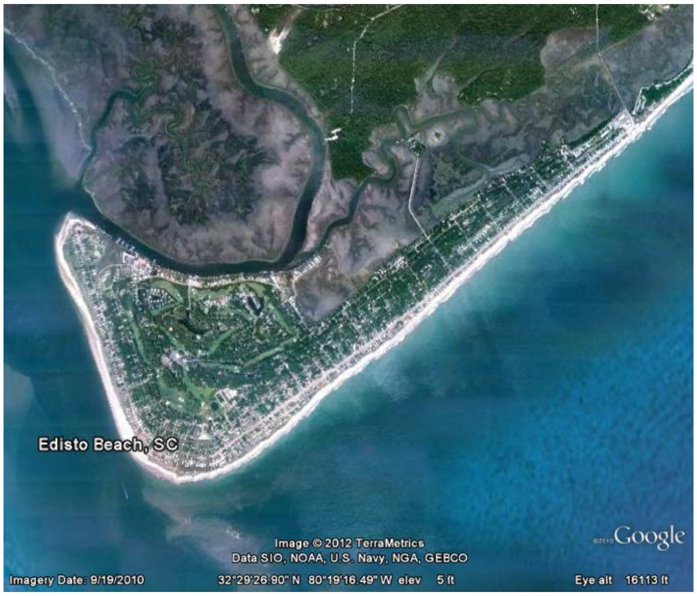
US Army Corps
Of Engineers®
Charleston District

FINAL INTEGRATED FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT

COASTAL STORM DAMAGE REDUCTION GENERAL INVESTIGATION STUDY

EDISTO BEACH, COLLETON COUNTY SOUTH CAROLINA

February 2014



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EXECUTIVE SUMMARY

This Integrated Feasibility Report and Environmental Assessment presents the results of studies performed to examine the feasibility of federal coastal storm damage reduction for the Town of Edisto Beach, South Carolina. It describes baseline conditions, the formulation and evaluation of alternative plans and the identification of a Recommended Plan.

Edisto Island is a barrier island located at the mouth of the South Edisto River in Colleton County, South Carolina, approximately 45 miles southwest of Charleston, South Carolina and approximately 20 miles east-northeast of Beaufort, South Carolina. The study area is illustrated in Figure S.1. Edisto Beach encompasses approximately 6 miles of sand shoreline, all of which were included in the feasibility study.

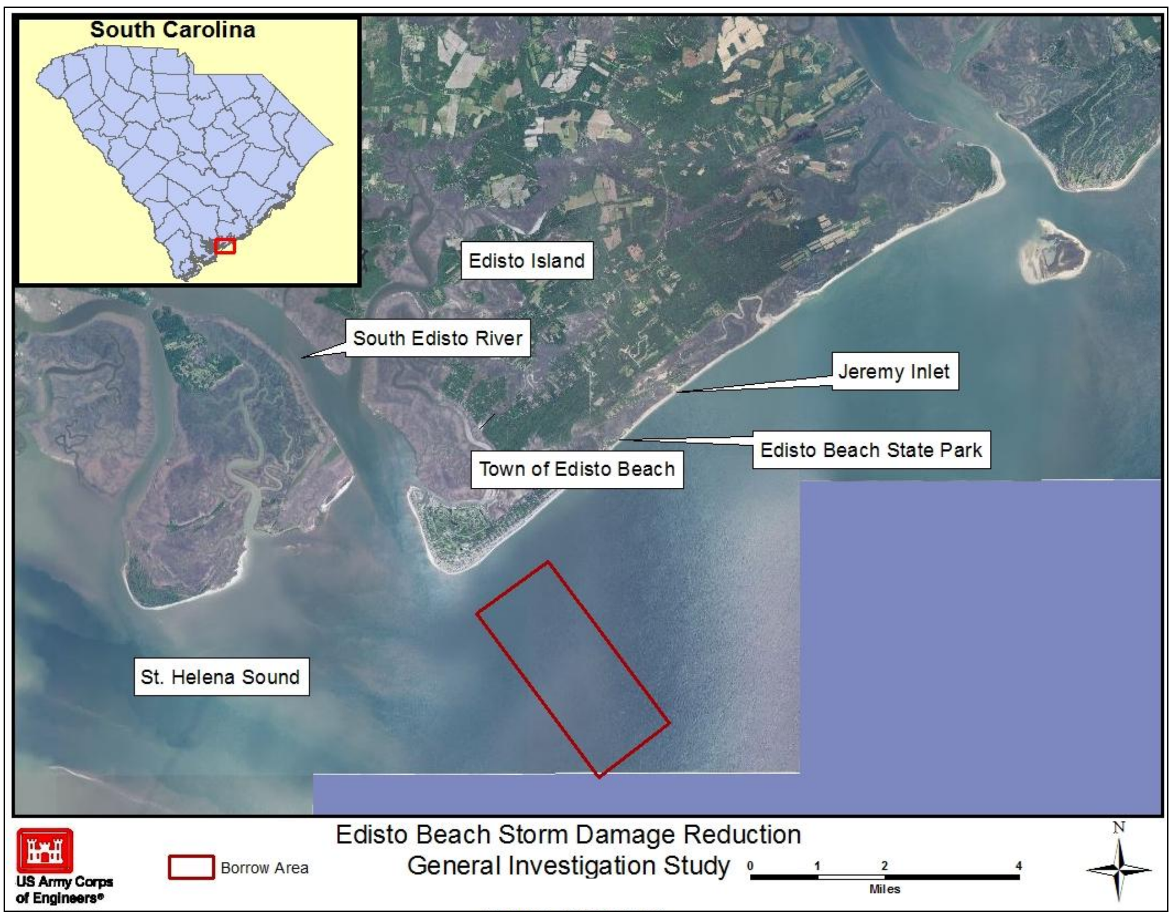

Figure S.1: Location of Edisto Beach study area.

The primary goal of the study is to reduce the adverse economic effects of coastal storms at Edisto Beach. Six action alternatives and the no action alternative were evaluated and compared in order select and recommend an alternative. The action alternatives included:

1. Mid-size dune and berm fill combined with 1,090 ft of groin lengthening
2. Minimum size dune and berm fill combined with 360 ft of groin lengthening
3. Maximum size dune and berm fill combined with 1,970 ft of groin lengthening
4. Mid-size dune and berm fill combined with 1,130 ft of groin lengthening
5. Dune sand fencing on some reaches with dune and berm fill on other reaches
6. Non-Structural/Demolition (over limited reaches)

The mid-size dune and berm fill combined with 1,130 ft of groin lengthening alternative (number 4 above) generated the highest net economic benefits and was selected as the recommended plan. The primary features of the plan are illustrated in Figure S-2 and summarized in the text, below.

The primary features of the Recommended Plan include:

- A 15-foot high, 15-foot wide dune beginning at the northern end of the project and extending southward along the beach for 16,530 feet. This dune would be fronted by a 7-foot high (elevation) berm. The first 7,740 feet of berm length would have a width of 75 feet. The width would taper to a 50-foot width over the remaining length of the berm. The width of each end of the berm would taper to match the existing beach profile

- Beginning at the southern end of the 15-foot high dune, the dune would transition to a 14-foot high, 15-foot wide dune and extend around the end of the island for 5,290 feet. No berm would be constructed in front of this dune because the existing beach profile provides an adequate berm

- Approximately 1,130 ft of groin lengthening across 23 of the existing groins.

- 16-year renourishment interval

It is worth noting that the Edisto Beach State Park was initially a part of the study area. However, it was not included in the Recommended Plan because of a lack of existing infrastructure needed to generate enough benefits to justify the cost to protect that portion of beach.

Figure S.2: Primary Features of Recommended Plan

Based on 2014 price levels, the initial construction cost of the project is $21,129,000, and the renourishment cost that is expected to occur every 16 years is $10,914,000, with the present value totaling $16,030,800. The interest during construction is approximately $106,800 and operations and maintenance approximately $83,000. The project related costs, including the total average annual cost for the Recommended Plan are summarized in Table S.1, below.

Table 1: Recommended Plan Cost Summary

Initial Construction	$	21,129,000
1st Renourishment	$	6,294,200
2nd Renourishment	$	3,629,900
3 Renourishment	$	2,093,400
Total First Cost	$	33,146,400
Interest During Construction	$	106,800
Total Project Cost	$	33,252,800
Average Annual First Cost	$	1,418,000
O&M	$	83,000
Total Average Annual Cost	**$**	**1,501,000**

The total expected average annual coastal storm damage reduction benefits (at 3.5% interest rate) for the Recommended Plan are estimated to be $2,849,000. The average annual recreation benefits are $573,200. The benefits associated with the Recommended Plan, as well as the Benefit-to-cost ratio are summarized in Table S.2, below.

Table S.2: Recommended Plan Benefits Summary

Average Annual CSDR Benefits	$2,894,000
Average Annual Recreation Benefits	$ 573,200
Total Average Annual Benefits	$3,467,200
Total Average Annual Cost	$1,501,000
Benefit-to-Cost Ratio	2.3
Net Average Annual Benefits	$1,966,200

The Environmental Assessment and Finding of No Significant Impact were distributed in August 2013 for a 30 day comment and review period. The Final Environmental Assessment addresses the comments received during this review period. The findings demonstrate that the proposed project will not significantly adversely affect environmental resources or human health, the preparation of an Environmental Impact Statement is not warranted.

FEASIBILITY REPORT AND ENVIRONMENTAL ASSESSMENT

COASTAL STORM DAMAGE REDUCTION

EDISTO BEACH, COLLETON COUNTY

SOUTH CAROLINA

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1. STUDY OVERVIEW*

This Integrated Feasibility Report and Environmental Assessment presents the results of studies to examine the feasibility of federal coastal storm damage reduction for the Town of Edisto Beach, South Carolina. As an integrated report, it includes all elements that are required for a U.S. Army Corps of Engineers (USACE) Feasibility Report, as well as an Environmental Assessment (EA) per the National Environmental Policy Act (NEPA). Sections which integrate both NEPA and Feasibility Report elements and requirements are denoted with a "*" at the end of the section title.

1.1 Study Authority

The Edisto Beach Coastal Storm Damage Reduction General Investigation (GI) Feasibility Study is being conducted in response to a resolution adopted on April 22, 1988 by the Committee on Environment and Public Works of the United States Senate:

> "*Resolved by the Committee on Environment and Public Works of the United States Senate, that the Secretary of the Army in accordance with the provisions of Section 110 of the River and Harbor Act of 1962, is hereby authorized to study, in cooperation with the State of South Carolina, its political subdivisions and agencies and instrumentalities thereof, the entire Coast of South Carolina in the interests of beach erosion control, hurricane protection and related purposes. Included in this study will be the development of a comprehensive body of knowledge, information, and data on coastal area changes and processes for such entire coast.*"

1.2 Non-Federal Sponsor

The non-Federal sponsor for this project is the Town of Edisto Beach, South Carolina. The study was cost shared 50/50 per a feasibility cost sharing agreement that was signed September 29, 2006.

1.3 Location of Study Area

Edisto Island is a barrier island located at the mouth of the South Edisto River in Colleton County, South Carolina, approximately 45 miles southwest of Charleston, South Carolina and approximately 20 miles east-northeast of Beaufort, South Carolina (Figure 1.1). The incorporated Town of Edisto Beach is located on the island, as is Edisto Beach State Park. Edisto Beach encompasses approximately 6 miles of sand shoreline, all of which are included as part of the current feasibility study. The Town of Edisto Beach and Edisto Beach State Park are part of Edisto Island. They are separated from the main body of Edisto Island by Big Bay Creek, Scott Creek and the associated salt marsh to the northwest and Jeremy Inlet to the northeast. The Town of Edisto Beach and Edisto Beach State Park are also bounded by the South Edisto River and St. Helena Sound to the southwest and the Atlantic Ocean to the southeast. The maximum width at the southern end of this portion of Edisto Island is approximately 1.5 miles, while the northern end is much narrower. The Town of Edisto Beach occupies the central and southern portions of the island and is separated from Edisto Beach State Park by SC Hwy, which provides the only access to and from the island. The Town's beachfront extends approximately 4.5 miles between SC Hwy 174 and the South Edisto River/St. Helena Sound. The town has been developed as a permanent and seasonal residential area with limited commercial development. Edisto Beach State Park occupies approximately 1,255 acres of the island and is structured around a dense live oak and maritime forest. It offers ocean and marsh side camping sites, as well as cabins, picnic areas and nature and hiking trails. The park is one of the most heavily visited of the South Carolina state parks, with approximately 254,400 recorded visitors in 2009. Its beachfront extends approximately 1.5 miles between Jeremy Inlet and SC Hwy 174. Additionally, the project is adjacent to the Ashepoo, Combahee and Edisto (ACE) Basin. This area represents one of the largest undeveloped estuaries on the east coast of the United States and consists of approximately 1.1 million acres of diverse habitats. The study area also includes an offshore borrow site study area located approximately 1 to 5 miles offshore of Edisto Beach. Material from the area has been used previously for a locally funded project and is known to contain beach compatible sand.

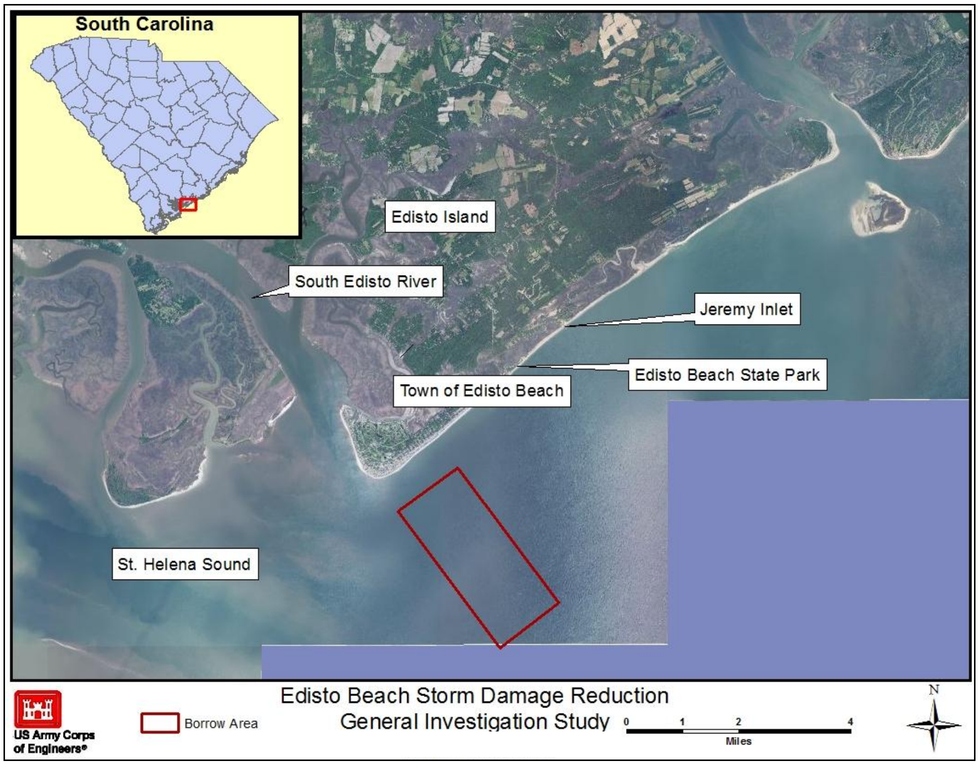

Figure 1.1: Location of Edisto Beach and offshore borrow area.

1.4 Scope of Study

This study consists of the analysis of measures and alternative plans for reducing coastal storm damages in the study area. This study, and others like it, identify the plan with the highest net National Economic Development (NED) benefits, a locally preferred plan (LPP), if applicable, or determine that no plan of improvement is justified under current planning criteria and policies.

1.5 Study Process

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 planning process is used to identify and respond to problems and opportunities associated with the federal objective and specific state and local concerns. 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, risk and uncertainty, the reasons and rationales used and the significant implications of each alternative plan. The process concludes with the selection of a recommended plan. The six steps are:

Step 1- Identifying problems and opportunities
Step 2- Inventorying and forecasting conditions
Step 3- Formulating alternative plans
Step 4- Evaluating alternative plans
Step 5- Comparing alternative plans
Step 6- Selecting a plan

Specific aspects of the process are described in more detail in subsequent chapters of this report.

1.6 Prior Studies and Reports

The following studies have been previously conducted at Edisto Beach:

- In 1952, a report on beach erosion at Pawleys Island and Folly, Edisto and Hunting Island Beaches, South Carolina, was prepared by the Charleston District in cooperation with the State of South Carolina under the authority of Section 2 of the Rivers and Harbors Act approved 3 July 1930, as amended. The purpose of the investigation was to determine the best method of preventing further erosion and of stabilizing and improving the beaches. In that report, it was concluded that the best method of protection for Edisto Beach would require a system of groins and subsequent maintenance by artificial placement of beach material.

- An Interim Hurricane Survey Report entitled "Edisto and Hunting Island Beaches, South Carolina" was prepared by the Charleston District, submitted to the Chief of Engineers and printed on 5 April 1967 as House Document No. 100 of the 90th Congress, 1st Session. The report concluded that no economically justified method of protecting against potential damages at Edisto Island Beach had been found and that local interests had not expressed any desire for hurricane protection works. The report recommended that no improvement for hurricane protection be undertaken at Edisto Beach.

- A National Shoreline Study Report printed on 29 June 1973 as House Document 93-121 of the 93rd Congress, 1st Session was prepared by the USACE to appraise the erosion problems along the coasts of the Atlantic and Pacific Oceans, the Gulf of Mexico, the Great Lakes, Puerto Rico and the Virgin Islands. The report describes that erosion through the reach including Botany Bay Island, Edingsville Beach and Edisto Beach had been most severe at the northern end of the reach with a decreasing rate to the south. The report documents that the north end of Edisto Beach, at the State Park, had eroded approximately 700 feet between 1856 and 1954, while one mile up from the southern end of Edisto Beach there had been virtually no change in the shoreline position. The report also documents that the southern end of Edisto Beach had accreted significantly. At a point 0.4 mile northeast from the southern tip of Edisto Beach, the shoreline had advanced 1,600 feet between 1856 and 1933 and then had receded 150 feet between 1933 and 1954, resulting in a net gain of 1,450 feet.

- A Detailed Project Report on beach erosion control for Edisto Beach was submitted to the Chief of Engineers on 2 July 1970. The report concluded that the best plan of improvement of several alternatives considered was periodic beach nourishment to provide an artificial feeder beach that would arrest erosion and stabilize the beach fronting Edisto Beach State Park. Since the alternatives for improvement were determined to be economically unjustified, the report recommended no Federal participation in a project at that time.

- A Reconnaissance 905(b) report on beach erosion entitled “Edisto Beach, Charleston County, South Carolina” was completed in July 1973 by the Charleston District under the authority of Section 103 of the Rivers and Harbors Act of 1962 (Title I, P.L. 87-874), as amended. The purpose of the reconnaissance study was to consolidate readily available data on beach erosion at Edisto Beach, including Edisto Beach State Park and to make a preliminary evaluation of the data to determine whether further study was warranted. The report concluded that there was little justification for a Federally-supported shore protection project at the south end of Edisto Beach, due to recently constructed groins and allowing the groins a period of time to demonstrate their effectiveness. The report also concluded that, for Edisto Beach State Park, it was impossible to justify Federal participation in the cost of shore protection measures for that length of the beach. The report recommended that a detailed study of Edisto Beach not be undertaken at that time.

- A Reconnaissance 905(b) report for storm damage reduction entitled “Edisto Beach, South Carolina” was completed by Charleston District in July 1990 under authority of Section 103 of the Rivers and Harbors Act of 1962, as amended. The purpose of the reconnaissance study was to determine the extent of problems experienced and to evaluate preliminary alternative plans for controlling beach erosion of Edisto Beach. The report concluded that there was sufficient justification for continued Federal investigation to perform detailed analysis of storm damage reduction alternatives and focuses on a recommended plan to nourish approximately 1.5 miles of shoreline near the center of Edisto Island using an offshore borrow source located offshore of the southern end of the island. The report recommended that further Federal participation to alleviate storm damages at Edisto Beach was warranted and that a detailed, cost-shared project study be initiated. Upon completion of the reconnaissance phase, the sponsor opted to pursue another course of action for beach erosion control at Edisto Beach.

- Because of the time that had passed since the first 905(b) report, a second 905(b) report for coastal storm damage reduction entitled “Edisto Island, SC” was completed in August 2004 by the Charleston District. This report recommended the current feasibility study. The reconnaissance phase was completed in September 2006.

