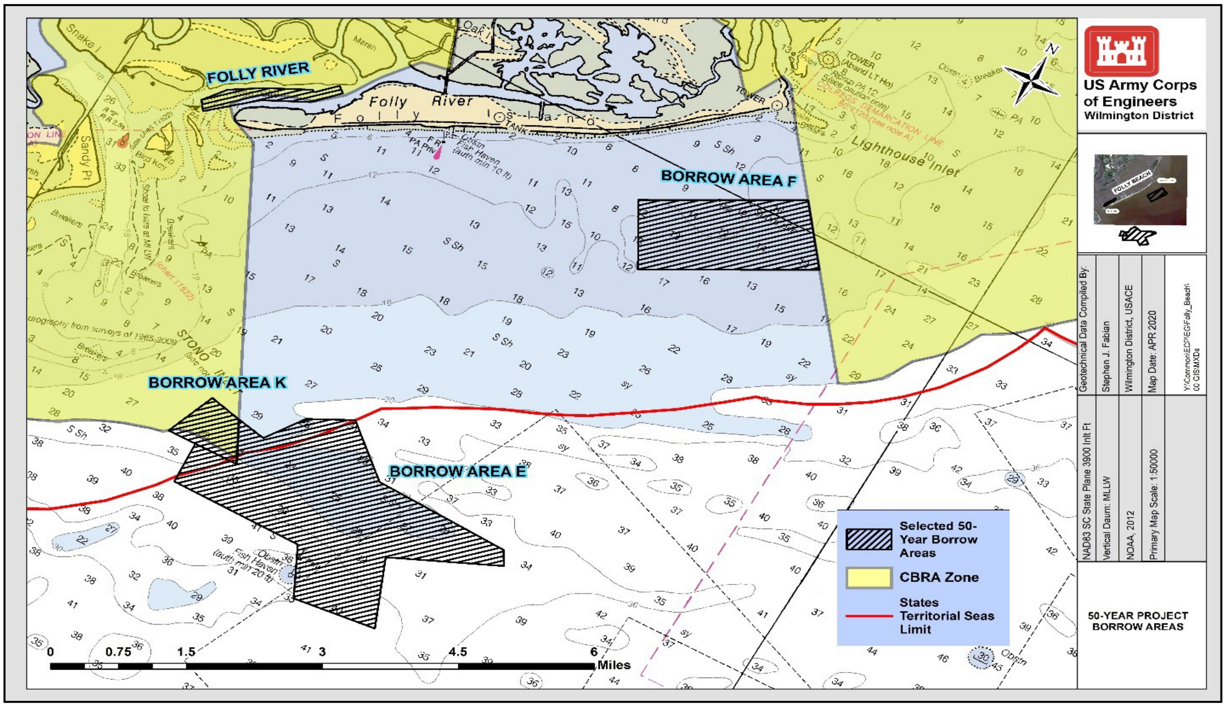

Figure 5-1. Borrow Area Locations.

Alternative 7 (Non-Structural)
This alternative included buyout and demolition of all 820 structures currently built in what are approximately the first three rows from the shoreline. Alternative 7 is not covered below because it does not meet the project objectives. Except for where demolished structure areas would naturally vegetate and become habitat, impacts of Alternative 7 would be the same as Alternative 1 (No Action) for the following resources; Geology and Sediments, Climate Change, Sea Level Change, Water Quality, Benthos, Estuarine and Surf Zone Fishes and Nekton, Hard Bottoms, EFH-HPAC, Wetlands and Floodplains, Vegetation, Wildlife, Whales, Manatees, Sea Turtles, Atlantic and Shortnose Sturgeon, Seabeach Amaranth, Piping Plover, Red Knot, Demographics, Economics and Income, Aesthetic and Recreation, Commercial and Recreational Fishing, Cultural, Hazardous, Toxic, Radioactive Waste and Coastal Barrier Resources Act. Impacts of Alternative 7 on Air Quality and Noise would be similar to Alternative 3 (Recommended Plan), except Alternative 7 would not affect noise levels in the marine environment.

5.01 Physical Resources

5.01.1. Geology and Sediment

The coastal zone of South Carolina is situated within the South Atlantic Bight (Georgia Bight), which extends from Cape Hatteras, NC to West Palm Beach, FL (Davis and Fitzgerald, 2003). This region is characterized by a wide, shallow continental shelf on the trailing edge of the tectonically stable North American Plate. South Carolina’s embayed beaches are strongly influenced by the presence of underlying warped and/or faulted basement rock of the Carolina Platform. Overlying these warped basement rocks are Cretaceous to Tertiary strata that form a shelf-ward thickening sedimentary wedge, internally comprised of unconformably bound, on-lapping, and off-lapping units (Horton and Zullo, 1991). Superimposed on these strata are numerous erosive channeling and scour features caused by fluctuations of sea-level (Schwab et al., 2009).

Folly Beach's geomorphology is characterized by linear dune ridges separated by inner swale lows and swamps. The ridges were formed by naturally-occurring high sea level stands over geologic time, beginning about 38,000 years ago (Cleary and Pilkey, 1996). Thus, the most landward ridge set resulted from the locally highest shoreward transgression, with each subsequent ridge set being formed by punctuated lower (or regressed) sea-level stands. These linear ridges continue seaward and make-up some of the past and current borrow sources offshore of Folly Beach.

The entire length of Folly Beach is experiencing shoreline recession with higher rates at the ends of the island and lower rates along the middle. The dominate longshore drift is toward the southwest. Historically, on average, the Folly Beach shoreline erodes from 2.00 ft per year to 8.88 ft per year. A detailed analysis of Folly Beach erosion rates can be found in Appendix A, Engineering.

The grain size characteristics of the native beach sand, which are used in the compatibility analyses, are a major factor when assessing the usefulness of a borrow area. Forty-one beach sediment samples were collected and analyzed to determine the native beach grain size characteristics (GDM, 1991). The mean grain diameter of the native beach sand was 0.17 mm with a standard deviation of 0.79 mm, identified as fine-grained sand using the Unified Soil Classification System. These samples were acquired from the upper beach profile (above the mean low water line). Sediment samples were also acquired below the mean low water line. Averaging the grain sizes using samples from above the low water line results in a finer native mean grain diameter of 0.149 mm.

Typical USACE contract specifications for nourishment projects generally recognize suitable beach material as Poorly Graded Sand, or Poorly Graded Sand with Silt per the Unified Soil Classification System, as long as the portion of material meets these criteria:

- Less than 10 %, by weight, material passes #200 sieve over weighted average.
- Less than 10 %, by weight, material retained on the #4 sieve over weighted average.
- Material retained on the ¾-inch sieve does not exceed, by percentage or size, that found on the native beach.
- Contains no construction debris, toxic material, or other foreign matter. Contains no clasts or lithified rock.

The USACE guideline for beach placement is no more than 10 % of the material passing the # 200 sieve, i.e., dredged material must be 90 % sand. All dredged material that will be placed on Folly Beach meets the USACE guideline and will be dredged from either the same inlet that has been used as a borrow source in the past or from a new offshore borrow source. A full discussion of sediment and geology can be found in Appendix B, Geotechnical.

Offshore Area "F" (Lighthouse)

Water depths range from -12 to -28 ft MLLW. Vibracore data are from 1994 to 2019. Usable sand thicknesses reach up to 10.0 ft and average 5.0 ft. The grain sizes in this borrow area range from 0.13 to 0.54 mm with an average grain size of 0.26 mm. Percent fines passing the No. 200 sieve average 5.3%. The origin of this borrow area is likely tidally influenced paleo-channels that deposited poorly graded sands and clayey sands to this area.

Folly River Borrow Area

Historically, this source located in a CBRA zone has been used for previous nourishments of Folly Beach with the first use being initial construction in 1993. Thereafter, the Folly River has been used for periodic nourishments with the most recent use in 2018, placing 500,000 CY of sand on Folly Beach. Vibracore data from 2012 and 2015 show usable sand thicknesses reach up to 20.0 ft and average 14.0 ft. The water depths range from -4 to -15 ft MLLW. Grain sizes in this borrow area range from 0.14 mm to 0.21 mm with an average grain size of 0.16 mm. The percent of fines passing the No. 200 sieve averages 2.20%.

Since the completion of the terminal groin in 2014, the amount of sediment that fills in the Folly River borrow area per year (recharge rate) has decreased. According to previous engineering reports, the Folly River had a recharge rate of 18.0% per year before the completion of the groin. Translating to any material removed and used for nourishment would require a waiting period of approximately five years until the area could be used again for nourishment (Van Dolah et al, 1998). Post groin construction, hydrographic surveys from 2014 to 2019 indicated a recharge rate average of 12.5% per year, which extends the waiting period from five years to eight years before it could be utilized for nourishment.

Dredging material and deepening the Folly River could alter hydrodynamic exchange and sediment transport within the Stono Inlet complex. This was seen in the Folly River following the initial construction of the existing project in 1993. Erosion was documented on the southwestern end of Folly Beach at the Folly Beach County Park (CSE, 2001). Nearly 3,100,000 CY was dredged out of the Folly River in 1993. Erosion rates along the far southwest end of Folly Beach experienced an increase following the 1993 beach nourishment project when compared to historic erosion rates. The Folly River borrow area fully recharged by 1999 but erosion rates on this southern end at the County Park remained high after the borrow area filled-in. In 2014 a 745 foot long terminal groin was built on the southwest end of Folly Beach at the Charleston County Park to address this erosion and to stabilize the shoreline. Since construction of the terminal groin this section of beach has stabilized. The most recent beach nourishment project at Folly Beach occurred in 2018 with approximately 1,500,000 CY dredged from the Folly River. No negative issues were noted following the 2018 project along the southwest end of Folly Beach or within the Stono Inlet complex. The terminal groin has performed well in stabilizing the County Park shoreline.

Based on concerns following the 1993 project, a sediment transport modeling study was conducted by the USACE Engineer Research and Development Center (ERDC) in 2020 to evaluate the impacts of dredging beach nourishment material from the Folly River. The Coastal Modeling System was used to evaluate sediment transport and morphology changes to the Stono Inlet estuarine system including the Folly River, Folly Island, Kiawah Island, and the nearshore areas. The study included a field data collection effort to calibrate the model. Results of the model confirmed rapid recharge of the Folly River borrow area with the majority of that material originating from the nourished beach and nearshore area along Folly Beach and transported southwest around the terminal groin. The model results did not show negative erosion impacts to the County Park shoreline when removing 2,500,000 CY from the Folly River. The results confirmed the high sediment transport rates along the Folly Beach shoreline and within Stono Inlet resulting in recharging of the Folly River borrow area by 19% during the first year. Model results did show an increased in erosion of the river bottom below MLW immediately adjacent to the borrow area footprint but did not extend to the Folly Island shoreline or to Bird Key. Conclusions from the study include not exceeding 2,500,000 CY of material borrowed from the Folly River without additional modeling analysis. The ERDC report "Sediment Transport Modeling at Stono Inlet and Adjacent Beaches, South Carolina" may be reviewed in the Coastal Appendix.

Offshore area "K/E" (Stono Ebb)

Offshore borrow area K is within a CBRA zone and Offshore borrow area E is outside the CBRA zone. Historically, USACE was prohibited from using federal funds to support beach nourishment that involved removing sand from within, to outside CBRA zones. Therefore, each borrow area was separately analyzed if use of material from the CBRA zone (borrow area K) may not be allowed. If Offshore area "K/E" (Stono Ebb) is used for beach nourishment, both will be used in combination as a single borrow area.

Borrow area K is associated with Stono Inlet's large ebb-tide delta. Water depths range from -4 to -30 ft MLLW based on vibracore data from 2015. Usable sand thicknesses reach up to 13.8 ft and average 6.8 ft. The grain sizes range from 0.11 to 0.26 mm and average 0.18 mm. Percent of fines passing the No. 200 sieve averages 5.3%. Borrow area K has a thick area of usable sand and encounters a well-defined unsuitable continuous fat clay and clayey sand at -43 ft MLLW.

The location of Borrow Area E is seaward of the state's territorial seas limit (three nautical miles) and is approximately 4.0 to 6.0 miles from Folly Beach. Sediment dredged from this portion of the borrow area will require a Bureau of Ocean Energy Management (BOEM) lease, which will be obtained before construction begins. Water depths range from -33 to -44 ft NAVD88. Vibracore data are from 2015. Usable sand thicknesses reach up to 15.3 ft and average 5.8 ft. The grain sizes range from 0.18 to 0.62 mm with an average grain size of 0.22 mm. Percent fines passing the No. 200 sieve averages 3.8%.

This borrow area is likely the result of relict ebb shoals from Stono Inlet that occurred during a lower stand in sea-level. According to top of hole elevation and nautical charts, this borrow area is made up of a network of troughs and ridges. The ridges contain the greatest usable sand thickness, while the troughs indicate lesser thicknesses of usable sand.

Alternative 1 (No-Action): This alternative would result in the long-term erosion of approximately 2,160,000 CY of sediments from Folly Beach every 12 years. Sediments would not be removed from the proposed offshore borrow areas. Little to no sediment would be placed on Folly Beach, except under emergency conditions, and if then, only minimal volumes to protect select infrastructure.

Alternative 3 (Recommended Plan): Implementation of Alternative 3 would remove approximately 2,600,000 cubic yards of beach quality sediment from the borrow areas for initial construction and 2,500,000 cubic yards approximately every 12 years thereafter for renourishments. Over time, the sediment placed on the beach will be littorally-transported, generally north to south, toward Stono Inlet.

In 2019, the USACE ERDC Coastal Hydraulics Laboratory conducted an analysis of the proposed borrow areas on wave propagation at Folly Beach using the Steady-state wave model. Use of Offshore area "F" (Lighthouse) or Offshore area "K/E" (Stono Ebb) did not show any significant impacts to Folly Beach due to wave transformation impacts (Appendix A, Engineering).

The most recent dredging event in the Folly River occurred in 2018. Modifying the footprint and deepening the Folly River could alter hydrodynamic exchange within the Stono Inlet complex. This was seen in the Folly River during initial construction of the existing project in 1993. Severe erosion was documented on the southwestern end of Folly Beach (CSE, 2001). Nearly 3,000,000 CY were pulled out of the Folly River in 1993, resulting in significant changes to the flood and ebb tidal currents. The ERDC study assisted in identifying sediment transport and morphologic changes from Alternative 3 as incorporated in this final report. Alternating of the borrow areas will allow for the Folly River borrow area to refill over time. The offshore borrow areas are not expected to refill.

Beach quality sediment identified for all federal and non-Federal renourishment projects throughout South Carolina is most often identified from: upland sites, maintenance or deepening of navigation channels, inlets and/or offshore borrow areas. This project would reduce the overall quantity of beach quality sediment from the offshore borrow areas that do not refill over time (borrow areas F, K and E), but would not be expected to have a significant negative impact on sediments.

5.01.2 Water Quality

Water quality standards are State regulations or rules that protect lakes, rivers, streams, and other surface water bodies from pollution. These standards are used to determine if the designated uses of a water body are being protected. Those uses are defined by the classifications assigned to the water body. Surface Water Classifications are designations applied to surface water bodies, such as streams, rivers, and lakes, which define the best uses to be protected within these waters (for example swimming, fishing, drinking water supply) and carry with them an associated set of water quality standards to protect those uses.

SC Department of Health and Environmental Control (SCDHEC) water classifications:

- Class SFH (shellfish harvesting waters), are tidal saltwaters protected for shellfish harvesting, and are suitable also for uses listed in Classes SA and SB.
- Class SA comprises "tidal saltwaters" suitable for primary and secondary contact

recreation, crabbing and fishing. These waters are not protected for harvesting of clams, mussels, or oysters for market purposes or human consumption. The waters are suitable for the survival and propagation of a balanced indigenous aquatic community of marine fauna and flora.

- Class SB are "tidal saltwaters" suitable for the same uses listed in SA. The difference between the Class SA and SB saltwater concerns the dissolved oxygen (DO) limitations. Class SA waters must maintain daily DO averages not less than 5.0 mg/l, with a minimum of 4.0 mg/l, and Class SB waters maintain DO levels not less than 4.0 mg/l.

The Folly River is classified as an SFH water body. The open ocean and the adjacent beach waters are classified as SA waters.

The Folly River borrow area is not as dynamic as the nearby inlet but is still impacted by the resulting ocean longshore currents, waves, and tidal influences. Storms and maintenance dredging of the navigation channel add to the levels of turbidity and suspended solids in the inlet.

Reasonably foreseeable actions in the project vicinity or in nearby areas that may result in similar impacts, as those described above, include homeowner actions, non-Federal and federal beach renourishment and federal navigation dredging with beach placement of navigation dredged material.

Homeowner Actions

Currently, the project area is subjected to repeated and frequent maintenance disturbance by individual homeowners and local communities following storm events. These efforts are primarily made to protect adjacent shoreline property and are expected to continue into the future. Such repairs consist of dune rebuilding using sand from beach scraping and/or upland fill. These maintenance efforts could keep the natural resources of the barrier island ecosystems from reestablishing a natural equilibrium with the dynamic coastal forces in some limited areas.

Non-Federal Beach Renourishment

Several local beach renourishment efforts, including Hilton Head, Hunting Island, Debordieu Beach, Acadian Shores and Pawleys Island, have been conducted throughout South Carolina or are in the permitting process to obtain permits/approvals for future work. The number of locally funded beach renourishment activities has increased in the last 20 years as local communities continue to seek avenues for restoring severely eroding shorelines. Though non-Federal beach renourishment efforts continue to increase, many of these projects are being pursued as one-time interim efforts until the federal beach renourishment projects can be implemented. Therefore, this increase in permitted non-Federal projects does not necessarily reflect a subsequent increase in resource acreage impacts.

Federal (USACE) Beach Renourishment

Federal beach renourishment activities typically include the construction and long-term (50-year) maintenance of a berm and dune. Maintenance responsibilities of the Non-Federal Sponsor continue after the 50-year Federal Period of Participation and are for the life of the project. The degree of impact would increase proportionally with the total length of beach renourishment project constructed. The constructed federal South Carolina beach renourishment projects include the Myrtle Beach and Folly Beach CSRM projects.

Federal (USACE) Navigation Channels with Beach Placement

Throughout South Carolina, two federal navigation projects have beach placement, they are Folly River and Murrells Inlet. Beach quality sand is a valuable resource that is highly sought by beach communities. When beach quality sand is dredged from navigation projects, it has become common practice of the USACE to make this resource available to beach communities when applicable laws, regulations, funding, and other considerations allow. Placement of this sand on beaches represents return of sediment to the littoral system. The Charleston District does not anticipate significant increases in beach placement from federal navigation projects in the foreseeable future.

Borrow Areas

Only two projects are known to have used or are currently using an offshore borrow area. They are Myrtle Beach and the Folly Beach CSRM projects. Although not constructed, the Edisto and Pawleys Island CSRM projects will utilize an offshore borrow area.

Alternative 1 (No-Action): Since there will be no dredging or placement of material on Folly Beach, this alternative would have no effect on water quality.

Alternative 3 (Recommended Plan): Dredging in a borrow area would involve mechanical disturbance of the bottom substrate and subsequent redeposition of suspended sediment and turbidity generated during the estimated 180 days for each dredging and placement event, which may occur any time of year. Factors known to influence sediment spread and turbidities are grain size, water currents and depths.

During beach placement, there would be elevated levels of turbidity and suspended solids in the immediate area of sand deposition when compared to the existing non-storm conditions of the surf zone. Significant increases in turbidity are not expected to occur outside the immediate nourishment area (turbidity increases of 25 nephelometric turbidity units [NTUs]) or less are not considered significant). Turbid waters (increased turbidity relative to background levels, but not necessarily above 25 NTUs) would stay close to shore and be transported with waves either up-drift or down-drift, depending on wind conditions. The work will be performed following the SARBO PDC which states, "Beach nourishment projects will be designed to minimize turbidity in nearshore waters by using methods that promote settlement before water returns to the water body (i.e., shore parallel dikes). Turbidity and marine sedimentation will be further controlled using land-based erosion and sediment control measures to the maximum extent practicable. Land-based erosion and sediment control measures will (1) be inspected regularly to remove excess material that could be an entanglement risk, (2) be removed promptly upon project completion, (3) and will not block entry to or exit from designated critical habitat for ESA-listed species."

Because of the low percentage of silt and clay in the borrow areas (less than 10 %), turbidity impacts from dredging in the Folly River would not be expected to be greater than the natural increase in turbidity and suspended material that occurs during storm events. Any increases in turbidity in the Folly River during project construction and maintenance would be expected to be temporary and limited to the area surrounding the dredging. Turbidity levels would be expected to return to background levels soon after the end of dredging. Past projects indicate that the extent of the dredging sediment plume is generally limited to between 1,640 – 4,000 ft from the dredge and elevated turbidity levels are generally short-lived, on the order of an hour or less (NASA, 2013; Wallops Island Environmental Assessment).

Offshore borrow areas typically are less disturbed and have less turbidity than inlets. Dredging within an offshore borrow area would result in increased turbidity and would be expected to be limited to the area surrounding the dredging. Monitoring studies done on the impacts of offshore dredging indicate that sediment suspended during offshore work are generally localized and rapidly dissipate when dredging ceases (Naqvi and Pullen 1982, Bowen and Marsh 1988, Van Dolah et al. 1992). Post-dredging infilling associated with the natural physical processes of the system is not anticipated.

In 2013, SCDHEC issued a notice that stated that groin construction and beach nourishment have very few water quality impacts and have waived the requirement for 401 certifications for these projects. A copy of the SCDHEC waiver can be found in Appendix I. The proposed action complies with Section 404(b)(1) (P.L. 95-2017) of the Clean Water Act. The Section 404(b)(1) evaluation is included in Appendix F. Resultant water column impacts associated with sedimentation and turbidity are discussed in Section 5.02; however, no measurable increase in bottom elevation is expected from the fallback of sediment during the dredging operations and the activity is not expected to destroy or degrade waters of the United States (33 CFR Section 323.2(d)(4)(i)).

Overall water quality impacts of the Recommended Plan would be expected to be short-term and minor. Living marine resources dependent on good water quality should not experience significant adverse effects from water quality changes.

There would be negligible differences in impacts to water quality between both alternatives described above. All impacts would be minor, temporary, and localized. Due to the widespread distribution of dredging and beach placement projects and the asynchronous timing of these projects, the impacts of the Folly Beach project to water quality when combined with the impacts of other foreseeable projects would be minimal.

5.01.3 Air Quality

The Clean Air Act requires the U.S Environmental Protection Agency (EPA) to establish health and science-based standards for air pollutants that have the highest levels of potential harm to human health or the environment. These National Ambient Air Quality Standards (NAAQS) are in place for six air pollutants, also referred to as criteria pollutants. The six criteria pollutants are Ozone, Sulfur Dioxide, Particulate Matter, Lead, Nitrogen Dioxide, and Carbon monoxide. Of the six current criteria pollutants, particle matter and ozone have the most widespread health threats, but they all have the potential to cause damage to human health and the environment. Areas of the country that persistently exceed the NAAQS are designated as “nonattainment” areas and those that meet or exceed the standards are designated “attainment” areas. The ambient air quality for Charleston County has been determined to be in compliance with the National Ambient Air Quality Standards and is designated as an attainment area. The State of South Carolina has a State Implementation Plan approved or promulgated under Section 110 of the Clean Air Act, as amended.

Greenhouse gases absorb infrared radiation, thereby trapping heat and making the planet warmer. The most important greenhouse gases directly emitted by humans include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and several other fluorine-containing halogenated substances. Although CO_2, CH_4, and N_2O occur naturally in the atmosphere, human activities have changed their atmospheric concentrations. From the pre-industrial era (i.e., ending about 1750) to 2017, concentrations of these greenhouse gases have increased globally by 45, 164, and 22 %, respectively.

Gases in the atmosphere can contribute to climate change both directly and indirectly. Direct effects occur when the gas absorbs radiation. Indirect radiative forcing occurs when chemical transformations of the substance produce other greenhouse gases, when a gas influences the atmospheric lifetimes of other gases, and/or when a gas affects atmospheric processes that alter the radiative balance of the earth.

In 2017, total gross U.S. greenhouse gas emissions were 6,472.3 MMT, or million metric tons, carbon dioxide. Total U.S. emissions have increased by 1.6 % from 1990 to 2017, and emissions decreased from 2016 to 2017 by 0.3 % (USEPA 2020).

The reasonably foreseeable future actions, including other existing and future federal and non-federal beach renourishment projects and federal navigation dredging with beach placement, may also affect the air quality as described above.

Alternative 1 (No-Action): This alternative would have no effect on air quality.

Alternative 3 (Recommended Plan): Temporary increases in exhaust emissions from the dredge and other nourishment equipment are expected, however, the emissions produced would be similar to that produced by other large pieces of machinery and should be readily dispersed. Each placement event (initial construction and subsequent nourishments) is expected to take approximately 180 days and all dredges must comply with the applicable EPA standards. The direct and indirect emissions from this alternative fall below the prescribed de minimis levels, and therefore will have no effect on air quality.

5.01.4 Sea Level Change

The sea level change (SLC) rate at Folly Beach was evaluated following the guidelines presented in USACE Engineer Pamphlet EP 110-2-1 “Procedures to Evaluate Sea Level Change: Impacts, Responses and Adaptation" (30 Jun 2019). The USACE online tool Sea Level Tracker was used in determining the historic rate of SLC and the projected rate of SLC, (https://climate.sec.usace.army.mil/slr_app/). The Sea Level Tracker tool calculates low, intermediate, and high sea level change scenarios based on global and local change effects.

The Folly Beach SLC analysis was based on the NOAA gauge located in Charleston, South Carolina (Station 8665530), approximately eight miles north of Folly Beach. The gauge is compliant with a historic data record of 1921 to present. This gauge was selected to represent the project site since it was the closest long-term gauge to the project location.

The mean sea level trend at Charleston, South Carolina gauge based on regionally corrected (2006) mean sea level data of 0.00965 ft/year. The defined 50-Year period of analysis is from 2025 to 2075. The projected low, intermediate, and high scenario SLC curves from the Sea Level Tracker tool are provided below in Figure 5-2. The intermediate sea level change scenario was selected for the Folly Beach project. This rate was selected because the 19-year mean sea level moving averaged trended most accurately with the intermediate rate curve. During the 50-Year period of analysis of 2025 to 2075 the expected intermediate SLC was an increase of 0.99 ft in mean sea level. The intermediate rate was used in the engineering and economic Beach-fx analysis. The low SLC scenario was 0.49 ft and the high was 2.65 ft and were used in the analysis to better quantify the risk associated with adopting the intermediate rate. Detailed analysis on SLC is provided in the Coastal Engineering Appendix.

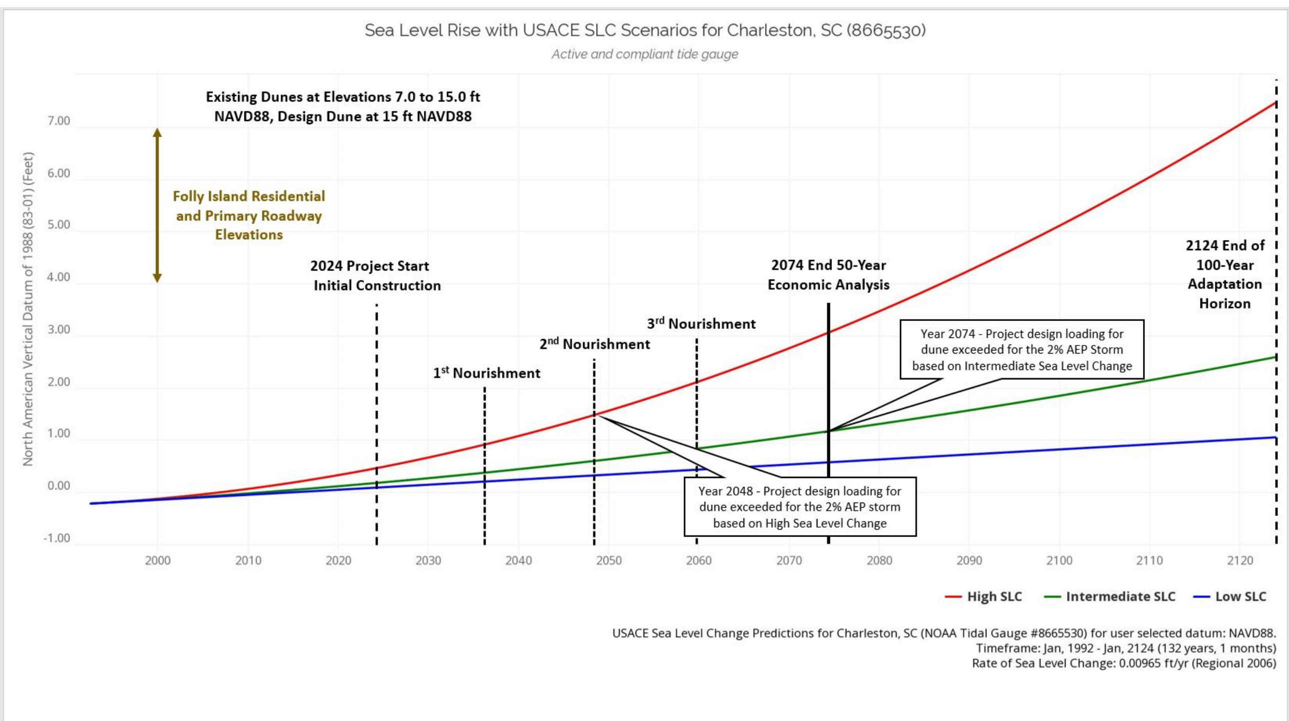

Figure 5-2. USACE Sea-Level Change Scenarios.

Alternative 1 (No-Action): The No-Action analysis assumes that the intermediate sea level change scenario 0.99 ft over the remaining life of the project. Impacts of rising sea level on total water levels experienced at Folly Beach include overtopping of oceanside and backside structures, increased shoreline erosion, and flooding of low-lying areas. The No-Action alternative would not affect sea level change.