- Numerous other reports covering the study area have been developed by others. These include:

  - Preliminary Groin Field Assessment, Cubit Engineering, May 1987

  - Town of Edisto Beach: A Beachfront Management Plan, Planning Services Group, 1990

- Erosion Assessment and Beach Restoration Alternatives for Edisto Beach State Park, Coastal Science and Engineering, Sept 1990
- Edisto Beach Nourishment Project, Engineering Report, Geotechnical Studies, Coastal Science and Engineering, Dec 1992
- Edisto Beach Groin Study, Coastal Science and Engineering, June 1993
- Coastal Management at Edisto Beach SC - A Geologic Perspective, Pilkey and Young, April 1994
- Department of Army (DOA) Permit Public Notice, Town of Edisto, 1995
- Survey Report Number 3, Edisto Beach SC, Coastal Science and Engineering - Baird, 1997
- Survey Report Number 5, Edisto Beach SC, Coastal Science and Engineering, 2001
- Beach Restoration Plan, Draft Summary Report, Coastal Science and Engineering, 2002
- Town of Edisto Beach Comprehensive Plan, Planning Department, Low Country Council of Governments, 2003
- SC Annual State of the Beaches Report, South Carolina Department of Health and Envioronmental Control – Ocean and Coastal Resource and Management (SCDHEC–OCRM), March 2003
- Groin Conditions and Repair Recommendations, Edisto Beach, SC, Coastal Science and Engineering, Nov 2003
- Edisto Beach: A Beach Access Management Plan, Clemson University, January 2004

1.7 Existing Federal and Non-Federal Projects

There are no Federal navigation or coastal storm damage reduction projects in the study area. There was a non-Federal project to renourish Edisto Beach in 2006. This project is discussed in more detail in Section 3.1.1 of this report.

2. PROBLEMS, OPPORTUNITIES, OBJECTIVES AND CONSTRAINTS*

The first step in the plan formulation process is to identify the primary problems and opportunities the study will focus on. Appropriate study objectives are then be developed based on these problems and opportunities. Specific constraints, which limit the formulation process, are also identified at this stage.

2.1 Problems and Opportunities

The Town of Edisto Beach has indicated that the most significant problem facing the study area in the near future is the threat to buildings and infrastructure from coastal storms, particularly along the northern portions of the shoreline. Figure 2.1 shows the eroded beach at the town pier, located at the northern end of the island adjacent to the state park. The threat to structures is exacerbated by high levels of long-term beachfront erosion. The loss of the beachfront threatens not only the local economy and tourism in the small coastal community, but also has National Economic Development impacts when resources that could be used elsewhere are devoted to storm recovery and rebuilding efforts that could have been prevented. Additionally, there is a lack of local resources, both natural and financial, available to address coastal storm damage problems. In addition to the ifrasturcture related problems, ongoing erosion could adversely affect sea turtle nesting success as well as shorebird nesting and forageing habitat.

Figure 2.1: Eroding berm at north end of Edisto Beach, adjacent to state park. (November 2011)

However, there are opportunities to address the identified problems. There are both structural and non-structural coastal storm damage reduction measures that could reduce future coastal storm damages to buildings and infrastructure. A discussion of potential measures is provided in Chapter 5 of this report.

2.2 Goals and Objectives

2.2.1 Federal Objective

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

2.2.2 Study Goals and Objectives

The overall goal of the study is to reduce the adverse economic effects of coastal storms at Edisto Beach, South Carolina. Identifying and considering the problems, needs and opportunities of the study area in the context of Federal objective defined in the previous section resulted in the establishment of the following study specific objectives:

Objectives: Over a 50-year period of analysis and while minimizing or avoiding adverse impacts to natural resources:

1. Provide coastal storm damage reduction (as measured by increases in NED net benefits) to approximately 4.5 miles of the Edisto Beach shoreline.

2. Reduce the risk of damages to SC Hwy 174, which is the only emergency evacuation route for the community.

3. Preserve sea turtle nesting habitat and protect shorebird nesting habitat, foraging areas and roosting areas.

Achieving these objectives would likely yield increased benefits to recreation. However, those benefits are considered incidental to the primary goal of providing coastal storm damage reduction benefits to the study area and are not specifically formulated for.

2.3 Constraints

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

a. The limited amount of space on the island that is available for implementing certain alternatives.

b. The South Carolina Coastal Zone Management Program (CZMP) currently bans the building of certain types of hard structures along the state's coast.

c. The project alternatives cannot adversely impact down drift beaches, or the ACE Basin.

3. EXISTING CONDITIONS*

The second step of the planning process is to inventory and forecast conditions. This chapter describes the relevant environmental, physical and economic conditions as they currently exist within the study area. The existing conditions are used as the baseline for the forecast of future without project conditions, which are discussed in Chapter 4.

3.1 Physical Conditions and Processes

3.1.1 Historical Shoreline Conditions

Historical erosion of Edisto Beach has lead to a long history of shoreline management activities, including the construction of a series of groins, leading to the current existing condition of the shoreline. Construction of groins began in 1948 at the north end and continued southward until 1975. By that time, a total of 34 groins had been constructed along the Edisto Beach shoreline. Figures 3.1 and 3.2 provide the locations and an example groin, respectively.

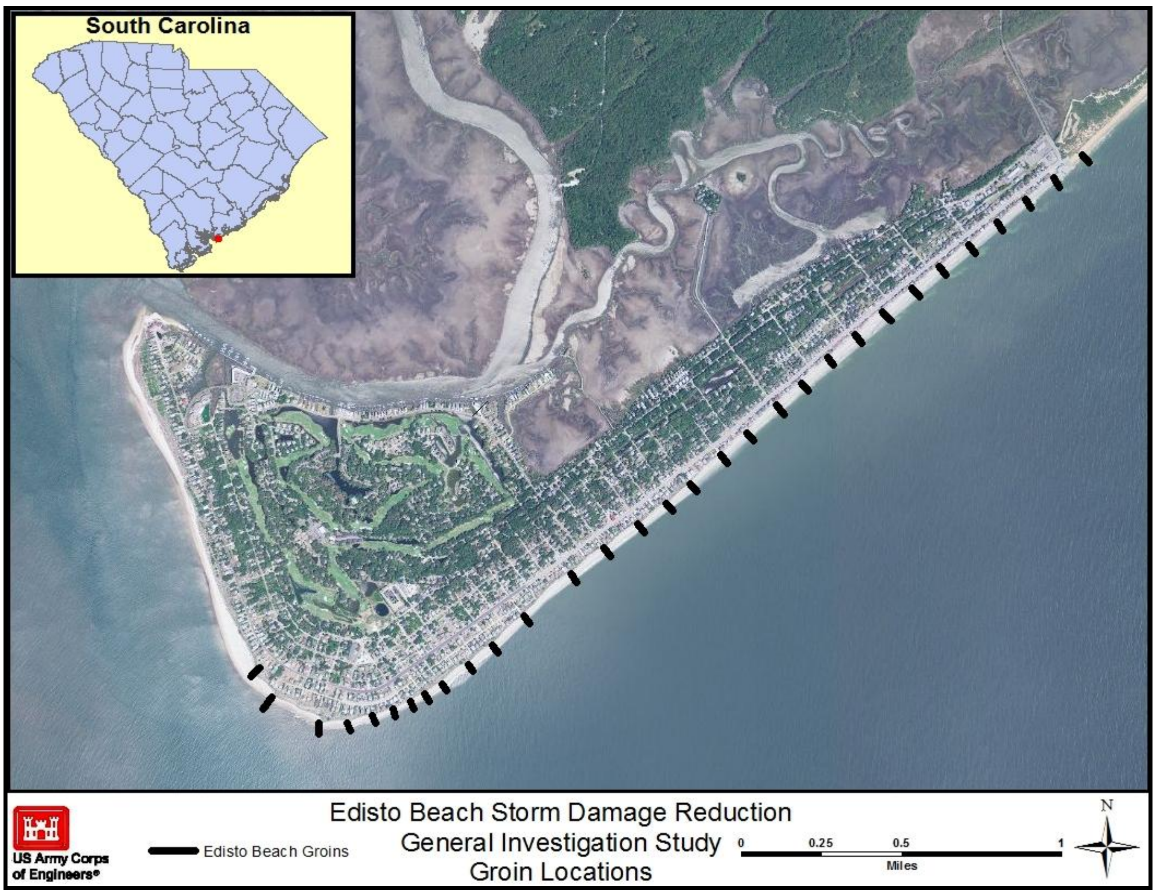

Figure 3.1: Location of functioning groins built on Edisto Island. Although 34 groins were originally built, 3 of those have subsequently become buried.

Figure 3.2: Example of one of the 34 groins built on Edisto Island.

Despite the construction of groins, erosion continued to threaten certain areas of the shoreline. As a result, in 1954 the South Carolina Highway Department (now SC Department of Transportation) undertook the first nourishment of Edisto Beach. Approximately 830,000 cubic yards (cy) of material consisting of sand, shells and mud was dredged from the marsh behind the island and placed between groins 1 and 12 at the northern end of the town. Unfortunately, much of the material was not suitable for beach fill and the fine portions washed away quickly. The next beach nourishment took place in 1995 when approximately 155,000 cy of fill was placed between groins 1 to 17 (Pavilion to Chancellor Street) and groins 24 to 28 (Laroche Street to Billow Street). This beach fill project was accompanied by major improvements to the groins in those areas. Despite the groin improvement and beach fill project in 1995, the Edisto Beach shoreline continued to be vulnerable to erosion. Therefore, another non-Federal beach nourishment project was constructed in 2006. This most recent beach nourishment project added approximately 850,000 cy (192,100 cy in the Edisto Beach State Park area) of beach compatible material along 18,258 feet (3,200 feet in the state park) of shoreline from Edisto Beach State Park to groin 27.

South Carolina's 2008 Annual State of the Beaches Report states that Edisto Island has a low long-term erosion rate, but an extreme lack of sand. The report does not quantify the long-term erosion rate, but does indicate that the low erosion rate is due to the presence of the extensive groin field. According to the report, the southern half of the developed portion of Edisto Beach has the widest oceanfront beach on the island, while the northern half was one of the most critically eroded sections of beach anywhere in the state prior to the 2006 renourishment. The northern half of Edisto Island is critically eroding because the supply of sediment to this area, from the north, has been diminishing and is expected to continue to diminish as the barrier islands to the north are reduced in elevation due to natural processes. As these barrier islands lose elevation, the amount of littoral material that is removed from the active littoral system by increased barrier island overwash processes increases, which further reduces updrift sediment supply to the northern portion of Edisto Island. The erosion rates tend to decrease to the south because of a reduction in net longshore sand transport rate gradients due to the presence of the groin field. Along the inlet-facing shoreline, the beach is stable to slightly accretive because of the change in shoreline orientation and because this area receives sediment eroded from the Atlantic-facing shoreline. It has a substantial berm but not a substantial dune. Pictures of the existing shoreline along the north and south ends of the island are shown in Figures 3.3 and 3.4, respectively.

Figure 3.3: Example of narrow berm at northern end of Edisto Beach. Photo dated November, 2011.

Figure 3.4: Example of a wider berm at the southern end of Edisto Beach. Photo dated November, 2011.

3.1.2 Coastal Storm Climatology

Coastal processes at Edisto Beach are driven by high energy waves and water levels generated by both tropical and extratropical storms. Significant tropical storm events (defined here as storms that generated at least 1.0 ft of storm surge) impacted the Edisto Beach shoreline approximately once every 4 years over the past 100 years (Scheffner et al 1994). These tropical storms normally occur between June and November with more than 65 percent of them occurring in the months of August and September. Extratropical storms, on the other hand, are a frequently occurring storm type that impacts Edisto Beach annually with significant events occurring about once every year and a half. Extratropical storms typically occur in the fall (September and October) and again in the winter (January through March) with most occurring in February. Tropical storm events are typically fast moving storms associated with elevated water levels and large waves whereas extratropical storms are slower moving storms with comparatively lower water level elevations and large wave conditions. Both storm types can produce extensive beach erosion and morphological changes as well as coastal inundation. The most recent storm to affect Edisto Island was Hurricane Irene, in August 2011. Irene caused minimal property damage, but caused extensive erosion of the beach berm in several areas. The last hurricane that caused substantial economic damage on the island was Hurricane Gracie, a Category 3 (out of a potential 5 rating) storm which made landfall on the southern edge of the island in September, 1959. About 80 houses on the island were severely damaged or destroyed during that storm.

3.1.3 Sediment Transport

Net longshore sand transport along Edisto Beach is from north to south and the magnitude of the longshore sand transport rate tends to increase moving from north to south. Intra-annual reversals in the longshore transport direction at Edisto Beach can be significant and are readily observed by shoreline position changes within groin compartments. These intra-annual transport direction reversals are driven by seasonal changes in the incident wave direction. Generally, during the more stormy late Fall/Winter/early-Spring seasons, net transport direction is to the south, whereas during the milder weather in the late-Spring and Summer season the net transport direction is often directed to the north (CSE, 1993).

Gross longshore sand transport rates in the vicinity of Edisto Beach have been estimated at approximately 210,000 cy/year, about 44,000 cy/year directed to the north and about 167,000 cy/year directed to the south. The current net longshore sand transport rate is about 123,000 cy/year, directed to the south (CSE, 1993).

3.1.4 Geomorphology

Edisto Beach is at the southern end of what was once a classical prograding drumstick shaped barrier island common in South Carolina. Over time, erosion in the central portion of the larger barrier island system due to a net longshore transport divergence has resulted in opening of new tidal inlets (Frampton Inlet, Jeremy Inlet and an un-named inlet north of Frampton Inlet) and loss of littoral sediments to developing shoal features at those inlets. Continued erosion has reduced the central barriers to little more than swash shoals that allow littoral material to wash over the barriers and become trapped in the coastal marshes. As a consequence, the Edisto Beach barrier island is transitioning to a landward migrating transgressive barrier island.

The geomorphology of Edisto Beach is unique among South Carolina beaches in that the sediment composition of the beach is coarser grained than most South Carolina beaches with a median grain size of approximately 0.4 mm (CSE, 2006) and significant shell content. The relatively coarse sediment grain size results in comparatively steep foreshore slopes. Within the oceanfront groin compartments, the foreshore slope is approximately 1 on 10. Within Edisto Beach State Park, the foreshore slope is slightly milder at 1 on 15. The foreshore slope along inlet shoreline is milder still at approximately 1 on 25. These steep foreshores slopes, together with a fairly high tidal range (average spring tide range is 6.3 ft), reduce the beach area between the low-tide terrace and the foredunes compared to other South Carolina beaches. Due to these geomorphic conditions, wave energy associated with storm conditions is not significantly dissipated before it reaches the relatively low foredunes.

3.1.5 Existing Beach Profile

For the purposes of coastal storm damage modeling, the existing beach profile was characterized across 23 reaches covering the length of the beach. Figure 3.5 shows the locations of these reaches. In each of these reaches, an “idealized” beach profile was characterized based on surveys performed in August 2004, November 2005, July 2007 and July 2008. An idealized profile is a simplified representation of the shoreline that is used for modeling purposes. The process of determining the idealized profiles is detailed in Appendix A (Coastal Engineering Appendix).

Figure 3.5: Location of modeling reaches.

Figure 3.6 depicts a generic idealized profile cross-section. Table 3.1, below, shows the idealized dune and berm heights and widths across these reaches.

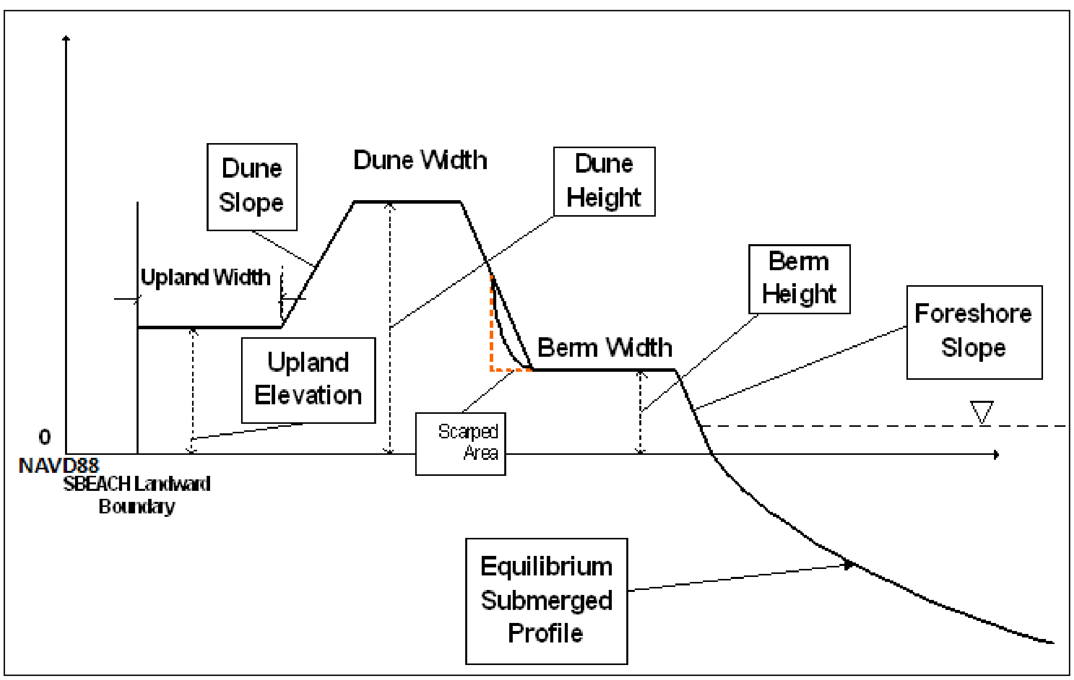

Figure 3.6: Features of an idealized shore profile cross-section.

Table 3.1: Idealized shoreline dimensions across the project study area.

Reach	Upland Elevation (ft)	Upland Width (ft)	Dune Slope (X:1)	Dune Elevation (ft)	Dune Width (ft)	Berm Elevation (ft)	Berm Width (ft)	Foreshore Slope (X:1)
I1	7	775	11	8.5	0	6	20	28
I2	7	425	6	10	5	6	20	32
I3	7	500	6	10	5	6	20	32
I4	7	700	6	10	5	6	20	32
P1	7	650	6	9.5	15	7	60	13
P2	7	475	7	10.5	10	7	30	10
E1	8	500	4	11.5	10	7	40	10
E2	8	550	4	12	10	7	45	11
E3	8	525	4	12	10	7	45	11
E4	8	375	6	12	5	7	70	10
E5	8	300	6	12	5	7	70	10
E6	7	275	6	12	10	7	60	11
E7	7	200	3	10.5	25	7	90	10
E8	7	250	3	10	15	7	85	12
E9	7	200	3	11	15	7	105	10
E10	7.5	175	7	11.5	10	7	85	11
E11	7.5	150	7	11	10	7	70	11
E12	8	150	7	12	10	7	40	12
E13	8	200	3	11	10	7	55	10
E14	8	250	5	12	15	7	35	11
E15	8	250	7	11	5	7	35	11
SP1	8	350	5	11.5	5	7	75	13
SP2	4	450	12	8.5	5	7	0	20

The beach contains a relatively short and flat dune (Figure 3.7). The berm is generally narrower and the shoreline is closer to homes at the northern end of the island. (see Figures 3.3 and 3.4 Section 3.1.1)

Figure 3.7: Example of one of the “taller” dunes at Edisto Beach, around reach E12.

3.1.6 Characterization of Beach Material

Table 3.2 lists the average sediment composition of the existing beach material, in terms of percent silt and shell. The composition determination is based on beach samples collected at 34 stations along Edisto Beach and reflects conditions after the 2006 renourishment. Each station included four grab samples – one each from the toe of the dune, berm, beach face and low tide swash zone. Additional details are contained in Appendix D (Geotechnical Engineering).

Table 3.2: Average sediment composition of native beach material and borrow area.

	MEAN (phi)	STD DEV (phi)	% PASSING #5	%PASSING #10	% PASSING #200*	% PASSING #230	% VISUAL SHELL
Edisto Native Beach	1.31	1.33	97.8	93.5	0.1	0.0	26.9
Borrow Area	1.73	1.31	94.7	90.0	0.4	0.2	18.8

*The % passing the #200 sieve is considered the % silt and clay.

3.1.7 Offshore Borrow Area

The sand borrow area being proposed for the project is an approximately 1 square mile portion of the ebb tide delta located about 2 miles offshore of the west side of the island (Figure 3.8). It contains approximately 7.2 million cubic yards of beach quality material. The average sediment composition of the borrow area, as compared to the composition of the native beach, is shown in Table 3.2. The curves in the northern and eastern corners of the borrow area are due to cultural resource avoidance areas (see Section 7.16). The proposed borrow area was narrowed down from a larger area containing about 30 million cubic yards of material. The larger area was evaluated and characterized based on 77 cores taken at approximately 1,000 ft spacing throughout the site. Additional details on how the borrow area was narrowed down, as well as the sampling methodology and material composition of the borrow site, are contained in Appendix D (Geotechnical Engineering Appendix). Other potential offshore borrow areas were also identified based on previous experience and limited historical data in the vicinity of Edisto Beach to 3 miles offshore. However, no subsurface investigation was performed in these areas due to the high cost of the sampling and analysis. These potential borrow areas were removed from further consideration because there is an adequate quantity of beach quality material to nourish Edisto Beach over a 50 year period in the primary borrow site. Additionally, the material offshore is believed to be finer than the ebb tide delta material and therefore not as compatible with the native beach and the site has been successfully used before by the Town of Edisto Beach to nourish the beach.

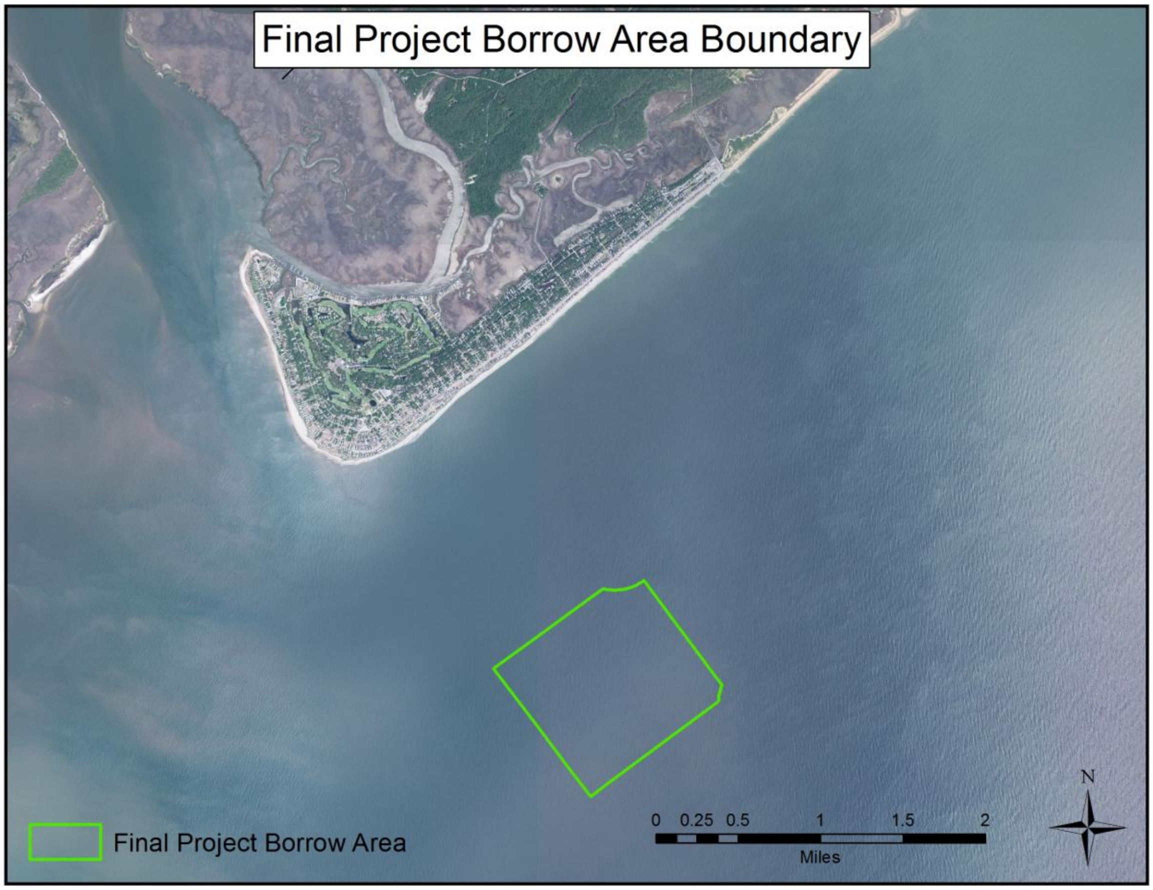

Figure 3.8: Location of proposed borrow area for the Edisto Beach project.

3.2 Environmental and Cultural Resources

3.2.1 Wetlands

Wetlands are transitional habitats between water and dry land. The coastal wetlands that are prevalent at Edisto Island consist primarily of salt marshes. In contrast to surrounding states, South Carolina does not have adequate habitat for submerged aquatic vegetation and coastal areas consist predominantly of intertidal emergent habitat (http://portal.ncdenr.org/c/document_library/get_file?uuid=6edc629c-628d-48fb-a8bf-dbbfbca94a2c&groupId=38337). Other wetlands in the project area include bottomland hardwood swamps and fresh marshes. Marsh communities have been well documented in terms of productivity, animal diversity and importance to the marine system (and to people). In fact, they are among the most productive ecosystems on Earth (Stedman and Dahl 2008).

Tidal marshes serve many important functions and are prevalent on the backside of Edisto Beach (Figure 3.9). The basis of the importance of these marsh communities involves the basic high productivity of the marsh itself and its ability to capture and retain nutrients. The dense plant growth in the marsh also provides excellent cover for many species of birds, aquatic and semi-aquatic mammals, reptiles and amphibians and typically provides spawning grounds, nurseries, shelter and food for many species of finfish, shellfish, birds and other types of wildlife. Besides the water quality and habitat benefits, marshes also serve to buffer storm waves and slow shoreline erosion.

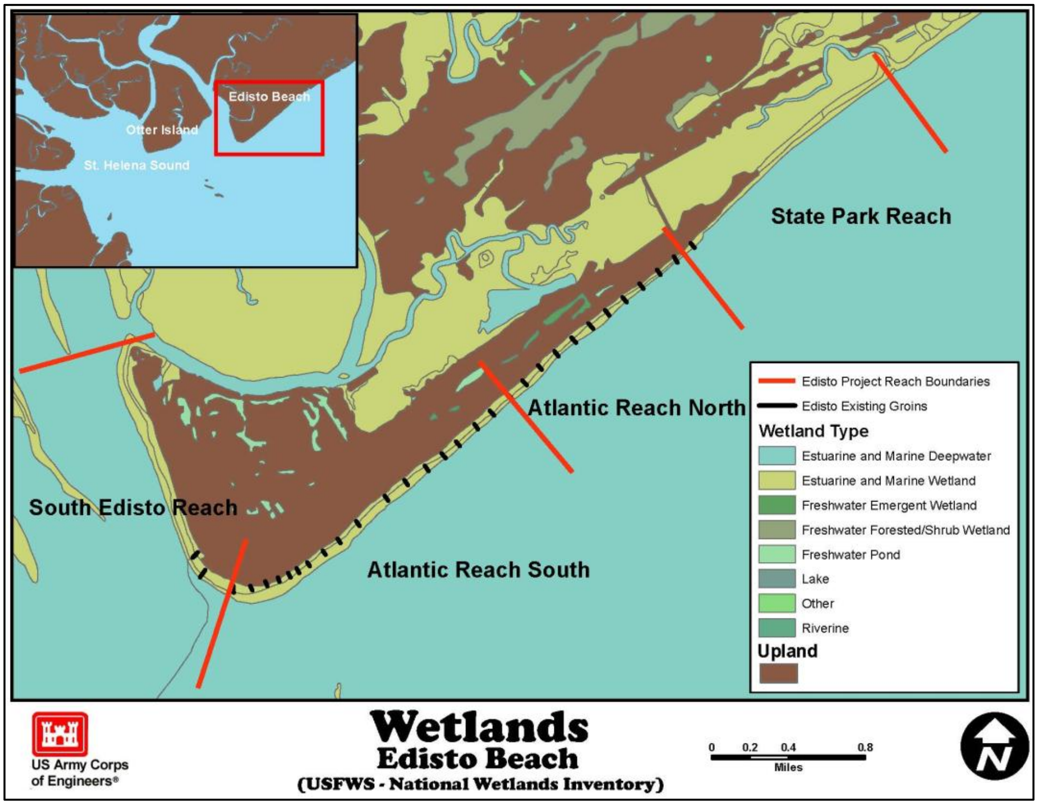

Figure 3.9: Location of wetlands within the project area.

Substrates in these communities are inhabited by a myriad of foraminiferans, nematodes, annelids, arthropods, mollusks such as the salt marsh snail (*Melampus bidentatus*), marsh periwinkle (*Littorina littorea*), ribbed muscle (*Modiolus demissus*) and eastern oyster (*Crassostrea virginica*) and crustaceans such as the penaeid shrimps (*Penaeidae*), sand fiddler (*Uca pugilator*), mud fiddler (*U. pugnax*) and blue crabs (*Callinectes sapidus*). The marsh community provides a nursery ground for the principal commercial marine organisms of the state - white (*Litopenaeus setiferus*) and brown shrimp (*Farfantepenaeus*) and blue crabs.

Marshes also serve as spawning and nursery grounds for many commercial and sport fishes and shellfishes, in addition to being valuable shellfish growing areas. Numerous shorebirds, waterfowl, gulls, herons and egrets can be found throughout these marsh communities. Birds such as the clapper rail (*Rallus longirostris*), plovers (*Charadrius sp.* and *Pluvialis sp.*), dowitchers (*Limnodromus sp.*) and sandpipers (many species) thrive on the benthic invertebrate population around the shoreline and on open flats. In the open water bordering these communities, waterfowl feed on vegetation or small marine fishes and free-swimming invertebrates. The herons and egrets feed on fish, invertebrates, reptiles, amphibians and small mammals. They also are found nesting and roosting during the summer months. Many gulls utilize these communities for resting and scavenging year-around. Other birds such as the red-winged blackbird (*Agelaius phoeniceus*), common and boat-tailed grackles (*Quiscalus sp.*), sparrows and warblers can be found nesting and feeding on insects and grains. Birds of prey such as the osprey

(*Pandion haliaetus*) and marsh hawk (*Circus cyaneus*) also utilize these communities to some degree. Mammals of the marshes typically include the raccoon (*Procyon lotor*), otter (*Lutra canadensis*), marsh rice rat (*Oryzomys palustris*), opossum, (*Didelphis virginiana*), marsh rabbit (*Sylvilagus palustris*) and American mink (*Mustela vison*).

3.2.2 Sand and Mud Flats

Sand and mud flats are found in the project area, predominantly near Jeremy Inlet and the South Edisto River Inlet area. In most areas they lie below the mean high water line and are alternately covered and exposed by wind-driven or lunar tides and are typically devoid of vascular plants, but are frequently inhabited by numerous species of diatoms, bacteria, oysters, and infaunal invertebrates. These flats are usually fringed with stands of vigorously growing and highly productive smooth cordgrass and open water or beach and open water. Tidal action provides a constant influx of particulate organic matter to these habitats creating a rich nutrient supply for filter feeding benthic invertebrates. When the tidal flats are covered by water, these animals and nutrients constitute an important food source for a variety of fish species. When the flats are exposed, numerous wading birds and shorebirds feed upon the benthic animals.

3.2.3 Nearshore Ocean

Nearshore fisheries are monitored by the Southeast Area Monitoring and Assessment Program – South Atlantic (SEAMAP-SA) Coastal Survey, which has been conducted by SCDNR since 1986. The survey provides long-term, fishery-independent data on seasonal abundance and biomass of all finfish, elasmobranchs, decapod and stomatopod crustaceans, sea turtles, horseshoe crabs, and cephalopods that are accessible by high-rise trawls.

Phytoplankton and zooplankton serve as food for benthic fauna and for some juvenile fishes along beachfronts and structures (Hay and Sutherland 1988). Zooplankton communities are composed of holoplankton, such as copepods, and the larvae of benthic fauna and infauna, or meroplankton. These populations experience large fluctuations in density and species composition throughout the year (Hay and Sutherland 1988).

A majority of the South Atlantic Bight is inhospitable habitat for seaweeds because of the amount of unconsolidated sediments. Blue-green algae grow in the highest density in the intertidal zone, while the most abundant subtidal seaweed on nearshore structures is the brown alga, *Sargassum*. Other prevalent species are the brown alga, *Padina*, *Dictyota*, *Ectocarpus*, *Punctaria*, and *Petaloni*a; the green alga, *Bryopsis*; the red alga, *Chondria*, *Callithanmion*, *Champia*, *Dasya*, *Hypoglossum*, *Calonitophyllum*, and *Grinnellia*.

3.2.4 Maritime Shrub Thickets

These thickets normally occur landward of the dune where it is protected from ocean spray and waves. These habitats are rare and sporadic along the beachfront of Edisto Island, occurring on the marsh side of the island and at the Edisto Beach State Park area. Dominant shrubs and trees in this community are wax myrtle (*Myrica cerifera*), yaupon (*Ilex vomitoria*), red cedar (*Juniperus virginica*), live oak (*Quercus virginiana*), and loblolly pine (*Pinus taeda*). Vines are also common with greenbriar (*Smilax bona-nox*), pepper-vine (*Ampelopsis arborea*) and grape (*Vitus rotundifolia*) being particularly abundant. This community offers cover for a variety of songbirds. Other important species that may be found in the thickets include the seaside sparrow, painted bunting, saltmarsh sharp-tailed sparrow, Nelson's sharp-tailed sparrow, and marsh and sedge wrens.

3.2.5 Beach and Dune

Intensive development along the front beach has altered the natural areas and vegetation of the island. Vegetation on inland areas consists of maritime forest complex with slash (*Pinus elliottii*) and loblolly (*Pinus taeda*) pine, live oak (*Quercus virginiana*), magnolia (*Magnolia* sp.), cabbage palm (*Sabal palmetto*), dwarf palmetto (*Sabal minor*) and red bay (*Persea borbonia*). The high marsh behind the island is composed of a mixture of cordgrass (*Spartina* sp.), needlerush (*Juncus roemerianus*), yaupon (*Ilex vomitoria*) and sea myrtle (*Baccharis halimifolia*). The low marsh complex consists primarily of smooth cordgrass (*Spartina alterniflora*). The beach and dunes are the only biotic communities that would be affected by direct beach nourishment. Primary grasses on the dunes include sea oats (*Uniola paniculata*) and panic grass (*Panicum amarum*) interspersed with sedges and sandburs (*Cenchrus* sp.).

Beach vitex is a widespread plant found from Japan and China south to Malaysia, India, Sri Lanka, and Australia (Wagner et al. 1999). Since it is a prostrate, spreading woody shrub, it is considered an excellent beach stabilizing plant. Additional properties include its salt tolerance and rapid growth (Dirr 1998). Beach vitex was introduced in the mid-1980's as an ornamental and dune stabilization plant (Westbrooks and Madson 2006). While these were good intentions, it has become a serious threat to natural plant and animal communities along the coast of the Carolinas (Westbrooks and Madson 2006). The dense, woody mats can be a barrier to native vegetation and to sea turtles attempting to use those dunes as nesting sites. Yearly surveys have found Beach vitex as far south as Folly Beach in SC (www. beachvitex.org). As of 2006, the South Carolina Beach Vitex Task Force had documented 125 sites planted with Beach vitex in coastal communities of Horry, Georgetown, and Charleston counties. It is expected that the plants' range could extend throughout the southeastern US from Virginia to Florida (Westbrooks and Madson 2006). Because of this threat, the introduction of Beach vitex is a concern on Edisto Island, as the island is a heavily used site for sea turtle nesting. A local ordinance prohibiting the planting of Beach vitex was passed by a number of coastal communities, including the Town of Edisto Beach.

3.2.6 Surf Zone Fishes

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 inhabitat 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*).

3.2.7 Anadromous Fishes

Anadromous fish spend most of their lives in either estuaries or oceans. They typically swim upstream to freshwater rivers in order to spawn. South Carolina is home to a variety of anadromous fish, including blueback herring (*Alosa aestivalis*), American shad (*Alosa sapidissima*), hickory shad (*Alosa mediocris*) , white perch (*Morone americana*), striped bass (*Morone saxatilis*), shortnose sturgeon (*Acipenser brevirostrum*) and Atlantic sturgeon (*Acipenser oxyrinchus*). The blueback herring and American shad are most numerous.

3.2.8 Benthic Resources

3.2.8.1 Beach Zone

The area where beach nourishment placement would occur at Edisto Beach is considered beach community. 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.

3.2.8.2 Nearshore Ocean

Sessile invertebrates in the intertidal zone consist largely of barnacles, oysters, and mussels (Hay and Sutherland, 1988). Several mobile organisms exist in this intertidal zone, including the large invasive isopod *Lygia exotica*, and the Atlantic oyster drill.

3.2.9 Hard bottom Resources

Hard bottoms are defined as localized areas not covered by unconsolidated sediments, where the ocean floor consists of hard substrate. Hard bottoms 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. 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). There is no suspected hardbottom habitat within the nearshore environment of Edisto Beach. The presence of hard bottom resources within the currently identified offshore borrow area was investigated as part of a hardbottom and cultural resources survey. No hardbottom habitat was found in the borrow area or within a quarter mile buffer surrounding the area. A more detailed description of the findings can be found in Appendix J (Hardbottom and Cultural Research Survey Final Report).

3.2.10 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 salt marsh. EFH within the boundaries of the project reaches can be seen in Table 3.3 below. A detailed description of the EFH in the project area is contained in Appendix G (Essential Fish Habitat Assessment).

Table 3.3: Essential Fish Habitat types and presence within the project area.

Essential Fish Habitat List and Study Area Occurrence

Habitat Type	Habitat Name	Project Area
Estuarine	Estuarine Emergent Wetland (tidal marsh)	Yes
Estuarine	Estuarine Scrub/shurb 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/Hard bottoms	No
Marine	Coral and coral reefs	No
Marine	Artificial/manmade reefs	No
Marine	Sargassum	No
Marine	Marine water column	Yes
Marine	Surf zone	Yes

3.2.11 Avian Species

3.2.11.1 Shorebirds

The beach zone is also utilized by many species of shorebirds for nesting and feeding. Species commonly observed are the American oystercatcher (*Haematopus palliatus*), plovers (*Charadrius sp.*), willet (*Catoptrophorus semipalmatus*), sandpipers (*Scolopacidae*), lesser/greater yellow-legs (*Tringa flavipes/T. melanoleuca*), and gulls/terns (*Laridae*). 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 (Sanders and Murphy 2009).

3.2.11.2 Seabirds

Seabirds nest on small coastal islands in mixed colonies. The three common families of seabirds are Pelecaniae (pelicans), Pynchopidae (skimmers), and Laridae (gulls and terns). Seabirds that frequent the South Carolina coast 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). The Least Tern is listed as state threatened due to a loss of nesting habitat (Thompson et al 1997 in Murphy et al 2009). All of the birds are subject to loss of suitable nesting habitat (Murphy et al 2009). Seabirds usually nest on isolated coastal islands that are high enough to prevent over-washing, yet small enough to not support mammalian predators (Murphy et al 2009). They are picivorous and feed in nearshore and estuarine waters. During the nesting season, foraging occurs within 10 to 15 miles of their nesting sites.

3.2.11.3 Migratory birds

Migratory birds in South Carolina represent three families: Scolopacidae (sandpipers), Charadriidae (plovers), and Recurvirostridae (avocets). Migrations can span across continents. Migratory shorebirds in South Carolina may be transient on northbound flights in the spring, southbound in the fall, or even wintering birds. Surveys of migrant shorebirds over the last three decades indicate that populations are on the decline (Manomet 2004); however, piping plovers are the only listed species.

3.2.12 Coastal Barrier Resources

Coastal barriers along the Atlantic and Gulf coasts provide quality habitat for migratory birds and other wildlife. This habitat is essential for spawning, nursery, nesting, and feeding for a variety of commercially and recreationally important species of finfish and shellfish. Recognizing this and the fact that barrier islands contain recreational and cultural resources, serve as natural protective buffers from storms, Congress passed the Coastal Barrier Resources Act in 1982. In this Act, Congress declared that the purpose of the act is to minimize the loss of human life, wasteful expenditure of Federal revenues, and the damage to fish, wildlife, and other natural resources by restricting future Federal expenditures and financial assistance that could potentially encourage development of barrier islands (16 U.S.C. 3501 et seq.). There are three important goals of the Coastal Barrier Resources Act, which include: (1) minimize loss of human life by discouraging development in high risk areas; (2) reduce wasteful expenditure of Federal resources; and (3) protect the natural resources associated with coastal barriers.