Alternative 3 (Recommended Plan): Potential impacts of rising sea level on total water levels experienced at Folly Beach include overtopping of oceanside and backside structures, increased shoreline erosion, and flooding of low-lying areas. In general, relative sea level change (Baseline, Intermediate, and High) will not affect the overall function of the proposed project. Relative vulnerability to flooding during extreme events is consistent between both the with and without-project conditions.

RSLC using a higher rate of SLR does not change the recommended plan to a non-structural plan, it just results in a larger dune and berm template, with increased costs. The reader is referred to Table 6-4.

5.02 Marine Resources

5.02.1. Benthic Resources

Aquatic organisms that live in close association with the bottom, or substrate, of a body of water, are collectively called the benthos. Benthos communities provide a link between planktonic and benthic production and commercially important fish species (Posey, 1991). Benthic communities of the project area exhibit a wide range of organism composition and density, and community structure may vary considerably depending on substrate type, salinity regime, proximity to structural habitat, and the like. Benthic substrate type and structural habitat within the project area range between fine- to coarse-grained sand and shell hash. Specifically, the nearshore soft bottom environment just offshore of the beach face consists of transitioning regions of shell hash and sand.

The area where beach nourishment placement would occur at Folly Beach is considered the beach community and encompasses a total of 98.3 acres. The beach community is comprised of a dry berm zone located beyond the high tide line, an intertidal zone that is alternately covered and exposed by tidal action, and a subtidal zone that occurs below the low tide line and extends seaward, merging with the ocean surf. In general, beaches are gently sloping communities that serve as transitional areas between open water and upland terrestrial communities. These communities experience almost continuous changes as they are exposed to erosion and deposition by winds, waves, and currents. Sediments are unstable and vegetation is absent. Wave action, longshore currents, shifting sands, tidal rise and fall, heavy predation, and extreme temperature and salinity fluctuations combine to create a rigorous environment for macro- invertebrates. Macro-invertebrates are the predominant faunal organisms inhabiting the beach region and most live beneath the sand surface where salinities and temperatures are most constant. Relatively few species inhabit sandy beaches, but those present frequently occur in large numbers. Consequently, high-energy beaches are far from being biological deserts, and together with the associated fauna they act as extensive food-filtering systems. Typical beach inhabitants are beach fleas (*Orchestia sp*.) and ghost crabs (*Ocypode quadrata*) in the beach berm. Coquinas (*Donax variabilis*), mole crabs (*Emerita talpoida*) and various burrowing worms inhabit the beach intertidal zone and blue crabs (*Callinectes sapidus*), horseshoe crabs (*Limulus polyphemus*), sand dollars (*Echinarachnius parma*) and numerous clams and gastropod mollusks inhabit the beach subtidal areas. Beach intertidal macrofauna are also a seasonally important food source for numerous shorebird species.

The surf zone of the beach shoreface is extremely dynamic and is characterized as the area from mean low tide landward to the high tide mark. The area serves as habitat for invertebrate communities adapted to the high-energy, sandy-beach environment. Important invertebrates of the surf zone and beach/dune community include the mole crab (*Emerita talpoida*), coquina clams (*Donax variabilis*), polychaete worms, amphipods, and ghost crabs (*Ocypode quadrata*). Mole crabs and coquinas represent the largest component of the total macrofaunal biomass of North Carolina intertidal beaches, which is comparable in conditions to Folly Beach, SC, and they are consumed in large numbers by important fish species such as flounders, pompanos, silversides, mullets, and kingfish (Reilly and Bellis 1978). Beach intertidal macrofauna are also a seasonally important food source for numerous shorebird species

Similar to the surf zone, tidal salt waters, which encompass the Folly River borrow area, can also be highly dynamic. Typical inlet invertebrate infauna that have evolved to survive in high energy, disruptive habitat include the mole crab (*Emerita talpolida*), haustorid amphipods (*Haustorius* spp.), coquina clam (*Donax variablilis*), and spionid worm (*Scolelepis squamata*). The epifaunal blue crab (*Callinectes sapidus*), and lady crab (*Ovalipes ocellatus*) are also found in the intertidal zone. These invertebrates are prey to various shore birds and nearshore fishes.

Offshore sand bottom communities along the South Carolina coast are relatively diverse habitats containing over 100 polychaete taxa. Tube dwellers and permanent burrow dwellers are important benthic prey for fish and epibenthic invertebrates. These species are also most susceptible to sediment deposition, turbidity, erosion, or changes in sediment structure associated with sand mining activities, compared to other more mobile polychaetes. On ebb tide deltas, polychaetes, crustaceans (primarily amphipods), and mollusks (primarily bivalves) were the most abundant infauna, while decapod crustaceans and echinoderms (sand dollars) dominated the epifauna (Deaton et al. 2010). Because periodic storms can affect benthic communities along the Atlantic coast to a depth of about 115 ft (35 meters), the soft bottom community tends to be dominated by opportunistic taxa that are adapted to recover relatively quickly from disturbance. Many faunal species documented on the ebb tide delta are important food sources for demersal predatory fishes and mobile crustaceans, including spot, croaker, weakfish, red drum, and penaeid shrimp. These fish species congregate in and around inlets during various times of the year, presumably to enhance successful prey acquisition and reproduction (Deaton et al. 2010).

The reasonably foreseeable future actions, including other existing and future federal and non-federal beach renourishment projects and federal navigation dredging with beach placement, may also affect the same benthic resources as those described above.

Alternative 1 (No-Action): This alternative would result in the long-term reduction in benthic macro-invertebrate abundance in the beach environment due to erosion and scour of beach habitat. There would be no effect to offshore benthic resources.

Alternative 3 (Recommended Plan): Beach placement would cover a maximum of 98.3 acres on Folly Beach may have negative effects on intertidal macrofauna through direct burial or increased turbidity in the surf zone; such effects would be expected to be localized, short-term, and reversible. Any reduction in the numbers or biomass (or both) of intertidal macrofauna present immediately after beach placement may have localized limiting effects on surf-feeding fishes and shorebirds because of a reduced food supply. In such instances, those animals may be temporarily displaced to other locations, but would be expected to return within 1–2 years following placement.

Dredging from the borrow area would impact a maximum 1,079 acres from borrow area F (Lighthouse), 2,821 acres from borrow area K/E (Stono Ebb) and 151 acres in the Folly River. Benthic organisms within the tidal salt waters of the Folly River borrow area and offshore borrow sources dredged for construction and periodic nourishments would be lost. In a recent study of two offshore borrow areas located off of Folly Beach, total infauna density and number of species decreased, and species evenness increased immediately following dredging. Although some general biological measures (e.g., species diversity) showed evidence of minimal impact or recovery, the persistent change in faunal composition six and eight years later, combined with the persistent change in sediment composition from relatively clean sandy bottoms to muddy bottoms, indicates that benthic infauna had not recolonized to conditions observed before dredging in the borrow area or compared to the reference area (Crowe et al., 2016). However, recolonization by opportunistic species would be short-term and expected to begin soon after the dredging activity stops due to maintaining similar benthic sediment characteristics. This would be accomplished by leaving a 2-foot dredge buffer between beach quality material and non-beach quality material. Because of the opportunistic nature of the species that inhabit the soft- bottom benthic habitats, recovery would be expected to occur within 1–2 years, well within the 12-year nourishment cycle. Demersal fish may incur a slight risk due to entrainment by dredging activities.

Considering all proposed and existing dredged material placement and renourishment impacts throughout the ocean beaches of South Carolina, a significant portion of the shoreline may be impacted by beach placement activities in the foreseeable future, likely resulting in time and space crowded perturbations. However, recognizing the funding constraints to complete all authorized and/or permitted activities, the availability of dredging equipment, etc.; it is very unlikely that all of these proposed projects would ever be constructed at the same time.

Therefore, though time and space crowded perturbations are expected in the reasonably foreseeable future, assuming each project adheres to project related impact avoidance measures, it is likely that adjacent unimpacted and/or recovered portions of beach will be available to support dependent species and facilitate recovery of individual project sites to pre-project conditions. When combined with the impacts of other foreseeable projects, potential impacts to borrow sites or to beaches on which the material is placed would be minimal.

5.02.2. Estuarine and Surf Zone Fishes and Nekton

The surf zone along Folly Beach provides important fishery habitat on which some species are dependent. Several species of fish are commonly observed in the surf zone along the project area, many of which are of importance to the sport and commercial fisheries of the state. The most abundant nekton in these waters are the estuarine dependent species, which inhabit the estuary as larvae and the ocean as juveniles and adults. Important fishes in inshore waters include spot (*Leiostomus xanthurus*), Atlantic croaker (*Micropogon undulatus*), flounder

(*Paralichthys* sp.), spotted seatrout (*Cynoscion nebulous*), sheepshead (*Archosargus probatocephalus*), bluefish (*Pomatomus saltatrix*), kingfish (*Menticirrhus* sp.), black drum (*Pogonias cromis*), red drum (*Sciaenops ocellatus*), the Atlantic silverside (*Menidia menidia*), bay anchovy (*Anchoa mitchilli*), Florida pompano (*Trachinotus carolinus*), striped mullet (*Mugil cephalus*), rough silverside (*Membras martinica*), striped killifish (*Fundulus majalis*), striped anchovy (*Anchoa hepsetus*), permit (*Trachinotus goodei*), and planehead filefish (*Monacanthus hispidus*).

Spawning grounds for many marine fishes are believed to occur on the continental shelf with immigration to estuaries during the juvenile stage. The shelter provided by the marsh and creek systems serves as nursery habitat where young fish undergo rapid growth before returning to the offshore environment. Transport from offshore shelves to estuarine nursery habitats occurs in three stages: offshore spawning grounds to nearshore, nearshore to the locality of an inlet or estuary mouth, and from the mouth into the estuary (Boehlert and Mundy, 1988).

Oceanic nekton are active swimmers, not at the mercy of the currents, and are distributed in the relatively shallow oceanic zone. They are composed of three phyla-chordates, mollusks, and arthropods, with chordates (i.e., fish species) forming the largest portion.

As with the other resources of the marine environment, reasonably foreseeable future actions that involve dredging and beach placement may also result in similar impacts to estuarine and surf zone fishes and nekton as those described above.

Alternative 1 (No-Action): This alternative would have no effect on surf zone fishes, inlet, and oceanic nekton.

Alternative 3 (Recommended Plan): Beach placement and subsequent turbidity increases may have short-term effects on surf zone fishes and prey availability. However, the opportunistic behavior of the organisms within the dynamic surf zone environment enables them to adapt to short-term disturbances. Because of the adaptive ability of representative organisms in the area, such effects would be expected to be temporary and minor. Due to nekton's ability to avoid the disturbed areas, entrainment impacts are expected to be minor.

Dredging will result in increased turbidity in the borrow areas during and immediately following dredging. Any entrainment of adult fish, and other motile animals in the vicinity of the borrow areas during dredging would be expected to be minor because of their ability to actively avoid the disturbed areas. Fish species are expected to leave the area temporarily during the dredging operations and return when dredging ceases. Because of the adaptive ability of representative organisms in the estuarine and offshore areas, effects would be expected to be temporary and minor.

Although entrainment of benthic oriented organisms would be expected from the proposed dredging activities, dredge operations in the open ocean would pump such a small amount of water in proportion to the surrounding water volume that any entrainment effects associated with dredging of borrow material for the project are not expected to adversely affect species at the population level. Though entrainment rates during dredging are expected to be minor.

5.02.3. Hardbottoms

Hardbottoms are defined as localized areas not covered by unconsolidated sediments, where the ocean floor consists of hard substrate. In the South Atlantic Bight, such hardbottoms vary in relief from high (higher than 2.0 m (6.6 ft) to low (lower than 0.5 m (1.6 ft) profile and range nearshore (within the 3-nautical-mile territorial sea limit) to beyond the continental shelf edge (more than 200 m [656 ft] [Moser et al. 1995]). Hardbottoms are also considered "live-bottoms" because they support a rich diversity of invertebrates such as corals, anemones, and sponges, which are refuges and food sources for fish and other marine life. They provide valuable habitat for reef fish such as black sea bass, red porgy, and groupers. Hardbottoms are also attractive to pelagic species such as king mackerel, amberjack, and cobia. When substrate has been cleared or new structure is constructed, recolonization in these hardbottom areas is restored within about a year (Hay and Sutherland, 1988).

Between 1994 to 2019, geophysical surveys such as single-beam, multi-beam, and back scatter surveys as well as hundreds of vibracores have been collected from the Folly River and offshore Folly Beach. A more detailed analysis can be found in Appendix B, Geotech. Based on geophysical surveys completed to date, there is no suspected hardbottom habitat within the nearshore environment of Folly Beach or any of the borrow areas. However, if during PED (Preconstruction, Engineering and Design), any hardbottoms are identified, a buffer, that's coordinated with appropriate resource agencies will be implemented prior to removal of any material from the subject borrow site(s).

Alternative 1 (No-Action): This alternative would have no effect on hardbottoms.

Alternative 3 (Recommended Plan): There are no suspected hardbottom habitats within the nearshore or proposed borrow areas. If hardbottoms are identified during PED, they will be avoided (with ample buffer), therefore Alternative 3 will have no effect on hardbottoms.

5.02.4. Essential Fish Habitat

The 1996 Congressional amendments to the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) (PL 94-265) set forth new requirements for the National Marine Fisheries Service (NMFS), regional fishery management councils (FMC), and other federal agencies to identify and protect important marine and anadromous fish habitat. These amendments established procedures for the identification of Essential Fish Habitat (EFH) and a requirement for interagency coordination to further the conservation of federally managed fisheries.

EFH is defined in the Magnuson-Stevens Fishery Conservation and Management Act as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (16 U.S.C. 1802(10)." The definition for EFH may include habitat for an individual species or an assemblage of species, whichever is appropriate within each Fisheries Management Plan (FMP). Estuarine and inshore EFH within the vicinity of the project consists of the estuarine water column and wide expanses of estuarine emergent wetlands. Marine EFH within the vicinity of the project consists of the marine water column and the surf zone. EFH within the boundaries of the project reaches are listed in Table 5-1 below.

Table 5-1: **Essential Fish Habitat List and Study Area Occurrence**		
Habitat Type	**Habitat Name**	**Within Project Area**
Estuarine	Estuarine Emergent Wetland (tidal marsh)	Yes
Estuarine	Estuarine Scrub/shrub mangroves	No
Estuarine	Sea grass	No
Estuarine	Oyster reefs and shell banks	Yes
Estuarine	Intertidal flats	Yes
Estuarine	Palustrine emergent and forested wetland	No
Estuarine	Aquatic beds	No
Estuarine	Estuarine Water Column	Yes
Estuarine	Unconsolidated Bottom	Yes
Marine	Live/Hardbottoms	No
Marine	Coral and coral reefs	No
Marine	Artificial/manmade reefs	No
Marine	Sargassum	No
Marine	Marine water column	Yes
Marine	Surf zone	Yes

Table 5-1. Essential Fish Habitat List and Study Area Occurrence.

Estuarine emergent wetlands occur along much of the Southeastern coast where the twice-daily tides alternately flood and drain vast low-lying areas just inland from the ocean. South Carolina has about a half-million acres of estuarine emergent wetlands, more marsh than any other Atlantic coast state. Estuarine emergent wetlands provide highly productive nursery grounds for numerous commercially and recreationally important species and serve as filters to remove sediments and toxins from the water (http://dnr.sc.gov/).

Oysters are typically found in estuaries, sounds, bays, and tidal creeks from brackish water (5 parts per thousand [ppt] salinity) to full strength seawater (35 ppt salinity). Oysters are tolerant organisms, able to withstand wide variations in temperature, salinity, and concentrations of suspended sediments and dissolved oxygen. Throughout much of its range, the oyster occurs mostly in subtidal areas. But in South Carolina, almost all oysters live in the intertidal zone (http://score.dnr.sc.gov/). The Folly River borrow area is within Shellfish Growing Area 10A (Figure 5-3). The nearest Shellfish Harvest Boundary is S206W, located to the northeast outside of the borrow area (Figure 5-4).

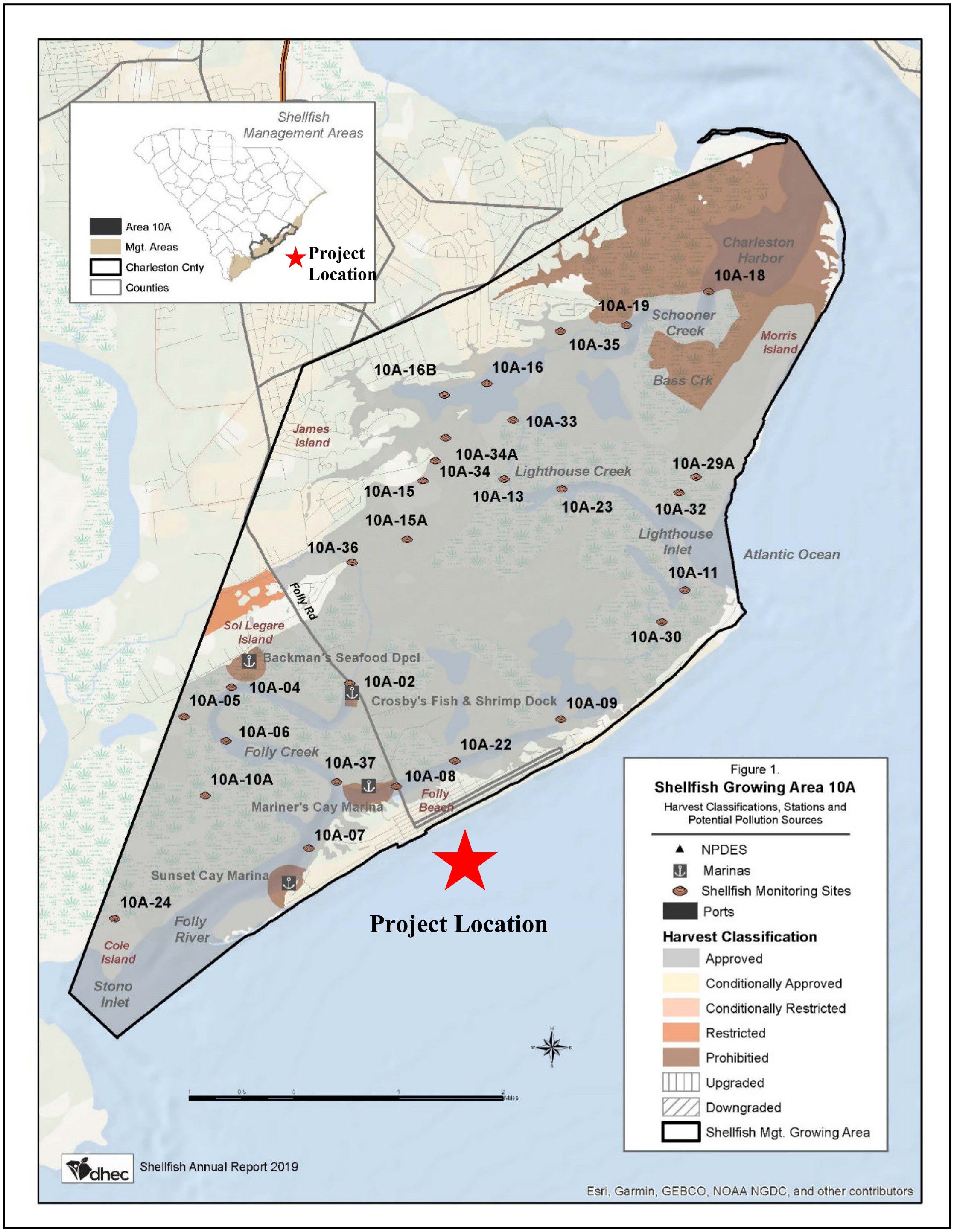

Figure 5-3. Shellfish Growing Area 10A

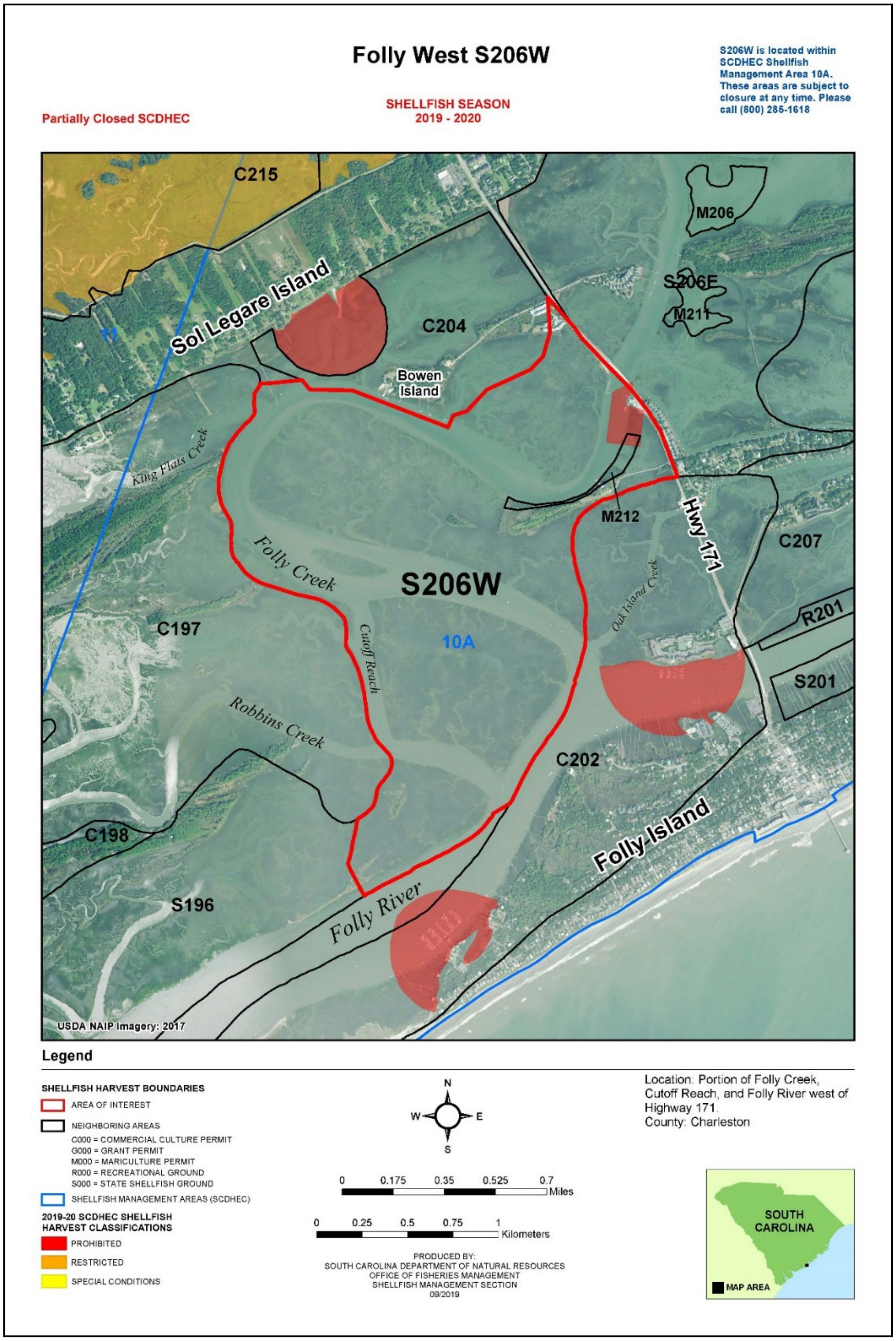

Figure 5-4. Folly West S206W Shellfish Harvest Boundary.

Intertidal flats are the unvegetated bottoms of estuaries and sounds that lie between the high and low tide lines. These flats occur along mainland or barrier island shorelines or can emerge in areas unconnected to dry land. Intertidal flats are most extensive where tidal range is greatest, such as near inlets and in the southern portion of the coast. Conditions on intertidal flats are physically stressful for associated marine organisms. Drastic fluctuations in salinity, water, and air temperature (in addition to air and wind exposure) occur during each tidal cycle (https://safmc.net/uncategorized/intertidal-flats-habitat/).

Habitat Areas of Particular Concern (HAPC), a subset of EFH, are habitat types and/or geographic areas identified by the eight regional fishery management councils and NOAA Fisheries as priorities for habitat conservation, management, and research. Table 5-2 shows the categories of HAPC for managed species that were identified in the FMP Amendments affecting the South Atlantic area.

Table 5-2: GEOGRAPHICALLY DEFINED HABITAT AREAS OF PARTICULAR CONCERN

Area – Wide

Council-designated Artificial Reef Special Management Zones

Hermatypic (reef-forming) Coral Habitat & Reefs

Hardbottoms

Hoyt Hills

Sargassum Habitat

State-designated Areas of Importance of Managed Species

Submerged Aquatic Vegetation

Coastal Inlets, the Throat of Inlets, and Associated Shoal Complexes

South Carolina

The Charleston Bump

Hurl Rocks

Georgetown Hole

Table 5-2. Lists the federally managed species that may occur in the project area for which Fishery Management Plans have been developed by the South Atlantic Fishery Management Council (SAFMC), and National Marine Fisheries Service (NMFS).

Table 5-3. Fishery Management Plans (FMPS) and Managed Species that may occur in project.

Species Category	Species Common Name	Species Scientific Name
Shrimp	Brown shrimp	*Farfantepenaeus aztecus*
	Pink shrimp	*Farfantepenaeus aduorarum*
	Rock shrimp	*Sicyonia brevirostris*
	Royal red shrimp	*Pleoticus robustus*
	White shrimp	*Litopenaeus setiferus*
Snapper Grouper Complex	Jack crevalle	*Caranx hippos*
	Gag grouper	*Mycteroperca microlepis*
	Black sea bass	*Centropristis striata*
	Mutton snapper	*Lutjanus analis*
	Red snapper	*Lutjanus campechanus*
	Lane snapper	*Lutjanus synagris*
	Gray snapper	*Lutjanus griseus*
	Yellowtail snapper	*Ocyurus chrysurus*
	Spadefish	*Chaetodipterus faber*
	White grunt	*Haemulon plumieri*
	Sheepshead	*Archosargus probatocephalus*
	Hogfish	*Lachnolaimus maximus*
Coastal Migratory Pelagics	King mackerel	*Scomberomorus cavalla*
	Spanish mackerel	*Scomberomorus maculatus*
	Cobia	*Rachycentron canadum*
Mid-Atlantic FMP species which occur in South Atlantic	Bluefish	*Pomatomus saltatrix*
	Summer flounder	*Paralichthys dentatus*
Highly Migratory Species (Managed by NMFS)	lemon shark	*Negaprion brevirostris*
	bull shark	*Carcharhinus leucas*
	blacknose shark	*Carcharhinus acronotus*
	finetooth shark	*Aprionodon isodon*
	dusky shark	*Carcharhinus obscurus*
	bonnethead shark	*Sphyrna tiburo*
	Atlantic sharpnose shark	*Rhizoprionodron terraenovae*

Shrimp

In the southeastern United States, the shrimp industry is based on the white shrimp (*Litopenaeus setiferus*), brown shrimp (*Farfantepenaeus aztecus*), pink shrimp (*Farfantepenaeus duorarum*), and the deeper water rock shrimp (*Sicyonia brevirostri*). The royal red shrimp (*Pleoticus robustus*) also occurs in deeper water and sustains a limited harvest (SAFMC, 2021). For the above species, coastal inlets have been classified as HAPC. Within the project area, this includes the estuarine and marine water columns within Stono Inlet and the Folly River. These areas are the connecting waterbodies between inshore estuarine nursery areas, offshore marine habitats used for spawning and growth to maturity. Essential Fish Habitat for rock shrimp and royal red shrimp occurs in deeper offshore waters beyond the offshore borrow areas (SAFMC, 2021).

Snapper Grouper Complex

The snapper grouper complex utilizes both pelagic and benthic habitats throughout their life

cycles. Larvae are free swimming within the water column. During this stage they commonly feed on zooplankton. Juveniles and adults are frequently bottom dwellers that associate with hard structures with moderate to high relief. The principal fishing areas are located in live bottom and shelf-edge habitats in deeper waters. Several patterns are present: (1) for many groupers, spawning occurs over one or two winter months, (2) spawning occurs at low levels year-round with peaks during the warmer months, and (3) the species tend to form sizable spawning aggregations, but this might not be the case with all species (SAFMC, 2021).
Ten families of fish containing 73 species are managed by the South Atlantic Fishery Management Council. There is variation in specific life history patterns and habitat use among the snapper grouper species complex. Snapper grouper species utilize both benthic and pelagic habitats during their life cycle. They live in the water column and feed on zooplankton during their planktonic larval stage, while juveniles and adults are demersal and usually associate with hard structures with high relief (SAFMC, 2021). EFH for these species in SC includes estuarine emergent wetlands, estuarine scrub/shrub wetlands, unconsolidated bottom, live/hard bottom, and oyster beds. Coastal inlets are considered Habitat Areas of Particular Concern, along with oyster beds. These areas are critical for spawning activity as well as feeding and daily movements.

Coastal Migratory Pelagics
King and Spanish mackerel and cobia are coastal migratory pelagic species managed by the SAFMC. EFH for these species include Stono Inlet. Many coastal pelagic prey species are estuarine-dependent in that they spend all or a portion of their lives in estuaries (SAFMC, 2021). Accordingly, the coastal pelagic species, by virtue of their food source, are to some degree also dependent upon estuaries and, therefore, can be expected to be detrimentally affected if the productive capabilities of estuaries are greatly degraded.

Mid-Atlantic FMP species which occur in South Atlantic
Bluefish and summer flounder are two species listed in the Mid-Atlantic Fisheries Management Plan that occur in the South Atlantic. Bluefish juveniles and adults are listed as using estuaries from North Carolina to Florida and are common around the project area.