The Town of Edisto Beach lies between two Coastal Barrier Resources Systems (CBRS) units, the Edisto Complex Unit (M09 and M09P) and the Otter Island Unit (M10) (Figure 3.10). Unit M09P is an "Otherwise Protected Area" (OPA) and is not a part of the CBRS. Because it is an OPA, any measures that occur within Edisto Beach State Park (M09P) would be consistent with the intent of the Coastal Barrier Resources Act. The Edisto Unit is composed of three small marsh islands, Botany Bay Island, Edingsville Beach, part of Jeremy Inlet, and Deveaux Bank. The Otter Island Unit includes the southwestern half of the South Edisto River, Pine Island, Otter Island, and the southeastern tips of Fenwick Island and Hutchinson Island. Through coordination with the USFWS it has been determined that the proposed borrow site that would be used for a nourishment project is not located in the CBRS (Appendix I, USFWS, letter dated Jan 27, 2010).

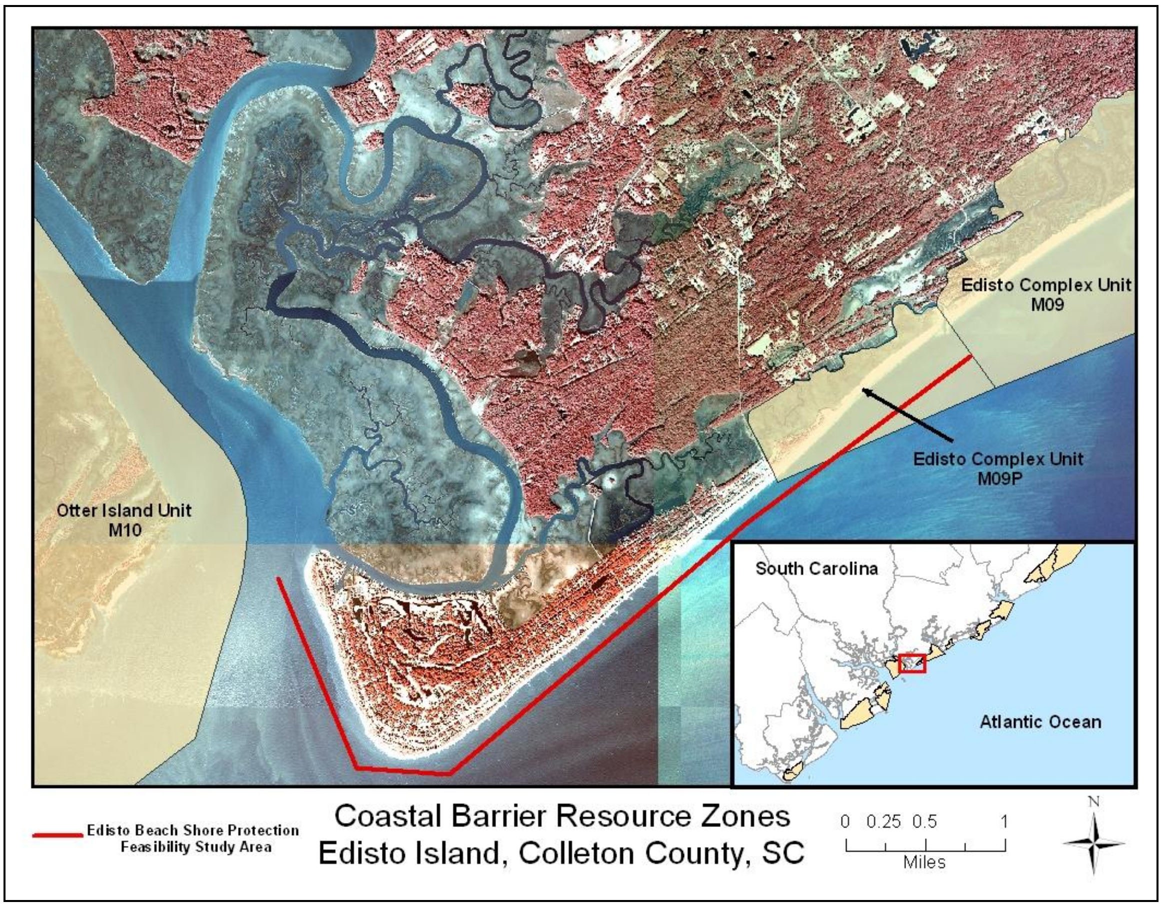

Figure 3.10: Location of Coastal Barrier Resource Zones in the vicinity of the project area.

3.2.13 Threatened and Endangered Species

Table 3.4 contains a list of threatened and endangered species in South Carolina under the jurisdiction of NMFS. Table 3.5 contains a list of federally threatened and endangered species that have been listed by the USFWS as occurring or possibly occurring in Colleton County.

3.2.13.1 Sea Turtles

There are four species of sea turtles that inhabit waters off of South Carolina, including the loggerhead (*Caretta caretta*), Kemp's ridley (*Lepidochelys kempii*), leatherback (*Dermochelys coriacea*), and green (*Chelonia mydas*) sea turtles. Although hawksbill (Eretmochelys imbricate) turtles have been stranded in Georgia and North Carolina, there have been no records of this species in South Carolina over the past two decades (Griffin et al., 2007).

The loggerhead sea turtle is the most likely sea turtle species to be affected by the proposed project. Loggerheads are Federally listed as a threatened species.

Table 3.4: NMFS listed threatened and endangered species found in South Carolina.

Common Name	Scientific Name	Status	Date Listed
Marine Mammals			
Blue whale	*Balaenoptera musculus*	E	12/2/1970
Finback whale	*Balaenoptera physalus*	E	12/2/1970
Humpback whale	*Megaptera movaeangliae*	E	12/2/1970
North Atlantic right whale	*Eubalaena glacialis*	E	12/2/1970
Sei whale	*Balaenoptera borealis*	E	12/2/1970
Sperm whale	*Physeter macrocephalus*	E	12/2/1970
Turtles			
Kemp's ridley sea turtle	*Lepidochelys kempii*	E	12/2/1970
Leatherback sea turtle	*Dermochelys coriacea*	E	6/2/1970
Loggerhead sea turtle	*Caretta caretta*	T	7/28/1978
Green sea turtle	*Chelonia mydas*	T	7/28/1978
Hawksbill sea turtle	*Eretmochelys imbricata*	E	6/2/1970
Fish			
Atlantic sturgeon	*Acipenser Oxyrinchus*	E	2/6/2012
Shortnose sturgeon	*Acipenser brevirostrum*	E	3/11/1967
E - Federally endangered		*T - Federally threatened*	

There are four nesting subpopulations of loggerheads in the western Atlantic. The Northern Subpopulation extends from North Carolina to Northeast Florida and produces approximately 6,200 nests/year. South Carolina nesting produces more than 30% of the nesting of the Northern Subpopulation. Recent surveys of South Carolina nesting beaches indicate a downward trend. Information obtained from NMFS suggests that the numbers of nesting female loggerhead sea turtles may be declining in South Carolina and Georgia. Since loggerheads require 20 to 30 years to mature, the effects of a decline may not be evident on nesting beaches for many years. Edisto Beach has a significant number of true nests and nesting attempts each year. Edisto Beach State Park, as reported by park personnel (SCDNR, personal communication) has the highest density of nesting sea turtles on a populated beach in the state.

Critical habitat is not currently designated in the continental U.S. for the five species of sea turtles identified to occur within the proposed project vicinity. However, USFWS and NMFS have proposed listing critical habitat for the Northwest Atlantic Ocean Distinct Population Segment of the loggerhead sea turtle. Critical habitat has been proposed for Edisto Beach and all surrounding beaches and the nearshore waters (i.e., from the mean highwater line seaward 1.6 km) off these beaches.

Table 3.5: USFWS listed threatened and endangered species occurring or possibly occurring in Colleton County, SC.

COLLETON COUNTY T&E Species			
Common Name	**Scientific Name**	**Status**	**Occurrence**
Bald eagle	*Haliaeetus leucocephalus*	BGEPA	Known
Wood stork	*Mycteria americana*	E	Known
Red-cockaded woodpecker	*Picoides borealis*	E	Known
Piping plover	*Charadrius melodus*	T, CH	Known
Kemp's ridley sea turtle	*Lepidochelys kempii**	E	Known
Leatherback sea turtle	*Dermochelys coriacea**	E	Known
Loggerhead sea turtle	*Caretta caretta*	T, CH*	Known
Green sea turtle	*Chelonia mydas**	T	Known
Shortnose sturgeon	*Acipenser brevirostrum**	E	Known
Atlantic sturgeon	*Acipenser oxyrinchus**	E	Known
Pondberry	*Lindera melissifolia*	E	Possible
Canby's dropwort	*Oxypolis canbyi*	E	Known
Southern dusky salamander	*Desmognathus auriculatus*	SC	Possible
Angiosperm (no common name)	*Elytraria caroliniensis*	SC	Known
Godfrey's privet	*Forestiera godfreyi*	SC	Known
Pondspice	*Litsea aestivalis*	SC	Known
Boykin's lobelia	*Lobelia boykinii*	SC	Known
Carolina bird-in-a-nest	*Macbridea caroliniana*	SC	Known
Crested fringed orchid	*Pteroglossaspis ecristata*	SC	Known
Bachman's sparrow	*Aimophila aestivalis*	SC	Possible
Kirtland's warbler	*Dendroica kirtlandii*	E	
Henslow's sparrow	*Ammodramus henslowii*	SC	Possible
Rufa Red knot	*Calidris canutus rufa*	P	Possible
Black-throated green warbler	*Dendroica virens*	SC	Possible
Swallow-tailed kite	*Elanoides forficatus forficatus*	SC	Known
American kestrel	*Falco sparverius*	SC	Possible
American oystercatcher	*Haematopus palliatus*	SC	Known
Loggerhead shrike	*Lanius ludovicianus*	SC	Possible
Black rail	*Laterallus jamaicensis*	SC	Possible
Painted bunting	*Passerina ciris ciris*	SC	Possible
Gull-billed tern	*Sterna nilotica*	SC	Known
Bluebarred pygmy sunfish	*Elassoma okatie*	SC	Known
Southern hognose snake	*Heterodon simus*	SC	Possible
Island glass lizard	*Ophisaurus compressus*	SC	Known
Rafinesque's big-eared bat	*Corynorhinus rafinesquii*	SC	Known

E - Federally endangered Federally threatened P - Proposed
BGEPA - Bald and Golden Eagle Protection Act CH - Critical Habitat Designated CH - proposed*
SC - State Species of Concern. These species are rare or limited in distribution but are not currently legally

SCDNR has indicated that the waters offshore of Edisto are very active with sea turtles, particularly loggerheads and leatherbacks. They are frequently seen in higher numbers near the project area during airplane surveys than in any other area of the state (SCDNR, personal communication).

At Edisto Beach State Park in 2003, 87 nests were laid, of which 62 had to be relocated. Since 1994, a total of 679 nests have been laid. Of these, 229 (34 percent) had to be relocated and 694 false crawls were made. A total of 72,622 eggs have been laid. The nesting success averaged 89 percent with a hatching success of 72 percent. Data from 2008 for Edisto Beach shows that Edisto Beach has the third highest number of sea turtle nests in the State. However, Edisto Beach also had the fifth lowest hatch success rate. These data indicate that while Edisto Beach is heavily used by nesting turtles, the conditions on the beach are not favorable to hatch success rates. Data from the past 5 nesting seasons (i.e., 2008 thru 2012) shows that Edisto Beach had the sixth highest number of sea turtle nests in the State (Figure 3.11).

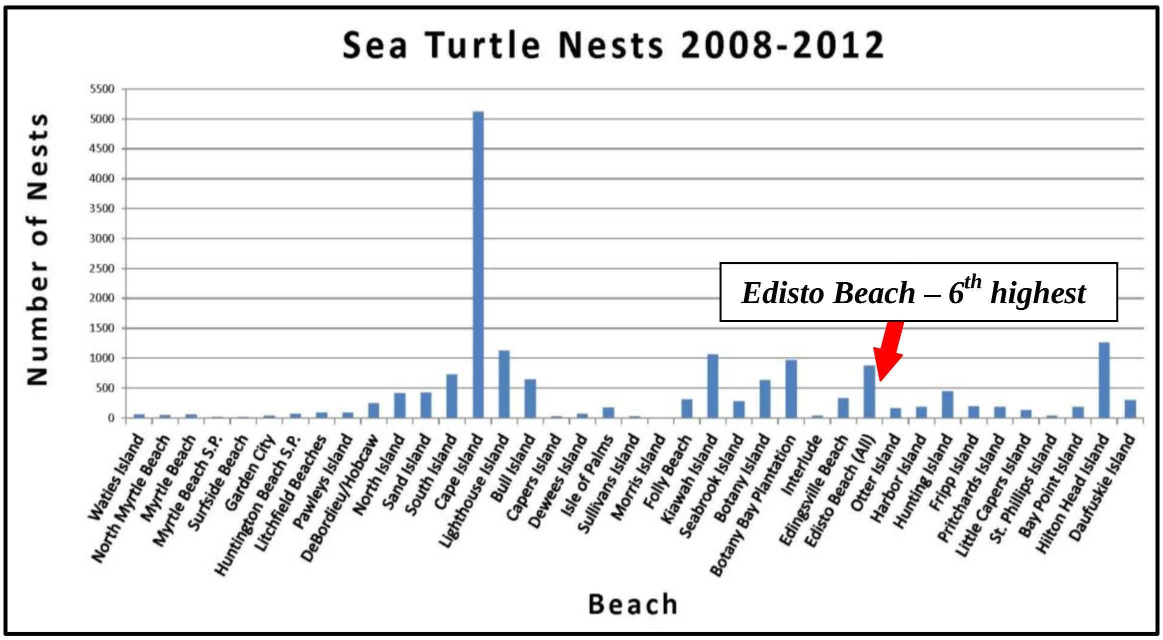

Figure 3.11: 2008-2012 count of sea turtle nests at South Carolina beaches.

3.2.13.2 Piping Plover

The piping plover (*Charadrius melodus*) is Federally classified as threatened with critical habitat in South Carolina, where it winters. Critical habitat for the piping plover is found north of the project area at Deveaux Bank and south of the project area at the southern rim of Otter Island (Figure 3.12). This species prefers expansive sand and mud flats for feeding which are in close proximity to a sandy beach for roosting. These birds tend to prefer isolated areas and may generally be found at accreting ends of barrier islands, on sandy peninsulas and near coastal inlets. The area near the proposed project, particularly the northern end of Edisto Beach State Park, may provide suitable habitat for these birds, since this area tends to be more isolated with fewer park visitors and is closer to Deveaux Bank.

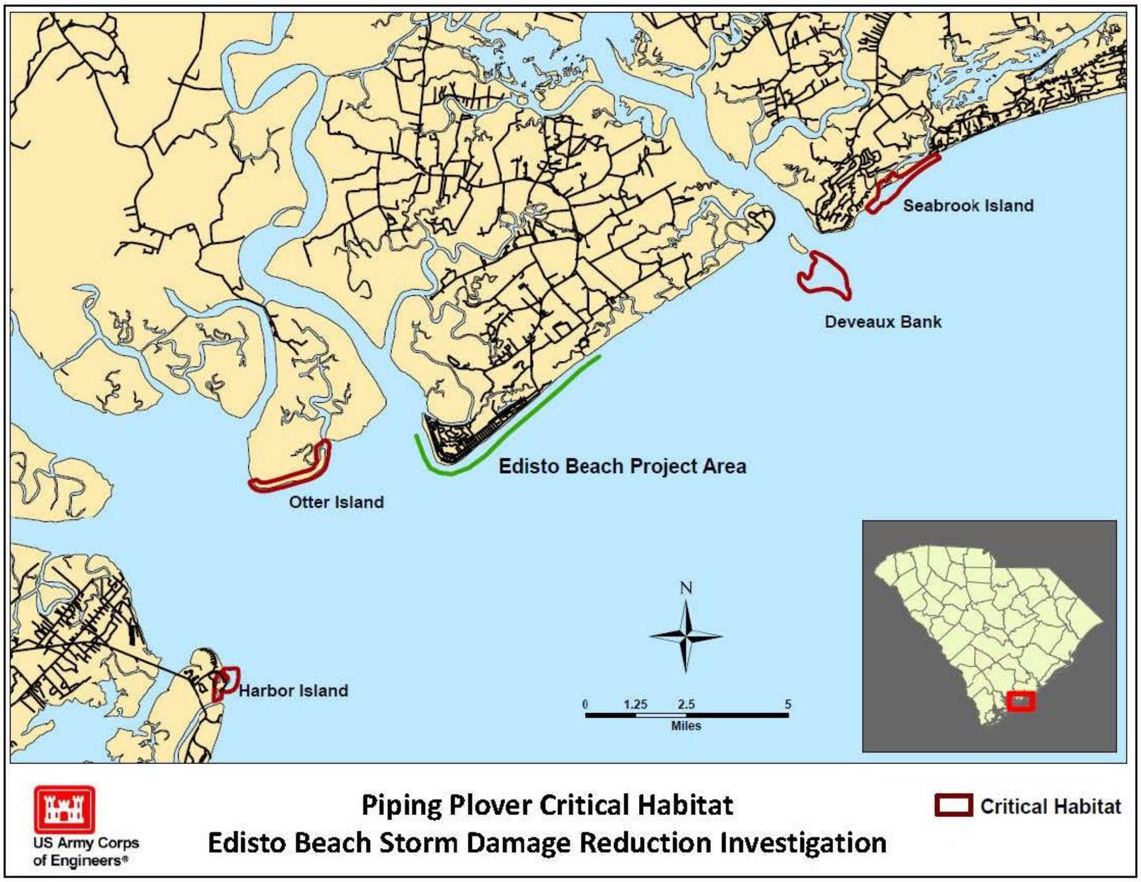

Figure 3.12: Location of piping plover critical habitat in the vicinity of the project area.

3.2.13.3 Rufa Red Knot

Rufa red knots (*Calidris canutus rufa*) are medium-sized shorebirds approximately 9 to 11 inches long. Each year red knots make one of the longest distance migrations known in the animal kingdom, traveling up to 19,000 mi annually. This migration occurs between the red knot's breeding grounds in the Canadian Arctic and several wintering areas, including the Southeast United States, the Northeast Gulf of Mexico, northern Brazil, and Tierra del Fuego at the southern tip of South America ("Winter" is used to refer to the nonbreeding period of the red knot life cycle when the birds are not undertaking migratory movements.). During both the northbound (spring) and southbound (fall) migrations, red knots use key staging and stopover areas to rest and feed. Red knots are a specialized molluscivore, eating hard-shelled mollusks, sometimes supplemented with easily accessed softer invertebrate prey, such as shrimp and crab-like organisms, marine worms, and horseshoe crab eggs. Red knots occupy all known wintering areas from December to February, but may be present in some wintering areas as early as September or as late as May. The primary threats to the red knot are loss of both breeding and non-breeding habitat; reduced prey availability throughout the non-breeding range; potential for disruption of natural predator cycles on the breeding grounds; and increasing frequency and severity of asynchronies (i.e., mismatches) in the timing of their annual migratory cycle relative to favorable food and weather conditions (USFWS, 2013b).

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. The mud flats on Botany Bay Plantation get some red knot activity during migration (Sept/Oct and April/May); however, the red knot has not been sited on Edisto Island during either of the last two winter surveys. SCDNR indicates that red knots do not likely concentrate on Edisto Beach (Felicia Sanders, personal communication, 11/22/2013).

3.2.13.4 Sturgeon

The two types of sturgeon, indigenous to South Carolina, are the Atlantic sturgeon (*Acinpenser oxyrinchus*) and the Shortnose sturgeon (*Acipenser brevirostrum*). The Shornose sturgeon has been listed as "endangered" under the ESA since 1967. The American Fisheries Society deemed it "threatened" in 1989. It is much smaller than the Atlantic sturgeon, with adults reaching 1.2 m in length and maximum weight of around 18 kg. The body is shaped similar to a shark, and the body is protected by three rows of scutes (a protective armoring). They are benthic feeders and primarily prey on invertebrates. Their historical range is from the St. John River, Canada to the St. Johns River, Florida. In South Carolina, these species occur as distinct populations by river system, a characteristic typical for anadromous fishes. There are a minimum of five populations in South Carolina, one of which is located in the Ashepoo, Combahee, and Edisto (ACE) Basin. They move primarily from tidal estuarine into freshwater rivers to spawn. During fall and winter, sturgeon move seaward into estuarine waters to feed. Impediments to river flow (i.e., dams) are the major challenge that these species face. Other challenges include dredging and bridge construction that allows additional saltwater intrusion as well as the removal of prey from the benthos. Yet another challenge is from commercial and recreational fishing operations. By-catch from gill nets, trawls or trotlines may also cause increased mortality.