Highly Migratory Pelagics
This category consists of Atlantic Bluefin Tuna, Atlantic Bigeye Tuna, Atlantic Yellowfin Tuna, Atlantic Albacore Tuna, Atlantic Skipjack Tuna, Swordfish, Blue Marlin, White Marlin, Sailfish, Longbill Spearfish, and Atlantic sharks. These species tend to occupy deep water and will not occur within the project area.

As with the other resources of the marine environment, reasonably foreseeable future actions that involve dredging and beach placement may also result in similar impacts to EFH as those described above.

Alternative 1 (No-Action): This alternative would result in no effects on EFH or HAPC.

Alternative 3 (Recommended Plan): Dredging of the Folly River would result in suspended sediment plumes, increased turbidity, and potentially cause deposition of suspended sediment on EFH resources resulting in minor, temporary, impacts (~180 days every 12 years) to the estuarine emergent wetlands, oyster reefs and shell banks, intertidal flats, estuarine water column and unconsolidated bottom. Dredging of the offshore borrow areas would have a minor, relatively short-term impact to the marine water column due to suspended sediment plumes and related turbidity. Placement of sediment on Folly Beach would have minor, short-term impacts to the surf zone

Elevated turbidity levels during the nourishment operation could be transported outside the immediate placement area via longshore and tidal currents. Turbidity associated with beach fill placement operations would most commonly extend west into Stono Inlet and the estuarine water column from longshore currents and tidal influx, however these effects are expected to be minor.

Entrainment of benthic oriented organisms would be expected from the proposed dredging activities, however dredge operations in the open ocean would pump such a small amount of water in proportion to the surrounding water volume that any entrainment effects associated with dredging of borrow material for the project are not expected to adversely affect species at the population level.

Although project impacts may directly affect life cycle requirements of managed species in the South Atlantic Region, this alternative would not be expected to cause any significant adverse impacts to EFH or HAPC for managed species identified in the Fisheries Management Plan Amendments affecting the South Atlantic Area. When combined with the impacts of other foreseeable projects, potential physical and biological impacts to EFH would be minimal.

Although, impacts to estuarine and surf zone fishes and nekton, benthic resources, hardbottoms and EFH slightly increase from the No Action Plan and the Recommended Plan, impacts of both alternatives are anticipated to be less than significant. Due to the widespread distribution of dredging and beach placement projects in region and the varied timing of existing and future foreseeable dredging and renourishment projects, the magnitude of the Folly Beach project as compared to the large expanse of undisturbed surf zone and ocean areas is so small and when combined with the impacts of other foreseeable projects, potential impacts to the marine environment would be minimal.

5.03 Wetlands and Floodplains

5.03.1. Wetlands

Executive Order 11990 directs all federal agencies to issue or amend existing procedures to ensure consideration of wetlands protection in decision making and to ensure the evaluation of the potential effects of any new construction proposed in a wetland. Wetlands are those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support a prevalence of vegetation typically adapted for life in saturated soil conditions (33 C.F.R. § 328.3). Wetlands possess three essential characteristics: hydrophytic vegetation, hydric soils, and wetland hydrology. Although abundant Estuarine Emergent Wetlands are found along the Folly River, no wetlands are found along the ocean shoreline of the project area. No fill will be placed in wetlands and no Section 404 jurisdictional wetlands (having the three essential characteristics) would be impacted by the proposed project. This project is in full compliance with EO 11990.

5.03.2. Floodplains

The 100-year floodplain is established by the Federal Emergency Management Agency (FEMA) and is identified on Federal Insurance Rate Maps. Base flood elevations for flood zones and velocity zones are also identified by FEMA, as are designated floodways. All portions of the project area are within the 100-year floodplain. Executive Order 11988 requires federal agencies to avoid to the extent possible the long and short-term adverse impacts associated with the occupancy and modification of flood plains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative. In accomplishing this objective, "[e]ach agency shall provide leadership and shall take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health, and welfare, and to restore and preserve the natural and beneficial values served by flood plains in carrying out its responsibilities…"

Any placement of material on the beach would occur within the 100-year floodplain and would therefore constitute an alteration of the floodplain, displacing the floodplain seaward. Placement of sediment on Folly Beach cannot be accomplished outside the floodplain.

Alternative 1 (No-Action): The No-Action Plan will result in no changes to wetlands or hydrology, but the continued erosion would cause permanent loss of land area in the floodplain.

Alternative 3 (Recommended Plan): The Recommended Plan will result in insignificant changes throughout the study area and therefore will not alter existing hydrology in the floodplain. The eight steps discussed in E.O. 11988 are addressed as follows:

1. Floodplain and/or wetland determination.
The project is within the 100-year floodplain. The proposed action will not adversely impact any floodplains or wetlands, upstream, within, or downstream of the project.

2. Public notification.
Public involvement began with scoping and will continue throughout the study process. This report will be provided to the public for comment. All comments received have been considered during development of the report and will be considered throughout the study process.

3. Identify and evaluate practicable alternatives to locating in the base flood plain.
The report discusses all practicable alternatives and illustrates the deliberative process by which the proposed action was selected. Since the project involves beach nourishment, there is no alternative outside the Floodplain.

4. Identify the impacts of the proposed action. Impacts of the Recommended Plan are fully discussed in the report and are compared side- by-side in the Environmental Quality System of Accounts analysis (Table 4-7).

5. Evaluate measures to reduce potential adverse impacts of the proposed action.

The Recommended Plan has evaluated potential measures to reduce adverse impacts. The report contains a thorough analysis of all positive and negative impacts and presents them in the Environmental Quality System of Accounts analysis (Table 4-7).

6. Re-evaluate the alternatives.
All alternatives were thoroughly evaluated and re-evaluated during the deliberative USACE planning process, and are presented in an evaluative, comparative, and screened process, in the report.

7. Make the final determination and present the decision.
The final determination and presentation of the Recommended Plan are contained in the report.

8. Implement the action.
Implementation of the Recommended Plan will result in no significant impacts to floodplains or wetlands. The existing hydrology of the floodplain will not be changed. The proposed project complies with Executive Orders 11990 and 11988.

5.04 Terrestrial Resources

Terrestrial beach and dune communities that may be impacted by proposed project actions occur along most of the Folly Beach shoreline. Terrestrial habitat types within the areas include sandy or sparsely vegetated beaches and dune communities. The first line of stable vegetation is outside or landward of the proposed project limits.

5.04.1. Vegetation

When compared to most upland communities, the beach and dune community in the project area could be considered lacking in species variety in both plants and animals. The environment on the beach is severe because of constant exposure to salt spray, shifting sands, wind, and sterile soils with low water retention capacity. Beach vegetation known from the area includes beach spurge (*Euphorbia polygonifolia*), sea rocket (*Cakile edentula*) and pennywort (*Hydrocotyle bonariensis*). The dunes along Folly Beach are more heavily vegetated with American beach grass (*Ammophila breviligulata*), panic grass (*Panicum amarum*), and sea oats (*Uniola paniculata*) being commonly observed.

The zones and some of their dominant plants, according to Godfrey and Godfrey (1976) are:

- Beaches--essentially devoid of vegetation except unicellular algae.
- Berms--created by a few plants such as sea oats growing in the driftline, which may build small dunes, depending on storm frequency.
- Tidal Flats--intertidal areas essentially unvegetated except for stands of salt marsh cordgrass; found at inlets.

- Dunes--Low scattered dunes formed by sea oats in overwash-influenced areas, and high densely vegetated dune fields where vines such as Virginia creeper may be found on the back side.
- Open Grasslands--sparsely vegetated by salt meadow cordgrass and pennywort, both of which grow up through sand after burial in overwash.
- Closed Grasslands--greater cover of pennywort, broomsedge, and hairgrass; Also, species of rush where water stands. Salt meadow cordgrass, closer to the water table.
- Woodlands--shrub thickets of wax myrtle, silverling, or of yaupon and live oak; maritime Virginia red cedar, and American holly. Both protected lands. Marsh elder, and forests of live oak, are on higher ground.
- High Salt Marshes--dominated by black needlerush and salt meadow cordgrass; flooded by spring and storm tides.
- Low Salt Marshes--dominated by salt marsh cordgrass and is flooded at mean high tide.
- Subtidal Marine Vegetation--extensive stands of eelgrass and widgeon grass in protected, shallow waters.

Alternative 1 (No-Action): Long-term erosion is expected to destroy habitat for beach vegetation over time.

Alternative 3 (Recommended Plan): If the dune is under the design template height of 15 ft NAVD88 or if the dredging contractor damages the dune during construction or a periodic nourishment event, stabilization will be accomplished by planting vegetation during the optimum planting season following dune construction. Dune stabilization would be accomplished by planting vegetation on the dune during the optimum planting seasons for the particular plants. Representative native planting stocks may include sea oats (*Uniola paniculata*), American beachgrass (*Ammophila breviligulata*), and panic grass (*Panicum amarum*). The vegetative cover would extend from the landward toe of the dune to the seaward intersection with the storm berm for the length of the dune. Sea oats would be the predominant plant with American beach grass and panic grass as a supplemental plant. Overall, minimal impacts to dune vegetation would be expected to occur due to replanting and placing material away from the vegetation along the berm.

The beaches where the material is placed support a variety of vegetation. Although some vegetation may be destroyed during construction or nourishment, the long-term increase in beach habitat would result in a benefit to the same species. The degree of impact would increase proportionally with the total length of beach impacted. Considering all proposed and existing navigation placement and renourishment impacts throughout the ocean beaches of South Carolina, a significant portion of the shoreline may experience beach placement activities in the foreseeable future. Potential impacts to beaches on which the material is placed are likely to result in temporary significant adverse impacts to various vegetation species; however, long- term, the increase in beach habitat would be beneficial to beach vegetation.

5.04.2. Wildlife

Examples of mammals occurring in the project area are opossums, red foxes, gray foxes, raccoons, feral cats, shrews, moles, voles, and house mice. Reptile and amphibian species include southern leopard frog, green tree frog, black rat snake, anole, glass lizard, diamondback terrapin turtle, yellow-bellied slider turtle, and American alligator.

Species of shorebird commonly observed are the American oystercatcher (*Haematopus palliatus*), plovers (*Charadrius* sp.), willet (*Catoptrophorus semipalmatus*), sandpipers (*Scolopacidae* sp.), lesser/greater yellow-legs (*Tringa flavipes*/*T. melanoleuca*), and gulls/terns (*Laridae* sp.). Shorebirds typically feed by foraging for invertebrates in mud flats and sandy beaches. Plovers are medium sized birds with short, thick bills. They run to feed on vulnerable invertebrates. Avocets are larger shorebirds with long recurved bills that feed by using both tactile and visual methods. Foraging activity is usually focused around periods of low tide, where they feed in the intertidal zone. During high tides, shorebirds roost in flocks on the high beach, marsh, and sometimes on docks.

Seabirds that frequent the South Carolina coast and are present in the project area are the Sandwich Tern (*Thalasseus sandvicensis*), Least Tern (*Sterna albigrons*), Royal Tern (*Thalasseus maximus*), Common Tern (*Sterna hirundo*), Eastern Brown Pelican (*Pelecanus occidentalis*), Forster's Tern (*Sterna forsteri*), Gull-billed Tern (*Gelochelidon nilotica*), Black Skimmer (*Rynchops nigra*), Willet (*Cataoptrophorus semipalmatus*), and Wilson's Plover (*Charadrius wilsonia*). All of the birds are subject to loss of suitable nesting habitat. Seabirds usually nest on isolated coastal islands that are high enough to prevent over-washing, yet small enough to not support mammalian predators. They are piscivorous (eats primarily fish) and feed in nearshore and estuarine waters. During the nesting season, foraging occurs within 10 to 15 miles of their nesting sites.

The dunes of the project area support fewer numbers of birds but can be very important habitats for resident species and for other species of songbirds during periods of migration. Other birds occurring in the area are mourning doves, swallows, starlings, meadowlarks, redwinged blackbirds, boat tailed grackles, and savannah sparrows.

The reasonably foreseeable future actions, including other existing and future federal and non-federal beach renourishment projects and federal navigation dredging with beach placement, may also affect the same wildlife resources as those described above.

Alternative 1 (No-Action): Beach erosion would result in the loss of roosting, foraging, breeding, and nesting habitat for mammals, reptiles, amphibians, and birds.

Alternative 3 (Recommended Plan): Construction and periodic nourishments would not be expected to have an adverse effect on wildlife present along the beach. However, short-term transient effects could occur to mammalian species using the dune and fore-dune habitat, but those species are mobile and would be expected to move to other, undisturbed areas of habitat during the construction and periodic nourishment events.

Although the project area is heavily developed and sustains heavy recreational use, migratory shorebirds could still use the project area for foraging and roosting habitat. Bulldozers would be used to construct seaward shore-parallel dikes to contain the material on the beach, and to shape the beach to the appropriate nourishment cross-section template. Beach nourishment activities could temporarily affect the roosting and intertidal macro-fauna foraging habitat, however, recovery often occurs within one to two years due to the fact that material is compatible with existing beach sediment. Birds that use the inlet as feeding grounds would be temporarily impacted during dredging activities but would be expected to return following dredging.

Birds that use the borrow areas as feeding grounds may be temporarily impacted during dredging activities but would quickly return when the dredge leaves. This alternative would not be expected to significantly affect breeding and nesting shorebirds or colonial waterbirds in the project area.

Executive Order 13186 directs departments and agencies to take certain actions to further implement the Migratory Bird Treaty Act. Specifically, the executive order directs federal agencies, whose direct activities would likely result in the take of migratory birds, to develop and implement a Memorandum of Understanding (MOU) with the USFWS that must promote the conservation of bird populations. The proposed project is not expected to adversely affect migratory birds and therefore, is in compliance with Executive Order 13186.

The reasonably foreseeable future actions, including other existing and future federal and non-federal beach renourishment projects and federal navigation dredging with beach placement, may also affect the same wildlife species as those described above, but impacts should be minimal and temporary.

5.05 Threatened and Endangered Species

The Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531–1543), provides a program for the conservation of threatened and endangered (T&E) plants and animals and the habitats in which they are found. The lead federal agencies for implementing the ESA are the USFWS (http://www.fws.gov/) and the NOAA Fisheries Service (http://www.nmfs.noaa.gov/). In accordance with Section 7 (a)(2) of the ESA, USACE and has been in consultation with the USFWS and NMFS since beginning this study.

Formal consultation was completed for the recent nourishment of the current Folly Beach Coastal Storm Risk Management Project upon issuance of the USFWS Biological Opinion (BiOp) dated July 11, 2018. USFWS has agreed that this Biological Opinion is sufficient for the Recommended Plan. However, USFWS has requested consultation be reevaluated prior to initial construction to ensure an up-to-date BiOp reflecting updated conditions. The USFWS request was based on the upcoming critical habitat designation for red knots and updated information on construction details. The USACE will accomplish all future work in accordance with the 2020 NMFS South Atlantic Regional Biological Opinion (SARBO) for dredging and material placement activities in the Southeast United States utilizing the appropriate project design criteria. There are two conservation recommendations included in the USFWS BiOp.

For the first recommendation, the City of Folly Beach will continue to address placement of life history explanations of beach dependent species as practicable. For the second recommendation, the USACE will not commit to performing piping plover or red knot surveys on Folly Beah due to funding availability. If funding is made available, consideration will be made to accomplish this recommendation when practicable.

Updated lists of threatened and endangered (T&E) species for the project area were obtained from NMFS (Southeast Regional Office, St. Petersburg, FL) and the USFWS (South Carolina Ecological Services Field Office, Charleston, SC) (Appendix I). These were combined to develop the composite list shown in Table 5-4, which includes T&E species that could be present in the area based on their historical occurrence or potential geographic range. However, the actual occurrence of a species in the area depends on the availability of suitable habitat, the season of the year relative to a species' temperature tolerance, migratory habits, and other factors.

Table 5-4: U.S. FISH &WILDLIFE SERVICE AND NOAA FISHERIES THREATENED AND ENDANGERED SPECIES IN CHARLESTON COUNTY

CATEGORY	COMMON NAME	SCIENTIFIC NAME	STATUS
Amphibians	Frosted flatwoods salamander	*Ambystoma cingulatum*	T, CH
Birds	American Wood stork	*Mycteria americana*	T
	Bachman's warbler	*Vermivora bachmanii*	E
	Piping plover	*Charadrius melodus*	T, CH
	Red-cockaded woodpecker	*Picoides borealis*	E
	Red knot	*Calidris canutus rufa*	T
Fishes	Atlantic Sturgeon*	*Acipenser oxyrinchus*	E
	Oceanic whitetip shark*	*Carcharhinus longimanus*	T
	Giant manta ray*	*Manta birostris*	T
	Shortnose sturgeon*	*Acipenser brevirostrum*	E
Mammals	Blue Whale*	Balaenoptera musculus	E
	Fin whale*	*Balaenoptera physalus*	
	Northern long-eared bat	*Myotis septentrionalis*	T
	North Atlantic right whale*	*Balaena glacialis*	E, CH
	Sei whale*	*Balaenoptera borealis*	E
	Sperm whale*	*Physeter macrocephalus*	E
	West Indian manatee	*Trichechus manatus*	T
Plants	American chaffseed	*Schwalbea americana*	E
	Canby's dropwort	*Oxypolis canbyi*	E
	Pondberry	*Lindera melissifolia*	E
	Seabeach amaranth	*Amaranthus pumilus*	T
Reptiles	Green sea turtle**	*Chelonia mydas*	T
	Kemp's ridley sea turtle**	*Lepidochelys kempii*	E
	Hawksbill sea turtle**	*Eretmochelys imbricata*	E
	Leatherback sea turtle**	*Dermochelys coriacea*	E

	Loggerhead sea turtle**	*Caretta*	T, CH,

NOTES:

* NOAA Fisheries has jurisdiction of this species
** Jurisdiction of this species is shared by the U.S. Fish and Wildlife Service (FWS) and NOAA Fisheries

E - Federally Endangered T - Federally Threatened CH - Critical Habitat P – Proposed for Listing

Table 5-4. U.S. Fish and Wildlife Service and NOAA Fisheries Threatened and Endangered Species in Charleston County.

The following T&E species and their habitat were not found in the project area and therefore the project would have no effect:

- Frosted flatwoods salamander
- American Wood stork
- Bachman's warbler
- Eastern black rail
- Red-cockaded woodpecker
- Oceanic whitetip shark
- Giant manta ray
- Northern long-eared bat
- American chaffseed
- Canby's dropwort
- Pondberry

The reasonably foreseeable future actions, including other existing and future federal and non-federal beach renourishment projects and federal navigation dredging with beach placement, may also affect the same threatened and endangered species as those described below.

5.05.1. Large Whales

Figure 5-5. Example of a North Atlantic Right Whale (Photo Credit: www.fisheries.noaa.gov/species/north-atlantic-right-whale).

This discussion covers the following whale species: Blue Whale, Fin Whale, North Atlantic Right Whale (NARW) (Figure 5-5), Sei Whale, and Sperm Whale. These whale species all occur infrequently in the ocean off the coast of South Carolina. Of these, only the NARW routinely comes close enough inshore to encounter the project area.

The NARW continues to be one of the most critically endangered populations of large whales in the world as revealed by the most recent review of the photo-ID recapture database in 2009 indicating that, at a minimum, 361 individually recognized whales in the catalog were known to be alive during 2005 (NMFS, 2010a). There are 6 major habitats or congregation areas for the western NARW; these are the coastal waters of the southeastern United States, the Great South Channel, Georges Bank/Gulf of Maine, Cape Cod and Massachusetts Bays, the Bay of Fundy, and the Scotian Shelf. However, the frequency with which NARWs occur in offshore waters in the southeastern U.S. remains unclear. While it usually winters in the waters between Georgia and Florida, the NARW can, on occasion, be found in the waters off South Carolina. The occurrence of NARWs in the State's waters is usually associated with spring or fall migrations.

When defining critical habitat for right whales, the NMFS considered the physical and/or biological features of foraging and calving habitats. The physical and biological features of right whale calving habitat that are essential to the conservation of the North Atlantic right whale are: (1) Calm sea surface conditions of Force 4 or less on the Beaufort Wind Scale; (2) sea surface temperatures from a minimum of 7 °C, and never more than 17 °C; and (3) water depths of 6 to 28 meters, where these features simultaneously co-occur over contiguous areas of at least 231 nm^2 of ocean waters during the months of November through April. When these features are available, they are selected by right whale cows and calves in dynamic combinations that are suitable for calving, nursing, and rearing, and which vary, within the ranges specified, depending on factors such as weather and age of the calves.

NMFS's critical habitat for NARW off the southeast US coast contains the essential features for calving right whales (Figure 5-6). This area comprises waters of Brunswick County, North Carolina; Horry, Georgetown, Charleston, Colleton, Beaufort, and Jasper Counties, South Carolina; Chatham, Bryan, Liberty, McIntosh, Glynn, and Camden Counties, Georgia; and Nassau, Duval, St. John's, Flagler, Volusia, and Brevard Counties, Florida. Of the six species of whales that may occur off the coast of South Carolina, only the NARW would normally be expected to occur within the project area.

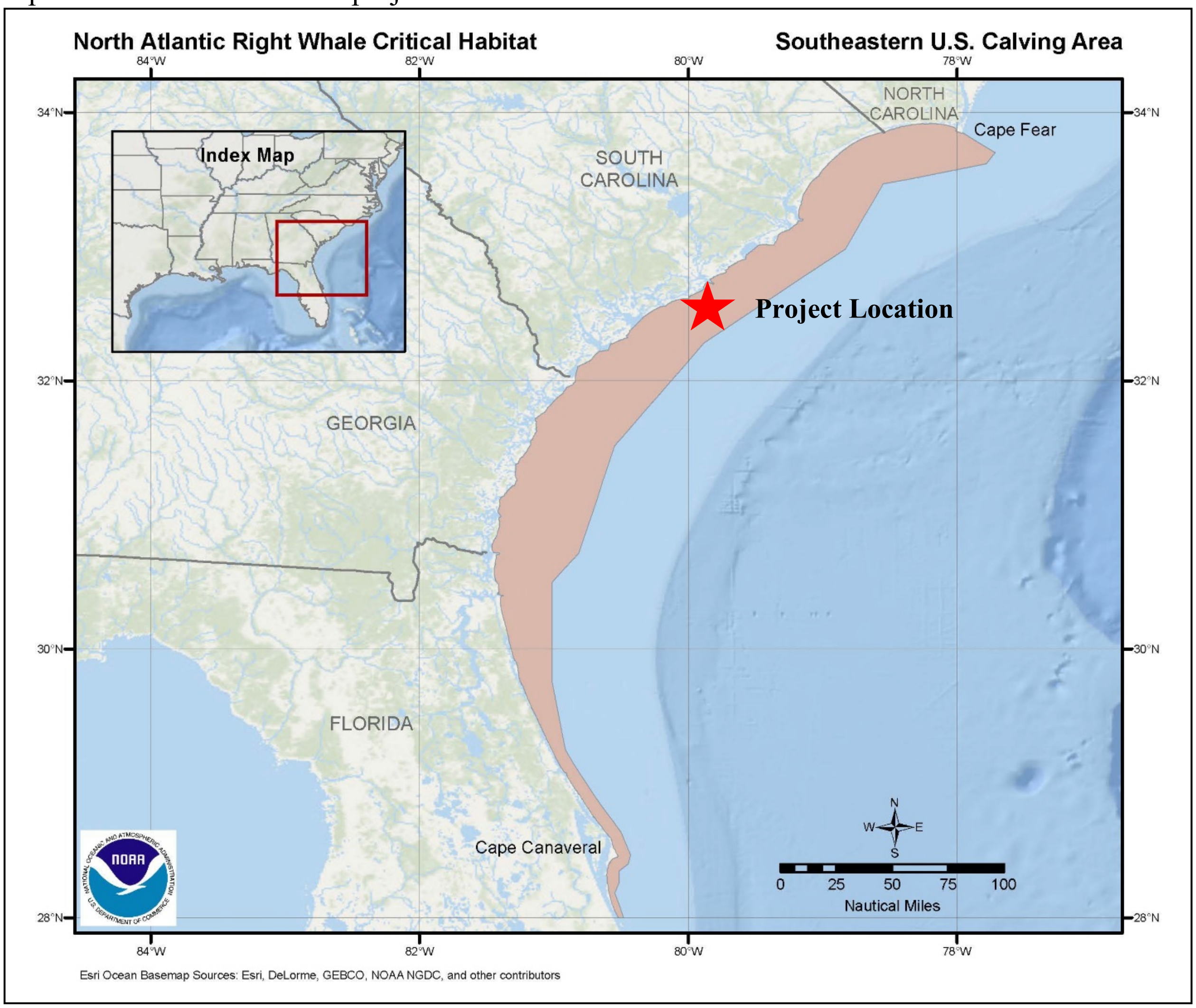

Figure 5-6. North Atlantic Right Whale Critical Habitat

Alternative 1 (No-Action): This alternative would have no effect on the six species of whales potentially in the project area.

Alternative 3 (Recommended Plan): Entanglement in fishing gear and vessel strikes are the leading causes of North Atlantic right whale mortality. Of the five species of whales described above, only the NARW would normally be expected to occur within the project area.

Increasing ocean noise levels from human activities are also a concern since the noise may interfere with right whale communication and increase their stress levels. On the basis of the ability of marine mammals to move away from the immediate noise source, noise generated by dredging activities would not be expected to affect the migration, nursing/breeding, feeding/sheltering or communication of large whales. Although behavioral effects are possible (i.e., a whale changing course to move away from a vessel), the number and frequency of vessels present in a given project area would be small, and any behavioral impacts would be expected to be minor. More information regarding dredging noise can be found in Section 5.10.

The 2020 South Atlantic Regional Biological Opinion requires a risk-based assessment to determine the best time of year for beach nourishment and maintenance dredging actions. The SARBO risk-based adaptive project-management process involves the consideration of institutional knowledge of particular project sites, the potential effects to ESA-listed species and designated critical habitat, and the use of any current or new best available information. Annually, project specific issues will be discussed, and any associated minimization measures will be considered to reduce take.

Although each dredging and placement event will require approximately 180 days and may be done any time of the year, conditions outlined in the 2020 SARBO (or any future superseding NMFS biological opinion) will be implemented as a component of this project. These conditions include implementing the North Atlantic right whale Conservation Plan during the North Atlantic right whale migration and calving season from November 1 through April 30. The NARW conservation plan which requires the collection of additional data about the presence of the NARW off of North Carolina and South Carolina waters encourages the timing of projects to be such to minimize the potential interaction with these critically endangered whales (e.g., ship strikes). Other conservation measures agreed upon by USACE and NMFS and included in the NARW conservation plan, include the presence of trained Protected Species Observers onboard vessels, speed restrictions (<10 knots), and established right whale early warning system participation that includes aerial survey species tracking. In addition, USACE is funding daily aerial surveys (weather permitting) for NARW off the coasts of North Carolina and South Carolina during the months of mid-November to mid-April. These surveys are performed yearly. Project Design Criteria (PDCs) covered under the SARBO are the specific criteria indicating how an individual project must be sited, constructed, or otherwise carried out. PDCs avoid or minimize adverse effects to ESA-listed species and designated critical habitat. The North Atlantic Right Whale Conservation Plan complies with USACE Environmental Operating Principles, Civil Works Ecosystem Restoration Policy (ER 1165-2-501), and supports the conservation intent of the Marine Mammal Protection Act (16 U.S. Code Chapter 31). With adoption of the protection measures above, this alternative may affect, not likely to adversely affect the NARW.

There is NARW critical habitat in the project area. Conditions outlined in previous consultations (or any future superseding NMFS biological opinion) will be implemented as a component of this project. Based on the implementation of these conditions, the proposed project may affect, but not likely to adversely affect the NARW critical habitat.

5.05.2. West Indian Manatee

Figure 5-7. Example of a West Indian Manatee: (Photo Credit: www.ecos.fws.gov/ecp0/profile/speciesProfile?sId=4469).

Manatees are a sub-tropical species with little tolerance for cold. Though they are generally restricted to warm inland and coastal waters of Florida, in warmer months they may be found throughout the United States. South Carolina is one location along the Southeast coast where the manatee is an occasional summer resident. The species can be found in shallow (5 ft to usually <20 ft), slow-moving rivers, estuaries, saltwater bays, canals, and coastal areas. The West Indian manatee (Figure 5-7) is herbivorous and eats aquatic plants such as hydrilla, eelgrass, and water lettuce. Manatees are thermally stressed at water temperatures below 18ºC (64.4ºF); therefore, during winter months, when ambient water temperatures approach 20ºC (68ºF), the U.S. manatee population confines itself to the coastal waters of the southern half of peninsular Florida and to springs and warm water outfalls as far north as southeast Georgia. The species is considered a seasonal inhabitant of South Carolina with most occurrences reported from June through October.

Alternative 1 (No-Action): This alternative would have no effect on manatees.

Alternative 3 (Recommended Plan): Guidelines for Avoiding Impacts to the West Indian Manatee (USFWS, 2017) precautionary measures will be implemented for transiting vessels associated with the project. The habitat and food supply of the manatee will not be significantly impacted. Therefore, this alternative may affect, but not likely to adversely affect the manatee.

5.05.3. Sea Turtles

Figure 5-8. Example of a Green Turtle (Photo Credit: https://www.fisheries.noaa.gov/species/green-turtle).

All five species of sea turtles (Table 5-4) identified above are known to occur in both the estuarine and oceanic waters of South Carolina. Loggerhead, green, and Kemp's Ridley sea turtles are known to frequently use coastal waters offshore of South Carolina as migratory travel corridors.

Of the five species of sea turtles potentially occurring in the project area, only the loggerhead sea turtle, green sea turtle, leatherback sea turtle, and Kemp's Ridley sea turtle nest on South Carolina beaches, with over 99 % of the nests being loggerhead nests. The number of green, leatherback, and Kemp's Ridley sea turtle nests is less than 0.5 % of the total. Table 5-5 shows the total number of recorded sea turtle nests in South Carolina as a whole and on Folly Beach from 2010 to 2019. A total of 776 nests have been laid within the project area since 2010, which is an average of 77.6 nests per year. The beachfront of Folly Beach consists of approximately six linear miles of available nesting habitat. The USACE will comply with SARBO which states, "…all work, including equipment, staging areas, and placement of materials, will be done in a manner that does not block access of ESA-listed species from moving around or past construction. Sand placed on the beach or in the nearshore littoral areas will be placed in a manner that does not create mounds or berms that could prevent nesting sea turtles or hatchings from entering or exiting the beach from nearshore waters. All placement, will not create an obstruction of species movement in the area (e.g., does not create a mound that would deter or prevent species from moving through the area)." The USACE will also comply with all terms and conditions of the 2018 USFWS BiOp or any superseding BiOp issued prior to initial construction and of each nourishment event. These conditions include morning sea turtle nest monitoring, nighttime monitoring of the construction area for sea turtles, limiting the amount of beach lighting to prevent disorientation of nesting sea turtles and hatchlings and compaction testing of placed sand and tilling as necessary.

Critical Habitat: The NMFS identified physical biological features (PBF)s of habitat essential for the conservation of the loggerhead sea turtle, the Primary Constituent Elements (PCE)s that support the PBFs, and the specific areas identified using these PBFs and PCEs. A description of the means used to identify PBFs, PCEs and specific areas can be found in the proposed rule (78 FR 18000, March 25, 2013).

Of the five categories of NMFS habitat identified in Loggerhead critical habitat, only Nearshore Reproductive Habitat is in the project area (Figure 5-9). Nearshore Reproductive Habitat is described as the PBFs of nearshore reproductive habitat as a portion of the nearshore waters adjacent to nesting beaches that are used by hatchlings to egress to the open-water environment as well as by nesting females to transit between beach and open water during the nesting season.

The USFWS designated areas in terrestrial environment as critical habitat for the Northwest Atlantic Ocean Distinct Population Segment (DPS) of the loggerhead sea turtle (Figure 5-10). This critical habitat is defined as the specific areas within the geographical area occupied by the species on which are found those physical or biological features essential to conservation of the species and which may require special management considerations or protection and specific areas outside the geographical area determined to be essential for the conservation of the species. Recovery Unit LOGG-T-SC-09 consists of the entire shoreline of Folly Beach from Stono Inlet in the south to Lighthouse Inlet in the north.

Table 5-5 Sea Turtle Nests in South Carolina and on Folly Beach (2010-2019)		
Year	**Number of Nests in South Carolina**	**Number of Nests on Folly Beach**
2010	3150 (3141 loggerhead, 6 green, 3 leatherback)	54 (53 loggerhead, 1 leatherback)
2011	4021 (4014 loggerhead, 3 green, 4 leatherback)	82 (all loggerhead)
2012	4619 (4611 loggerhead, 7 green, 1 leatherback)	74 (all loggerhead)
2013	5195 (5190 loggerhead, 5 green)	108 (all loggerhead)
2014	2080 (2070 loggerhead, 8 green, 2 leatherback)	22 (all loggerhead)
2015	5093 (5088 loggerhead, 2 green, 2 leatherback, 2 Kemp's ridley)	98 (all loggerhead)
2016	6435 (all loggerhead)	88 (all loggerhead)
2017	5250 (5232 loggerhead, 18 green)	71 (all loggerhead)
2018	2765 (2761 loggerhead, 1 green, 3 leatherback)	34 (all loggerhead)
2019	8799 (8778 loggerhead, 20 green, 1 Kemp's ridley)	145 (all loggerhead)

Table 5-5. Sea Turtle Nests in South Carolina and on Folly Beach (2010 to 2019).

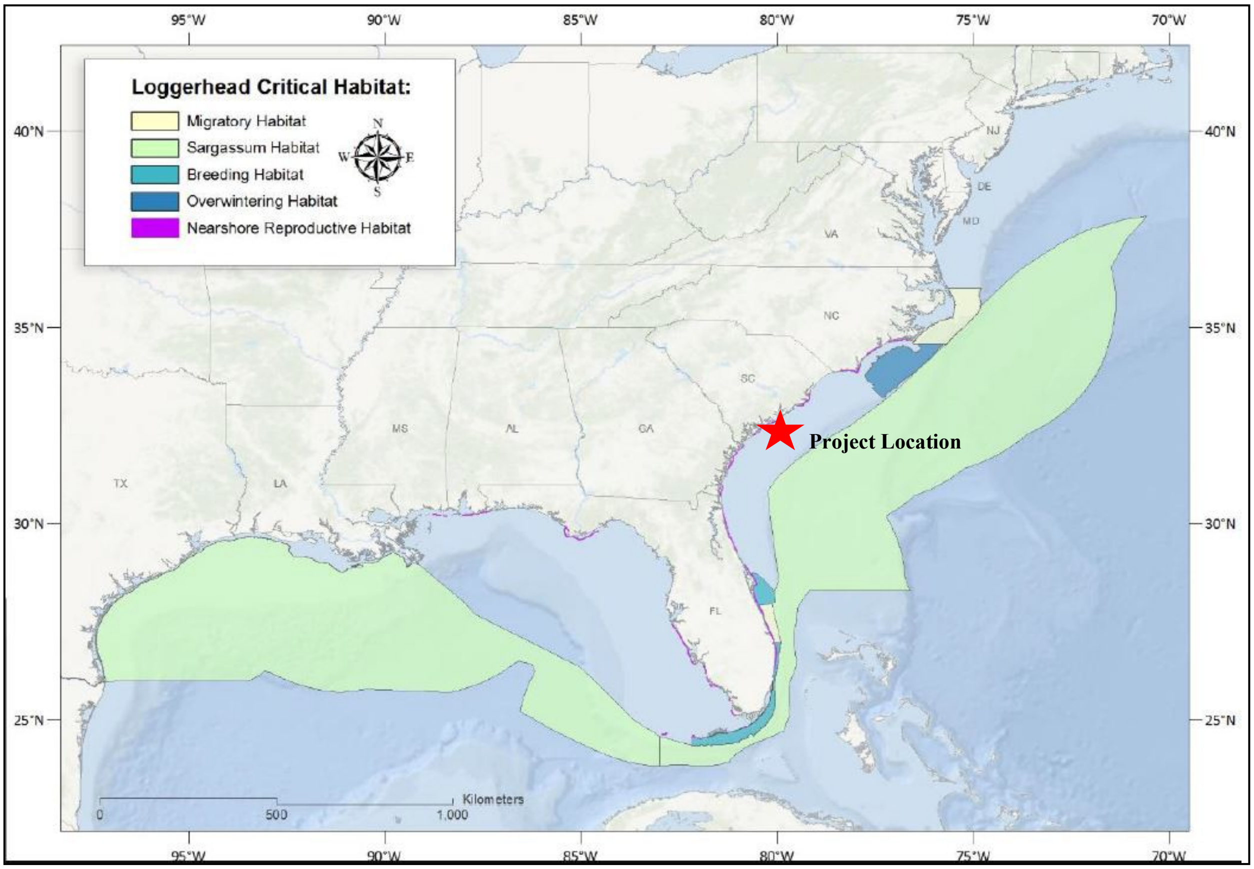

Figure 5-9**. NMFS Loggerhead Critical Habitat**

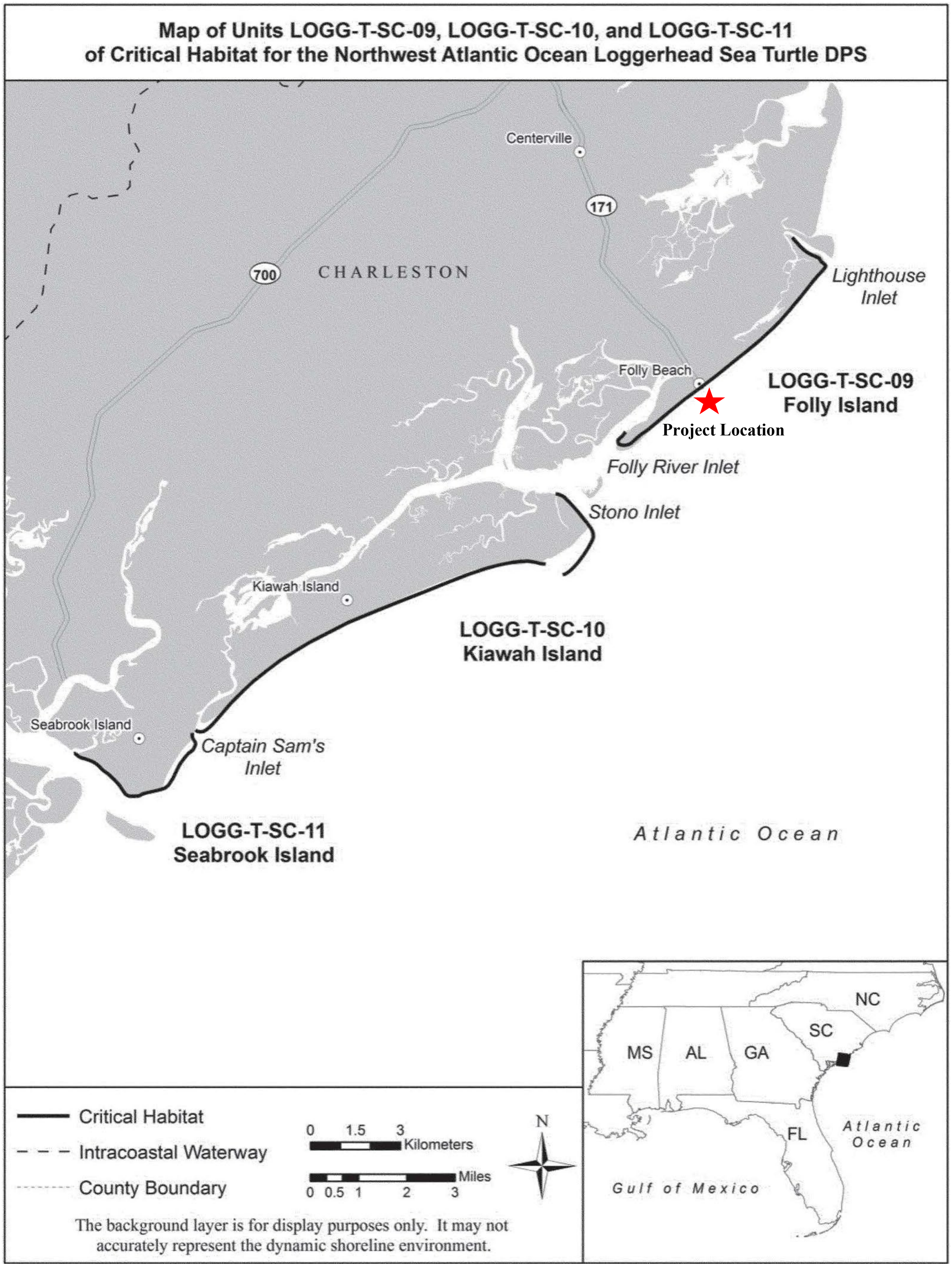

Figure 5-10. USFWS Loggerhead Critical Habitat

Alternative 1 (No-Action): This alternative would have no effect to sea turtles as a result of dredging; however, this alternative would result in the long-term reduction of available nesting habitat due to erosion and therefore may affect, likely to adversely affect sea turtles.

Alternative 3 (Recommended Plan): Each dredging and placement event will require approximately 180 days and work may take place any time of the year. The project will be constructed using the risk-based approach of the SARBO that weighs the effects to turtles with the effects to other species to determine the timing of the project. Dredging in accordance with the SARBO and adherence to the USFWS BiOp terms and conditions is not expected to appreciably reduce the likelihood of survival or recovery of these species in the wild. Therefore, the proposed action is not likely to jeopardize the continued existence of sea turtles.

The proposed project could potentially affect sea turtles both directly and indirectly during beach placement in the following ways: (1) The pipeline route running parallel to the shoreline may impede nesting sea turtles from accessing suitable nesting sites, (2) The operation of heavy equipment on the beach may impact nesting females and incubating nests, (3) Associated lighting impacts from the nighttime operations and the increased beach profile elevation may deter nesting females from coming ashore and may disorient emerging hatchlings, (4) Burial of existing nests may occur if missed by monitoring efforts, (5) Escarpment formations could result in impediments to nesting females as well as potential losses to the beach equilibration process, (6) Relocation efforts could reduce nest success rates, and (7) Sediment density (compaction), shear resistance (hardness), sediment moisture content, beach slope, sediment color, sediment grain size, sediment grain shape, and sediment grain mineral content may be altered, potentially affecting the nesting and incubating environment.

During dredging sea turtles may be lethally entrained in the hopper dredge dragheads if a hopper dredge was used. However, conditions outlined in the 2020 SARBO (or any future superseding NMFS biological opinion) will be implemented as a component of this project to reduce entrainment. Some of the conditions in the SARBO include utilizing draghead deflectors, adherence to the risk-based assessment process and monitoring of inflow screening, overflow screening, and dragheads by protected species observers (PSO). Although listed sea turtle species may be taken, as discussed further in the 2020 SARBO, no species will be jeopardized and there will be minimal if any detectable change on population numbers regardless of the time of year dredged. Therefore, take of green, Kemp's ridley, and loggerhead sea turtles may occur, and therefore the proposed project then may affect likely to adversely affect those sea turtles at the dredging location as analyzed in further detail under the 2020 SARBO with NMFS. The proposed project may affect, but not likely to adversely affect leatherback and hawksbill sea turtles.

<u>Loggerhead Critical Habitat –</u> The proposed project will have no effect to the NMFS critical habitat for the threatened loggerhead sea turtle.

There are inherent changes in beach characteristics as a result of mechanically placing sediment on a beach from alternate sources. The change in beach characteristics often results in short-term decreases in nest success and/or alterations in nesting processes. Based on post-nourishment monitoring, in most cases, nesting success decreases during the year following nourishment as a result of escarpments obstructing beach accessibility, altered beach profiles, and increased compaction of sand. However, when done properly, beach nourishment projects may mitigate the loss of nesting beach when the alternative is severely degraded or non-existent habitat. Though significant alterations in beach substrate properties may occur with the input of sediment types from other sources, re-establishment of a berm and dune system with a gradual slope can enhance nesting success of sea turtles by expanding the available nesting habitat beyond erosion and inundation prone areas. Therefore, the proposed project may affect, likely to adversely affect the USFWS Northwest Atlantic Ocean Loggerhead DPS critical habitat.

5.05.4. Sturgeon

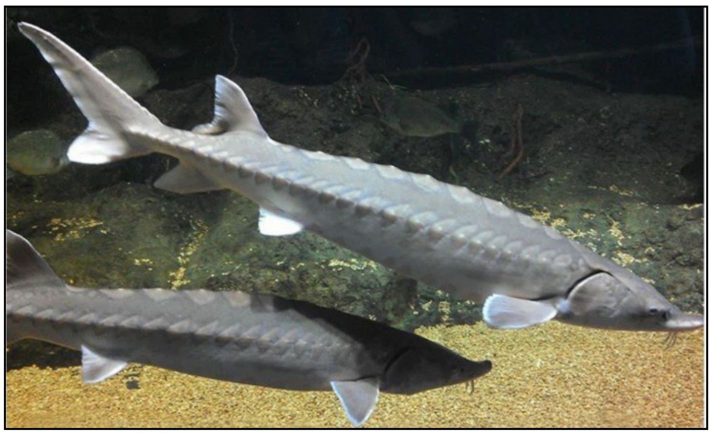

Figure 5-11. Example of an Atlantic Sturgeon.

Shortnose Sturgeon - Populations of shortnose sturgeon range along the Atlantic seaboard from the Saint John River in New Brunswick, Canada, to the Saint Johns River, Florida. This species may have once been abundant throughout South Carolina's waters; however, many of these early records are unreliable due to confusion between this species and the Atlantic sturgeon (*Acipenser oxyrhynchus*). The shortnose sturgeon is principally a riverine species and is known to use three distinct portions of river systems: (1) non-tidal freshwater areas for spawning and occasional over wintering; (2) tidal areas in the vicinity of the fresh/saltwater mixing zone, year-round as juveniles and during the summer months as adults; and (3) high salinity estuarine areas (15 parts per thousand (ppt.) salinity or greater) as adults during the winter. It is not likely that shortnose sturgeon would be present in the Folly River, Stono Inlet, the beach area or the offshore borrow areas due to the historic lack of siting.

Atlantic Sturgeon - The general life history pattern of Atlantic sturgeon (Figure 5-11) is that of a long lived, late maturing, estuarine dependent, anadromous species. The species' historic range included major estuarine and riverine systems that spanned from Hamilton Inlet on the coast of Labrador to the Saint Johns River in Florida. Atlantic sturgeon spawn in freshwater, they spend most of their adult life in the marine environment. Spawning adults generally migrate upriver in the spring/early summer; February-March in southern systems, April-May in mid-Atlantic systems, and May-July in Canadian systems. Comprehensive information on current or historic abundance of Atlantic sturgeon is lacking for most river systems; however, the presence of

Atlantic sturgeon in the Cooper River is well documented. Atlantic sturgeon spawning is believed to occur in flowing water between the salt front and fall line of large rivers, where optimal flows are 46-76 cm/s and deep depths of 11-27 meters. Sturgeon eggs are highly adhesive and are deposited on the bottom substrate, usually on hard surfaces. Juveniles spend several years in the freshwater or tidal portions of rivers prior to migrating to sea. On reaching a size of approximately 76-92 cm, the subadults may move to coastal waters, where populations may undertake long range migrations. Though no site-specific data pertaining to Atlantic sturgeon distribution within the borrow sources is available, based on their documented migratory pathways using existing tagging data, it is possible that sturgeon may be migrating through or spending time in or near Stono Inlet or the Folly River.

Effective September 18, 2017, the NMFS designated critical habitat for several distinct population segments of Atlantic sturgeon. Folly Beach is between the Carolina DPS Unit and the South Atlantic DPS Unit. Unit C7 of the Carolina DPS Unit (i.e., Santee River, SC/Rediversion Canal, SC/North Santee River, SC/South Santee River, SC/Tailrace Canal-West Cooper River, SC/Cooper River, SC (Figure 5-12) is the closest critical habitat river system to the proposed project.

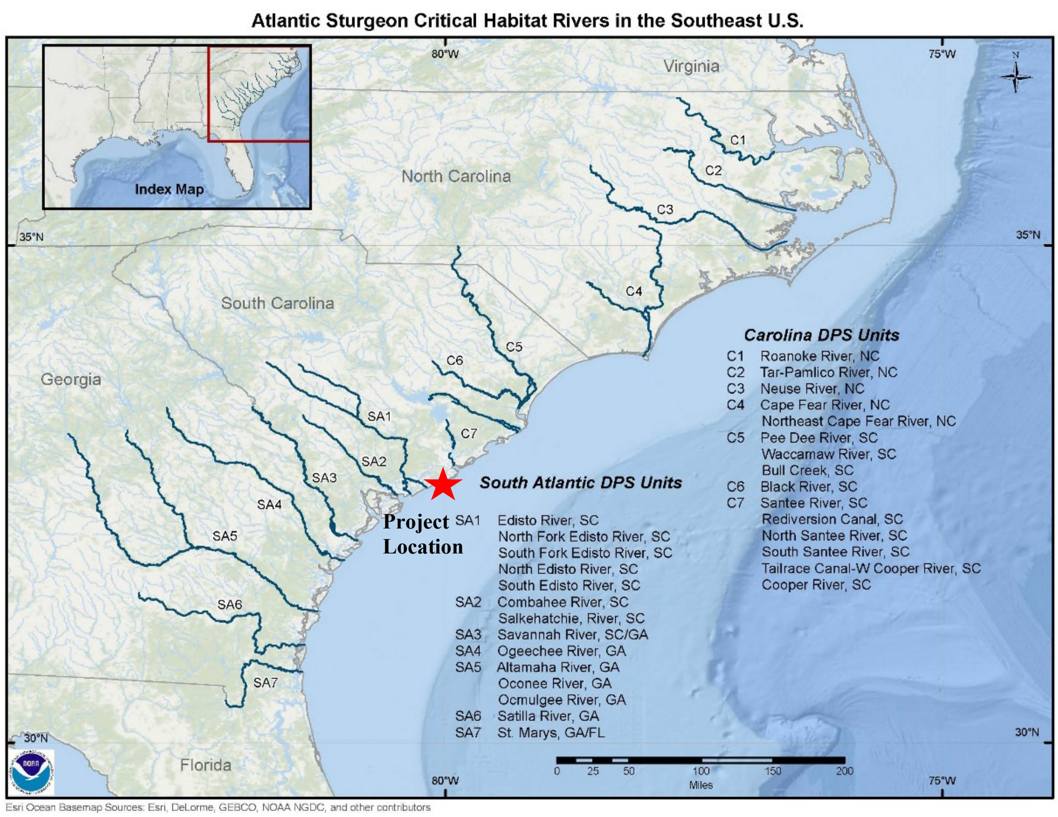

Figure 5-12. Atlantic Sturgeon Critical Habitat

Alternative 1 (No-Action): This alternative would have no effect on sturgeon species and no effect on Atlantic sturgeon critical habitat.

Alternative 3 (Recommended Plan): As it is not likely that shortnose sturgeon would be present in the Stono Inlet, Folly River or Folly Beach area, the proposed project will have no effect on the shortnose sturgeon.

Each dredging and placement event will require approximately 180 days and work may be accomplished any time of the year. During dredging Atlantic sturgeon may be lethally entrained in the hopper dredge dragheads. Dredging may also indirectly impact Atlantic sturgeon through (1) relatively short- term impacts to benthic foraging and refuge habitat, (2) short-term impacts to water and sediment quality from re-suspension of sediment and subsequent increase in turbidity/siltation, and (3) disruption of spawning migratory pathways. However, conditions outlined in the 2020 SARBO (or any future superseding NMFS biological opinion) will be implemented as a component of this project to reduce entrainment. Some of the conditions in the SARBO include utilizing draghead deflectors, adherence to the risk-based assessment process and monitoring of inflow screening, overflow screening, and dragheads by protected species observers. Therefore, the proposed dredging activities, are not likely to jeopardize the continued existence of the Atlantic sturgeon. Beach placement activities would have no effect on Atlantic sturgeon. There is no designated critical habitat in the project area, therefore this alternative will not result in an adverse modification of Atlantic sturgeon critical habitat.

5.05.5. Seabeach Amaranth

Figure 5-13. Example of a Seabeach Amaranth (Photo Credit: https://ecos.fws.gov/ecp0/profile/speciesProfile?sId=8549).

Seabeach amaranth (Figure 5-13) is an annual or sometimes perennial plant that usually grows between the seaward toe of the dune and the limit of the wave uprush zone occupying elevations ranging from 0.2 to 1.5 m above mean high tide. Greatest concentrations of seabeach amaranth occur near inlet areas of barrier islands, but in favorable years many plants may occur away from inlet areas. Seabeach amaranth is considered a pioneer species of accreting shorelines, stable foredune areas, and overwash fans. Seed dispersal of seabeach amaranth is achieved in a number of ways, including water and wind dispersal.

Historically, seabeach amaranth was found from Massachusetts to South Carolina, but according to recent surveys, its distribution is now restricted to North and South Carolina with several populations on Long Island, New York. The decline of this species is caused mainly by development of its habitat, such as inlet areas and barrier islands, and increased off road vehicle and human traffic, which tramples individual plants. Since seabeach amaranth seeds are fairly resilient and germination is dependent on critical physical conditions, populations of seabeach amaranth are very dynamic with numbers of plants fluctuating dramatically from year to year. Germination begins in April as temperatures reach about 25ºC (77ºF) and continues at least through July with greatest germination occurring at 35ºC (95ºF). Seed production begins in July or August, peaks in September, and continues until the plant dies. Seabeach amaranth is physically controlled (saltwater inundation, temperature, emergence at depth, etc.) rather than biologically controlled (web worm). Furthermore, seedlings are unable to emerge from depths greater than 1 cm; however, seabeach amaranth seeds are resilient, and century–old seeds of some species of amaranth are capable of successful germination and growth.

The southern terminus of the historical seabeach amaranth range is Folly Island. However, there are currently no known populations on the island, and there have been no known populations on the island in many years.

Alternative 1 (No-Action): This alternative would have a no effect to seabeach amaranth.

Alternative 3 (Recommended Plan): There are no known populations of seabeach amaranth along Folly Beach, therefore the project will have no effect seabeach amaranth.

5.05.6. Piping Plover

Figure 5-14. Example of Piping Plover (Photo Credit: https://ecos.fws.gov/ecp0/profile/speciesProfile?sId=6039).

The Atlantic Coast piping plover (Figure 5-14) population breeds on coastal beaches from Newfoundland to North Carolina (and occasionally in South Carolina) and winters along the Atlantic Coast (from North Carolina south), the Gulf Coast, and in the Caribbean where they spend a majority of their time foraging. Since being listed as threatened in 1986, only 800 pairs were known to exist in the three major populations combined and by 1995 the number of detected breeding pairs increased to 1,350 (USFWS, 1996). This population increase can most likely be attributed to increased survey efforts and implementation of recovery plans.

The species typically nests in sand depressions on unvegetated portions of the beach above the high tide line on sand flats at the ends of sand spits and barrier islands, gently sloping foredunes, blowout areas behind primary dunes, sparsely vegetated dunes, and washover areas cut into or between dunes. Piping plovers head to their breeding grounds in late March or early April and nesting usually begins in late April; however, nests have been found as late as July. Feeding areas include intertidal portions of ocean beaches, washover areas, mud flats, sand flats, wrack lines, and shorelines of coastal ponds, lagoons, or salt marshes. Prey consist of worms, fly larvae, beetles, crustaceans, mollusks, and other invertebrates.

The piping plover is a common winter resident along the beaches of South Carolina. On 10 July 2001, the USFWS designated 137 areas along the coasts of North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, and Texas as critical habitat for the wintering population of the piping plover where they spend up to 10 months of each year on the wintering grounds. Constituent elements for the piping plover wintering habitat are those habitat components that are essential for the primary biological needs of foraging, sheltering, and roosting, and only those areas containing these primary constituent elements within the designated boundaries are considered critical habitat. The USFWS has defined textual unit descriptions to designate areas within the critical habitat boundary. These units describe the geography of the area using reference points, include the areas from the landward boundaries to the MLLW, and may describe other areas within the unit that are utilized by the piping plover and contain the primary constituent elements.

SC-9 is a USFWS designated piping plover critical habitat unit in the vicinity of the project (see Figure 5-15). SC-9 is located in Stono Inlet immediately southwest of Folly Beach. SC-9 includes the contiguous shoreline from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur along the Atlantic Ocean and either inlet.

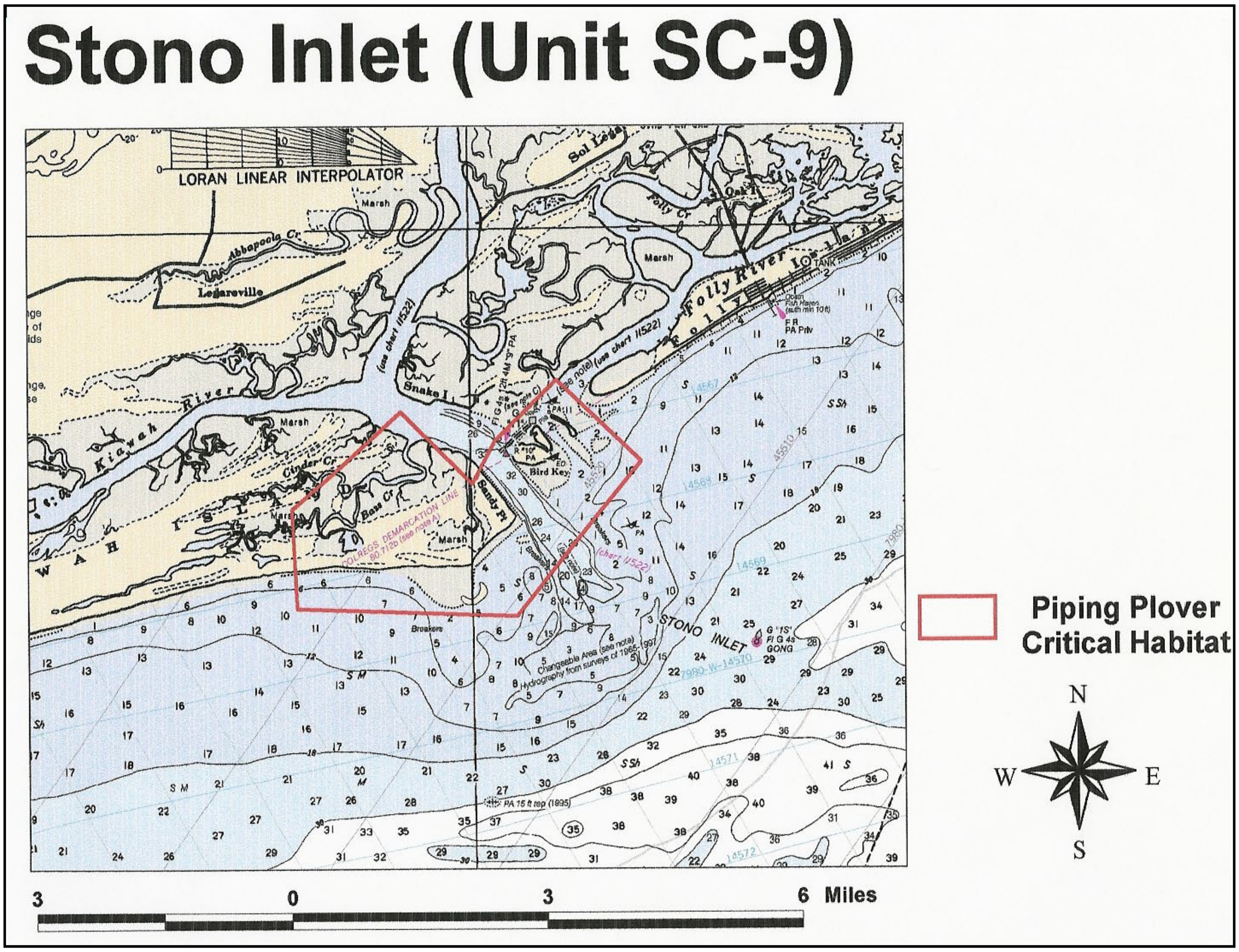

Figure 5-15. Piping Plover Critical Habitat

Alternative 1 (No-Action): Beach erosion would result in the loss of roosting and foraging habitat for the piping plover.