The Atlantic sturgeon was listed as "endangered" under the ESA on February 6, 2012. The Atlantic sturgeon is a long-lived, estuarine dependent, anadromous fish. They can grow up to 14 feet long and can weigh up to 800 pounds. They appear similar to the shortnose sturgeon but are larger, have a smaller mouth, different snout shape, and scutes. Adults spawn in freshwater in the spring and early summer and migrate into estuarine and marine waters where they spend most of their lives. This species faces threats due to by-catch, habitat degradation and loss from human activities such as dredging, dams, water withdrawals, and other development.

3.2.13.5 Whales

A variety of whale species are known to frequent South Carolina waters, including the blue whale, finback whale, humpback whale, North Atlantic right whale, sei whale, and sperm whale.

3.2.13.6 Manatees

The West Indian manatee (*Trichechus manatus*) was listed as endangered on March 11, 1967, under a law that preceded the Endangered Species Act of 1973, as amended (16 USC 1531 et seq.). Additional Federal protection is provided for this species under the

Marine Mammal Protection Act of 1972, as amended (16 USC 1461 et seq.). SCDNR indicates that manatees have been observed in SC since 1850. From 1850-2004 there have been 1117 records of manatees were documented in SC. These data suggest that manatees are infrequent visitors in SC (http://www.dnr.sc.gov/manatee/dist.html). However, in 2012, the SCDNR online reporting system noted that manatee sightings were reported beginning in April and lasting until October. Manatees have large, seal-shaped bodies with paired flippers and a round, paddle-shaped tail. They are grey in color and occasionally spotted with barnacles or colored by patches of green or red algae. The manatees' range is generally restricted to the southeastern United States; individuals occasionally range as far north as Massachusetts and as far west as Texas (http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=A007). There is no designation of critical habitat for the West Indian manatee in SC.

3.2.13.7 State Rare, Threatened, and Endangered Species

The State of South Carolina's Rare, Threatened and Endangered Species Inventory includes the loggerhead sea turtle, the Wilson's Plover (*Charadrius wilsonia*), and the Least tern (*Sterna antillarum*). All three species are listed on the State inventory as threatened. Least terns, willets, and Wilson's plovers have been observed nesting at the Edisto Beach State Park or present with young of the year (SCDEC, personal communication). American oystercatchers have also been observed utilizing the beach areas. Although American oystercatchers are not currently considered threatened or endangered, SCDNR has reported that the oystercatcher population is declining due to the continued loss of suitable habitat and increased beachfront development.

3.2.14 Cultural Resources

There are no known cultural resources on the beachfront at Edisto Beach. A comprehensive cultural resources review was conducted for the proposed offshore borrow area, including a quarter mile buffer around the area. Two potential sites of prehistoric interest were identified in the survey area. Discussion of these sites, as well as a detailed description of the paleo-environmental setting, the prehistoric context, and historic context of the study is contained in Appendix J of this report.

3.2.15 Water Quality

The proposed project would occur within the open ocean and on an adjacent beach. These waters are classified as Class SA waters by the SC Department of Health and Environmental Control (SCDHEC). SA waters are tidal saltwaters suitable for primary and secondary contact recreation, crabbing, and fishing, except harvesting of clams, mussels, or oysters for market purposes or human consumption and uses listed in Class SB. They are also suitable for the survival and propagation of a balanced indigenous aquatic community of marine fauna and flora. Over the past few years Edisto Beach has had a few beach advisories due to high levels of bacteria after rain events.

The proposed project would occur in the open ocean and on an adjacent beach. SCDHEC issued a notice on 401 water quality certifications 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.

Section 404 of the Clean Water Act (CWA) governs the discharge of dredged or fill material into waters of the U.S. Although the USACE does not process and issue permits for its own activities, the USACE authorizes its own discharges of dredged or fill material by applying all applicable substantive legal requirements, including public notice, opportunity for public hearing, NEPA, and application of the section 404(b)(1) guidelines. A 404(b)(1) evaluation has been completed for this project and is included as Appendix H to this report.

3.2.16 Air and Noise Pollution

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 pollution 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 which persistently exceed the NAAQS are designated as “nonattainment” areas and those which meet or exceed the standards are designated “attainment” areas. Colleton County is designated as an attainment area.

With regards to noise pollution, ambient noise levels along Edisto Beach are low to moderate and are typical of recreational environments and are not considered an issue or nuisance. The major noise producers include the breaking surf, residential areas, and traffic (vehicular and to a lesser extent, boat).

3.2.17 Hazardous, Toxic and Radioactive Wastes (HTRW)

There are currently no known hazardous, toxic or radioactive waste producers adjacent to the project site or any entity that discharges toxic effluents nearby.

3.3 Socio-Economic Resources

3.3.1 Demographics and Population

As of the census of 2010, there were 414 people in the Town of Edisto Beach. This is a decrease of 35.4% since the 2000 census which showed a population of 641 people. However, according to a Town of Edisto Beach representative, the 2010 population count of 414 has been challenged because the Town did not have a mail out census, just a door to door count during a season when many people are out of town. According to the sponsor, the voter registration is 704 people, a 10 percent increase from the 2000 census.

Based on the 2010 census, there are 2,181 housing units, with 10.6 percent being occupied and 89.4 percent being vacant housing units mainly for rent or seasonal use. There are 232 households out of which 3.4 percent had children under the age of 18 living with them; 62.9 percent are married couples living together; 1.7 percent have a female householder with no husband present and 35.3 percent are non-families. The average household size is 1.78 and the average family size is 2.13.

3.3.2 Income

In 2010, the per capita income was $51,628. The median income for a household in the town was $64,125, and the median income for a family was $96,250. About 2.9% of families were below the poverty line.

3.3.3 Education

According to the 2010 census, the education attainment in Edisto Beach for high school graduates is 20.8 percent. The population that attained an associate's degree is 6.5 percent, and the population percentage that received a bachelor's degree is 35.7, and 19 percent of the population has a graduate or professional degree.

3.3.4 Employment

In 2010, Edisto Beach had 261 people in the labor force. The occupations in Edisto Beach are as follows: management, business, science and arts (154 people), service occupation (22 people), sales and office (38 people), natural resources, construction and maintenance (12 people), and production, transportation and material moving (20 people). The unemployment rate is 5.7 percent.

3.3.5 Transportation and Utilities

The Town of Edisto Beach is accessible from Edisto Island and the mainland via SC Hwy 174. The William McKinley Jr. Bridge connects Edisto Island to the mainland. Major local roads on the island include Palmetto Boulevard (a section of SC Hwy 174 which runs parallel and close to the beach), Lybrand Street, Jungle Road, Dock Site Road and Myrtle Street. One company supplies well water to the Town of Edisto Beach. There is also one sewer plant for the Town.

3.3.6 Land Use and Development

Land use on Edisto Beach is primarily residential in the form of single and multiple family dwelling units. The west end of the island has been developed as a planned gated community. The Edisto Beach State Park occupies approximately one third of Edisto Beach at the northern end and offers numerous scheduled activities and educational opportunities. Edisto Beach has relatively few commercial units, and commercial development is limited. Approximately 34 acres, 2 percent, of the 1,531 acres on the beach is zoned for commercial use, excluding resort amenities within the gated section of Wyndham Resort. There are 4.67 miles of walking/biking trails that provide recreational activities to the public throughout the town. The town is already near full development capacity with less than 2 percent of developable lots vacant.

3.3.7 Historical Storms and Damages

Edisto Island has had a number of damaging storms and hurricanes affect its shores. Some of the major hurricane events to impact Edisto in recent history include:

- On August 11, 1940 a powerful (unnamed) hurricane directly hit Edisto Island at high tide, damaging nearly every house on the island and completely destroying more than half of the approximately two hundred beachfront homes at the time.

- The first named storm to hit Edisto was Able, which struck on August 31, 1952. The storm completely destroyed many beach cottages and damaged many others. Palmetto Boulevard (SC Hwy 174) also sustained heavy damage.

- Category 3 Hurricane Gracie made landfall on the southern edge of Edisto Island on September 29, 1959. The Pavilion's fishing pier was largely destroyed, 16 homes were wrenched from their foundation, and 63 other homes were severely damaged. If Gracie had not come ashore at low tide, the amount of damage would have undoubtedly been much worse.

- Hurricane Hugo in 1989 landed 40 miles to the north of Edisto Island. Only moderate property damage, largely from high winds, was incurred at Edisto as a result of the hurricane.

Since Hugo, Edisto Beach has not suffered major damages from a single event. However, long term erosion of the shoreline continues, making structures even more vulnerable to future storms.

3.3.8 Structure Inventory

Beach front development is predominantly single family dwellings, many of which are vacation rental properties. Figure 3.13 shows examples of some typical shoreline structures. A complete structure inventory was completed in 2010 of existing structures that based on location would most likely benefit from a storm damage reduction project. These are generally houses in the two rows closest to the shoreline. There are no public structures in the study area inventory, although public structures exist elsewhere on Edisto Island. The depreciated replacement cost for the structure values were also calculated in 2010 (see Appendix C, Structure Inventory Analysis). There are only about 8 developable lots in the inventory area that are currently vacant. A summary of the structure inventory is shown in Table 3.6.

Table 3.6: Edisto Beach structure inventory count

Edisto Beach Structure Inventory	
Damage Element	**Number**
Commercial	15
Single-Family	505
Multi-Family	16
Walkovers	80
Road	8
Utility	16

The ‘Road’ damage element is Palmetto Boulevard. It has been divided based on reaches and treated as a linear damage element. The ‘Utility’ damage element refers to the underground water pipes that run along the side of the road that have potential to be damaged. There are twice as many utilities as roads because the utilities run along both sides of the road.

Figure 3.13: Examples of some typical structures along the Edisto Beach shoreline.

3.3.9 Structure and Content Value

The value of structures in the study area required for economic analysis to determine NED benefits is expressed in terms of depreciated replacement costs. Staff from the USACE Savannah District prepared the Edisto Beach Structure Inventory Analysis that determined the depreciated replacement cost for the structures (Appendix C). Tax Assessor’s records on the current inventory were examined and studied. Variables relating to assessed value, date of construction, type of construction, number of floors, square footage, recent sales and selling prices, along with other information were analyzed. Content value was taken at 50 percent of the structure value. A web search of trade associations of homeowner casualty underwriters revealed that insurers generally use a content to structure ratio between 50 and 75 percent of replacement cost. For this analysis, the more conservative number of 50 percent was used. Based on this analysis, the total existing value of structures included in the inventory, is $126,007,000 and the content value is $62,531,000.

3.3.10 Beach Parking and Access

The Town of Edisto Beach provides widespread public access to their beach, particularly within the study area. There are 38 existing public access points within the Town (locations are detailed in Appendix B). Edisto Beach State Park also provides additional public access points at the northern end of the study area. Access points exist at a rate of one per each quarter mile in the northern end of the study area and are more frequent (about every 300 feet) at the southern end of the study area. These access points vary in size from walking paths to wooden walkovers.   Signage for the access points is uniformly designed and is adequate for identification by the public of the location of the access points. There is no restricted public access/private beach within the study area.

Parking is provided at 11 of the public access points, some of which have lots that can accommodate up to 150 cars. In addition, there are 113 on-street parking spaces within the study area. Parking is also provided at a town-owned, 20-space parking lot at Jungle

Street on the northern end of the study area. Edisto Beach State Park is also available for parking and can accommodate an additional 400 vehicles. Informal observation of the parking situation during tourist season indicates that lack of parking during peak days has not historically been an issue on the island. A significant amount of beach-goers are overnight visitors and utilize the private parking associated with rental properties.

4. FUTURE WITHOUT PROJECT CONDITIONS*

The existing conditions described in the previous chapter form the basis on which the future without project conditions are developed. Although the future without project conditions discussion in this chapter touches on all major resource areas, it is generally only quantified for those areas that are directly related to the study objectives, which in this case is the reduction of coastal storm damages.

4.1 Assumptions

For the purposes of USACE planning, the future without project condition is defined as the most likely condition of the project area over a fifty year period of analysis, in the absence of a USACE coastal storm damage reduction project. Predictable or planned actions undertaken by others (including other federal agencies), as well as expected maintenance of existing USACE projects, are all included as part of the future without project condition. The discussion of the without project condition in the subsequent sections is based on the following assumptions: a) continued maintenance of the existing groin fields, b) no additional groin construction, c) due to a lack of dedicated funding, no additional planned beach nourishments by the local interests, d) smaller scale “emergency” nourishment activities would take place as areas become increasingly threatened, and e) SC Hwy 174 would be armored as it becomes increasingly threatened, since the road is the primary evacuation route off the island and is essential for public safety. These assumptions are derived from conversations with the Town of Edisto Beach regarding actions they would or would not take in the absence of a federal project and an assessment of previous actions that have been taken. An additional assumption being made for the future without project condition and the future with project condition is that the level and type of development in the study area will remain consistent with existing conditions.

4.2 Shoreline Rate of Change

The future without project average annual rates of change, as determined through Beach-*fx* simulations for each of the 23 project reaches (see section 3.1.5), are shown in Table 4.1. Beach-*fx* is a Monte-Carlo life-cycle simulation model for evaluating the physical performance and economic benefits of coastal storm damage reduction projects (Gravens et al, 2007). The predicted rate of change includes the effects of emergency nourishment actions that are considered part of the future without project condition. The method by which these rates were determined is detailed in Appendix A. As indicated in the table, the shoreline is largely erosional and a resultant decrease in beach width can be expected to occur in the future without project scenario.

4.3 Sea Level Rise

The historical rate of sea level rise for the study area, which is 3.19 mm/yr, is also being applied as the future without project sea level rise rate. The “Intermediate” rate of future sea level change was computed using modified NRC Curve 1 and equations 2 and 3 in EC-1165-2-212 Appendix B. The “High” rate of future sea level change was computed using modified NRC Curve III and equations 2 and 3 in EC-1165-2-212 Appendix B.

The relationships for future sea level change as outlined in EC-1165-2-212 are coded within Beach-fx and sea level change is internally computed continuously throughout the simulated project lifecycle.

Table 4.1: Expected future without project condition shoreline average annual rate of change (AARC) as estimated through Beach-*fx* simulations. A negative value indicates erosion, positive values indicate accretion.

Reach	AARC (ft/yr)	Reach	AARC (ft/yr)	Reach	AARC (ft/yr)
I1	1.37	**E3**	-1.09	**E11**	-2.07
I2	0.62	**E4**	-1.64	**E12**	-1.67
I3	0.38	**E5**	-1.83	**E13**	-1.80
I4	0.16	**E6**	-1.96	**E14**	-1.98
P1	0.22	**E7**	-2.44	**E15**	-1.99
P2	0.13	**E8**	-2.28	**SP1**	-4.38
E1	-0.17	**E9**	-2.50	**SP2**	-5.13
E2	-0.58	**E10**	-2.33		

4.4 Future Development

As the town is already nearly fully developed, a large increase in the number or type of structures in the future is not expected. There are a few developable vacant lots that will likely eventually be developed. However, for the purposes of being conservative in the project economics analysis, those lots are assumed to remain vacant. The analysis also assumes that houses that are damaged or destroyed will be rebuilt to the same level of construction as the existing structure, assuming there is sufficient room on the lot to allow for rebuilding.

4.5 Coastal Storm Damages

Average annual coastal storm damages occurring in the future without project condition were calculated using the Beach-*fx* software, as detailed in Appendix A and Appendix B (Economics Appendix). In order to account for local actions taken under the future without project condition, the following parameters were included as part of the analysis:

1) Armoring of SC Hwy 174 is triggered when the seaward edge of the berm gets within 20 feet of the road.

2) Emergency nourishment is triggered in a reach when dune height in that reach falls below 9 ft. During emergency nourishment, the dune is reconstructed with a target elevation of North American Vertical Datum 11 ft (if achievable) with a fill density 10 cy/ft.

Table 4.2 provides the expected average annual without project condition damages for each of the 23 defined reaches. The future without project average annual damages over the entire study area are estimated at $2,068,000.

Table 4.2: Summary of future without project structure and content damages. FY 2012 interest rate of 4.000%.

Reach	**Average Structure Damage**	**Average Content Damage**	**Average Total Damages**	**Average Annual Total Damages**
I-1	$6,317,733	$2,990,364	$9,308,097	$433,294
I-2	$3,062,552	$1,114,885	$4,177,437	$194,461
I-3	$718,326	$296,763	$1,015,089	$47,253
I-4	$1,042,894	$417,459	$1,460,353	$67,980
P-1	$369,642	$141,146	$510,788	$23,777
P-2	$636,016	$271,999	$908,015	$42,268
E-1	$252,774	$126,588	$379,362	$17,659
E-2	$702,507	$288,870	$991,377	$46,149
E-3	$848,403	$280,191	$1,128,594	$52,536
E-4	$1,419,165	$645,353	$2,064,518	$96,104
E-5	$1,047,363	$315,453	$1,362,816	$63,439
E-6	$335,689	$145,157	$480,845	$22,383
E-7	$123,200	$55,066	$178,266	$8,298
E-8	$1,310,857	$640,868	$1,951,725	$90,853
E-9	$1,444,122	$714,053	$2,158,175	$100,463
E-10	$2,151,029	$1,057,831	$3,208,860	$149,373
E-11	$2,196,338	$1,087,834	$3,284,172	$152,879
E-12	$388,255	$183,945	$572,199	$26,636
E-13	$1,112,656	$543,753	$1,656,409	$77,106
E-14	$3,637,260	$1,790,893	$5,428,153	$252,682
E-15	$1,481,667	$721,851	$2,203,518	$102,574
SP-1	$0	$0	$0	$0
SP-2	$0	$0	$0	$0
Total	**$30,598,447**	**$13,830,322**	**$44,428,769**	**$2,068,168**

In addition to the storm damages to structures and contents documented above, additional damages based on land loss are also incurred in a future without project condition. Table 4.3 contains the average annual land loss value for only the reaches where net erosion is occurring, but excluding the state park. The total land loss value is based on the annual erosion rates in table 4.1, and a near shore upland value of $19.76 per square foot (see Appendix C for details as to how the near shore land value was estimated).

Table 4.3: Summary of future without project damages resulting from land loss.

Reach	Average Annual Land Loss Damages
E1	$1,656
E2	$9,959
E3	$26,406
E4	$56,646
E5	$45,454
E6	$47,637
E7	$27,000
E8	$56,631
E9	$29,689
E10	$53,223
E11	$25,196
E12	$19,800
E13	$20,701
E14	$47,341
E15	$67,713
Total	**$535,054**

To summarize, the results of the future without-project scenario, as simulated with Beach-*fx*, indicate an unfavorable future within the project study area due to chronic long term erosion and damaging storms. The total average annual future without project damages are estimated at $2,603,000 per year (4.000% interest rate). In recent history, substantial damages have largely been avoided due to successful local nourishment projects that were constructed in 1995 and 2006. However, future local nourishment projects are not anticipated due to funding constraints. Therefore, significant damages and even complete losses to privately held developed properties could occur in the without project condition, although these losses might be somewhat mitigated by local emergency protection efforts. Indications are that Edisto State Park would be subject to extreme losses due to coastal erosion including the inability to support recreational camping within the park. Figures 4.1 to 4.3 depict the predicted future without project location of the shoreline from the inlet to the state park (reaches I1-E15) and Figure 4.4 shows recent landside inundation in Reach 15 due to high tides.

Figure 4.1: Predicted location of the shoreline between reaches I1 and E3 (purple line) after 50 years in the future without project scenario.

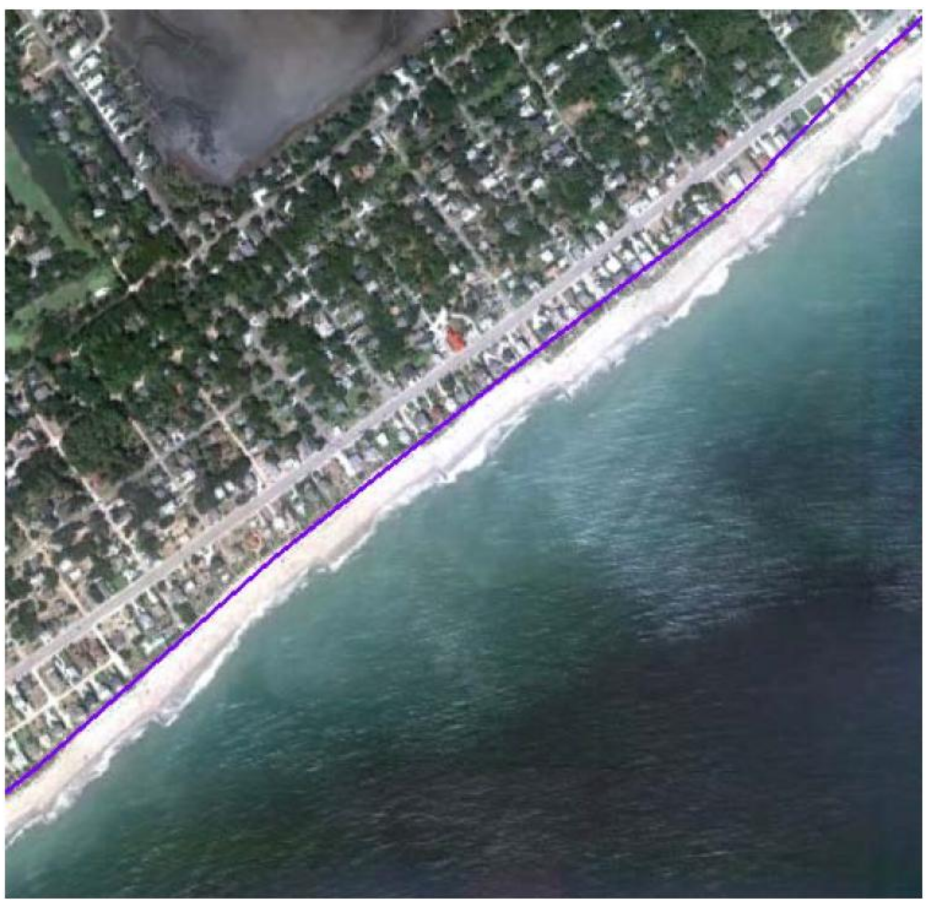

Figure 4.2: Predicted location of the shoreline between reaches E4-E7 (purple line) after 50 years in the future without project scenario.