Alternative 3 (Recommended Plan): Impacts to the piping plover from sediment placement projects typically include disturbance and disruption of normal activities, such as roosting and foraging. The direct impacts would be temporary (during beach placement of material) and would be expected to impact a limited number of piping plovers that may be present in the area.

Burial and suffocation of invertebrate species will occur during sediment placement. Each dredging and placement event will require approximately 180 days and work may be accomplished any time of year. It is expected that the prey base of piping plover will recover within two years after initial construction and each nourishment event. These impacts would be temporary and would be expected to impact a limited number of piping plovers that may be present in the project area over future wintering and migration seasons.

The long-term effects of the project may restore lost roosting and foraging habitat through the addition of beach fill; however, short-term impacts to foraging, sheltering, and roosting habitat may occur during nourishment. Therefore, the project may affect, likely to adversely affect the piping plover and their critical habitat.

5.05.7. Red Knot

Figure 5-16. Example of Red Knot (Photo Credit: https://ecos.fws.gov/ecp0/profile/speciesProfile?sId=1864).

The red knot (*Calidris canutus rufa)* (Figure 5-16) is a medium-sized shorebird that undertakes an annual 30,000 km hemispheric migration, one of the longest among shorebirds. Its migration route extends from overwintering sites in the southernmost tip of South America at Tierra del Fuego, up the Eastern coast of the Americas through the Delaware Bay, and ultimately to breeding sites in the central Canadian Arctic. Red knots break their migration into strategically timed and selected non-stop segments, of approximately 1,500 miles, throughout the entire Atlantic coast, including South Carolina. These staging areas consist of highly productive foraging locations which are repeatedly used year to year. As the red knot moves towards the northern extent of its migration route, the timing of departures becomes increasingly synchronized. One critical foraging stop for red knots occurs in the Delaware Bay where they feed almost exclusively on horseshoe crab eggs, due to their high fat content and ease of digestion, in order to reach threshold departure masses (180-200 grams) prior to heading for the Arctic breeding grounds. The arrival of the red knot in the Delaware Bay coincides with the spawning of the horseshoe crabs, which peaks in May and June. Birds arrive emaciated and can nearly double their mass (~4.6 grams/day) prior to departure if foraging conditions are favorable, eating an estimated 18,000 fat rich horseshoe crab eggs per day. This critical foraging stopover enables red knots to achieve the nutrient store levels necessary for migration, survival, and maximizing the reproductive potential of the population. In order to increase their body mass at such a rapid rate during their refueling stopover in the Delaware Bay, red knots morph their guts during their migration route from South America to Delaware.

Red knots feed extensively in the intertidal zone on small coquina clams and horseshoe crab eggs. So, they are either seen feeding voraciously or resting. Once they build up adequate fat reserves, they fly to their next stopover site. Some red knots have geo-locators on their leg bands and such data demonstrate that they can fly hundreds of miles without stopping if they have adequate fat stores. The best places for them to feed and rest are large intertidal areas for foraging, with foredunes in which to rest. No disturbance at these sites from pedestrians, dogs, or vehicles would be tolerated by the birds; thus, busy sites are not used.

The red knot is a regular visitor along the South Carolina coast during both the spring and fall migrations. Flocks of over 1000 birds have been observed in the spring with lesser numbers being observed in the fall. The red knot also uses the South Carolina coast as a wintering area. In the general project area, red knots are most abundant during the spring, northward migration with most sightings occurring on Kiawah Island and on the beaches, sand flats, and mud flats in Stono Inlet, approximately 4000 ft south of the Folly Beach project area and on the beaches, sand flats, and mud flats in Lighthouse Inlet, approximately 2000 ft north of the project. In the immediate area of the project, where sediment will be placed on the beach, red knots are less abundant (SCDNR, 2013).

Alternative 1 (No-Action): Beach erosion would result in the loss of migrating and wintering habitat for red knots.

Alternative 3 (Recommended Plan): Short-term impacts of the proposed action on the red knot would result from the placement of sediment on Folly Beach, which would occur approximately every twelve years for approximately 180 days with construction and each renourishment event. Work may be accomplished any time of year. This activity would restore beach and intertidal area for this species. The long-term effects of the project may restore migrating and wintering habitat through the addition of beach nourishment activities within Folly Beach; however, short-term impacts to foraging, feeding, sheltering, and roosting habitat may occur during construction and nourishment events. The placement of beach quality sediment on Folly Beach may affect, likely to adversely affect the red knot. Red knots tend to congregate at the inlets and are less abundant in the project area; therefore, in the NEPA context, project impacts to red knots are insignificant.

Pursuant to the ESA, non-Federal actions include anticipated state, local, and private activities that would not be subject to Section 7 consultation. Anticipated non-Federal actions within the action area would include temporary sandbag placement and beach scraping activities above the MHW line. These activities would have the potential for impacts on piping plovers and red knots that are comparable to those associated with dredged material placement. Depending on the timing and location of specific projects, both the proposed action and non-Federal actions could have combined effects on piping plovers and their habitats.

This NEPA assessment addresses both the impacts at the borrow sites and the beaches where the material is placed. These areas provide habitat for the threatened and endangered species that may be present in the project areas. The long-term increase in beach habitat would result in a benefit to the same species. The degree of impact would increase proportionally with the total length of beach impacted. Considering all proposed and existing navigation placement and renourishment impacts throughout the ocean beaches of South Carolina, a significant portion of the shoreline may experience beach placement activities in the foreseeable future.

However, recognizing the funding constraints to complete all authorized and/or permitted activities, the availability of dredging equipment, etc.; it is very unlikely that all of these proposed projects would be constructed/renourished at the same time. Neither potential impacts to borrow sites nor to beaches on which the material is placed are likely to result in significant adverse impacts, as defined under NEPA, to threatened and endangered species.

5.06 Coastal Barrier Resources Act (CBRA) Areas

The Coastal Barrier Resources Act (CBRA) of 1982 established the John H. Chafee Coastal Barrier Resources System (CBRS), comprised of undeveloped coastal barriers along the Atlantic, Gulf, and Great Lakes coasts. The USFWS maintains the repository for CBRA maps enacted by Congress that depict the CBRS and has promulgated regulations implementing the CBRA.

CBRA maps show two CBRA sites in the immediate area of Folly Beach, Morris Island M06 and Bird Key M07; however, neither area is within the beach fill template. The Morris Island Complex (M06) is located at northeast end of the island, and the Bird Key Complex (M07/M07P) is located at the southwest end of the island. CBRA maps for the Folly Beach area are shown in Figure 5-1. The Folly River Borrow Area and portions of Borrow Area K are located within the Bird Key Complex. Borrow Areas F and E are outside the CBRA sites.

As discussed in Section 4.08.4, USACE studied the feasibility of utilizing areas in the Folly River and Stono Inlet (Borrow Area K), located within CBRS units M006 and M07/M07P, to provide sand for this project. Use of these two sites was determined to be feasible from an engineering perspective, economically justified, and environmentally acceptable. Utilization of sand from within a CBRS unit to nourish a beach outside the unit was determined by US Department of the Interior (USDoI) to be an acceptable action in a November 2019 Solicitor's opinion. On July 15, 2021, the Department of Interior reinstated its earlier interpretation under CBRA as it relates to certain federally funded shoreline stabilization actions, vacating the 2019 opinion. On August 5, 2021, the USFWS notified USACE that, as it relates to this project, "the CBRA exception under 16 U.S.C. § 3505(a)(6)(G) for 'nonstructural projects for shoreline stabilization that are designed to mimic, enhance, or restore a natural stabilization system' cannot be applied to removal of sand from within the CBRS to support beach nourishment projects that occur outside of the CBRS." As a result, the recommended plan will not utilize borrow sites located within a CBRS Unit. Further changes to CBRA or unit maps may occur during the 50-year life of the project, environmental analysis of the utilization of these two borrow areas will remain in this EA in recognition that future conditions may change.

<u>Proposed Changes to CBRS</u>

The U.S. Fish and Wildlife Service has prepared draft revised boundaries for Unit M06 and a proposed new unit (Unit M06P) in in the project area (Figure 5-17). In January 2021, the *Federal Register* notice announced the availability of the proposed revised boundaries for a 60-day public comment period. The 60-day public comment period for this proposed change closed on March 5, 2021. The USFWS will make any appropriate changes based on public comments, CBRA criteria, and objective mapping protocols. The USFWS will also prepare summaries of and responses to the comments received along with final recommended maps for Congressional consideration. The revised CBRS boundaries (including recommended removals and recommended additions) will only become effective once the revised maps are adopted into law by Congress.

Proposed Changes to Unit M06:

The change to Unit M06 is outside the area of effect of the proposed project. Borrow area F includes a portion of the proposed new Otherwise Protected Area (OPA), Unit M06P; however, consultation with the Service is not required if the proposed project is located within an OPA.

Proposed Removals:

■ Two structures and adjacent fastland along Sweetgrass Creek Road near its terminus

Proposed Additions:

■ An undeveloped secondary barrier island known as Long Island and associated aquatic habitat located between Folly Island and Long Island River (including a minor area that is privately owned and subject to a conservation easement held by the South Carolina Battleground Preservation Trust, located at the western end of Long Island)

■ Wetlands along Seaside Creek in the vicinity of Secessionville, along Clark Sound in the vicinity of Oceanview and Lighthouse Point, and along a tributary of Parrot Point Creek north of Fort Johnson Estates subdivision

Other Modifications/Information:

■ Modification of the boundary of the unit to account for natural changes along a portion of the shoreline of Folly Island on the south side of Lighthouse Inlet. This modification results in a small addition of mostly open water.

■ An area of wetlands that is owned by the City of Charleston and subject to a deed restriction (held by The Trust for Public Land) is currently within System Unit M06, located on Cummings Point at the northern end of Morris Island. This area is not proposed for reclassification to an OPA because the deed restriction was not in place when this area was first included in 1982 within the CBRS.

■ A portion of Lighthouse Inlet Heritage Preserve (owned by the Charleston County Parks and Recreation Commission and managed under a cooperative partnership with the South Carolina Department of Natural Resources) is currently within System Unit M06. This area is not proposed for reclassification to an OPA because it was acquired for conservation and/or recreation by the County after the area was first included in 1990 within the CBRS.

Proposed New Unit M06P:

New Unit CBRS Status:

■ Not currently within the CBRS

New Unit Area:

Included within new OPA Unit M06P are the following area(s):

■ A portion of Lighthouse Inlet Heritage Preserve located at the northeastern end of Folly Island (owned by the Charleston County Parks and Recreation Commission and managed under a cooperative partnership with the South Carolina Department of Natural Resources)

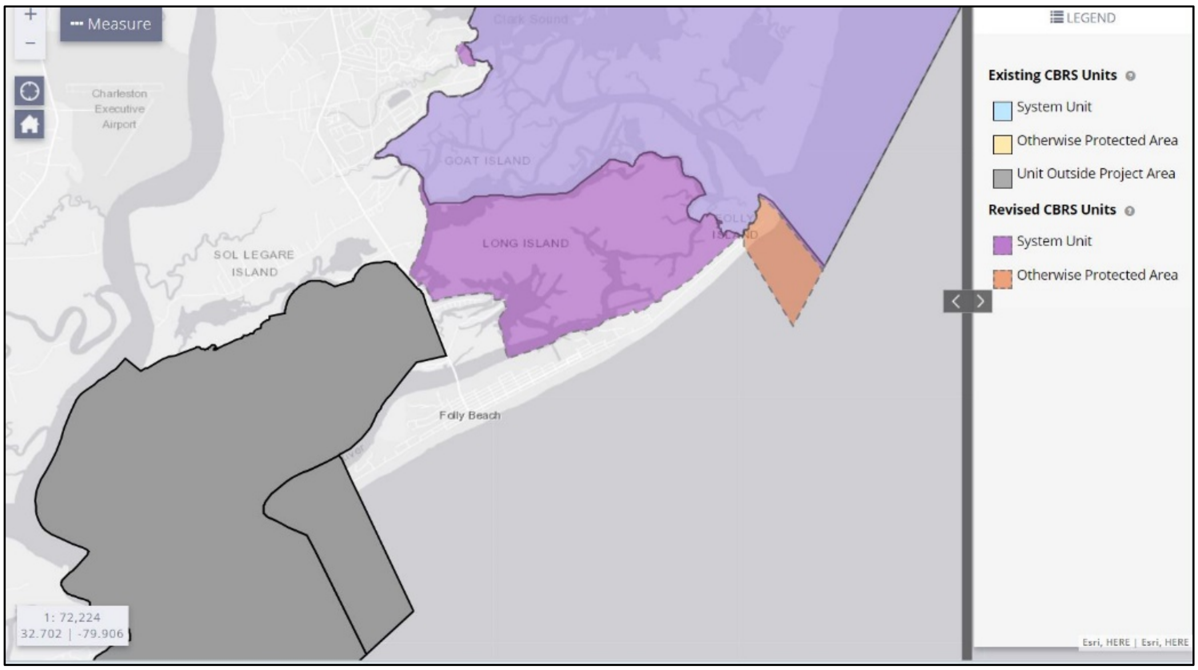

Figure 5-17. Service Map of Draft Proposed Changes to Existing CBRS Units in the Project Area

Alternative 1 (No-Action): The potential ecological impacts of the No-Action alternative are not well understood. Based on a recent review of past satellite imagery, Bird Key Stono (the predominant emergent sand bar/island in Stono Inlet) is a dynamic sand bar that is constantly moving and changing shape. The predominant movement appears to be toward the southwest, away from the southwestern tip of Folly Beach. As Bird Key Stono migrates, new submergent sand bars begin to form between Bird Key Stono and Folly Beach. As Bird Key Stono migrates further and further to the southwest, the submergent sand bars continue to grow until they become a single emergent sand bar. This was the condition of the sand bar islands in Stono Inlet at the time of the original 1993 Folly Beach CSRM project. It appears that Bird Key Stono will continue to migrate southwestward until it is slowly eroded away by the ebb tidal channel coming out of the Stono River. While this erosion is happening, the emergent sand bar between Bird Key Stono and Folly Beach continues to grow until it becomes the new predominant emergent sand bar/island in Stono Inlet. This new predominant emergent sand bar/island will, over time, also migrate southwestward and ultimately be replaced by a new emergent sand bar. This cycle is believed to take about 20 to 30 years to complete.

Alternative 3 (Recommended Plan): The USACE initiated consultation with the USFWS under the Coastal Barrier Resources Act with the USFWS. The USACE determined utilization of the Folly River and Borrow Area K as borrow sites for the Folly Beach CSRM project would qualify under the exception to CBRA found at 16 U.S.C. 3505(a)(6)(G) for "non-structural projects for shoreline stabilization that are designed to mimic, enhance, or restore a natural stabilization system." The USFWS responded that they believe these borrow do not meet an exception to the CBRA and therefore, the USACE has removed them from the Recommended Plan (Appendix I). Nevertheless, both borrow areas have been included in the impact analysis below in the event they may meet any future exceptions.

Sediment removed from offshore and placed on Folly Beach will introduce a significant amount of sand in the littoral system and is believed to accelerate the cycle of Bird Key Stono's southwestward migration and its ultimate demise and replacement by a new emergent sand bar.

Sediment removed from the Folly River borrow area and Borrow Area K in the Bird Key Complex (M07) would be placed outside of the CBRS unit, reducing the amount of sediment in Stono Inlet with each nourishment event that uses the Folly River or parts of the Stono Inlet Ebb Shoal borrow areas. The sediment that would be removed from the Folly River would be recharged through riverine sediment transport at a recharge rate of 18% per year (Van Dolah, 1998). Stono Inlet Ebb Shoal recharge rates are unknown but anticipated to recharge at a rate lower than Folly River. It is also expected longshore currents would return some of the sand to the CBRS unit.

Other current or foreseeable projects that have CBRA sites in the vicinity of the project include the Folly River, Murrells Inlet, Little River, Charleston Harbor federal navigation projects; the Edisto, Pawleys Island and Myrtle Beach federal CSRM projects and the Debidue Beach non-federal navigation project with beach placement. Considering all proposed and existing dredged material placement and renourishment impacts throughout the ocean beaches of South Carolina, a significant portion of CBRA resources may be impacted by beach placement activities in the foreseeable future, likely resulting in time and space crowded perturbations. However, recognizing the funding constraints to complete all authorized and/or permitted activities, the availability of dredging equipment, etc.; it is very unlikely that all of these proposed projects would be constructed/renourished at the same time. When combined with the impacts of other foreseeable projects, potential impacts to CBRA sites would be minimal.

5.07 Cultural Resources

The only known cultural resource in the project area is located in the Lighthouse Inlet Heritage Preserve. This site is known as the Folly North Site in the National Register of Historic Places. This site is listed due to its significance during the Civil War. There are two other sites (Neck Redoubts and Lines Federal Earthwork Fortifications) on Folly Island that are outside the project footprint and not currently listed in the Nation Register of Historic Places.

A comprehensive cultural resources review will be conducted for the above mentioned sites and proposed offshore borrow areas. All identified shipwrecks and archaeological sites eligible or potentially eligible for listing on the National Register of Historic Places will be avoided by utilizing a quarter mile dredging buffer. In order to achieve full compliance with Section 106 of the National Historic Preservation Act of 1966 and the Abandoned Shipwreck Act of 1987, the proposed action is currently and will continue be coordinated with the South Carolina State Historic Preservation Office (SHPO).

A Programmatic Agreement (Appendix J) between USACE, BOEM, SHPO, South Carolina Institute for Archaeology and Anthropology (SCIAA), and the City of Folly Beach was developed to identify cultural resources and potential impacts within the project area. The agreement was sent out for public review on May 18, 2021. A 30-day public comment period closed on June18, 2021. There were no comments received from the public.

Alternative 1 (No-Action): No known archeological resources are above MHW in the project area that could be exposed due to beach erosion, so the no-action alternative will not impact cultural resources.

Alternative 3 (Recommended Plan): Nourishment activities have the potential to encounter buried shipwrecks, but there are no known cultural resources on the beachfront at Folly Beach. Prior to final designation of potential borrow sources, and in order to achieve full compliance with Section 106 of the National Historic Preservation Act of 1966 and the Abandoned Shipwreck Act of 1987, magnetometer surveys will be conducted in areas under consideration and will be coordinated with the South Carolina Office of State Archaeology. In conjunction with the surveys, all stipulations outlined in the August 3, 2021 Programmatic Agreement will be carried out to ensure that all identified shipwrecks and archaeological sites eligible or potentially eligible for listing on the National Register of Historic Places will not be significantly impacted by the proposed project. All locations identified as acceptable alternatives for beach access for pipeline, pipe staging areas, location of pipeline routes, and offshore anchoring will be coordinated with the South Carolina Office of State Archeology. Contractors shall be made aware that in the event unknown resources are encountered, work in that area shall cease until assessment and consultation by the USACE and South Carolina Office of State Archaeology has been completed.

5.08 Aesthetic and Recreational Resources

All reaches in the study area are available for a multitude of beach recreation activities—swimming, surfing, wading, walking, sightseeing, picnicking, sunbathing, surf fishing, jogging, and so on. The total environment of barrier islands, beaches, ocean, estuaries, and inlets attract many residents and visitors to the area to enjoy the total aesthetic experience created by the sights, sounds, winds, and ocean sprays. The Folly Beach Fishing Pier is located in the project area and is considered an important recreational facility. During fall months, recreational surf fishing is a popular activity.

A scenic setting is provided by the ocean and sound, coastal beaches, and the numerous vessels common to these waters, including commercial and recreational boats. The marine environment provides opportunities for boating and fishing.

Alternative 1 (No-Action): This alternative would have an adverse and long-term detrimental effect on aesthetic and recreational resources due to beach erosion.

Alternative 3 (Recommended Plan): Placement of beach fill would result in temporary use of dredge pipeline, bulldozers, and other equipment on the beach. These objects would detract from the normal appearance of the beach, as well as create elevated levels of noise, vibration, lighting, etc. within the nourishment area. Also, recreational activities on beaches may experience some interruption or interference during work periods, but the degenerated, eroded conditions of the beaches already present recreational constraints. Construction equipment, sand placement, and increased noise levels may have a negative impact to sightseeing and fishing at the Folly Beach Pier. After work is completed on the beach and the heavy equipment is removed, the resulting wider beach would be expected to represent an aesthetic enhancement and an improvement for recreation.

The ocean and navigable waters in the vicinity of the study area would be affected to a minor extent in that dredges, barges, and other watercraft associated with the work would be on-site when dredging. However, that is judged to be an insignificant effect.

The Folly River navigability would be temporarily delayed when the dredge, barge, tug, and crew boats, associated with the work would be on-site during dredging and nourishment events. As a result, recreational boating navigability will be insignificantly affected.

Implementation of the Recommended Plan would result in an overall, relatively short-term minor adverse and long-term beneficial effects on aesthetic and recreational resources. Implementing the proposed action could cause a temporary reduction of aesthetic appeal and some interference with recreational activities in the areas of project nourishment for 180 days; however, these impacts would only occur about every 12 years.

Considering all proposed and existing dredged material placement and renourishment impacts throughout the ocean beaches of South Carolina, a significant portion of the shoreline, and to a lesser extent navigation channels may be impacted by beach placement activities in the foreseeable future, likely resulting in time and space crowded perturbations. However, recognizing the funding constraints to complete all authorized and/or permitted activities, the availability of dredging equipment, etc.; it is very unlikely that all of these proposed projects would be constructed/renourished at the same time. Therefore, though time and space crowded perturbations are expected in the reasonably foreseeable future, assuming each project adheres to project related impact avoidance measures, it is likely that adjacent unimpacted and/or recovered portions of beach will be available to support aesthetic and recreational resources. When combined with the impacts of other foreseeable projects, potential impacts to aesthetics and recreation placed would be minimal.

5.09 Commercial and Recreational Fishing

Commercial and recreational fishermen extensively utilize the nearshore marine and estuarine waters of South Carolina's coast on a year-round basis. The USACE maintains a navigation channel in the Folly River that is actively fished, or provides passage to other waters, including the Atlantic Ocean. In addition, recreational surf fishermen frequently utilize area beaches.

Recreational fishing includes fishing from head boats, charter boats, private boats, pier, and the surf. Fishing from head boats is best in the winter months for snapper and grouper. Fishing from charter boats is excellent for king mackerel and bottomfish during the winter. Offshore, gulfstream species, like yellowfin tuna and wahoo are available. Inshore fishing has been successful for inshore species such as red drum, speckled trout, and flounder.

Alternative 1 (No-Action): This alternative would have no effect to commercial and recreational fishing.

Alternative 3 (Recommended Plan): The Recommended Plan construction impacts on shore fishing would be limited to the area where material is being placed on the beach. Such localized temporary impact can easily be avoided by anglers in the area. Nearshore fishing boats can operate around the dredging equipment operating in the area. Fishing on the ocean pier may be impacted during construction, during the period equipment is located near the pier. Recreational fishing may be impacted in locations in which equipment is sited. During river dredging, fishing boat traffic navigability would be insignificantly affected. Dredging in the offshore borrow areas may have a slight temporary impact to commercial and recreational fishing due to disturbance of the water and substrate; however, these temporary impacts would be limited to the area where material is being dredged.

Considering all proposed and existing dredged material placement and renourishment impacts throughout the ocean beaches of South Carolina, commercial and recreational fishing may be impacted by dredging and beach placement activities in the foreseeable future, likely resulting in time and space crowded perturbations. However, recognizing the funding constraints to complete all authorized and/or permitted activities, the availability of dredging equipment, etc.; it is very unlikely that all of these proposed projects would ever be constructed at the same time. Therefore, though time and space crowded perturbations are expected in the reasonably foreseeable future, assuming each project adheres to project related impact avoidance measures, it is likely that adjacent unimpacted and/or recovered portions of beach or nearshore will be available to support commercial and recreational fishing. When combined with the impacts of other foreseeable projects, potential impacts to commercial and recreational fishing would be minimal.

5.10 Socioeconomics

According to the US Census Bureau, the 2010 population of Folly Beach was 2,617, and 350,209 for Charleston County, making it the 3rd most populous county in South Carolina. In the past several years, the county has seen strong population growth. In fact, between 2010 and 2019, the county grew by an estimated 17.5 %. The ethnic makeup of Charleston County is 64.2 % white, 29.8 % African American, 1.3 % Asian, less than 1 % Native American, less than 1 % Pacific Islander, and less than 1 % from other races. 5.4 % of the population were Hispanic or Latino of any race. Folly Beach's racial makeup was 96.6 % white, with less than 1 % of each additional race represented. The Hispanic population in Folly Beach represents 1.4 % of the total population. The following statistics also come from the US Census Bureau unless otherwise cited.

5.10.1 Economics

Charleston County has a service-based economy that has benefited from an influx of permanent residents, and a thriving tourism industry. The percentage of the workforce employed in social services (defined as educational services, healthcare, or social assistance) is 26.4 %, with the second highest percentage of individuals working in the food service industry (12 %), followed by the retail industry (10 %), and professional, scientific, and technical services (9.8 %). Within the first three blocks of the project area, landward of the ocean, are a pier, three hotels, seven restaurants, seven retail stores and multiple other commercial buildings.

With numerous notable attractions located in its borders and nearby, tourism is a critical component of the Charleston County and Folly Beach economy. In addition to miles of beaches, prestigious surfing competitions are held at Folly Beach throughout the year.

5.10.2 Income

On average, the socioeconomic composition of Charleston County and Folly Beach is higher than the remainder of South Carolina. The median household incomes are $61,028 and $86,660 respectively for the county and town, which is higher than the State average of $51,015. The per capita incomes in Charleston County and Folly Beach are $37,801 and $56,683 respectively, both higher than the State average of $27,986.

5.10.3 Minority and Low-Income Populations

Any individual with total income less than an amount deemed to be sufficient to purchase basic needs of food, shelter, clothing, and other essential goods and services is classified as poor. The amount of income necessary to purchase these basic needs is the poverty line or threshold and is set by the Office of Management and Budget (www.census.gov). The 2018 poverty guideline for the contiguous states for an individual was $12,140. The poverty guideline for a three-person family was $20,780. For a five-person family, the poverty guideline was $29,420 (https://aspe.hhs.gov/2018-poverty-guidelines). Folly Beach has 7.6 % of the population in poverty. On average, the socioeconomic composition of Folly Beach is higher than the remainder of South Carolina. The median household income is $86,660, which is higher than the State average of $52,306. The ethnic makeup of Folly Beach is 99.3 % white, 0.7 % African American (2018 American Community Survey).

Alternative 1 (No-Action): In the absence of a project, it is expected there would be adverse impacts to tourism and the risk of damages to existing structures would increase, hindering economic growth, increasing potential adverse impacts to the existing tax base and impacts to commercial and public entities.

Alternative 3 (Recommended Plan): This alternative would result in continued economic growth and have a beneficial impact on tourism. Also, this alternative will minimize the risk of damages to residential, public, and commercial structures, as well as reduce the risk of damages to critical infrastructure. The 2010 US Census data showed the minority/low-income populations and low-income communities are not found on Folly Beach. Accordingly, the proposed action would not cause disproportionately high and adverse impacts on minority populations or low-income populations. No impacts to either minority/low income populations or low-income communities are anticipated as a result of the Proposed Action. Therefore, the action would comply with EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations.

5.11 Other Significant Resources (Section 122, PL 91-611)

Section 122 of P.L. 91-611 identifies other significant resources which must be considered during project development. These resources, and their occurrence in the study area, are described below.

Noise. Noise is a prominent feature in the study area because of the sound of the breakers and at times, tourists, and traffic. The sounds of breakers are tranquil and add to the pleasure experienced by visitors. No large manufacturing, industrial, or mining-type of operations are located on Folly Beach. No airports or other area establishments or entities create unbearable noise levels on the community. Any harbor or open-water coastal environment has a number of underwater ambient noise sources such as commercial and recreational vessel traffic, dredges, wharf/dock construction (e.g., pile driving), natural sounds (e.g., storms, biological), and so on. To better assess potential species effects (i.e., disturbance of communication among marine mammals) associated with dredge-specific noise from navigation maintenance, deepening, or borrow area dredging operations, Clarke et al. (2002) performed underwater field investigations to characterize sounds emitted by bucket, hydraulic cutterhead, and hopper dredge operations. A summary of results from the study are presented below and are a first step towards developing a dredge sounds database that will encompass a range of dredge plant sizes and operational features:

- **Cutterhead Suction Dredge**
  Noise generated by a cutterhead suction dredge is continuous and muted and results from the cutterhead rotating within the bottom sediment and from the pumps used to transport the effluent to the placement area. The majority of the sound generated was from 70 to 1,000 hertz (Hz) and peaked at 100 to 110 decibel (dB) range. Although attenuation calculations were not completed, reported field observations indicate that the cutterhead suction dredge became almost inaudible at about 500 meters (Clarke et al. 2002).

- **Hopper Dredge**
  The noise generated from a hopper dredge is similar to a cutterhead suction dredge except there is no rotating cutterhead. The majority of the noise is generated from the dragarm sliding along the bottom, the pumps filling the hopper, and operation of the ship engine/propeller. Similar to the cutterhead suction dredge, most of the produced sound

energy fell within the 70- to 1,000-Hz range, however peak pressure levels were at 120 to 140 dB (Clarke et al. 2002).