Figure 4.3: Predicted location of the shoreline between reaches E8-E15 (purple line) after 50 years in the future without project scenario.

Figure 4.4: Recent photograph of high tide in Reach 15.

4.6 Environmental Resources

Overall, it is expected that sea turtle nesting habitat, shorebird habitat, quality beach and dune habitat would likely decrease in a future without project condition. A general listing of the impacts of a future without project condition (no action alternative) on environmental resources is provided in Table 5.6. However, the future without project condition of some environmental resources would vary along three distinct sections of the beach. These are the Inlet section, Atlantic Facing section, and Edisto Beach State Park section. These varying outcomes are discussed in the sections, below.

4.6.1 Edisto Beach State Park Section

The ongoing erosion that would continue to occur in this section in the future without project condition would reduce the shoreline area available for nesting sea turtles and potentially reduce the successful hatching rate of juvenile turtles as they are more vulnerable to overwash from waves. In the northern part of the island, this effect might be minimized because of the lack of development and the potential for the beach to migrate landward. Edisto Island has the third highest rate of nesting turtles in South Carolina, and quality habitat would be reduced if erosion were to continue. However, as there are adjacent beaches available for nesting, it is unknown whether this would result in more turtles nesting on those beaches rather than Edisto Beach.

The salt marsh that exists behind Edisto Beach State Park would likely be reduced in size as the mean high water line shifts landward in the future without project condition. As a result of a diminished area of salt marsh behind the beachfront, there would likely be a loss of Essential Fish Habitat. Shorebirds would thrive in the overwash fans created as a result of tidal and wave inundation. Recreational beach area would be diminished with future erosion, which could result in fewer visitors to the park. However, fewer visitors would be beneficial to wildlife species including birds as they would likely be disturbed less frequently.

4.6.2 Atlantic Facing Section

In the without project condition, it is assumed that a minimal measure of protection would be provided for beach front properties and SC Hwy 174 along the Atlantic facing reaches of Edisto Beach. This minimal measure of protection would not facilitate a healthy beach and dune system along these reaches. Beaches without coastal development could migrate landward without drastic consequences to the beach and dune system. In developed areas, roads and other infrastructure would act as an impediment to this landward migration. SC Hwy 174 would likely be protected by a revetment which would act as a sea wall and reduce the area of active beach above the MHW line. SCDHEC OCRM states about seawalls, bulkheads, and revetments that, "While these structures can protect coastal property and infrastructure from erosion, they do so at the expense of the long-term health of the beach/dune system and the public's access to this shared resource. The structures themselves can intensify erosion problems in their immediate vicinity; and as sea levels rise, eventually the dry sand and intertidal beach will be lost." (SCDHEC-OCRM 2010) In time, there would be minimal beach even at low tide. Without a healthy dune system, coastal properties are more vulnerable to storm damage.

Dune systems support a wide array of wildlife (discussed in section 3) which would lose habitat with continued erosion. Negative impacts to sea turtle hatching rates and habitat would be similar or greater than those that are experienced in the park section. In addition to potentially impacting sea turtles, an eroding beach would also result in a loss of shorebird nesting habitat, foraging area, and roosting area. Also, the diminishment of the intertidal area would negatively affect the various macroinvertebrate species that inhabit the intertidal beach. Presently, Edisto Beach does not see many water quality advisories in any given year. However, water quality impairments could increase in the without project condition if infrastructure such as water and sewer lines are compromised and not repaired properly.

4.6.3 Inlet Section

Based on current and predicted accretion rates, the mean high water line would advance seaward in this portion of the beach. The South Edisto River portion of the study area would continue to accrete and build a dune system similar to what is presently there. This dune system is diverse but has a very low profile due to the nature of the coarse sand at Edisto Beach. Being in a dynamic inlet area, the rate of accretion is subject to short and long term influences. The low profile dune system leaves this habitat vulnerable to periodic overwashing duringo storm events. Washover fans are valuable habitat to a variety of shorebirds (Section 3.2.11.1). The seaward advance of the MHW line would help enhance habitat for sea turtle nesting, which would be crucial to turtle nesting along Edisto Beach, especially due to the assumption that only short term small scale protection measures would be applied along the Atlantic facing shoreline of the Town. This would likely limit the availability of adequate nesting habitat. It is likely that sea turtle volunteers and various resource agencies would need to utilize this portion of beach to relocate nests. Beach and dune habitat as described in Section 3 of this report would be enhanced in the without project condition. Additionally, the small pockets of existing maritime forest may be able to grow larger in size due to additional protection from salt spray and inundation.

4.7 Socioeconomic Resources

In a future without project condition where the beach is allowed to erode, a large economic impact would likely be felt by the local community, which is largely reliant on tourism dollars. Absent the beach, revenue gained from tourism could be expected to decrease as recreational opportunities diminish. Additional discussion of the impact on socioeconomic resources in the future without project condition (no action alternative) is contained in Tables 5.5 and 5.6 later in this report.

5. PLAN FORMULATION*

This chapter describes the plan formulation process through the selection of a recommended plan. It includes a discussion of the general plan formulation and evaluation criteria being used, the identification and screening of measures, the creation of comprehensive alternative plans through the combination of measures and the evaluation and comparison of alternative plans. A number of measures/alternatives are usually identified early in the planning process and their number is reduced by screening and evaluation through an iterative sequence in increasing levels of detail to finally identify the recommended plan.

5.1 Formulation and Evaluation Criteria

Alternative plans are evaluated by applying numerous, rigorous criteria. Per the *Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies*, four general criteria are considered during alternative plan screening: completeness, effectiveness, efficiency, and acceptability. Those terms are defined, below.

<u>Completeness:</u> Completeness is the extent that an alternative provides and accounts for all investments and actions required to ensure the planned output is achieved. These criteria may require that an alternative consider the relationship of the plan to other public and private plans if those plans affect the outcome of the project. Completeness also includes consideration of real estate issues, operations and maintenance (O&M), monitoring, and sponsorship factors. Adaptive management plans formulated to address project uncertainties also have to be considered.

<u>Effectiveness:</u> Effectiveness is defined as the degree to which the plan would achieve the planning objective. The plan must make a significant contribution to the problem or opportunity being addressed.

<u>Efficiency:</u> The project must be a cost-effective means of addressing the problem or opportunity. The plan outputs cannot be produced more cost-effectively by another institution or agency.

<u>Acceptability:</u> A plan must be acceptable to Federal, state, and local government in terms of applicable laws, regulation, and public policy. 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.
- Recreation benefits may not be more than 50 percent of the total benefits required for economic justification.

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 (EOPs).

Adverse impacts to the environment would be avoided to the extent practicable. In cases where adverse effects cannot be avoided, mitigation must be provided based on the guidance in ER 1105-2-100, paragraph C-3(d)(1), and Memorandum dated 31 August 2009 Implementation Guidance for Section 2036(a) of WRDA 2007-Mitigation for Fish and Wildlife and Wetland Losses, which states:

> "it is the policy of the Corps of Engineers Civil Works program to demonstrate that damages to all significant ecological resources, both terrestrial and aquatic, have been avoided and minimized to the extent practicable and than any remaining unavoidable damages have been compensated to the extent possible per ER 1105-2-100, paragraph C-3(d)(3)(l)....in order to compensate for non-negligible impacts to aquatic and terrestrial resources to the extent incrementally justified and to ensure that the recommended project would not have more than negligible adverse impacts on ecological resources."

5.2 Environmental Operating Principles

The USACE Environmental Operating Principles were developed to ensure that USACE 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

5.3 Identification of Measures

A variety of potential measures can be considered and combined when formulating alternative plans for reducing coastal storm damages. These measures generally are categorized as either structural or nonstructural. Structural measures are those that directly affect conditions that cause storm damage. The nonstructural measures are measures taken to reduce damages without directly affecting those conditions.

A wide variety of structural measures for addressing coastal storm damage reduction were initially considered for this study. These measures include "soft" stabilization activities such as beach nourishment, and "hard" stabilization structures such as breakwaters, seawalls, revetments, and groins. These measures are discussed in more detail below:

5.3.1 Hard Stabilization

S-1: Emergent Breakwaters

Breakwaters are generally shore-parallel structures that reduce the amount of wave energy reaching the protected area. They are similar to natural bars, reefs or nearshore islands and are designed to dissipate wave energy. The reduction in wave energy slows the littoral drift and results in sediment deposition in the sheltered area behind the breakwater. Some longshore sediment transport may continue along the coast behind the nearshore breakwater. Properly designed, breakwaters can be effective in reducing erosion and in building up the beaches locally using natural littoral drift. At the same time, they are also effective in holding nourished beach material (Burcharth and Hughes 2003).

S-2: Submerged Artificial Reefs

This management measure would use the perched beach concept to limit the amount of underwater fill and retain the dry beach for a longer period. This would be accomplished by placement of a submerged artificial reef in shallow water with beach fill material placed "perched" behind the reef structure. This measure may reduce initial fill quantities and offer environmental benefits by creating nearshore hardbottom habitat. The submerged artificial reef would be constructed out of large size rock, and/or ReefBalls® with a foundation material to avoid subsidence. The beach fill material would come from the identified borrow area at the ebb-tidal shoal at the south end of Edisto Island.

SCDNR manages an extensive array of artificial reefs that have been proven to be beneficial to wildlife habitat for benthic organisms and fish species. However, artificial reefs are not commonly used for coastal storm damage reduction purposes in South Carolina, and the amount of coastal storm damage reduction benefits they could provide is uncertain.

S-3: Groins

Groins are the oldest and most common shore-connected, beach stabilization structure. They are structures that extend, fingerlike, perpendicularly or at nearly right angles from the shore and are relatively short compared to navigation jetties at tidal inlets. Usually constructed in groups called groin fields, their primary purpose is to trap and retain sand, nourishing the beach compartments between them. Groins initially interrupt the longshore transport of sediment within the littoral drift. They are most effective where longshore transport is predominantly in one direction and where their action does not cause unacceptable downdrift erosion. When a well designed groin field fills to capacity, longshore transport continues at about the same rate as before the groins were built and a stable beach is maintained. However, if the groins fields are not filled, the overall effect is accretion on the updrift side and erosion on the downdrift side (Burcharth and Hughes 2003). Kraus (http://www.springerlink.com/content/p43lnl710912k6x3/fulltext.pdf) states that a long groin intercepts too much sand moving alongshore, which causes erosion of the downdrift beach by impounding or blocking sediment on the updrift side.

Modern coastal engineering practice is to combine beach nourishment with groin construction to permit sand to immediately begin to bypass the groin field system. At the end of the sediment cell, terminal groins may be used to anchor the beach and limit the movement of sand into a navigational channel or onto an ebb-tidal shoal at tidal inlets.

Groins have been constructed from a wide range of materials including armorstone, pre-cast concrete units or blocks, rock-filled timber cribs and gabions, steel sheet pile, timber sheet pile, and grout filled bags and tubes. There are also a variety of possible groin configurations.

In the state of South Carolina, new groins are only allowed in conjunction with a financial commitment to renourishment and on beaches that have high erosion rates, with erosion threatening existing development or public parks (SC Beachfront Management Act, R.30-15(G)).

Two groin related measures were initially considered:

S-3a: Adding New Groins

This measure would consist of creating new groins to supplement the existing groin field.

S-3b: Lengthen Existing Groins

This measure would lengthen the existing groins. As lengthening the groins would only be effective if additional sand was added to the beach, this measure would only be considered in conjunction with a beach fill measure (see S-6), and groins would only be lengthened to the extent necessary to support the added beach fill.

S-4: Seawalls

Seawalls are usually massive, vertical structures used to protect backshore areas from heavy wave action, and in lower wave energy environments, to separate land from water. They can be constructed using a range of materials; the most common being poured concrete, steel sheet pile, concrete blocks, gabions, and timber cribs. While erosion of the land seaward of the seawall might be reduced, erosion of the seabed immediately in front of the structure will be enhanced due to increased wave reflection caused by the seawall (Burcharth and Hughes 2003). Seawalls often exhibit some instability because of the erosion around the toe of the structure. Furthermore, they are not readily adaptable if sea level rise exceeds the original design level of the structure.

The SC Beachfront Management Act specifically prohibits the use of these types of structures seaward of the 40-year setback line.

S-5: Revetments

Revetments are a cover or facing of erosion resistant material placed directly on an existing slope, embankment or dike to protect the area from waves and strong currents. They are usually built to preserve the existing uses of the shoreline and to protect the slope. Like seawalls, revetments armor and protect the land behind them. They may be either watertight, covering the slope completely, or porous, to allow water to filter through after the wave energy has been dissipated.

Most revetments do not significantly interfere with transport of littoral drift. They do not redirect wave energy to vulnerable unprotected areas, although beaches in front of steep revetments can be prone to erosion. Materials eroded from the slope before construction of a revetment may have nourished a neighboring area, however. Accelerated erosion occurring after the revetment is built can be controlled with a beach-building or beach-protecting structure such as a groin or breakwater.

The SC Beachfront Management Act specifically prohibits the use of these types of structures seaward of the 40-year setback line.

5.3.2 Soft Stabilization

S-6: Beach Fill

Beach fill measures consist of placing sand in order to create or expand the beach berm (the flat 'shoreline' part of the beach) or dune (the more elevated portion of the beach landward of the berm). Beach fill measures are oftentimes considered preferable to hardened structures because they mimic the natural environment and can be shaped to maximize net storm damage reduction benefits. Additionally, a beach fill measure is naturally adaptable to sea level rise. However, the beach fill template would need to be periodically renourished throughout the life of the project.

The beach berm reduces coastal storm damages by increasing the distance between structures and the water, thus reducing the potential for erosion related damages, and dampening storm surge and wave heights. It is also the area of the beach that is generally recreated upon. The dune functions as sacrificial line of defense and an additional repository of sand, and can further protect structures from wave attack.

Three beach nourishment measures were considered:

S-6a: Dune Only Fill

This measure can consist of increasing the width and/or height of an existing dune, or creating a new dune if one does not already exits.

S-6b: Berm Only Fill

This measure consists of maintaining or increasing the width of the existing berm with no expansion to the existing dune dimensions. Berm widths that may initially be considered are 50, 75, and 100 foot berms. The height of the berm is generally kept at the natural berm elevation.

S-6c: Dune and Berm Fill

This measure is a combination of S-6a and S-6b.

S-7: Dune Vegetation

Proper vegetation on dunes increases erosion resistance by binding the sand together via extensive root masses penetrating into the sand. Such vegetation also promotes dune growth through sand trapping when wind transports substantial quantities of sand. Vegetation is an effective and inexpensive way to stabilize dunes. It also enhances the natural beauty of the landscape by providing a pleasing variety and contrast to the eye and attracting small animals to the food, nesting sites and the protective cover it affords.

However, vegetation does not protect against major storms and it is more fragile than other erosion control measures. As such, this measure, by itself, would not provide adequate coastal storm damage reduction and would need to be used in conjunction with a beach nourishment measure.

S-8: Dune Sand Fencing

Sand fences built along the seaward faces of dunes can trap windblown sand and naturally build up the dune feature. Their effectiveness is dependent on a variety of factors, such as the availability and composition of the sand.

5.3.3 Non-Structural Measures

N-1: Removal

One category of nonstructural measures involves moving beachfront structures away from the damage threat. There are three potential removal measures:

N-1a: Retreat

This measure consists of moving an existing structure away from the shoreline a short distance within the same property parcel.

N-1b: Relocation

This measure consists of moving an existing structure away from the shoreline a longer distance to a vacant property.

N-1c: Demolition

This measure consists of acquiring the property and demolishing the structure.

N-2: Floodproofing Structures

This measure consists of protective measures directly applied to the structure that would help protect it from water inundation. There are a variety of floodproofing techniques that could be considered.

N-3: Elevating Structures

This measure consists of raising the structure in place, thereby protecting it from a majority of damages if the water remains below the raised first floor elevation.

N-4: Regulations

Regulatory measures consist of things like coastal building codes, building construction setbacks, floodplain regulations and comprehensive evacuation planning. Many regulatory measures are already in place and considered part of the existing conditions. Recommendations to implement regulatory measures were considered during this project to further reduce risk. The associated recommendations are provided in Section 11.

5.4 Screening of Measures

The management measures initially identified underwent a preliminary screening process. The screening process used pertinent technical and policy/legal constraints, while also considering the measure's acceptability, efficiency, completeness and effectiveness (see section 5.1). Table 5.1 summarizes the screening process and provides information about which measures were carried forward for the formulation of alternative plans and the rationale for dropping some measures from consideration. Measures were screened out if there were technical or policy/legal constraints precluding implementation of the measure or if the measure was determined to be inefficient or ineffective, relative to other measures. Although acceptability of the measure was also considered, it was not used as the sole factor for ruling out a measure during preliminary screening.