- **Bucket Dredge**
  Bucket dredges are relatively stationary and produce a repetitive sequence of sounds generated by winches, bucket impact with the substrate, bucket closing, and bucket emptying. The noise generated from a mechanical dredge entails lowering the open bucket through the water column, closing the bucket after impact on the bottom, lifting the closed bucket up through the water column, and emptying the bucket into an adjacent barge. On the basis of the data collected for this study, which included dredging of coarse sands and gravel, the maximum noise spike occurs when the bucket hits the bottom (120 dB peak amplitude). A reduction of 30 dB re 1 µPa/m occurred between the 150 m and 5,000 m listening stations with faintly audible sounds at 7 km. All other noises from the operation (i.e., winch motor, spuds) were relatively insignificant (Clarke et al. 2002).

Alternative 1 (No-Action): This alternative would have no effect on noise.

Alternative 3 (Recommended Plan): This alternative would result in the initial construction and then nourish Folly Beach approximately every twelve years. Each dredging and placement event will require approximately 180 days and work may be accomplished any time of the year. Noise in the outside environment associated with beach nourishment activities would be expected to minimally exceed normal ambient noise in the project area, however, nourishment noise would be attenuated by background sounds from wind and surf. Though noise generated from dredging equipment is within the hearing range of sea turtles, marine mammals, and fishes, no injurious effects would be expected because they can move from the area, and the significance of the noise generated by the dredging equipment dissipates with an increasing distance from the noise source.

On the basis of the ability of marine mammals to move away from the immediate noise source, noise generated by dredging activities would not be expected to affect the migration, nursing/breeding, feeding/sheltering or communication of large whales. Although behavioral effects are possible (i.e., a whale changing course to move away from a vessel), the number and frequency of vessels present in a given project area would be small, and any behavioral impacts would be expected to be minor.

Considering all proposed and existing dredged material placement and renourishment impacts throughout the ocean beaches of South Carolina, sea turtles, marine mammals, and fishes may be impacted by noise due to dredging and beach placement activities in the foreseeable future. However, recognizing the funding constraints to complete all authorized and/or permitted activities, the availability of dredging equipment, etc.; it is very unlikely that all of these proposed projects would ever be constructed at the same time. Therefore, though time and space crowded perturbations are expected in the reasonably foreseeable future, assuming each project adheres to project related impact avoidance measures, it is likely that adjacent unimpacted and/or recovered portions of beach or nearshore will be available to support sea turtles, marine mammals, and fishes. When combined with the impacts of other foreseeable projects, noise impacts to sea turtles, marine mammals, and fishes would be minimal.

5.12 Hazardous and Toxic Materials

USACE standard tiered approach for analyzing the potential for encountering contaminated sediments in the potential borrow areas was used to assess the potential borrow areas for HTRW. According to that analysis, before any chemical or physical testing of sediments would be conducted, a reason to believe that the sediments could be contaminated must be established. The sources of the sediments in the selected borrow areas are derived from sediment transport and deposition by ocean currents. The probability of the areas being contaminated by pollutants is low.

The bottom sediments that would be dredged from the borrow areas and placed on the beach would consist of predominately fine-grained sand with some shell. Therefore, no further analyses or physical and chemical testing of the sediments is recommended.

A review of the EPA Superfund National Priorities List identified three sites in Charleston County. All three were over five miles inland. It would not be expected that any hazardous and toxic waste sites would be encountered during construction or periodic nourishment. However, if any hazardous and toxic waste sites are identified, response plans and remedial actions would be the responsibility of the local sponsor.

A search of the USEPA Brownfields-Cleanups, Cleanups, and Resource Conservation and Recovery Act Information showed no documented hazardous material spills or associated environmental issues within the project area.

6 THE RECOMMENDED PLAN*

The purpose of this report section is to centralize information concerning the Recommended Plan. The Recommended Plan is discussed in terms of features, construction, maintenance, real estate requirements, accomplishments, and economic feasibility.

6.01 Plan Description and Components

The Recommended Plan consists of a 5.85 mile (30,890 linear foot) main dune and berm combination beach fill, see Figure 6-1. The southwest portion of the project includes a 35 ft wide berm between reaches 1 to 17 for 19,170 feet (ft), see Figure ES-1. This includes the 2,200 ft County Park portion of the Recommended Plan plus the 16,970 ft portion of the Recommended Plan that has a 35 ft wide berm. The northeast portion includes a 50 ft wide berm between reaches 18 to 26 for 9,720 ft, plus a 2,000 ft portion of the Recommended Plan which includes the County-administered Lighthouse Inlet Heritage Preserve. The berm is at elevation 8.0 ft North American Vertical Datum 88 (NAVD88). The Plan includes constructing a new dune or raising the existing dune to a uniform elevation of 15 ft NAVD88 with a minimum top width of 5 ft. Neither the County Park at the southern end of the Recommended Plan nor the Lighthouse Inlet Heritage Preserve at the northern end of the Recommended Plan would feature a dune. The beach fill includes a 750-foot tapered transition at the ends of the project and a 500 ft transition between the 35 ft and 50 ft wide berm. During the 50-Year period of recommended federal participation in the project, material for the beach fill would be dredged from two proposed offshore borrow sources and transported to the beach likely by pipeline for the beach fill construction and all renourishments. The renourishment interval for the project is approximately twelve years. Typical project plan views and cross sections are contained in Appendix A Coastal Engineering.

6.01.1 Main fill

The Recommended Plan has a total fill length of 30,890 ft. The beach fill begins at the terminal groin at Stono Inlet located within the Folly Beach County Park. The Plan continues to the northeast and terminates 2,000 ft northeast of Station 288+90 at the northern boundary of the Lighthouse Area Heritage Preserve. The design berm elevation is set at elevation 8.0 ft NAVD88, which is consistent with the previously authorized project and approximates the natural berm elevation. Restricting the design berm elevation to the natural berm elevation minimizes scarping of the beach fill as it undergoes adjustment. Vertical scarps can hinder the beach access of nesting sea turtles and may also pose safety problems related to recreational beach use. A berm lower than 8.0 ft NAVD88 would not provide enough storm protection.

The dimensions of the Recommended Plan main fill are provided Note that the dune dimensions listed for the Recommended Plan are based on the existing idealized dune dimensions for those reaches and represent the maximum size of the construction template. However, the actual final project design (which is done during PED) may involve some variations in the constructed dune width and height from what is shown in the table, to account for constructability issues and the avoidance of real estate. However, in no case will the constructed dune exceed the dimensions listed in the Recommended Plan project template.

Stations	Length (ft)	Landward Dune Slope (X:1)	Max Dune Elevation (ft, NAVD88)	Dune Base Width (ft)	Seaward Dune Slope (X:1)	Berm Elevation (ft, NAVD88)	Berm Width (ft)	Berm Seaward Slope (X:1)
SW end of County Park to 22+00	2,200	NA	NA	NA	NA	8.0	35	15
22+00 to 191+70	16,970	3	15	47	-3	8.0	35	15
191+70 to 288+90	9,720	3	15	47	-3	8.0	50	15
288+90 to NE end of Heritage Preserve	2,000	NA	NA	NA	NA	8.0	50	15

Table 6-1. Recommended Plan Beach Fill Dimensions

6.01.2 Transition Sections

Transition sections are needed to improve project stability and reduce end losses. The length of the transition sections were determined during the GenCade modeling of the shoreline change rates with the beach fill in place, details provided in Appendix A. At the southwest end of the island, the dune tapers 750 ft into the Folly Beach County Park where it transitions into the berm only section. The berm only section terminates at the terminal groin. The berm and dune profile on the northeast end transitions to berm only at the existing timber groin at the City of Folly Beach municipal boundary line. The berm continues to the existing terminal groin at the northeast end of the island. The transition between the 35ft wide berm and the 50 ft wide berm will be 500 ft in length.

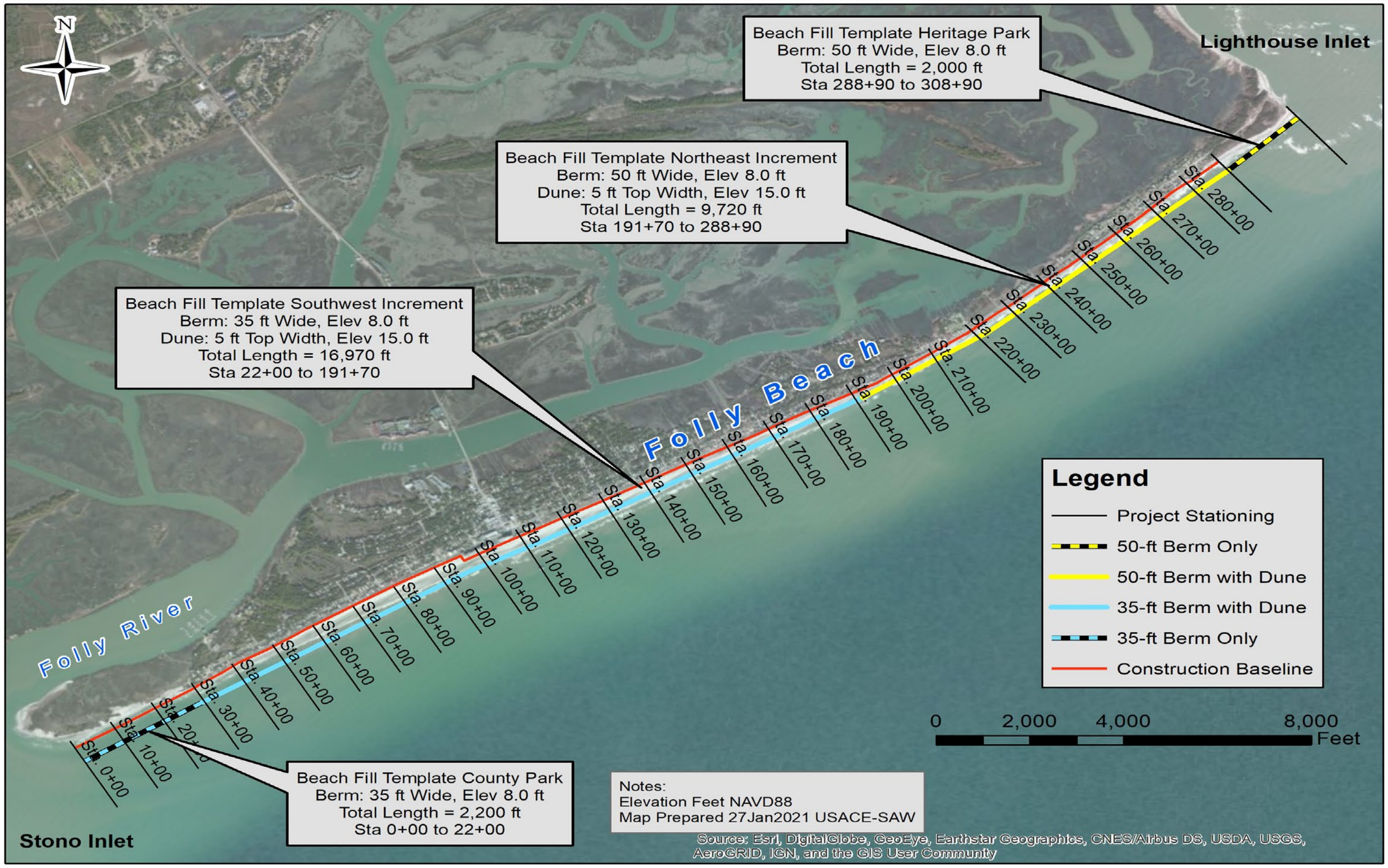

Figure 6-1. Folly Beach Study Area Base Map, the recommended plan.

6.02 Design and Construction Considerations

6.02.1 Initial Construction and Renourishment

The Recommended Plan will require 2.2 million cubic yards of material for initial beachfill, followed by a periodic nourishment placing 1.9 million cubic yards, then 2.0 million cubic yards, and finally 2.4 million cubic yards. The cycles of renourishment will occur approximately every 12 years. During the 50-year period of analysis, three renourishment events would require a forecasted total volume of 6.3 million cubic yards of material which, when added to the initial construction volume requirement of 2.2 million cubic yards results in a total project volume requirement of approximately 8.5 million cubic yards of material. The higher volume of sand in the final renourishment is to ensure the project remains functional throughout the project period of analysis.

The dredged material would most likely be pumped to the beach and shaped by earth-moving equipment. In both initial construction and during periodic nourishments, material between the toe of dune and mean high water line would be tilled to prevent compaction. Due to limitations in the ability of equipment to shape material underwater, the berm is not constructed in the shape of the design berm profile. Instead, the volume of material necessary to create the design berm is pumped out into an initial construction profile (see Figure 6-2). The initial construction profile would extend seaward of the final design berm profile by a variable distance to cover anticipated sand movement during and immediately after construction. Once sand distribution along the foreshore occurs (about 6 months), the adjusted profile should resemble the design berm profile. Initial construction is anticipated to take 6 months using one large dredge, and each periodic nourishment is anticipated to take 6 months using one dredge.

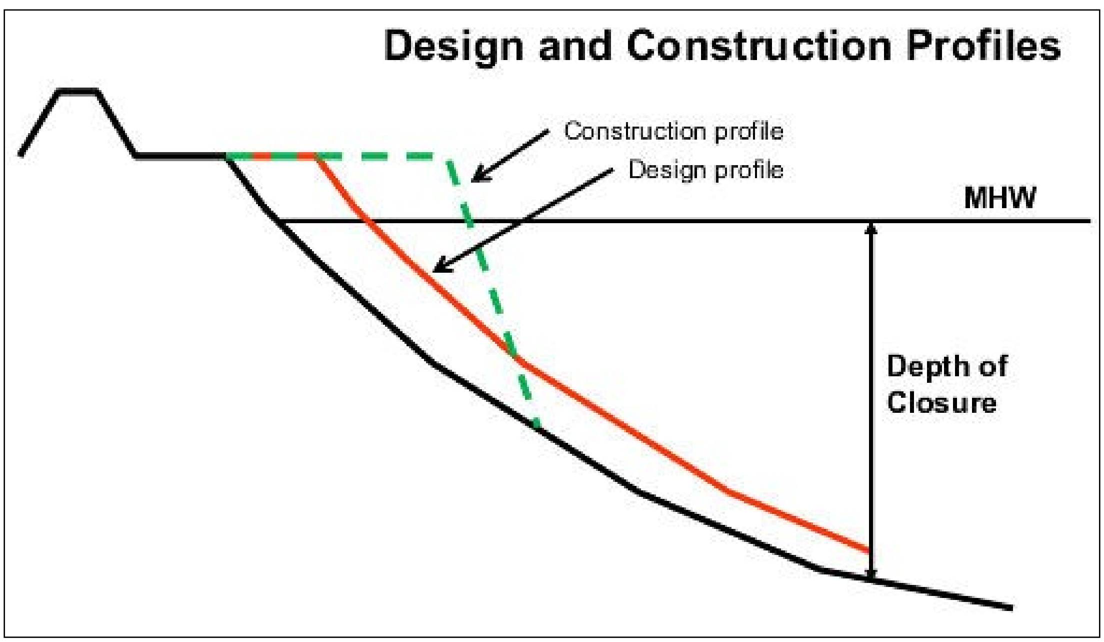

Figure 6-2. Representation of a berm construction vs. design profile.

6.02.2 Dune Vegetation

The dune portions of the project would be stabilized against wind losses by planting appropriate native beach grasses. Sand fencing is not needed since the dune will be constructed at the appropriate height. Dune stabilization would be accomplished by planting vegetation on the dune during the optimum planting season following dune construction. Planting stocks would consist of a variety of native dune plants including sea oats (*Uniola paniculata*), American beachgrass (*Ammophila breviligulata*), and panic grass (*Panicum amarum*). The vegetative cover would extend from the landward toe of the dune to the seaward intersection with the berm for the length of the dune. Plant spacing guidelines would follow the recommendations provided by the South Carolina Sea Grant, *The Dune Book* (Nash and Rogers, 2003). Sea oats would be the predominant plant with American beach grass and panic grass as supplemental plants. The total area for dune plantings is estimated to be 75 acres.

6.02.3 Construction Access

Construction access to the project will be obtained by public roads and rights-of-way. There are two Sponsor-owned staging areas as well as enough access areas along the beach at the ends of public streets and access areas for contractors to move pipe and construction equipment to the beach. Seven publicly owned access areas could potentially be used as construction staging areas if additional staging areas are needed for the project. These areas are described further in Appendix D Real Estate.

6.02.4 Borrow Area

The order in which each borrow area will be utilized for the project has not been determined. Many possible sequences and methods can be used for placing available material on the beach for the project. In addition to borrow area parameters (material quantities and location), the dredging production rates and dredging window are critical to selecting optimum borrow use plan. Offshore borrow areas beyond 3 nautical miles offshore are also subject to federal mining requirements of the Bureau of Ocean Energy Management (BOEM). The specific borrow areas and corresponding borrow area use plans will be determined and finalized during the PED phase of the study. During that phase, additional vibracore boring data in the borrow areas would be collected as needed and if necessary, additional environmental compliance documentation completed for any change in borrow area designation. Overall, the maximum amount of material that may be removed and the time frames between nourishments would not differ considerably in the future, therefore no significant impacts are expected due to the order in borrow area use. For additional details regarding which areas will be used for initial construction and periodic nourishments please refer to Section 6.02.1 Initial Construction and Renourishment.

6.02.5 Dredging Production.

Dredging production refers to the average volume transported per day and relates to factors such as plant, material, distance, and weather. This information is used to estimate project cost and construction time.

6.02.6 Dredging Window.

Dredging operations for the project will be performed in accordance with the 2020 National Marine Fisheries Service (NMFS) South Atlantic Regional Biological Opinion (SARBO) for Dredging and Material Placement Activities in the Southeast United States or any superseding SARBO that is prepared by NMFS.

The SARBO uses a risk-based assessment to determine the best time of year for beach nourishment and maintenance dredging actions. The SARBO risk-based adaptive project-management process involves the consideration of institutional knowledge of particular project sites, the potential effects to ESA-listed species and designated critical habitat, and the use of any current or new best available information. Annually, project specific issues will be discussed, and any associated minimization measures will be considered to reduce take.

The anticipated duration needed for initial construction and the subsequent renourishment efforts is approximately 6 months. This duration factors in contingency and weather delays.

6.03 Public Parking and Access Requirements

ER 1165-2-130 (Federal Participation in Shore Protection) requires reasonable public parking and access to the beach to be provided by the non-Federal sponsor. These requirements ensure that all portions of the project shoreline are available for public use as defined by adequate parking and access facilities. Per ER 1165-2-130, paragraph 6.h.: "Parking should be sufficient to accommodate the lesser of the peak hour demand or the beach capacity", and "public use is construed to be effectively limited to within one-quarter mile from available points of public access to any particular shore. In the event public access points are not within one-half mile of each other, either an item of local cooperation specifying such a requirement and public use throughout the period of analysis must be included in the project recommendations or the cost-sharing must be based on private use." The USACE Wilmington District has further interpreted the policy for adequate parking and access to mean that for participation in Coastal Storm Risk Management damage reduction projects within the District's boundaries of South Carolina and Virginia, a minimum of 10 public parking spaces need to be located at each access point.

Appendix E Economics contains an inventory of existing parking facilities and access points along the project shoreline. Due to Folly Beach having a previously authorized federal project, they are currently in compliance with the parking and access requirements.

6.04 Monitoring Requirements

6.04.1 Beach Fill Monitoring

A comprehensive monitoring program in accordance with USACE guidance (EM 1110-2-1100, Part V, Chapter 4) is planned for the Folly Beach project to assess and ensure project functionality throughout its design lifetime. Such monitoring supports the design efforts for periodic renourishment and would begin the year following the start of initial construction.

Estimated annual costs for beach fill monitoring over the 50-year project are $25,000, and would cover semiannual beach profile surveys, and an annual monitoring report. This beach fill monitoring is required for post-construction survey to confirm the final constructed beach profile after equilibration. Profile equilibration occurs about 6 months after completion of initial construction. This follow-on post-construction survey is considered continuing construction. Given that the nourishment interval for the proposed project is 12 years, post- and pre-construction surveys could occur in consecutive years. If budgetary constraints lengthen the nourishment interval beyond the 12 years identified in the NED Plan, any subsequent beach fill monitoring prior to pre-construction surveys conducted for the next nourishment cycle would be considered a local responsibility. The USACE will be responsible for including the pre and post-construction beach profile surveys as part of the 12 year cycle nourishment construction contract. The local sponsor will be responsible for the annual beach profile surveys between the nourishment cycles. It should be noted that the South Carolina Department of Health and Environmental Control, Ocean, and Coastal Resource Management (OCRM) conducts annual beach profile surveys at 31 locations along Folly Beach and prepares monitoring reports. The OCRM survey is readily available to the public.

Beach profile surveys would not only allow assessment of anticipated beach fill performance, but also allow determination of renourishment volume requirements. An aerial photographic record of the project would further facilitate assessment of the beach fill performance. The annual monitoring report would present the data collected and the corresponding analysis of project performance, including recommendations on renourishment requirements.

Evidence of erosion, including scarping, does not mean that the project is not functioning as intended. Erosion is part of the natural process for barrier islands. The project will frequently see evidence of this natural process.

Renourishment of the recommended beach fill template may be subject to effects of sea level change and episodic climate-forcing events monitored during the life of the project. The rate of SLC at the NOAA Charleston gauge will be monitored to determine when changes to the project may be necessary. During the PED phase and in preparing the Design Development Report parameters for requiring a renourishment will need to consider increased erosion rates above the rates used in the Feasibility Study in determining the recommended plan. Other parameter considered may include an increase in inland structural damages, increased damages to shoreline armoring, changes to borrow source and sand grain size, morphologic changes of Stono and Lighthouse Inlets and influences of modifications to the Charleston Harbor Jetties. Renourishment protocols developed during the PED phase will be used to inform production of the O&M manual.

6.04.2 Environmental Monitoring and Other Commitments

The environmental goal of the project is to avoid and minimize adverse impacts to the environment to the maximum extent practicable. A list of environmental commitments related to construction and maintenance of the proposed project, including but not limited to the USFWS and NMFS biological opinions are contained in Appendix I. Costs related to these commitments are factored into the total project construction and renourishment costs.

As part of the South Carolina Department of Natural Resources Marine Turtle Conservation Program, a local volunteer group performs daily surveys of sea turtle activity during sea turtle nesting season along the entire length of Folly Beach. It is recommended that these surveys continue, with or without a project in place.

6.05 Real Estate Considerations

The requirements for lands, easements, rights-of-way and relocations, and disposal/borrow areas (LERRDs) include the right to construct a dune and berm system along the shoreline of Folly Beach within the project limits. All lands required for the construction of the Folly Beach Renourishment Project were acquired by the project sponsor, the City of Folly Beach, for the Folly Beach Shore Protection Project in October 1992. If additional lands are identified during project design, the Sponsor will be required to provide those lands identified for acquisition prior to contract advertisement. Further details are provided in Appendix D (Real Estate Plan).

6.05.1 Borrow Areas

Permits and/or consent agreements for sand removal from portions of borrow areas within 3 nautical miles of the shore have been obtained (Appendix I). If sand mining extends outside the state limits into the Outer Continental Shelf (OCS), a noncompetitive negotiated agreement is required from the BOEM. Geotechnical analysis of selected borrow areas can be found Section 5.01.1 Geology and Sediment and Table 4-2 for comparison of borrow material to the native beach.

6.05.2 Pipeline

The material for initial project construction and nourishment would be dredged from the Folly River and offshore borrow areas, and then moved by pipeline to the beach. The pipeline would be routed along the ocean shoreline or back-barrier estuary, where it would be placed either below Mean High Water or in the acquired Perpetual (without any limitation of time) Beach Storm Damage Reduction Easements.

6.05.3 Construction Area

All lands required for this project were acquired for the original project. Based on a ground examination, it appears that there will be no adverse impact to the upland portion of ownerships. Improvements in the existing easement area are walkways, beach access crossovers and the fishing pier. Although every effort is made during construction to avoid damage to structures, private landowners have the option to remove their walkways to the beach prior to the start of project construction if they so desire to avoid damage to the walkways during construction. However, after construction of the project, the landowner would have to obtain a permit from the local authority to replace the walkway.

6.05.4 Real Estate Costs

The estimated real estate cost for the project is $4,375.00, which includes a 25% contingency. The cost consists of estimated costs federal and non-Federal administrative costs associated with Real Estate Certification. Please refer to Appendix H for more details regarding the project real estate costs.

6.06 Operation and Maintenance Considerations

Operation, maintenance, repair, replacement, and rehabilitation (OMRR&R) requirements of the sponsors would consist of project inspections and maintenance. The beachfill monitoring actions are different from the non-Federal sponsors' OMRR&R project inspections and surveillance, which consist of assessing dune vegetation, access facilities, dune crest erosion, trash and debris, and unusual conditions such as escarpment formation or excessive erosion. Periodic renourishment and beachfill monitoring (including the semiannual beach profile surveys) are classified as continuing construction, not as OMRR&R. Dune vegetation maintenance includes watering, fertilizing, and replacing dune plantings as needed. Other maintenance is reshaping of any minor dune damage, repairs to walkover structures and vehicle accesses, and grading any large escarpments. Estimated OMRR&R annual costs are $101,000.

6.07 Economics of the Recommended Plan

6.07.1 Recommended Plan— CSRM Benefits

Table 6-2 presents the applicable economic results at FY2021 price level for the Recommended Plan at the interest rate of 2.5%. The Recommended Plan's benefit to cost ratio at 2.5% interest is 0.87 to 1, while only considering CSRM benefits, 1.73 to 1 while considering recreation allowable for project justification, and 9.5 to 1, with full incidental recreation benefits.

Economic Category	Primary Storm Damage Reduction Benefit	Primary Storm Damage Reduction Benefit + Recreation Benefit for Project Justification	Primary Storm Damage Reduction Benefit + Full Incidental Recreation Benefit
Price Level	FY2021	FY2021	FY2021
FY2021 Federal Discount Rate	2.5%	2.5%	2.5%
Average Annual CSRM Benefit	$4,765,000	$4,765,000	$4,765,000
Average Annual Incidental Recreation Benefit	-	$4,765,000	$47,753,000
Average Annual Total Benefit	$4,765,000	$9,529,000	$52,518,000
Average Annual	$5,500,000	$5,500,000	$5,500,000

Total Cost			
Average Annual Net Benefit	-$735,000	$4,029,000	$47,018,000
BCR	0.87	1.73	9.5

Table 6-2. The applicable economic results at the FY2021 price level for the Recommended Plan at the interest rate of 2.5%.

The BCR as shown uses an intermediate sea level rise scenario. Other scenarios are illustrated in Table 6-4 that include a low, intermediate, and high rate of sea level rise

6.07.2 Recommended Plan— Recreation Benefits

Per ER 1105-2-100, the USACE policy on the application of recreation benefits is that "recreation must be incidental in the formulation process and may not be more than 50 % of the total benefits required for justification. If the criterion for participation is met, then all recreation benefits are included in the benefit to cost analysis." The Recommended Plan is justified based solely on CSRM benefits; therefore, all incidental recreation benefits are being claimed for the project.

Recreation benefits in this report were based on an analysis using a regional model utilizing the travel cost method (TCM) framework. Per USACE policy, to claim more than 750,000 annual visitations, a regional model utilizing the TCM or contingent valuation methodology is required. The average annual recreation benefit for the Recommended Plan (at 2.5% interest rate) is $47,753,000. See section 4.7 of Appendix E Economics for more detail on the recreation analysis.

The City of Folly Beach conducted a survey in May of 2020 that they provided to the Corps. This survey was used to elicit point values to use in the UDV analysis. More information on how this was done, including how potential bias from public stakeholder was accounted for, and other assumptions about the UDV model is available in Appendix E.

The average annual recreation benefit for the Recommended Plan (at 2. 5% interest rate) is $47,753,000.

6.07.3 Recommended Plan— Total Benefits

Combining the CSRM benefits and the recreation benefits yields a total average annual benefit for the Recommended Plan of $52,518,000.

6.07.4 Recommended Plan—Costs

Table 6-3 provides details on the distribution of cost by nourishment event. This estimate assumed that initial construction would occur in 2025 and re-nourishment events would occur at approximately 12-year intervals. Costs are project first costs (middle column of TPCS) at FY2022, include a contingency, include both the CSRM and Section 111 costs, and interest during construction. Costs are converted to present value (relative to the project base year of 2025) and to FY2021 (price level of benefits) for the economic analysis. Additional details on the project costs can be found in Appendix C - Cost Engineering.

The cost of initial construction is $50,544,000 ($49,146,000present value.) Interest during construction for the Selected Plan is estimated to be $254,000. The first cost for all three renourishments is $191,191,000 ($103,728,000 present value.) The economic cost is the present value of initial construction, IDC, and all renourishments. The economic cost totals $153,127,000 or $5,399,000 annualized. Finally, the annual OMRR&R cost of $101,000 (see sections 6.04 and 6.06) is included for a total annual cost of $5,500,000.

Item	Fiscal Year	Average Volume (cy)	First Cost from TPCS	Present Value[1]
Initial Construction PED	2024	-	$1,288,000	$1,269,000
Initial Construction	2025	2,169,000	$49,256,000	$47,877,000
Total Initial Construction Cost	-	2,169,000	$50,544,000	$49,146,000
Interest During Construction	2025	-	-	$254,000
1st Renourishment PED	2036	-	$1,308,000	$959,000
1st Renourishment	2037	1,871,000	$56,698,000	$40,979,000
2nd Renourishment PED	2048	-	$1,308,000	$713,000
2nd Renourishment	2049	2,040,000	$60,735,000	$32,640,000
3rd Renourishment PED	2060	-	$1,308,000	$530,000
3rd Renourishment	2061	2,408,000	$69,835,000	$27,907,000
Total Renourishment Cost	-	6,319,000	$191,191,000	$103,728,000
Economic Cost	-	8,488,000		$153,127,000
Average Annual Economic Cost	-	-	-	$5,399,000
Average Annual OMRR&R	-	-	-	$101,000
Average Annual Total Cost	-	-	-	$5,500,000

Table 6-3. Recommended Plan Annual Costs. [1]Present values at FY2021 price levels, FY2021 federal discount rate of 2.5%, FY2025 base year.

6.07.5 Benefit to Cost Ratio

With expected annual benefits of $4,765,000 and average annual costs of $5,500,000, the benefit to cost ratio for the Selected Plan, is 0.87 to 1, based on storm damage reduction. The average annual CSRM net benefits are -$735,000 at 2.5% interest at FY2021 price levels. See Appendix E for more detail.

6.08 Summary of Recommended Plan Accomplishments

The Recommended Plan would reduce coastal storm damages to structures along approximately 5.85 miles of beachfront. Additionally, the plan would halt future land loss over much of the same area. The Recommended Plan would also increase the recreational value and demand of the beach. The Recommended Plan would also potentially reduce future emergency response costs (although these have not been quantified for this study) and preserve or expand the amount of beach habitat available for sea turtle and shorebird nesting. Finally, the Recommended Plan will benefit the regional economy by maintaining the area as a popular year-round destination and supporting the jobs and businesses associated with that industry.

6.09 Evaluation of Risk and Uncertainty

6.09.1 Residual Risks

The proposed project would greatly reduce, but not completely eliminate future storm damages. Coastal storm risk is reduced by approximately 83 % over the 50-year period of analysis; therefore, the residual damages would be 17 %. Residual damages and risk for the shoreline are further discussed in the Coastal Engineering Appendix. The project is designed to reduce damages from storm waves, direct flooding, erosion, armor cost, land loss, and property condemnation but would not prevent any damage from back bay flooding; therefore, any ground-level floors of structures, ground-level floor contents, vehicles, landscaping, and property stored outdoors on the ground would still be subject to saltwater flooding that flows in through the inlets and the back bay channels. However, back-bay flooding is a relatively minor issue in the first three blocks of the island (four blocks in the commercial district) which is where the benefits of the project are being measured and those damages were not claimed as a project benefit. As the project is also not claiming any benefits beyond the third block of the island, damages from flooding to structures past the third row were not calculated. Structures would also continue to be subject to damage from hurricane winds and windblown debris. Even new construction is not immune to damage, especially from these processes.

The proposed beach fill would reduce damages but 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 project purpose is storm Risk Management, and the berm-and-dune is not designed to prevent loss of life. Loss of life is prevented by the existing procedures of evacuating the barrier island completely, well before expected hurricane landfall and removing the residents from harm's way. The erratic nature and unpredictability of hurricane path and intensity require early and safe evacuation. That policy should be continued either with or without the storm Risk Management project.

Plan formulation, evaluation, screening, and plan selection during the study process explicitly considered and incorporated risks to life-safety. The following is an assessment of residual risk and uncertainties to life-safety.

There will be residual risk in life-safety under the future with-project condition. It may be that this risk will be of greater magnitude than under current or without-project conditions, related to the larger proposed size of the Recommended Plan compared to the existing project. The presence of a project that contains a more significant structural component (i.e., constructed dune and berm) may introduce a false sense of security in individuals that remain uneducated or refuse to accept community education on risks associated with coastal storms and hurricanes. This false sense of security may lead individuals to remain on the island who might otherwise evacuate, or to delay the decision to evacuate until it is too late. Past experience has shown this to be a factor in loss of life in past coastal storm and hurricane events.

Past experience has shown that human behavior during coastal storm, hurricane, and flood events varies drastically, but in the presence of constructed projects, human beings have shown a greater propensity to believe they are better protected than those without knowledge of a constructed project. Assessments of coastal storm, hurricane and flood events has shown that as many as ten to fifteen percent of residents and visitors may remain in areas at risk. While factors such as availability of transportation, lower income, and other factors will influence the outcome, and introduce additional uncertainty, education on risks is of paramount importance.

The Recommended Plan is not designed to provide life-safety enhancement, much less "protection" from coastal storms and hurricanes. The Recommended Plan will not provide relief from *all* coastal storms or hurricanes. Either could over-top, or erode and then breach, the structural project features, and attack property and endanger or kill people on the island or causeway. The causeway is the sole method of egress or evacuation, from the island, and will be overtopped relatively early in a large event. Once the causeway is over-topped, there will be no further means of evacuation from the island. This is a significant life-safety risk that will not be fully addressed by the project.

Police, Fire, and emergency services/EMS will not be able to provide those services during large events, since none of those services provides sufficient protection to sustain services once enough water collects to impede vehicular or foot traffic. This could occur during even moderate coastal events.
These issues highlight the importance of community and visitor education, focused attention to signage and evacuation routing, and the criticality of attention to warnings by Police and Town officials, and timely evacuation off the island. These commitments are included in the Recommendations, and are Items of Local Cooperation required of the Non-Federal Sponsor, in the Main Report/EA.

With those important points made, the Recommended Plan would provide additional coastal storm risk reduction above the level currently provided by the existing project. The project would provide greater resilience to erosion by provision of a deeper and larger berm. It would also provide greater levels of inundation and wave attack reduction by provision of a larger and more consistent dune system. Quantification of these benefits in the life-safety realm is not possible within the limitations of this study.

6.09.2 Risk and Uncertainty in Economics

The Beach-*fx* model accounts for uncertainty in the economic evaluations through the use of Monte-Carlo simulations to model future damages. The average annual damages reported in this study are based on the damages averaged across 100 life cycles, with each life cycle experiencing a different suite of storms during the period of analysis. Additionally, uncertainty is accounted for in the damage functions that are used to determine the amount of damage incurred to a structure and its contents from a given storm. Each structure type is assigned a minimum, maximum, and most likely damage function, meaning that the amount of damage experienced by a structure due to a specific amount of erosion or water depth can vary between life cycles.

6.09.3 Risk and Uncertainty in Project Costs

In order to account for uncertainties in the final project costs, which could result from a variety of risk factors, all costs include a contingency to address potential risks to the baseline estimated costs. The contingencies will be based on a Cost Schedule Risk Analysis (CSRA), currently being developed through the Cost Engineering Center of expertise (MCX). Currently for this project, a contingency of 27% is being used for Borrow Area F and a 29% contingency for Borrow Area E. These contingencies are shown in the Cost Engineering Appendix C, Total Project Cost Summary (TPCS).

6.09.4 Risk and Uncertainty in Borrow Availability

An estimated 10.0 million cy of borrow material will be needed over the 50-year project. The current in-place volumes for each borrow area are as follows: Borrow Area F 2.8 million cubic yards, Borrow Area E 14.0 million cubic yards, Borrow Area K 0.8 million cubic yards, and Folly River 2.7 million cubic yards. The overall project would utilize 44% of the total volume available at the four sites. Removal of Borrow Area K and the Folly River due to CBRA restrictions has further reduced the available volumes by 3.5 million cubic yards but, the risk of running out of material over the 50-year period of analysis is minimal. The borrow area use order and further geotechnical investigations are being deferred to PED and therefore additional NEPA may be necessary to account for new information. However, the maximum amount of material that may be removed and the minimum time frames between removal indicate that environmental effects discussed in this report would not differ considerably in the future. Also, cultural resource surveys have not been completed over the four sites. The surveys could exclude portions of specific borrow areas thus decreasing the available volume. For example, if a significant cultural resource is encountered in borrow area F, it could diminish the available volume enough to not allow it to be used for construction. This would then force the dredging to be moved to borrow areas E and K, coming at a greater financial cost. There is a greater risk and uncertainty in the financial cost of this project rather than availability of material. Until the cultural resource surveys and additional geotechnical investigations are complete in PED phase the certainty of borrow availability will be better established.

6.09.5 Risk and Uncertainty in Sea Level Change Assumptions

Per ER 1100-2-8162, a sensitivity analysis on the economics of the Recommended Plan was performed using low and high accelerated sea level rise rates. A full discussion of the accelerated sea level rise rates and how they were calculated for the project area is contained in Appendix A.

The net benefits reported for the Recommended Plan are based on the intermediate sea level rise rate (0.0198ft/yr) being applied to both the future with and without-project conditions. The Recommended Plan was rerun in Beach-fx using both the low (0.0096 ft/yr) and high (0.0516 ft/yr) sea level rise rates for both the future with and without-project conditions. In the future without-project condition, damages increase under accelerated sea level rise scenarios. Under accelerated sea level rise, damages also increase in the with-project conditions, but to a lesser degree. Table 6-4 shows a comparison of with and without-project damages under the various scenarios. The increase in damages with increasing sea level is not consistent along the Folly Beach shoreline. The southwest part of the project area (reaches 1-21) is more susceptible to changes in sea level, because relatively more damage in that area is driven by wave and flood, rather than erosion. Although it appears that maximization of net benefits would occur under a High SLR Scenario, analysis of trends did not support use of a high SLR rate.

SLR Scenario	Average Annual Benefit	Average Annual Cost	BCR	Average Annual Net Benefit
Low	$4,434,000	$4,918,000	0.90	-$484,000
Intermediate	$4,765,000	$5,500,000	0.87	-$735,000
High	$6,209,000	$7,286,000	0.85	-$1,078,000

Table 6-4. Comparison of with and without-project damages and benefits under low, intermediate, and high sea level change scenarios.

The BCR as shown uses an intermediate sea level rise scenario. Other scenarios are illustrated in Table 6-4 that include a low, intermediate, and high rate of sea level rise

The decreases in project costs are relatively minimal under the low sea level change scenario. Cost increases by 32% under the high sea level change scenario. Project justification is almost identical between the low, intermediate, and high sea level change scenarios. This conclusion supports the concept of beach fill as naturally adaptable to sea level rise fluctuations.

The comparison of the final array indicated that berm and dune plans are the only plans that are economically justified. A non-structural plan, at over $400 million for removal and relocation, is not economically justified. Changes in RSLC would not change a plan from that of a berm and dune plan, just would make the dune and berm template larger and more expensive. Analysis indicates choice of a higher rate is not supported by evidence. The reader is referred to Table 6-4.

The CSRM analysis and design reflect future conditions based on the Intermediate SLC scenario which assumes an increasing rate of sea level rise over the 50-year study period. The uncertainty in estimating the future rates of sea level rise along the Atlantic coast requires flexibility in developing adaptation measures and triggers.

It is relatively easy to adapt the dune and beach restoration alternative to sea level change. Additional dredge material can be included in each renourishment operation to offset losses from sea level rise. The natural berm elevation will rise in concert with the rising sea surface, so the design berm should be adjusted accordingly. The dune crest elevation will also need to be raised in response to sea level rise to maintain the design performance. It is recommended that the design berm elevation and dune crest elevation be increased in 1-ft increments in the future to accommodate sea level rise. A 1-ft increase in the dune elevation would require approximately 140,000 CY of additional sand and the 1-ft increase in berm elevation would require 190,000 CY of additional sand for each nourishment assuming the template is depleted prior to a nourishment cycle.

The event threshold or trigger for the adaptation measure is when the rate of sea level rise at the Charleston NOAA gauge exceeds the Intermediate sea level change rate used in the design and analysis. From Figure 3-3 it can be noted that the project design loading for the dune crest at elevation 15 ft NAVD88 will be exceeded in year 2074 based on the Intermediate SLC. This is a 1.0 ft increase in sea level from 2024 to 2074. Under the High SLC scenario the design loading would be exceeded in year 2048 and the 1.0 ft increase would be the trigger to implement adaptive measures. Additional measures that should be evaluated at the time the threshold is met is decreasing the nourishment project frequency. At the Low SLC scenario no adaptation measures or triggers are required.

The continued function of the existing groin fields and terminal groins at Folly Beach will have to be evaluated under the higher water levels. Due to the uncertainty in sea level change as well as the design/performance of the groin system it is recommended that the groins be adapted in the future by adjusting renourishment quantities and placement locations. Even without considering sea level changes there will be some differences in the actual performance of the groins and the expected or modeled performance that will need to be adapted to by adjusting fill placement. Adapting the groin fields and terminal groins could include placing an additional layer of armor stone or extending seaward.

Additional sea level rise adaptation measures that will have to be addressed by the City of Folly Beach include interior drainage and more frequent flooding during spring tide events. The majority of the residents along Folly Beach also utilize septic tank for wastewater treatment and the vulnerability will have to be assessed. All of the shoreline armoring (bulkheads and revetments) along Folly Beach is landward of the SCDHEC OCRM Jurisdictional Baseline and is located on private property.

6.09.6 Risk and Uncertainty in Future Beach Placement Activities

As discussed in Section 3 (Future Without-project assumptions), continued dredged material placement from maintenance dredging of local navigation channels cannot be consistently relied on in the future without-project condition. This assumption is due to uncertainties in navigation funding, and also uncertainties associated with timing and placement locations for any dredged material that might become available. In addition, beach placement of dredge material does not provide a consistent or measurable level of damage reduction. As the estimated re-nourishment volumes for the Recommended Plan are based on the assumption of no future maintenance dredged material placement on area beaches, any such placement that did occur would have the effect of reducing the amount of renourishment material needed and therefore the cost of the proposed Federal Coastal Storm Risk Management project. In addition, if at the time of renourishment the beach profile is already at or greater than the design template of the Recommended Plan, then no additional material would be placed for the project at that time.

6.09.7 Risk and Uncertainty in Coastal Storms

Uncertainty regarding the number and intensity of future storms in the area is handled through the Beach-*fx* Monte Carlo simulation, whereby each lifecycle randomly selects (based on actual probabilities of storm occurrence) a suite of storms that will hit the project area over a given lifecycle. The storm suite is selected from a group of 444 plausible storms for Folly Beach. However, while the storms are randomly selected, the effect of any given storm on a given shore profile is determined by the SBEACH software and is fixed. The Beach-fx parameters which dictate storm selection are discussed in Appendix A.

7 PLAN IMPLEMENTATION*

7.01 Project Schedule

Table 7-1 shows the project schedule following assumed December 2022 project authorization. The schedule assumes expeditious review and approval of the project through all steps, including authorization and funding, and as such is subject to change.

Activity	Date
Complete Final Plans and Specs	Mar 2024
Sign PPA	Jul 2024
Complete Real Estate Acquisition	Aug 2024
Award Construction Contract	Sep 2024
Begin Initial Construction	Dec 2024
Complete Initial Construction	May 2025
Begin First Renourishment	Dec 2036
Complete First Renourishment	May 2037

Table 7-1. Project schedule following assumed December 2022 project authorization.

7.02 Division of Plan Responsibilities

7.02.1 General

Federal policy requires that costs for water resources projects be assigned to the various purposes served by the project. These costs are then apportioned between the federal government and the non-Federal sponsor according to percentages specified in Section 103 of the WRDA of 1986 (P.L. 99-662). For projects that provide damage reduction to publicly owned shores, the purposes are usually (1) Coastal Storm Risk Management and (2) separable recreation. For the Folly Beach project, there is no separable recreation component.

7.02.2 Cost-Sharing

All project costs for the Recommended Plan are allocated to the purpose of hurricane and storm damage reduction. Cost-sharing for initial construction would be approximately 90% federal/10% non-Federal, and renourishments would be cost-shared on an approximate 86% federal and 14% non-Federal basis, consistent with requirements resulting from a Section 111 Report finding (see Appendix G Section 111 for details), the base being provided by Section 103(c)(5) of WRDA 1986 as amended by WRDA 1996. Overall cost-sharing is approximately 87% Federal/13% non-Federal. The estimated federal share of the costs of the project is $209,914,000. This includes administrative costs for real estate. Non-Federal interests are required to provide all lands, easements, rights-of-way, relocations, and disposal (LERRDs) necessary for the project. The value of the non-Federal portion of the LERRD is $0.

The estimated First Cost of the Recommended Plan is $241,735,000 in FY2022 price levels, which would be cost-shared approximately 87% federal ($209,914,000) and 13% non-Federal ($31,821,000), in accordance with the cost-sharing exclusive to the project, as discussed in the Section 111 Appendix. Operations and maintenance costs are estimated at $101,000 a year and would be a 100% non-Federal responsibility. The project includes an approximate 12-year renourishment cycle (initial construction, plus three renourishments) with an estimated cost of $50,544,000 for initial construction and $191,191,000 over three renourishments) approximately $63,730,000 per renourishment). Initial construction would be cost shared on approximately 90% federal and 10% non-Federal basis. Renourishments would be cost-shared approximately 86% federal and 14% non-Federal basis. The benefit cost ratio is 9.5 to 1 (including Recreational Benefits). The total cost for initial construction and the three renourishments is $241,735,000 ($50,544,000 for initial construction plus $63,730,000 on average per renourishment, for the three renourishments).

Annual OMRR&R costs, such as inspection costs and dune vegetation maintenance costs, currently estimated at $101,000 per year, are a 100 % non-Federal responsibility. The federal government is responsible for preparing and providing an OMRR&R manual to the sponsor.

As noted previously, current federal policy requires that, unless there are other, overriding considerations, the NED plan would be the plan recommended for implementation. However, the non-Federal sponsor can request recommendation of a Locally Preferred Plan (LPP) that differs from the NED Plan if they are willing to pay 100% of the cost differential between the two plans. In this case, the non-Federal sponsor has not elected to pursue an LPP, therefore the Recommended Plan is the NED plan. Cost-sharing for the selected plan is shown in Table 7-2 at FY22 price levels.

As discussed in section 6.03 Public Parking and Access Requirements, the non-Federal sponsor has committed to constructing the required additional public accesses and parking requirements needed to support the determination of federal interest in a CSRM project. Any costs incurred by the sponsor in order to satisfy these requirements are not considered project costs and are not creditable towards the total amount of the non-Federal sponsor's required contributions. The cost apportionment shown in Table 8-2 is computed to assume that 100 % of the project would meet these requirements by the time the PPA is executed.

Actual cost-sharing percentages for the project will ultimately be based on a detailed assessment prior to initiation of construction, of the following factors:

Adequacy of public access and public parking throughout the constructed project reach;

7.01.7.2 Economic justification of the individual project reaches, and;

7.01.7.3 Presence of undeveloped lots.

All of these requirements may affect the cost-sharing percentages of federal and non-Federal sponsors. This issue is also re-visited prior to each re-nourishment, and cost-sharing may be adjusted accordingly. Continued maintenance (of access for the public by both access corridors and public parking) is an especially important factor in ensuring funding of the project. The non-federal sponsor for the Folly Beach project is fully aware of all the factors potentially affecting cost-sharing and has wholly committed to meeting those requirements.

Cost allocation for undeveloped lots would be 100% non-Federal. The presented cost-sharing percentages assume 100% development along the entire project shoreline. The number of undeveloped first-row lots would be reassessed before the signing of the PPA, and the cost-sharing would be recalculated at that time to reflect any remaining undeveloped lots.

Total project construction costs					
Project purpose	Project estimated cost	Apportionment %		Apportionment $	
		Non-Federal	Federal	Non-Federal	Federal
Coastal Storm Risk Management/ Section 111Mitigation	$50,544,000	10%	90%	$5,054,000	$45,490,000
LERRD credit	$0	100%	0%	$0	$0
Total initial cost	$50,544,000			$5,054,000	$45,490,000
Total renourishment costs					
Project purpose	Total cost (3 renourishments)	Apportionment %		Apportionment $	
		Non-Federal	Federal	Non-Federal	Federal
Coastal Storm Risk Management/ Section 111 Mitigation	$191,191,000	14%	86%	$26,767,000	$164,424,000
Annual OMRR&R costs					
	Cost per year	Apportionment %		Apportionment $	
		Non-Federal	Federal	Non-Federal	Federal
Beach fill monitoring	$25,000	100%	0%	$25,000	$0
General repair, maintenance, inspection	$76,000	100%	0%	$76,000	$0
Total annual OMRR&R	$101,000			$101,000	$0

Table 7-2. Cost allocation and apportionment, FY2022 price levels.

7.02.3 Financial Analysis

The non-Federal sponsor has submitted a statement of financial capability to the USACE.

7.02.4 Project Partnership Agreement

A model Project Partnership Agreement (PPA) will establish the responsibilities for project executions between the federal government and the non-Federal sponsor as required by Section

221 of Public Law 91-611, Flood Control Act of 1970, as amended (42 U.S.C. 1962d-5b), and Section 103 of the Water Resources Development Act of 1986, Public Law 99-662, as amended (33 U.S.C. 22130, which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until the Non-Federal sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element. The terms of local cooperation to be required in the PPA are described below. A Letter of Intent acknowledging this process and stating their intent to support project implementation has been obtained from the City of Folly Beach.

Federal commitments regarding a construction schedule or specific provisions of the PPA cannot be made to the non-Federal sponsors on any aspect of the Recommended Plan or separable element until the following are true:

- The Recommended Plan is authorized in a Water Resources Development Act (WRDA) or similar legislation.
- Construction funds are appropriated, apportioned by the OMB, and their allocation is approved by the Assistant Secretary of the Army for Civil Works (ASA [CW])
- The draft PPA has been reviewed and approved by the Assistant Secretary of the Army – Civil Works (ASA-CW)

The PPA would not be executed nor would construction be initiated on the project or any separable element until the Final EA has been fully coordinated and a FONSI has been signed and the three aforementioned items are complete.

7.03 Views of the Non-Federal Sponsor

The non-Federal sponsor, the City of Folly Beach, fully supports the Recommended Plan. A letter of support from them will be included in the Final Integrated Feasibility Report/EA.

8 COMPLIANCE WITH ENVIRONMENTAL REQUIREMENTS*

The following paragraphs summarize the relationship of the proposed action to the most pertinent federal, state, and local requirements. Table 8-1 at the end of this section lists the compliance status of all federal laws and policies that were considered for the proposed Folly Beach project.

8.01 National Environmental Policy Act of 1969, as Amended

In 2020, the CEQ issued an update to its regulations for Federal agencies to implement the NEPA. This EA has been prepared in accordance with the updated NEPA, the Council on Environmental Quality regulations (40 Code of Federal Regulations (CFR) parts 1500-1508,1515-1518). To ensure the EA included an assessment of impacts on all significant resources in the project area, the Wilmington District circulated a scoping letter by email dated January 2019, to state and federal resource agencies for a 30-day comment period. A formal scoping meeting was conducted in February 2019. Comments were received from SC Department of Health and Environmental Control (SCDHEC), SC Department of Archives History, and 3 residents. Concerns voiced were predominantly related to super beachfront lots, set back line, submerged cultural resources, sand compatibility and potential impacts to Bird Key Stono. All identified agency and stakeholder concerns were considered during the development of this EA. The draft feasibility study and EA were sent out to the public and resources agencies for a 30-day review on November 10, 2020. In addition, a virtual public information meeting was conducted on December 1, 2020. Comments received and the USACE responses are included in Appendix H.

Clean Water Act of 1972, as Amended

8.01.1 Section 401 of Clean Water Act of 1977

In 2013, SCDHEC issued a notice that stated that groin construction and beach nourishment have very few water quality impacts and have waived the requirement for 401 certifications for these projects. Therefore, the project would follow the requirements of the Section 401 of the Clean Water Act of 1977 (P.L. 95-217), as amended. SCDHEC waiver for 401 certification is included in Appendix I.

8.01.2 Section 404 of Clean Water Act of 1977

Pursuant to Section 404 of the Clean Water Act, the effects associated with the discharge of fill material into waters of the United States are discussed in the Section 404(b)(1) (P.L. 95-217) evaluation in Appendix F. If a hopper dredged is used, incidental fallback associated in the offshore borrow areas is anticipated. Resultant water column impacts associated with sedimentation and turbidity are discussed in Section 5.01.2; however, no measurable increase in bottom elevation is expected from the fallback of sediment during the dredging operations and the activity won't destroy or degrade waters of the United States (33 CFR Section 323.2(d)(2)(iii)). Therefore, incidental fallback from dredging in the borrow area is not being considered a discharge addressed under the Section 404 (b)(1) Guidelines Analysis.

8.02 Magnuson-Stevens Fishery Conservation and Management Act (Essential Fish Habitat)

Potential project effects on EFH species and their habitats have been evaluated and are addressed in Section 5.02.4 of this document. It has been determined that the proposed action would not have a significant adverse effect on such resources. The draft IFR/EA was submitted to the NMFS and in a letter dated January 19, 2021, the NMFS had no EFH conservation recommendations. Compliance obligations related to EFH provisions of the 1996 congressional amendments to the MSFCMA (P.L. 94-265) would be fulfilled before initiation of the proposed action.

8.03 Fish and Wildlife Coordination Act of 1958, as Amended

The Fish and Wildlife Coordination Act, as amended (16 U.S.C. 661, *et seq*), requires that USACE coordinate and obtain comments from the USFWS, the NMFS, where applicable, and appropriate State fish and wildlife agencies.

Coordination with NMFS, SCDNR, and USFWS was conducted and their comments can be found in Appendix H. Since this is a reevaluation of an existing federal project, the USFWS has determined that a Fish and Wildlife Coordination Act is not required.

8.04 Section 7 of the Endangered Species Act of 1973

Pursuant to Section 7 of the Endangered Species Act, informal consultation is ongoing between the USACE and the U.S. Fish and Wildlife Service (USFWS) for development of the Folly Beach Coastal Storm Risk Management Project. Formal consultation was completed for the recent nourishment of the current Folly Beach Coastal Storm Risk Management Project upon issuance of the USFWS Biological Opinion (BiOp) dated July 11, 2018. USFWS has agreed that this Biological Opinion is sufficient for the Recommended Plan. However, USFWS has requested consultation be reevaluated prior to initial construction to ensure an up-to-date BiOp reflecting updated conditions. The USFWS request was based on the upcoming critical habitat designation for red knots and updated information on construction details.

The USACE will accomplish all future work in accordance with the National Maine Fisheries Service (NMFS), 2020 South Atlantic Regional Biological Opinion for Dredging and Material Placement Activities in the Southeast United States utilizing the appropriate project design criteria or any superseding SARBO that is prepared by NMFS.

8.05 Section 106 of the Historic Preservation Act of 1966, as Amended & the Abandoned Shipwreck Act of 1987

Consultation with the South Carolina State Historic Preservation Office (SHPO) and the South Carolina Institute for Archaeology and Anthropology (SCIAA) is ongoing. Detailed surveys of the offshore borrow areas and pipeline routes has been deferred until the Pre-Construction Engineering and Design (PED) phase of the project. Consultation with SHPO and SCIAA will be completed prior to initial construction of the project. Any cultural resources identified in the offshore borrow areas will be avoided during dredging activities. The Folly River borrow area has been dredged previously; therefore, no additional surveys are required in this borrow area.

A programmatic agreement between USACE, SHPO, BOEM, the City of Folly Beach, and SCIAA has been prepared. Comments have been responded to and the revised document redistributed for signature. See Appendix J for a copy of the programmatic agreement.

Title of Public Law or Executive Order	**Compliance Status***	**Section Addressed**
Clean Air Act of 1972, As Amended	Full Compliance	5.01.3
Clean Water Act of 1972, As Amended	Full Compliance	5.01.2 & 8.01
Magnuson Fishery Conservation and Management Act	Full Compliance	5.02.4
Protection of Wetlands, E.O. 11990	Full Compliance	5.04.1 & 8.08
Floodplain Management, E.O. 11988	Full Compliance	5.04.2 & 8.07
Fish and Wildlife Coordination Act of 1958, As Amended	Full Compliance	8.04
Estuary Protection Act of 1968	Full Compliance	5.02
Endangered Species Act of 1973	Full Compliance	5.06 & 8.05
National Historic Preservation Act of 1966, As Amended	Full Compliance	5.08 & 8.06
Abandoned Shipwreck Act of 1987	Full Compliance	5.08
Coastal Barrier Resources Act of 1982	Full Compliance	5.07 & 8.11
Coastal Zone Management Act of 1972, As Amended	Full Compliance	8.10
Federal Actions to Address Environmental Justice and Minority and Low-Income Populations, E.O. 12898	Full Compliance	5.11.3 & 8.13

Table 8-1. The relationship of the proposed action to federal laws and policies.

*Full compliance once the NEPA process is complete.

8.06 South Carolina Coastal Zone Management Program

The proposed action would be conducted in the designated coastal zone of South Carolina. Pursuant to the Federal Coastal Zone Management Act of 1972, as amended (P.L. 92-583), Federal activities are required to be consistent, to the maximum extent practicable, with the federally approved coastal management program of the State in which their activities will occur.

The components of the proposed action have been evaluated and determined to be consistent, to the maximum extent practicable, with the South Carolina Coastal Management Program. The draft IFR/EA was provided to South Caroline Department of Environmental Control-Office of Ocean and Coastal Resource Management (OCRM) and no comments were received. In a letter dated September 3, 2021 (Appendix I), the OCRM conditionally concurred with the USACE is consistent to the maximum extent practicable with the following conditions:

1. A comprehensive monitoring program for the Folly Beach project must be performed to assess and ensure project functionality throughout its design lifetime. This monitoring should include, but not limited to, an evaluation of the material place on the shoreline for beach compatibility and profile surveys to monitor effectiveness of construction and lifespan of renourishment events.
2. Dredging and construction activities must be consistent with any future Biological Opinions received from the US Fish and Wildlife Service and/or NOAA National Marine Fisheries to ensure the protection of threatened and endangered species along with any critical habitats.
3. Activities located within the designated CBRA zones should adhere to the requirements and limitations within the Coastal Barrier Resources Act.
4. Any modifications to the proposed project, to include but not limited to changes in borrow area locations, dredge method, berm construction width, or beachfill volumes, must be coordinated with the SCDHEC OCRM to ensure continued consistency with the enforceable policies within the S. C. Coastal Zone Management Program.

All conditions of the consistency concurrence shall be implemented in order to minimize adverse impacts to the coastal zone.