In summary, the following measures were retained for further analysis:

Structural Measures

S-3b: Lengthen Groins
S-6a: Dune Only Fill (Reaches I1 to I4)
S-6b: Berm Only Fill
S-6c: Dune and Berm Fill
S-7: Dune Vegetation
S-8: Dune Sand Fencing (Reaches I1 to I4)

Non-Structural Measures

N-1c: Demolition

Table 5.1: Summary of Measures Screening Process

Measure	Description	Technical Constraints	Policy/Legal Constraints	Acceptability	Efficiency	Effectiveness	Completeness	Other	Retain?	Reason for screening out
Structural										
S-1	Emergent Breakwaters	The location of a breakwater would have to be carefully considered	None	Environmental Resource Agencies have expressed extreme concerns with the use of breakwaters	Breakwaters would likely not be a cost efficient method for reducing coastal storm damages	No historical proof of effectiveness for storm damage reduction, existing groins already providing some shoreline stability	Incomplete: Would require additional measures such as dune and/or berm fill over some portions of the project	None	No	Not relatively effective or efficient for reducing storm damages
S-2	Submerged Artificial Reefs	The location of the reefs offshore would have to be carefully considered. Reefs would likely also be used in areas with the highest erosion	None	Could cause navigational problems, act as an impediment to sea turtles	Not known at this time, but may not be cost effective depending on its location	May reduce some wave energy, but would need to be done in conjunction with a beach fill measure in order to provide any substantial benefits	Incomplete: Would require additional measures such as dune and/or berm fill over some portions of the project	This measure would likely provide ancillary environmental benefits. Local sponsor has no interest in this measure.	No	Effectiveness is unknown and would take additional modeling efforts to better quantify, no local sponsor interest
S-3a	Adding New Groins	The presence of 34 existing groins limits the locations where new groins could be added	None	Environmental resource agencies have expressed extreme concerns with the building of additional	Would likely not be cost efficient, due to the number of existing groins already in place	Would likely not be relatively effective, due to the number of existing groins already in place	Incomplete: Would likely require dune and/or berm fill measures to create a complete alternative	None	No	Technical constraints on location, and would likely not be efficient or effective
S-3b	Lengthen Existing Groins	None	None	Could cause some additional environmental impacts	Not known at this time, further analysis would be needed	Would need to be done in conjunction with a beach fill measure in order to provide any substantial benefits	Incomplete: Would likely require dune and/or berm fill measures to create a complete alternative	None	**Yes**	NA
S-4	Seawalls	None	Construction of seawall would violate SCBMA, and hence federal CZMA	Implementation of measure would not be acceptable due to violation of state and federal policy	Not known at this time, further analysis would be needed	Would likely be effective, however effectiveness would decrease with accelerated sea level rise	Complete: Primary storm damage reduction benefits would be achieved without additional measures	Measure would likely not provide ancillary environmental and recreation benefits, and is not readily adaptable to sea level rise	No	Would violate legal constraints, and not publicly acceptable for implementation
S-5	Revetments	None	Construction of revetment would violate SCBMA, and hence federal CZMA	Implementation of measure would not be acceptable due to violation of state and federal policy	Not known at this time, further analysis would be needed	Would likely be effective, however effectiveness would decrease with accelerated sea level rise	Complete: Primary storm damage reduction benefits would be achieved without additional measures	Measure would likely not provide ancillary environmental and recreation benefits, and is not readily adaptable to sea level rise.	No	Would violate legal constraints, and not publicly acceptable for implementation
S-6a	Dune Only Fill	On the north end of the island, there is not enough existing berm to build a dune on top of	None	No known issues	Not known at this time, further analysis would be needed	Would be effective in reducing storm damages	Incomplete: Would likely require berm fill and groin modifications to create a complete alternative	Would only be considered on the southern end of the island	**Yes**	NA
S-6b	Berm Only Fill (no expansion of existing dune)	None	None	No known issues	Not known at this time, further analysis would be needed	Would be effective in reducing storm damages	Incomplete: Would likely require berm fill and groin modifications to create a complete alternative	None	**Yes**	NA
S-6c	Dune and Berm Fill	None	None	No known issues	Not known at this time, further analysis would be needed	Would be effective in reducing storm damages	Incomplete: Would likely require berm fill and groin modifications to create a complete alternative	None	**Yes**	NA
S-7	Dune Vegetation Planting	None	None	No known issues	Not known at this time, further analysis would be needed	Existing dunes are already heavily vegetated. Dune vegetation on its own is not an effective storm damage reduction measure	Incomplete: Would likely require a combination of other measures to create a complete alternative	Would only be done in association with building of a dune	**Yes**	NA
S-8	Dune Sand Fencing	None	None	None	Not known at this time, further analysis would be needed	Effectiveness is uncertain for the study area	Incomplete: Would likely require a combination of other measures to create a complete alternative	Analysis of measure will assume some percentage of effectiveness as compared to direct dune construction measures	**Yes**	NA
Non-Structural										
N-1a	Retreat	Most properties are constrained by the existing road, and there is not room to move the property back in the lot	None	No known issues	Not known at this time, further analysis would be needed	Would be effective in reducing storm damages	Incomplete: Would likely require a combination of other measures to create a complete alternative	None	No	Technical constraints - limited room to move structures
N-1b	Relocation	Almost all lots on the island are developed, so there is essentially no available room to relocate houses	None	No known issues	Not known at this time, further analysis would be needed	Would be effective in reducing storm damages	Incomplete: Would likely require a combination of other measures to create a complete alternative	None	No	Technical constraints - few available lots to move structures to
N-1c	Demolition	None	None	Property owners and the town of Edisto Beach would likely not consider property buy-outs to be an acceptable solution	Not known at this time, further analysis would be needed	Would be effective in reducing storm damages	Complete: Large-scale demolition could achieve reductions in damages but may not be economically justifiable	None	**Yes**	NA
N-2	Floodproofing Structures	None	None	None	Not known at this time, further analysis would be needed	Would be effective in reducing storm damages from inundation, but not erosion and waves. However, many houses are already floodproofed so effectiveness would be minimal.	Incomplete: Would likely require a combination of other measures to create a complete alternative	Viability is uncertain because measure would be voluntary and mass participation would be unlikely, and there is little interest from the local sponsor.	No	Limited effectiveness and uncertain viability for implementation
N-3	Elevating Structures	None	None	None	Not known at this time, further analysis would be needed	Would be minimally effective as most houses are already elevated	Incomplete: Would likely require a combination of other measures to create a complete alternative	Most houses (97%) are already elevated, so this measure would only be considered on a small percentage of structures. Viability is uncertain because measure would be voluntary and mass participation would be unlikely, and there is little interest from the local sponsor.	No	Limited effectiveness and uncertain viability for implementation
N-4	Regulations	Regulations are already in place	None	No known issues	Efficient, as there are no direct project implementation costs	Shoreline management regulations are an effective method for reducing storm damages and limiting lives lost during hurricanes	Incomplete: Would likely require a combination of other measures to create a complete alternative	Shoreline management regulations are considered an integral part of any alternative, however, they are a local responsibility and proper regulations are already in place	No	Proper and effective regulations are already in place

5.5 Formulation of Alternative Plans

The alternative plans considered consist of one or more management measures identified in the previous section. Some measures may not be compatible with others, while others may need to be combined with others to be effective. For instance, measure S-3b (lengthen groins) would need to be combined with measure S-6b (berm only fill) or S-6c (dune and berm fill) to be effective.

To facilitate alternative evaluation, Edisto Beach was divided into 3 “planning reaches”. The reaches are distinguished by their shoreline morphology and include: the Inlet Reach (I1-I4), Atlantic Reach South (P1, P2, E1-E6), and Atlantic Reach North (E7-E15). No alternatives were formulated for the Edisto Beach State Park area (SP1, SP2) because the area lacks sufficient infrastructure to justify the cost of protecting it. However, any berm feature constructed along the entire Atlantic North Reach would need to be tapered over part of the park.

Some measures are only applicable within certain reaches. As an example, the dune only and sand fencing measures would only be effective in the Inlet Reach because the wide existing berm and accretionary nature of that reach does not require a constructed berm feature.

Four beachfill alternatives were developed and considered. The dimensions of these alternatives are provided in Table 5.2. Profile dimensions vary among the three planning reaches to account for the different morphology and erosional environment within those areas, but were kept consistent within each reach with the exception of some tapering of the berm features. Alternative 1 was designed to approximate the dimensions of the successful 2006 local beach renourishment effort. Alternative 2 was designed as the smallest practicable beachfill plan, while Alternative 3 was designed to be the largest practicable plan. After the first three beachfill alternatives were analyzed (see section 5.6 below), Alternative 4 was developed to better bracket the economic benefits. Alternative 4 generally mimics Alternative 1, but incorporates a higher dune feature. In order to maintain the effectiveness of the groin field with the designed increases in berm width, all the alternatives would require some lengthening of existing groins. Total groin extensions of 1,090, 360, 1,970, and 1,130 linear ft were used for Alternatives 1, 2, 3, and 4, respectively. Details on how these added groin lengths were determined are contained in Appendix A.

Table 5.2: Dimensions of the four beachfill alternatives analyzed.

Reach	Alternative 1: Beach and Dune fill			Alternative 2: Beach and Dune fill (minimum)			Alternative 3: Beach and Dune fill (maximum)			Alternative 4: Beach and Dune fill (bracketing)		
	Berm Width	Dune Height	Dune Width	Berm Width	Dune Height	Dune Width	Berm Width	Dune Height	Dune Width	Berm Width	Dune Height	Dune Width
I1		12	15		10	15		14	15		14	15
I2		12	15		10	15		14	15		14	15
I3		12	15		10	15		14	15		14	15
I4		12	15		10	15		14	15		14	15
P1	taper	12	15	taper	10	15	taper	14	15	taper	15	15
P2	25	14	15	13	12	15	38	16	15	13	15	15
E1	50	14	15	25	12	15	75	16	15	25	15	15
E2	50	14	15	25	12	15	75	16	15	50	15	15
E3	50	14	15	25	12	15	75	16	15	50	15	15
E4	50	14	15	25	12	15	75	16	15	50	15	15
E5	50	14	15	25	12	15	75	16	15	50	15	15
E6	50	14	15	25	12	15	75	16	15	50	15	15
E7	63	14	15	38	12	15	88	16	15	63	15	15
E8	75	14	15	50	12	15	100	16	15	75	15	15
E9	75	14	15	50	12	15	100	16	15	75	15	15
E10	75	14	15	50	12	15	100	16	15	75	15	15
E11	75	14	15	50	12	15	100	16	15	75	15	15
E12	75	14	15	50	12	15	100	16	15	75	15	15
E13	75	14	15	50	12	15	100	16	15	75	15	15
E14	75	14	15	50	12	15	100	16	15	75	15	15
E15	75	14	15	50	12	15	100	16	15	75	15	15
SP	taper			taper			taper			taper		

Two other non-beachfill alternatives were also considered. Alternative 5 consisted of dune sand fencing along reaches I1-I4, which would need to be combined with some sort of beachfill in the remaining reaches. Alternative 6 was a demolition non-structural plan. The non-structural plan was evaluated for only the two most vulnerable reaches - E14 and E15. Additional reaches were to be evaluated only if the non-structural plan yielded the highest net benefits at these two reaches.

To summarize, six action alternatives and the no action were evaluated and compared in more detail. The six action alternatives were:

- Alternative 1: Mid-size dune and berm fill (comparable to 2006 fill) + 1,090 ft of groin lengthening
- Alternative 2: Minimum size dune and berm fill + 360 ft of groin lengthening
- Alternative 3: Maximum size dune and berm fill + 1,970 ft of groin lengthening
- Alternative 4: Mid-size dune and berm fill (economic bracketing alternative) + 1,130 ft of groin lengthening
- Alternative 5: Dune Sand Fencing (reaches I1-I4) + dune and berm fill in remaining reaches.
- Alternative 6: Non-Structural/Demolition (reaches E14, E15)

5.6 Evaluation and Comparison of Alternative Plans

5.6.1 Evaluation of Beachfill Alternatives

The benefits of the four beachfill alternatives were evaluated using the Beach-*fx* model. The Beach-*fx* model is used to estimate the benefits and borrow volumes needed for each alternative. Details related to the model inputs such as storm forecasts and erosion rate assumptions are provided in Appendix A. It should be noted that the costs produced by the model and presented for the alternative screening stage are for comparative purposes only, as they only factor in borrow placement and mob/demob costs, but not other miscellaneous costs (monitoring, tilling, walkway replacement, vegetation planting, real estate, administration, PED, etc). Groin construction costs were also included in the analysis; however, these costs were estimated and incorporated outside of the Beach-*fx* model. The miscellaneous costs would be fairly similar among the various beachfill alternatives, and hence their exclusion would not affect the comparison of alternatives.

In order to avoid large real estate costs related to structure acquisition, a project construction baseline was established. The construction line was set so that the landward toe of the project dune did not intersect any habitable structures. This means the actual constructed project will be offset seaward of the alternatives modeled within Beach-fx. The additional sand volume associated with the offset between the simulated Beach-fx baseline and the construction baseline, and associated project costs, were calculated and incorporated in the analysis outside of the Beach-fx model. This external calculation was necessary because the Beach-fx model does not currently include the capability to specify an offset between the initial condition beach morphology and the constructed with-project morphology. Details on how these offset volumes were calculated are contained in Appendix A (Coastal Engineering).

The alternatives benefit analysis used the simulated Beach-fx baseline for analysis comparison. The difference in the construction baseline and the simulated Beach-fx baseline could overestimate the with-project damages. To compensate for the shift in the actual construction baseline and the modeled baseline an adjustment to the position of the structures relative to the modeled baseline was made. Essentially, the structures were shifted on a reach by reach basis landward an equivalent distance to the shift between baselines. This shift ensures that damages are correctly accounted for within Beach-FX and the calculation of net benefits is appropriate for the selected plan.

A full and detailed project cost was only developed for the recommended plan. Benefits for each alternative are comprised of reductions in structure and content damage, emergency nourishment costs, armoring costs for the state road and land loss as compared to the future without project condition.

5.6.2 Evaluation of Non-Structural Alternative

A total of 19 shorefront houses located within reaches E14 and E15 were evaluated for the nonstructural alternative. Several broad assumptions were made for this analysis, including 100% compliance by property owners and immediate and full implementation of the plan at the start of the project. The goal of this screening level evaluation was to determine if a non-structural measure or plan would a) be economically feasible and b) if it was economically feasible, 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 from the non-structural alternative were calculated based on the assumption that the average future without project condition structure/content damages to these 19 structures (taken from the earlier FWOP Beach-*fx* run) as well as emergency nourishment costs in reaches E14 and E15 would be reduced to zero when the plan is implemented. Costs for the non-structural plan were based on an acquisition cost using the actual land and structure value taken from the Structure Inventory Analysis (Appendix C) for each structure and a demolition cost for each structure. For simplification, an identical demolition/removal and land value acquisition cost was used for every structure and lot. The values were 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 also applied to the analysis.

5.6.3 Evaluation of Dune Sand Fencing Alternative

Because of the uncertainties regarding how large of a dune would be created by this alternative and how quickly it would be created, several assumptions were made regarding this alternative. First, based on examples of successful sand fencing projects that were implemented at Folly Beach and Myrtle Beach, SC, the creation of a maximum of 2 ft of extra dune via sand capture was considered to be reasonable. This is comparable to the increase in dune height that would be directly added to the Inlet Reach under Alternative 1. Hence, the damage reduction at the Inlet Reach resulting from Alternative 1 was considered the *maximum* damage reduction that could be assumed under the sand fencing alternative. In reality, the damage reduction would likely be less because the dune height increase via windblown sand capture would be much more gradual as compared to directly adding the material through dune construction. Hence, a 90% damage reduction capability as compared to Alternative 1 was initially assumed, although this percentage likely still overestimates the benefit. Costs for this alternative were based on constructing 5,293 ft of fencing and assuming it would need to be completely replaced three times during the 50 year project life.

This initial screening level evaluation was done only to see how this alternative would generally compare to the other alternatives in reaches I1-I4 only. If this initial evaluation revealed that sand fencing in the Inlet Reach could potentially be part of the NED plan, then additional analysis would need to be conducted to better quantify the potential benefits.

5.6.4 NED Comparison of Alternatives

Table 5.3 displays the average annual (AA) net benefits by alternative at each of the individual modeling reaches and a summary of the results by the three planning reaches and the entire study area (AS – Atlantic Reach South, AN – Atlantic Reach North, Inlet Reach). Additional details regarding the calculation of AA net benefits for the alternatives are contained in Appendix B.

Table 5.3: Comparison of average annual net benefits from the 6 alternatives analyzed (FY 2012 interest rate of 4.000%). The highest net benefit for each individual reach is highlighted.

	Average Annual (AA) Net Benefits					
Reach	**Alt 1**	**Alt 2**	**Alt 3**	**Alt 4**	**Alt 5**	**Alt 6**
I-1	$122,469	$15,882	$222,424	$222,424	$126,686	x
I-2	$57,558	$7,021	$107,922	$107,922	$69,198	x
I-3	$14,156	$2,234	$22,820	$22,820	$18,070	x
I-4	$19,108	$2,416	$33,788	$33,788	$22,476	x
P-1	$9,658	$9,076	$14,436	$17,528	x	x
P-2	-$14,101	$22,457	-$1,185	-$5,344	x	x
E-1	$3,472	$13,017	-$4,736	$9,951	x	x
E-2	$21,848	$22,470	$11,313	$21,978	x	x
E-3	$36,315	$46,123	$26,654	$38,632	x	x
E-4	$81,740	$28,222	$98,315	$93,723	x	x
E-5	$46,145	$27,247	$43,832	$51,606	x	x
E-6	$58,933	$66,524	$53,368	$59,216	x	x
E-7	$18,021	$21,968	$13,804	$16,423	x	x
E-8	$130,028	$104,432	$121,698	$133,471	x	x
E-9	$64,325	$21,001	$91,613	$76,090	x	x
E-10	$135,694	$70,100	$145,367	$151,388	x	x
E-11	$135,277	$67,594	$142,937	$145,952	x	x
E-12	$15,223	$14,570	$7,986	$16,015	x	x
E-13	$60,498	$46,982	$59,520	$61,747	x	x
E-14	$194,443	$113,188	$207,823	$213,951	x	($226,906)
E-15	$126,759	$120,963	$112,765	$130,192	x	($17,935)
Inlet Reach (I1-I4)	**$213,290**	**$27,553**	**$386,954**	**$386,954**	**$236,430**	x
AS Reach (P1-2, E1-E6)	**$244,010**	**$235,136**	**$241,996**	**$287,289**	x	x
AN Reach (E7-E15)	**$880,268**	**$580,798**	**$903,515**	**$945,230**	x	x
Total	**$1,337,568**	**$843,487**	**$1,532,465**	**$1,619,473**	x	x

Alternative 4 yields the highest AA net benefits for each of the planning reaches, the overall study area and the majority of the individual economic reaches. Thus, it is the NED plan.

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 21 modeling reaches used in the analysis. It should be noted that with beachfill 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. All individual modeling reaches, with the exception of P2, are economically justified with positive net benefits solely on the basis of storm damage reduction. Hence, the NED plan is also considered to be incrementally justified.

5.6.5 Comparison of Alternatives by RED, EQ, and OSE Accounts

In addition to the NED comparison shown in the previous section, alternative plans should also be compared based on potential impacts to Regional Economic Development (RED), Environmental Quality (EQ), and Other Social Effects (OSE). For the purposes of this comparison, the beachfill alternatives which require groin lengthening are lumped together into one category. Although there could be some differences among these beachfill alternatives as it relates to RED, EQ, and OSE, these differences would be minor and would not affect plan selection. Comparisons in these accounts are thus made between 1) Beachfill with groin extensions, 2) Dune sand fencing with beachfill, 3) Non-Structural alternative and 4) No-Action alternative. These comparisons are presented in Tables 5.4 to 5.6 below.

Table 5.4: OSE comparison of alternatives.

Account: OSE				
	Alternative			
Item	Beachfill with Groin Extensions	Dune Sand Fencing + Beachfill	Nonstructural	No Action
Life, Health, and Safety	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.	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.	No change. Continued stress during damaging storms. Evacuation would still be required before storm landfall.
Community Cohesion	Reduces displacements of all permanent residents and visitors.	Reduces displacements of all permanent residents and visitors.	Permanently displaces oceanfront residents/visitors. Periodic displacement of other residents.	Periodic displacement of all permanent residents and visitors.
Community Growth	Growth trends in population and recreation visitation would continue.	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.	Recreation visitation would likely decrease as the beachfront erodes away. Permanent population would likely decrease as lots are abandoned.
Traffic and Transportation	Reduces damages to streets and highways. Minor, short term increase in boat traffic due to dredging operations during initial construction and renourishments.	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	Continued risks to streets and highways
Community Growth	Growth trends in population and recreation visitation would continue.	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.	Recreation visitation would likely decrease as the beachfront erodes away. Permanent population would likely decrease as lots are abandoned.
Environmental Justice	No effect	No effect	No effect	No effect

Table 5.5: RED comparison of alternatives.