8.07 Coastal Barrier Resources Act of 1982

The Coastal Barrier Resources Act (CBRA) of 1982 (P.L. 97-348) prohibits expenditure of federal funds for activities within the designated limits of the Coastal Barrier Resources System unless specifically exempted by Section 6 of the act.

Designated maps showing the Coastal Barrier Resources System in South Carolina indicate two sites within the study area limits, but neither area is within the beach fill template. The Morris Island Complex (M06) is located at northeast end of the island, and the Bird Key Complex (M07/M07P) is located at the southwest end of the island. The USACE initiated consultation with the USFWS under the Coastal Barrier Resources Act and determined utilization of the Folly River and Borrow Area K as borrow sites for the Folly Beach CSRM project would qualify under the exception to CBRA found at 16 U.S.C. 3505(a)(6)(G) for "non-structural projects for shoreline stabilization that are designed to mimic, enhance, or restore a natural stabilization system." The USFWS responded that they believe these borrow do not meet an exception to the CBRA and therefore, the USACE has removed them from the Recommended Plan (Appendix I). Nevertheless, both borrow areas have been included in the impacts analysis in the event they may meet any future exceptions.

8.08 Estuary Protection Act of 1968

The Estuary (Estuarine) Protection Act provides a means to protect, conserve, and restore estuaries in a manner that maintains balance between the need for natural resource protection and conservation and the need to develop estuarine areas to promote national growth. The act authorizes the Secretary of the Interior to work with the states and other federal agencies in undertaking studies and inventories of estuaries of the United States.

The proposed project would be expected to have minimal effect on the estuarine environment, as discussed in Section 5.02 of this report; therefore, the project would be in compliance with the Estuary Protection Act.

8.09 Clean Air Act of 1972, as Amended

The Clean Air Act requires the U.S Environmental Protection Agency (EPA) to establish health and science-based standards for air pollutants that have the highest levels of potential harm to human health or the environment. The ambient air quality for Charleston County has been determined to be in compliance with the National Ambient Air Quality Standards and is designated as an attainment area. The State of South Carolina has a State Implementation Plan approved or promulgated under Section 110 of the Clean Air Act, as amended. The direct and indirect emissions from the proposed project fall below the prescribed de minimis levels; therefore, the project would be in compliance with the Clean Air Act.

9 SUMMARY OF AGENCY AND PUBLIC INVOLVEMENT*

9.01 Scoping

A scoping letter describing the proposed Folly Beach Study and requesting public and agency participation was circulated in January 2019. A public scoping meeting was held on February 19, 2019. Responses were received from: the U.S. Fish and Wildlife Service, U.S. Environmental Protection Agency and the South Carolina Office of the State Underwater Archaeologist and residents of Folly Beach.

The U.S. Fish and Wildlife Service stated concerns about sand compatibility, and the location of future borrow areas and their proximity to Bird Key Stono. The USACE made the necessary adjustments, such as increasing the number of sediment cores and decreasing the spacing between them, to improve the accuracy of the borrow area mapping process.

The U.S. Environmental Protection Agency stated concerns for the following environmental resources: wetlands, water quality, noise, air quality, environmental justice recreation socioeconomics and green infrastructure. The USACE addressed each resource and is incorporated in the Recommended Plan.

The South Carolina Office of the State Underwater Archaeologist stated concerns for the potential impacts to submerged cultural resources. A programmatic agreement between USACE, SHPO, BOEM, the City of Folly Beach, and SCIAA has been prepared. Comments have been responded to and the revised document redistributed for signature. See Appendix J for a copy of the programmatic agreement.

The residents' concerns included beach front development and high erosion rates. The issue of beachfront development was raised by several residents both in person at public scoping and in writing. USACE policy is that beachfront development cannot be addressed in the Federal project and is wholly a city responsibility. The high rate of erosion was considered and is incorporated in the Recommended Plan.

9.02 Cooperating Agencies

Pursuant to Section 1501.8 of the CEQ NEPA Regulations, the Bureau of Ocean Energy Management (BOEM) has agreed to participate as a cooperating agency during the preparation of the Integrated Feasibility Report and Environmental Assessment. BOEM has assisted and will continue to assist in developing information and preparing environmental analyses in areas which the BOEM has special expertise. This assistance enhances the interdisciplinary capability of the study team.

Public Law 103-426 enacted 31 October 1994 gave BOEM the authority to convey, on a noncompetitive basis, the rights to Outer Continental Shelf (OCS) sand, gravel, or shell resources for shore protection; beach or wetlands restoration projects; or for use in construction projects funded in whole or part or authorized by the federal government. In implementing this authority, BOEM may issue a negotiated non-competitive lease agreement for the use of OCS sand to a qualifying entity. OCS resources (beyond three miles) fall under BOEM's jurisdiction, as found in the OCS Land Act.

9.03 Coordination of this Document

The draft feasibility study and EA were sent out to the public and resources agencies for a 30-day review on November 10, 2020. In addition, a virtual public information meeting was conducted on December 1, 2020. Comments received and the USACE responses are included in Appendix H.

9.04 Recipients of this Document

Tribes

Absentee-Shawnee Tribe of Oklahoma
Alabama- Quassarte Tribal Town
Catawba Indian Nation
Chickasaw Nation
Delaware Tribe of Indians
Eastern Band of the Cherokee Indians
Eastern Shawnee Tribe of Oklahoma
Kialegee Tribal Town
Muscogee (Creek) Nation
Poarch Band of Creek Indians
Shawnee Tribe
Thlopthlocco Tribal Town

Federal Agencies

U.S. Environmental Protection Agency
Bureau of Ocean and Energy Management
National Marine Fisheries Service
U.S. Fish and Wildlife Service
US Department of Agriculture - National Resources Conservation Service
Commander, Fifth Coast Guard District

State Agencies

South Carolina Department of Natural Resources
South Carolina Department of Health and Environmental Control
South Carolina Department of Archives and History
South Carolina Institute Archaeology and Anthropology

Local Governments

Mayor, City of Folly Beach
City Administrator, City of Folly Beach

Charleston County Parks, Recreation and Tourism

Elected Officials

South Carolina United States Senators and Local District United States Congressmen
Local State Senators and Representatives

Conservation Groups/Recreation Groups

The Nature Conservancy
National Audubon Society
National Wildlife Federation
Sierra Club
Coastal Conservation League

10 CONCLUSIONS*

The Coastal Storm Risk Management problems and needs of the study area have been reviewed and evaluated with regard to the federal and non-Federal interests and with consideration of engineering, economic, environmental, social, and cultural concerns. The conclusions of the study are summarized as follows:

a) The Folly Beach shoreline is susceptible to major damage from future erosion and coastal storms.

b) The Recommended Plan consists of a 5.85 mile (30,890 linear foot) main dune and berm combination beach fill. The southwest portion of the project includes a 35 ft wide berm between reaches 1 to 17 for 19,170 feet (ft), see Figure ES-1. This includes the 2,200 ft County Park portion of the Recommended Plan plus the 16,970 ft portion of the Recommended Plan that has a 35 ft wide berm. The northeast portion includes a 50 ft wide berm between reaches 18 to 26 for 9,720 ft, plus a 2,000 ft portion of the Recommended Plan which includes the County-administered Lighthouse Inlet Heritage Preserve. The berm will be at elevation 8.0 ft North American Vertical Datum 88 (NAVD88). The Plan includes constructing a new dune or raising the existing dune to a uniform elevation of 15 ft NAVD88 with a minimum top width of five (5) ft. Neither the County Park in the southern end of the Recommended Plan nor the Lighthouse Inlet Heritage Preserve at the northern end of the Recommended Plan would feature a dune. The beach fill includes a 750-foot tapered transition at the ends of the project and a 500 ft transition between the 35 ft and 50 ft wide berm. During the 50-Year period of recommended federal participation in the Recommended Plan, material for the beach fill would be dredged from proposed borrow sources and likely transported to the beach by pipeline for the beach fill construction and all renourishments. The renourishment interval for the project is approximately twelve years.

c) The Recommended Plan is feasible on the basis of engineering and economic criteria, and is acceptable by environmental, cultural, and social laws and standards.

d) The Recommended Plan is supported by the non-Federal sponsor, the City of Folly Beach, South Carolina. The sponsor has the capability to provide the necessary non-federal requirements identified and described in section 7.02 of this report.

The estimated First Cost of the Recommended Plan is $241,735,000 in FY2022 price levels, which would be cost-shared at approximately 87% federal ($209,914,000) and 13% non-Federal ($31,821,000), in accordance with the cost-sharing exclusive to the project, as discussed in the Section 111 Appendix. Operations and maintenance costs are estimated at $101,000 a year and would be a 100% non-Federal responsibility. The project includes an approximate 12-year renourishment cycle (initial construction, plus three renourishments) with an estimated cost of $50,544,000 for initial construction and $191,191,000 over three renourishments (approximately $63,730,000 per renourishment). Initial construction would be cost-shared on approximately 90% federal and 10% non-Federal basis. Renourishments would be cost-shared approximately 86%

federal and 14% non-Federal basis. The benefit cost ratio is 9.5 to 1 (including Recreational Benefits). The total cost for initial construction and the three renourishments is $241,735,000 ($50,544,000 for initial construction plus $63,730,000 on average per renourishment, for the three renourishments).

11 DISTRICT ENGINEER'S RECOMMENDATIONS*

This study addresses the needs for Coastal Storm Risk Management for Folly Beach, South Carolina. The following recommendations include items for implementation by the Federal Government, State of South Carolina, and local governments and agencies, including the structural Coastal Storm Risk Management project. In order for risks to life and safety to be reduced, any structural project should be accompanied by additional measures meant to assure that residents have sufficient warning, knowledge, and resources to evacuate the area well ahead of hurricane arrival. Recommendations for these types of measures are listed below. While many of these recommendations may already be in place, due to their importance they are being reinforced as a component of this project.

11.01 Coastal Storm Risk Education

Numerous people have died as a result of hurricanes and other coastal storms, primarily because of the failure to evacuate to an area of safety. Any loss of life is tragic, and any number of those deaths might have been prevented. Even one death prevented is sufficient reason to improve our methods of educating the public on hurricane and storm threats and to ensure that all is done to warn all those residents or visitors to the coastline of South Carolina as to the dual hazards of wind and surge/waves. It is particularly vital to inform the public as to the potential for hurricane occurrence, particularly in the dangerous hurricane season, so they pay continued attention to media reports on weather. Education needs to include articulation of effects related to the potential magnitude of the threat, the urgency to heed potential calls to evacuate, and providing the means by which to make wise choices on evacuation methods and route (see recommendations given below under Hurricane Evacuation Planning). The following are suggested guidelines for implementation by State and local government, in the interests of good education on hurricane storm threats:

- Provide good science and information to the residents and visitors to coastal South Carolina, so they can understand the nature of the threat, and its possibility of happening at any time, especially within the hurricane season. This information should be provided in both written form and as an initial graphic on televisions provided in visitor's housing, and also in a variety of venues, including the following:
  - Posted and televised education in supermarkets, libraries, and public buildings
  - Teacher-provided, posted, and televised education in schools and at public meetings and gatherings, at intervals not to exceed 1 year
  - Publicly posted and visitor-housing-posted information on evacuation routes, and procedures, on publicly accessible Web sites, updated regularly (minimum 1 yr.)

It is not possible to maintain the lives and safety of coastal South Carolina residents and visitors if they do not have sufficient warning and if they then do not use that knowledge to evacuate in a timely manner.

Education regarding coastal storm risks is an ongoing effort of multiple agencies and educational institutions and not a funded program under existing USACE authorities. Updating Web sites containing evacuation routes and procedures should be done under existing programs implemented by State and local governments.

11.02 Hurricane and Storm Warning

Residents and visitors to the coast of South Carolina need to recognize that they live in, or visit, a high-hazard area. Although certain times of the year pose less risk than others, each year's hurricane season provides a strong possibility of hurricane impact somewhere along the coast of South Carolina. All residents and visitors need to be made aware of the current hurricane threat. But first, meteorological conditions must be evaluated, and any threat must be assessed and characterized by experts at NOAA's National Weather Service. That interpretation must then be passed to national and local media for dissemination. Continued support of NOAA's program, and the following supportive activities are critical to an adequate warning process:

- Ongoing efforts to upgrade the existing system of NOAA buoys, transmission capabilities, and advanced warning measures that provide data on the location and nature of weather conditions.
- Efforts directed at the interpretation of that data and its dissemination to the media and public, through the National Weather Service.
- Public appreciation for the need to be aware at all times of, and the need to listen to weather reports and advice given on various media. Television weather reports, radio, and the Internet all provide excellent, up-to-date information on weather conditions, and the development of threatening situations. Simply living in or visiting the barrier islands of South Carolina should be sufficient to create a consistent and ongoing process of being exceptionally aware of the weather and its potential consequences.
- The vital importance of heeding the advice of experts. One should know what needs to be done when a storm is approaching. Family members should conduct evacuation drills, keep needed phone numbers and travel supplies on hand, and be prepared to leave on short notice. One should be aware of evacuation routes, keep a full tank of gas during the hurricane season and have a plan for where one should go, how to maintain contact with other family members, and where one will relocate temporarily, particularly if the event turns out to be longer than expected.

11.03 Storm Evacuation Planning Upgrading

The critical need for adequate evacuation planning was borne out by Hurricanes Bertha, Fran, and Floyd, of the late 1990s, and brought even more to the forefront by the monumental impacts of Hurricane Katrina in 2005. An evacuation plan is an essential component of a comprehensive plan for ensuring the safety of residents of, and visitors, to the coast of South Carolina. The preservation of life is the single most important goal and objective of the recommendations. Joint FEMA/NOAA/USACE/South Carolina studies of evacuation routes and populations along the coastline has provided a tremendous amount of value to-date in aiding local government, individual, and family readiness in the face of approaching events. Support for that program is a critical element of the recommendations for the towns located on Folly Beach in support of its residents and visitors.

The following are some recommendations in support of efforts to support Hurricane Evacuation

Planning:

- Update this ongoing effort and to provide new and more widely disseminated data and tools for evacuation planning by the State and the towns, and also for use by individuals and families in their preparation for an impending event.
- Evacuation route signage is an important part of a successful evacuation campaign. Maintenance of hurricane evacuation route signage is viewed as a vital link in ensuring the safety of residents and visitors alike.
- The provision of additional signage illustrating surge height achieved during past events would be an added and continual link to ongoing education efforts. That could take the form of signs placed in locations in which there is significant traffic, such as major thoroughfares, where pedestrians walk, and particularly in those highest hazard zones according to elevation/depth data.

Evacuation Planning is an ongoing effort of multiple agencies, including the USACE, but its implementation is not a funded program under existing USACE authorities. Updating Web sites containing evacuation routes and procedures should be periodically updated under existing programs implemented by South Carolina.

A recommendation is also made that the sponsor add to their public access signage that includes text to the following “Evidence of erosion or scarping does not mean that the project is not functioning as intended. Erosion is a natural process on all barrier islands. Evidence of erosion will periodically be visible on this beach.

11.04 Structural Damage Reduction Features and Items of Local Cooperation

On the basis of the conclusions of this study, I recommend the implementation of the Recommended Plan, which consists of a 5.85 mile (30,890 linear foot) main dune and berm combination beach fill. The southwest portion of the project includes a 35 ft wide berm between reaches 1 to 17 for 19,170 feet (ft), see Figure ES-1. This includes the 2,200 ft Folly Beach County Park portion of the Recommended Plan plus the 16,970 ft portion of the Recommended Plan between reaches 2-17. The northeast portion includes a 50 ft wide berm between reaches 18 to 26 for 9,720 ft, plus a 50 ft wide berm in the 2,000 ft portion of the Recommended Plan which includes the County-administered Lighthouse Inlet Heritage Preserve. The berm is at elevation 8.0 ft North American Vertical Datum 88 (NAVD88). The Plan includes constructing a new dune or raising the existing dune to a uniform elevation of 15 ft NAVD88 with a minimum top width of 5 ft between reaches 2-26. Neither the County Park in the southern end of the Recommended Plan nor the Lighthouse Inlet Heritage Preserve at the northern end of the Recommended Plan would feature a dune. The beach fill includes a 750-foot tapered transition at the ends of the project and a 500 ft transition between the 35 ft and 50 ft wide berm. During the 50-Year period of recommended federal participation in the Recommended Plan, material for the beach fill would be dredged from proposed borrow sources and transported to the beach by pipeline for the beach fill construction and all renourishments. The renourishment interval for the project is approximately twelve years.

The total estimated First Cost of the Recommended Plan is $241,735,000 in FY2022 price levels, which would be cost-shared approximately 87% federal ($209,914,000) and 13% non-Federal ($31,821,000), in accordance with the cost-sharing exclusive to the project, as discussed in the Section 111 Appendix. Operations and maintenance costs are estimated at $101,000 a year and would be a 100% non-Federal responsibility. The project includes an approximate 12-year renourishment cycle (initial construction, plus three renourishments) with an estimated cost of $50,544,000 for initial construction and $191,191,000 over three renourishments (approximately $63,730,000 per renourishment). Initial construction would be cost-shared approximately 90% federal and 10% non-Federal basis. Renourishments would be cost-shared approximately 86% federal and 14% non-Federal basis. The benefit cost ratio is 9.5 to 1 (including Recreational Benefits). The total cost for initial construction and the three renourishments is $241,735,000 ($50,544,000 for initial construction plus $63,730,000 on average per renourishment, for the three renourishments).

As a result of the Feasibility Study and EA, I recommend that the project be authorized and implemented in accordance with the findings of this report.

Federal implementation of the project for coastal 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.

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.

11.05 Recommended Plan Summary

The total estimated First Cost of the project, at FY2022 price levels, is $241,735,000. The federal share, approximately 87%, of the total estimated project cost is estimated at $209,914,000. The non-Federal share, approximately 13%, of the total estimated project cost is estimated at $31,821,000. As previously indicated, the total project benefit-cost ratio is 9.5 to 1, meaning for every dollar spent on the project, approximately 9 dollars and 50 cents are realized in NED benefits.

Table 11-1 presents all applicable economic results at the FY2021 price level for the Recommended Plan at the interest rate of 2.5%. The Recommended Plan's benefit to cost ratio at 2.5% interest is 0.87 to 1, while considering CSRM benefits, 1.73 to 1 while considering recreation allowable for project justification, and 9.5 to 1, with full incidental recreation benefits.

Economic Category	Primary Storm Damage Reduction Benefit	Primary Storm Damage Reduction Benefit + Recreation Benefit for Project Justification	Primary Storm Damage Reduction Benefit + Full Incidental Recreation Benefit
Price Level	FY2021	FY2021	FY2021
FY2021 Federal Discount Rate	2.5%	2.5%	2.5%
Average Annual CSRM Benefit	$4,765,000	$4,765,000	$4,765,000
Average Annual Incidental Recreation Benefit	-	$4,765,000	$47,753,000
Average Annual Total Benefit	$4,765,000	$9,529,000	$52,518,000
Average Annual Total Cost	$5,500,000	$5,500,000	$5,500,000
Average Annual Net Benefit	-$735,000	$4,029,000	$47,018,000
BCR	0.87	1.73	9.5

Table 11-1. Applicable economic results at the FY2021 price level for the Recommended Plan at the interest rate of 2.5%.

The BCR as shown uses an intermediate sea level rise scenario. Other scenarios are illustrated in Table 6-4 that include a low, intermediate, and high rate of sea level rise. The Recommended Plan contained herein reflects 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 Recommended Plan may be modified before it is transmitted to Congress as a proposal for implementation funding. Prior to transmittal to Congress, the sponsor, State of South Carolina, interested federal agencies, and other parties will be advised of any modifications and will be afforded an opportunity to comment further.

Benjamin A. Bennett
Colonel, EN Commanding

12 POINT OF CONTACT*

Any comments or questions regarding this Integrated Feasibility Report and Environmental Assessment should be addressed to Folly Beach Project Manager, U.S. Army Corps of Engineers, 69 Darlington Avenue, Wilmington, NC 28403.

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ID the agency/org followed by the website link.

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City of Folly Beach
P.O. Box 48
Folly Beach, South Carolina 29439

September 12, 2018

Lieutenant Colonel Jeffrey Palazzini,
Commander, Charleston District
United States Army Corps of Engineers
69A Hagood Avenue
Charleston, SC 29403

Dear Lt. Col. Palazzini:

With respect to the recently passed Bipartisan Budget Act of 2018 (Public Law 115-123), the City of Folly Beach is willing and able to participate as the Sponsor for the Folly Beach Feasibility Study, in partnership with the U.S. Army Corps of Engineers (USACE), to cooperatively investigate erosion on the beachfront of Folly Beach.

The City of Folly Beach understands that a study cannot be initiated unless it is selected as a viable study with associated allocation of Federal funds provided through Public Law 115-123. After signing the agreement, a Project Management Plan will be developed and agreed upon by our agency and USACE. The study will be conducted and managed by USACE. The cost-sharing for the study, with funds from Public Law 115-123, will be 100% Federal.

The City of Folly Beach is aware that this letter constitutes an expression of intent to initiate a study partnership to address the specified water resources problems and is not a contractual obligation. We understand that work on the study cannot commence until it is included in the Administration's request, funds are allocated by the Office of Management and Budget, and an agreement is signed. It is understood that we or USACE may opt to discontinue the study at any time after the agreement is signed but will commit to work together as partners from the scoping phase, and subsequent decision points throughout the feasibility study, on providing the necessary support to risk-informed decision making. If it is determined that additional time or funding is necessary to support decisions to be made in order to complete the study, our agency will work with USACE to determine the appropriate course of action.

We also understand that if the results of the feasibility study culminate in a project that is found to be to be technically feasible, economically justified, and environmentally acceptable, that the Report of the Chief of Engineers could potentially make the project available for Preconstruction

Engineering and Design and eventual Construction under Public Law 115-123, subject to the availability of funds. We are prepared to work with USACE as these situations develop and are prepared to engage in negotiations on future agreements and potential Operations and Maintenance obligations as this project moves forward.

If you require additional information, please contact: Spencer Wetmore, City Administrator, at swetmore@cityoffollybeach.com

Sincerely,

Mayor Tim Goodwin
City of Folly Beach

FINDING OF NO SIGNIFICANT IMPACT

Folly Beach Coastal Storm Risk Management
Integrated General Reevaluation Study and Environmental Assessment
Folly Beach, Charleston County, South Carolina

The U.S. Army Corps of Engineers, Wilmington District (Corps) has conducted an environmental analysis in accordance with the National Environmental Policy Act of 1969, as amended. The final Integrated Feasibility Report and Environmental Assessment (IFR/EA) dated **DATE OF IFR/EA**, for the Folly Beach Coastal Storm Risk Management Project evaluates Coastal Storm Risk Management opportunities in Folly Beach, Charleston County, South Carolina. The Bureau of Ocean Energy Management is a cooperating agency under the National Environmental Policy Act for this project due to the proposed use of Outer Continental Shelf sand resources. The final recommendation is contained in the report of the Chief of Engineers, dated **DATE OF CHIEF'S REPORT**.

The Final IFR/EA, incorporated herein by reference, evaluated various alternatives that would reduce the adverse economic effects of coastal storms and erosion at Folly Beach, while protecting the Nation's environment in the study area. The recommended plan is the National Economic Development (NED) Plan and includes:

- The Recommended Plan consists of a 5.85 mile (30,890 linear foot) main dune and berm combination beach fill.
- The southwest portion of the project includes a 35 ft wide berm between reaches 1 to 17 for 19,170 ft.
- The northeast portion includes a 50 ft wide berm between reaches 18 to 26 and the Heritage Preserve for 11,720 ft.
- The berm is at elevation 8.0 ft.
- The Plan includes constructing a new dune or raising the existing dune to a uniform elevation of 15 ft NAVD88 with a minimum top width of 5 ft for reaches 2-26. Reach 1 (County Park) and the Heritage Preserve are berm only and have no dune.
- The beach fill includes a 750-foot tapered transition at the ends of the project and a 500 ft transition between the 35 ft and 50 ft wide berm.
- During the 50- Year period of recommended federal participation in the Recommended Plan, material for the beach fill would be dredged from two proposed offshore borrow sources and one riverine borrow source, transported to the beach by pipeline, for the beach fill construction.
- The renourishment interval for the project is twelve years.

Numerous alternatives were considered, but only Alternative 1 (No-Action), Alternative 3 (Recommended Plan) and Alternative 7 (Non- Structural) were evaluated in detail. Alternatives 2, 4, 5 and 6 have similar environmental consequences as Alternative 3 and therefore not further analyzed.

For both alternatives, the potential effects were evaluated, as appropriate. A summary assessment of the potential effects of the recommended plan are listed in Table 1:

Table 1: Summary of Potential Effects of the Recommended Plan

	Insignificant effects	Insignificant effects as a result of mitigation	Resource unaffected by action
Aesthetics	☒	☐	☐
Air quality	☒	☐	☐
Aquatic resources/wetlands	☒	☐	☐
Invasive species	☐	☐	☒
Fish and wildlife habitat	☒	☐	☐
Threatened/Endangered species/critical habitat	☒	☐	☐
Historic properties	☐	☒	☐
Other cultural resources	☐	☒	☐
Floodplains	☐	☐	☒
Hazardous, toxic & radioactive waste	☐	☐	☒
Hydrology	☒	☐	☐
Land use	☒	☐	☐
Navigation	☒	☐	☐
Noise levels	☒	☐	☐
Socioeconomics	☒	☐	☐
Environmental justice	☐	☐	☒
Soils	☒	☐	☐
Tribal trust resources	☐	☐	☒
Water quality	☒	☐	☐
Climate change	☒	☐	☐
Sea Level Rise	☒	☐	☐
Coastal barrier resources	☒	☐	☐

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, as appropriate, to minimize impacts. Environmental commitments can be found in Appendix I.

No compensatory mitigation is required as part of the recommended plan.

Public review of the draft IFR/EA and FONSI was completed on December 10, 2020. All comments submitted during the public review period were responded to in the Final IFR /EA and FONSI. A 30-day state and agency review of the Final IFR /EA was completed on **DATE SAR PERIOD ENDED**. Comments from state and federal agency review did not result in any changes to the final IFR/EA.

Pursuant to Section 7(a)(2)/7(d) of the Endangered Species Act of 1973, as amended, the U.S. Army Corps of Engineers determined that of the species under the USFWS's purview, the recommended plan may affect, not likely to adversely affect the West Indian Manatee, Seabeach Amaranth, Green, Hawksbill, Kemp's Ridley, and Leatherback Sea Turtles and may affect, likely to adversely affect the following federally listed species or their designated critical habitat:

- Piping Plover
- Piping plover critical habitat
- Red Knot
- Loggerhead Sea Turtle
- Loggerhead Sea Turtle Critical Habitat (per Section 5.05.3 in IFR/EA)

The USFWS concurred with the Corps' determination on August 2, 2021.

Pursuant to Section 7(a)(2)/7(d) of the Endangered Species Act of 1973, as amended, the U.S. Army Corps of Engineers determined that of the species under the NMFS's purview, the recommended plan may affect, not likely to adversely affect the Blue, Sei, Sperm, Finback and North Atlantic Right Whales, Hawksbill and Leatherback Sea Turtles and Atlantic Sturgeon, and may affect, likely to adversely affect the following federally listed species or their designated critical habitat:

- Green Sea Turtle
- Kemp's Ridley Sea Turtle
- Loggerhead Sea Turtle

Pursuant to Section 106 of the National Historic Preservation Act of 1966, as amended, the U.S. Army Corps of Engineers has made a determination that the recommended plan has no significant impacts on historic properties following the stipulations of the Programmatic Agreement between USACE, SHPO, BOEM, the City of Folly Beach, and SCIAA. Detailed surveys of the offshore borrow areas and pipeline routs has been deferred until the Pre-Construction Engineering and Design (PED) phase of the project.

Pursuant to the Clean Water Act of 1972, as amended, the discharge of dredged or fill material associated with the recommended plan has been found to be compliant with section 404(b)(1) Guidelines (40 CFR 230). The Clean Water Act Section 404(b)(1) Guidelines evaluation is found in Appendix F of the IFR/EA.

The South Carolina Department of Health and Environmental Control has waived water quality certification pursuant to section 401 of the Clean Water Act, as follows. Notice was published on October 22, 2010 in the South Carolina State Register. A copy of the letter can be found in Appendix I.

A consistency concurrence with the State of South Carolina Coastal Zone Management program pursuant to the Coastal Zone Management Act of 1972 was obtained from the South Carolina Department of Health and Environment Control, Office of Ocean and Coastal Resources Management prior to construction. In a letter dated September 3, 2021, the South Carolina Department of Health and Environmental Control- Office Ocean and Coastal Resource Management stated that the recommended plan appears to be consistent with state Coastal Zone Management plans, pending confirmation based on information to be developed during the Pre-construction, Engineering and Design (PED) phase. All conditions of the consistency concurrence shall be implemented in order to minimize adverse impacts to the coastal zone.

The Corps will enter into a lease agreement with the Bureau of Ocean Energy Management for the use of Federal Outer Continental Shelf sand for the initial construction or periodic renourishments.

All applicable environmental laws have been considered and coordination with appropriate agencies and officials has been completed. In a letter dated January 19, 2021, the NMFS had no EFH conservation recommendations. The Fish and Wildlife Service stated in a letter dated August 5, 2021 that they believe the project does not meet an exception to the CBRA.

Technical, environmental, and economic criteria used in the formulation of alternative plans were those specified in the Water Resources Council's 1983 Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies. All applicable laws, executive orders, regulations, and local government plans were considered in evaluation of alternatives. Based on this report, the reviews by other Federal, State and local agencies, Tribes, input of the public, and the review by my staff, it is my determination that the recommended plan would not cause significant adverse effects on the quality of the human environment; therefore, preparation of an Environmental Impact Statement is not required.

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Date

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Benjamin A. Bennett
Colonel, Corps of Engineers
District Commander