Account: RED				
	Alternative			
Item	Beachfill with Groin Extensions	Dune Sand Fencing + Beachfill	Nonstructural	No Action
Sales Volume	Rental sales and tourism sales preserved or increased	Rental sales and tourism sales preserved or increased	Reduced rental market and tourism market	Similar to nonstructural, although likely to occur at a slower pace
Income	Increased recreation visitation may improve the income of service industries and rental properties	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	Similar to nonstructural, although likely to occur at a slower pace
Employment	Seasonal employment may increase due to increased recreation visitation. Temporary increase in employment related to construction activities	Seasonal employment may increase due to increased recreation visitation. Temporary increase in employment related to construction activities	Seasonal employment may decrease due to decreased recreation visitation. Temporary increase in employment related to structure removals	Seasonal employment may decrease due to decreased recreation visitation
Tax Changes	Tax base and property values preserved or increased	Tax base and property values preserved or increased	Loss of tax base due to numerous structures being removed	Loss of tax base when houses are destroyed and cannot be rebuilt

Table 5.6: EQ comparison of alternatives

Account: EQ					
		Alternative			
Item	**Sub-Item**	**Beachfill With Groin Extensions**	**Dune Sand Fencing + Beachfill[1]**	**Nonstructural (E14-E15)**	**No Action**
Marine Environment	**Benthic Resources - Nearshore Ocean**	Short term impacts to benthic macro-invertebrates associated with dredging activities. A small area of sand substrate will be covered by the groin extensions; however, the groins will provide hard substrate for benthic invertebrates	No additional impact	Status quo maintained	Status quo maintained
		Risk of demersal fish entrainment by dredging activities.			
	Benthic Resources - Beach and Surf Zone	Short term and localized impact to surf zone benthic macro-invertebrate community from direct burial and turbidity associated with beach placement of sediment. Invertebrate recruitment will occur relatively quickly post construction.	No additional impact	Short term reduction in surf zone habitat and benthic macro-invertebrate abundance due to erosion, scarping, and scour of beach habitat towards existing infrastructure (i.e. Hwy 174) and long term impacts from the emergency stabilization techniques (i.e. sand bags, revetments) to protect the road.	Long term reduction in surf zone habitat and intertidal benthic macro-invertebrate abundance due to erosion and scour of beach habitat towards existing homes, infrastructure (i.e. roads), and short term stabilization techniques (i.e. sand bags, revetments, etc.). Along the inlet reaches, the status quo would be maintained.
	Turbidity	Short term impacts to adult, larval, and juvenile surf zone fishes from elevated turbidity levels associated with beach placement of sediment and dredging activities.	No additional impact	Short term impacts to adult, larval and juvenile fish from periodic emergency stabilization techniques to protect the road.	Status quo maintained
	EFH-HAPC	Short term impacts to the physiography of borrow areas. The location of the borrow area on an ebb tidal shoal will help to ensure relatively rapid recovery of the borrow area.	No additional impact	Status quo maintained	Status quo maintained
Terrestial Environment	**Beach and Dune**	Short term impacts to portions of the existing dune vegetation during construction of the new dune field. Planting of dune vegetation will mitigate this impact.	Existing dune vegetation will be able to keep pace with the dune accretion.	Long term degradation of beach habitat due to continued erosion of the berm and dune	Long term degradation of beach habitat due to continued erosion of the berm and dune along the atlantic facing reaches. The inlet reaches will continue to accrete and build dune system similar to what is present. The dune system will be more expansive than currently exists. Periodic inundation from storms will allow overwash fans to support bird habitat as well.
		Long term sustainability of dune habitat for nesting sea turtles and other dependent mammal and avian species	No additional impact		
		Short term impacts to ghost crabs and other invertebrates and their beach and dune habitat with long term stability of habitat.	No additional impact	Short term impacts to ghost crabs and their beach and dune habitat from short term resotarion protection measures (ie, beach scraping, sand bags, dune stabilization)	Short term impacts to ghost crabs and their beach and dune habitat from short term protection measures (ie, beach scraping, sand bags, revetments, dune stabilization)
	Shorebird Habitat	Short term impacts to shorebird foraging due to a temporary change in the species and diversity of surf zone macro-invertebrates	No additional impact	Short term reduction in surf zone habitat and benthic macro-invertebrate abundance due to erosion, scarping, and scour of beach habitat towards existing infrastructure (i.e. roads) and short term stabilization techniques (i.e. sand bags).	Long term reduction in surf zone habitat and benthic macro-invertebrate abundance due to erosion and scour of beach habitat towards existing homes, infrastructure (i.e. roads), and short term stabilization techniques (i.e. sand bags).
		Prevention of overwash fan habitat for shorebirds as a result of the constructed dunes.	No additional impact	Short term impacts would result in creation of overwash fan habitat for shorebirds with loss to development in the long term	Short term creation of available overwash fan habitat for shorebirds with loss to development in the long term. The State Park reach will migrate landward. Shorebird foraging habitat should be favorable; however, nests could be compromised by overwash risk.
Threatened and Endangered Species	**Sea Turtles**	Short term decrease in sea turtle nest success associated with changes to the physical chacracteristics of the beach. Construction equipment associated with groin extensions could impede sea turtle ingress to the beach. However, this effect will be minimal as construction will only be on one groin at a time and will proceed along the beach. Therefore, no area will be impacted for a considerable period of time.	Sand fencing design would adhere to the sea turtle requirements. No additional impacts anticipated.	Long term decrease in sea turtle nesting habitat and nest success due to beach erosion, scarping and scouring of the dune.	Long term decrease in sea turtle nest success due to beach erosion, scarping and scouring of the dune. Eventually there may only be a revetment fronting and protecting Hwy 174. In this case, there would be no available nesting habitat for turtles along the atlantic reaches of the Town. However, the inlet reaches would see an increasing beach front as the MHW line moves seaward. The wider beach would likely serve as a site for the turtle volunteers to relocate any nests from the atlantic reaches.
		Long term sustainability of sea turtle nesting habitat due to preservation of the beach berm. The additional groin length will not effect sea turtle nesting/hatchling success.	No additional impact		
		Long term reduction of beach lighting impacts to sea turtles from constructed dune	No additional impact	Risk of increased beach lighting impacts to sea turtles as dune erodes	Risk of increased beach lighting impacts to sea turtles as dune erodes
		Risk of sea turtle entrainment from hopper dredge	No additional impact		
	West Indian Manatee	Minimal threat of collision with whales during dredging and groin construction operations.	No additional impact	Status quo maintained	Minimal impact associated with periodic emergency nourishment which would occur to protect beachfront homes and Hwy 174.
	North Atlantic Right Whale	Minimal threat of collision with whales during dredging and groin construction operations.	No additional impact	Status quo maintained	Minimal impact associated with periodic emergency nourishment which would occur to protect beachfront homes and Hwy 174.
	Atlantic Sturgeon	Minimal risk of Atlantic sturgeon entrainment from hopper dredge.	No additional impact	No additional impact	Minimal risk of Atlantic sturgeon entrainment from dredging during likely periodic emergency nourishment events.
	Red Knot	No impact	No impact	No impact	No impact
	Piping Plover	No impact	No impact	No impact	No impact

Table 5.6 (continued): EQ comparison of alternatives (part 2 of 2)

Account: EQ					
		Alternative			
Item	**Sub-Item**	**Beachfill with Groin Extensions**	**Dune Sand Fencing + Beachfill[1]**	**Nonstructural**	**No Action**
Cultural Resources		Slight risk of encountering resources associated with beach placement and borrow area dredging, although risk in dredging areas is minimal since they have been surveyed. Long-term protection of any future potential historic resouces that would be affected by natural processes.	No additional impact or risk	Even with the removal of the at risk homes in E14 and E15, Hwy 174 will continue to be protected. Source of borrow material will be an issue as it is uncertain where emergency material would be obtained from.	Potential resources along the Atlantic reaches would continue to be vulnerable to natural processes. Source of borrow material will be an issue as it is uncertain where emergency material would be obtained from.
Water Quality		Short term and localized elevated turbidity and suspended solid concentrations offshore and in the surf zone associated with dredging and beach placement as well as groin construction activitites.	Fewer impacts than the beachfill only alternatives due to elimating need for heavy construction equipment along the inlet reaches.	Impacts could occur from the removal of the homes and infrastruture (e.g., water, sewer, power lines). Additionally, since emergency actions will still occur to protect Hwy 174, short term impacts to water quality could occur during these actions.	Since emergency actions will still occur to protect Hwy 174, short term impacts to water quality could occur during these actions. Additionally, certain infrastructure would be at greater risk to being compromised which could affect nearshore water quality (e.g., water, sewer, power lines, etc.).
Air Quality		Temporary air pollutant increase associated with dredging and heavy equipment during initial construction and the renourishment events.	No additional impacts	Temporary air pollutant increase associated with heavy equipment during structure demolition and removal. Temporary air pollutant increase associated with dredging and heavy equipment during emergeny protection events.	Temporary air pollutant increase associated with dredging and heavy equipment during emergeny protection events.
Noise Quality		Temporary noise increase associated with dredging and heavy equipment during initial construction and the renourishment events. These impacts will not affect any property dispropotionately because construction will proceed along the beach.	No additional impacts	Temporary noise increase associated with heavy equipment during structure demolition and removal	Temporary noise increase associated with heavy equipment during periodic emergency protection events.
Recreational and Aesthetic Resources		Improved appearance of beach would enhance recreational experience, and wider berm would increase recreational area. Lengthened groins could exacerbate downdrift scalloping effect that is currently seen along the beachfront.	There would be no burial of existing vegetation and minimal aesthetic impact to beach goers/homeowners in the inlet reach. Sand fencing may be considered an eyesore to some.	A more natural appearance along the beach that may be valued more by some users.	Recreation capacity would decrease as beach erodes. Inlet reach would maintain a high quality beach and dune system as the MHW line moves seaward.
		Temporary inconvenience to beach users during initial construction and future maintenance, although these would occur during low visitation months (Winter), when possible		Recreation capacity would decrease as beach erodes. Emergency protection measures (especially seawalls, revetments) would be a major impediment to beach access as well as an aesthetic eyesore.	
				Temporary inconvenience to beach users during removal and demolition of structures.	

1: Impacts are only described in this column in terms of effects on the inlet reach. The remaining reaches would receive beachfill with groin extensions and the impacts would be identical to the impacts contained in those columns.

5.7 Plan Selection

5.7.1 National Economic Development Plan

The NED Plan is Alternative 4, as it is the alternative which yields the highest net benefits. The dimensions of the beachfill template for the NED plan are shown in Table 5.7 below. The NED plan also involves lengthening 23 of the existing groins. Table 5.8 shows the amount of required lengthening at these groins and Figure 5.1 shows their locations.

Table 5.7: Beachfill template of the NED plan.

NED Beachfill Template					
Reach	**Length (ft)**	**Berm Width (ft)**	**Dune Height (ft)**	**Dune Width (ft)**	**Dune Slope (X:1)**
I1	1,900	x	14	15	3
I2	2,113	x	14	15	3
I3	645	x	14	15	3
I4	635	x	14	15	3
P1	526	taper	15	15	3
P2	882	13	15	15	3
E1	493	25	15	15	3
E2	869	50	15	15	3
E3	1,226	50	15	15	3
E4	1,748	50	15	15	3
E5	1,257	50	15	15	3
E6	1,230	50	15	15	3
E7	560	63	15	15	3
E8	1,257	75	15	15	3
E9	601	75	15	15	3
E10	1,156	75	15	15	3
E11	616	75	15	15	3
E12	600	75	15	15	3
E13	582	75	15	15	3
E14	1,210	75	15	15	3
E15	1,722	75	15	15	3
SP1	1,000	taper	x	x	x

Table 5.8: Groin extension lengths required for the NED plan.

NED Plan Groin Extension Lengths	
Groin #	**Extension length (ft)**
1	80
2	80
3	90
4	90
5	100
6	100
7	80
8	60
9	50
10	50
11	40
12	40
13	40
14	30
15	20
16	20
17	20
18	20
20	20
21	30
22	30
23	20
24	20
Total	**1,130**

Figure 5.1: Locations of groins to be lengthened under the NED plan.

5.7.2 Identification of NED Renourishment Interval

Beach-fx was used to identify the economically optimized renourishment cycle. The results enable the calculation of a frequency distribution of renourishment cycles which vary between as short as 1 year to as long as 20+ years depending on the sequence and severity of storms encountered in the project life-cycle. For the initial analysis used for developing and screening alternatives, a minimum renourishment trigger of 300,000 cubic yards was used. This volume was selected because it represented approximately a 2:1 placement cost to mobilization cost ratio. A ratio less than 2:1 is generally not considered cost efficient. Subsequently, the NED plan was run at 4, 6, 8, 10, 12, and 16 year renourishment cycles. The renourishment cycle setting in the model determines how often the project is "checked" for a renourishment need. However, in the model, a renourishment will only occur if established triggers are met and each interval has a different trigger based on projected erosion rates. Initial results indicated that the 12 year interval maximized net average annual benefits for the NED plan. However, subsequent revisions to mobilization costs and an update to the interest rate assumption used for the economic calculations caused the renourishment interval to shift from 12 years to 16 years.

Table 5.9 shows the average annual costs, benefits, and net benefits for each of the renourishment cycles, using the FY13 discount rate of 3.75 percent. The average annual costs used for this comparison assume that a mobilization and placement is occurring at each renourishment cycle.

Table 5.9: Comparison of average annual (AA) benefits, costs, and net benefits (3.75% discount rate) for the NED plan at renourishment intervals between 4 and 16 years.

Cycle (yrs)	AA Benefits	AA Placement Cost	AA Mob cost	AA Groin Cost	Total AA Cost	AA Net Benefits
4	$ 2,529,665	$ 453,637	$ 694,910	$ 65,747	$ 1,214,294	$ 1,315,371
6	$ 2,502,654	$ 448,241	$ 480,104	$ 65,747	$ 994,092	$ 1,508,562
8	$ 2,478,624	$ 445,727	$ 372,991	$ 65,747	$ 884,465	$ 1,594,158
10	$ 2,406,228	$ 422,585	$ 313,473	$ 65,747	$ 801,805	$ 1,604,424
12	$ 2,402,784	$ 432,214	$ 266,456	$ 65,747	$ 764,417	$ 1,638,366
14	$ 2,377,453	$ 429,477	$ 248,682	$ 65,747	$ 743,906	$ 1,633,547
16	$ 2,351,072	$ 425,004	$ 213,761	$ 65,747	$ 704,512	$ 1,646,560

Based on the model results, the 16 year renourishment interval was selected because it has the highest projected net average annual benefits.

5.7.3 Locally Preferred Plan (LPP)

No locally preferred plan was pursued.

5.7.4 Recommended Plan

As there is no locally preferred plan, the NED Plan (Alternative 4), is the Recommended Plan.

6. THE RECOMMENDED PLAN*

The purpose of this chapter is to centralize information concerning the Recommended Plan. The details of this plan are discussed in terms of its features, economic costs and benefits, design and construction considerations, operations and maintenance requirements, real estate requirements, any environmental monitoring or mitigation commitments, plan accomplishments and risk and uncertainty.

6.1 Plan Description and Components

The project area and basic features are shown in Figure 6.1. The Recommended Plan consists of the following elements: 1) A 15-foot high (elevation), 15-foot wide dune beginning at the northern end of the project (i.e., Reach E15 – the southern end of Edisto Beach State Park) and extending southward along the beach for 16,530 feet. This dune would be fronted by a 7-foot high (elevation) berm. The first 7,740 feet of berm length would have a width of 75 feet. The width would taper to a 50-foot width over the remaining length of the berm. The width of each end of the berm would taper to match the existing beach profile; 2) Beginning at Reach I4, the dune would transition to a 14-foot high, 15-foot wide dune that extends around the end of the island for 5,290 feet. No berm would be constructed in front of this dune because the existing beach profile provides an adequate berm; and 3) Approximately 1,130 ft of total groin lengthening across 23 of the existing groins.

It is worth noting that the Edisto Beach State Park was initially a part of the study area. However, it was not included in the Recommended Plan because of a lack of existing infrastructure needed to generate enough benefits to justify the cost to protect that portion of beach.

Figure 6.1: Project Area and Basic Features

6.2 Design and Construction Considerations

6.2.1 Initial Construction and Renourishment

The Recommended Plan will require about 924,000 cubic yards of borrow material for initial construction and about 476,000 cubic yards during each renourishment cycle (based on 16 year intervals). During the projected 50 year project life, this would equate to initial construction and 3 renourishment events. A total of about 2.4 million cubic yards of beach-compatible sand would be needed to construct and maintain the project.

The sand would most likely be pumped to the beach by pipeline and shaped using earth-moving equipment. During both initial construction and renourishment events, 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).

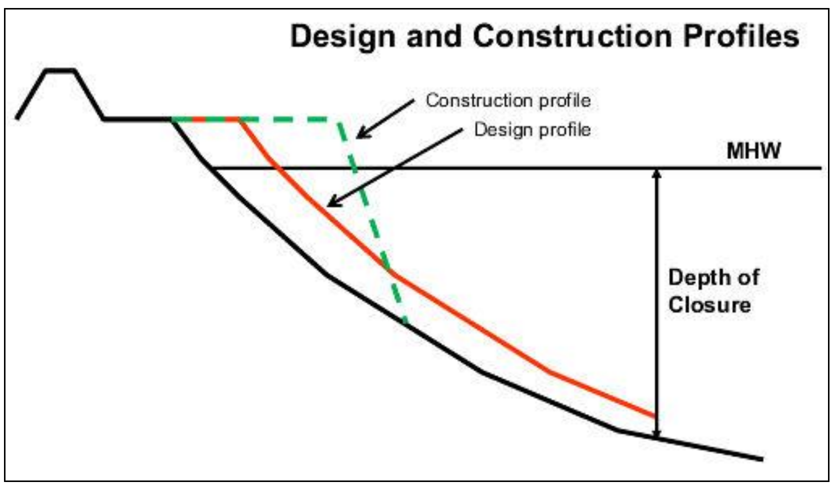

Figure 6.2: Representation of a berm construction vs design profile.

The initial construction profile would extend seaward of the final design berm profile by a variable distance (approximately 100-150 ft) to cover anticipated sand movement during and immediately after construction. Once sand distribution along the foreshore occurs, the adjusted profile should resemble the design berm profile. Initial construction is anticipated to take roughly 120-150 days (4-5 months) using one dredge, and each renourishment is anticipated to take roughly 30 days (1 month) using one dredge.

6.2.2 Dune Vegetation

Project construction may bury existing dune vegetation in some areas, especially along the inlet section of the beach. The dune portions of the project, including the dune foreslope and backslope, would be stabilized against wind losses by planting appropriate native beach vegetation. The total area of necessary dune planting is approximately 29.7

acres. Dune vegetation would be planted during the optimum planting season following dune construction. Plantings will be done in a matrix fashion and consist of native vegetation including, but not limited to sea oats, Bitter panicum, and American beachgrass (Bogue variety) and will follow guidelines from the SCDHEC-OCRM "How to Build a Dune" manual:
(http://www.dhec.sc.gov/environment/ocrm/docs/dunes_howto.pdf).

6.3 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 include that the beaches must be available for public use and provide adequate parking and access. As described in paragraph 6.h. of ER 1165-2-130, "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 project life must be included in the project recommendations or the cost sharing must be based on private use."

Edisto Beach currently meets the necessary parking and access requirements for full federal participation in the recommended plan. The Town has 38 public access points, with an average distance of 400 ft between points. The longest distance between any two access points is 1,425 ft.

As parking and access to the beach are considered items of local cooperation rather than real estate requirements, they are not creditable to the Non-Federal Sponsor as part of the LERRD credits.

6.4 Project Monitoring

In accordance with USACE guidance (Coastal Engineering Manual, Part V, Section 4), a comprehensive monitoring program is planned for the Edisto Beach project to assess and ensure project functionality throughout its design life. Such monitoring supports the design efforts for periodic renourishment and would begin the year following the start of initial construction. Based on the the costs experienced by the non-Federal sponsor since their last renourishment effort, the annual costs for maintenance, repair, replacement and rehabilitation (OMRR&R), including beachfill monitoring over the 50 year project, are estimated to be $83,000 and would include semiannual beach profile surveys through the depth of closure, aerial photography, and an annual monitoring report. These efforts are paid for by the non-Federal sponsor and are not cost shared. Beach profile surveys would allow assessment of beachfill performance and determination of renourishment volume requirements. An aerial photographic record of the beach would further facilitate assessment of the beachfill performance. The annual monitoring report would present the data collected and the corresponding analysis of project performance, including recommendations on renourishment requirements. These reports provide valuable information for future adaptive management opportunities at each renourishment interval.

Shorter-term (5 years) post-construction monitoring to detect any unanticipated adverse impacts of the lengthened groins on downdrift beaches (for Coastal Zone Consistency compliance) is included in the initial construction costs and is cost shared 65 percent Federal and 35 percent non-Federal.

6.5 Dredging and Material Shaping

The following discussion describes the dredging and construction plan.

6.5.1 Dredging Production

Dredging production refers to the average volume transported per day and placed on the shore. The production rate is affected by factors such as dredge plant, material composition, distance transported and weather conditions. This information is used to estimate the cost and construction duration for the project. Due to the proximity of the established borrow area to the area to be nourished, a hydraulic pipeline dredge was used to estimate the cost and construction schedule as this type of dredge is most efficient in this type of project. In addition, since the borrow area is outside the line of demarcation, an ocean certified dredge is required. This limits the choice of dredge plant to a 27" or 30" hydraulic pipeline dredge. A 30" dredge was used to calculate the cost with a production rate of between 21,000 and 22,000 cubic yards per day for both the initial construction and for periodic nourishments.

The use of a hopper dredge is an option for this project. If used, a medium sized hopper dredge with pump-out capability for beach placement would have a production rate of between 11,000 and 12,000 cubic yards per day for both the initial construction and renourishments.

6.5.2 Dredging Window

The USACE will make every effort to adhere to a construction window of November 1 through April 30, which will minimize impacts to sea turtles, fish, shellfish, and infauna, (see USFWS Construction Windows, Appendix A). The use of this window could change due to congressional funding, contractual issues, inclement weather, equipment failure, or other unforeseen difficulties. In this case, endangered species observers would be used.

6.5.3 Recommended Construction Plan

Construction would be by means of either a hydraulic cutterhead dredge or a hopper dredge that would transport the sand through a pipeline. The pipeline will run adjacent to the groins and parallel to the beach. Beach compatible material (sand) from an offshore source would be pumped along the 21,820 linear feet of the project and discharged as slurry. During construction, temporary training dikes of sand would be used to contain the discharge and control the fill placement. Fill sections will be graded by land-based equipment, such as dozers, articulated front-end loaders and other equipment as necessary to achieve the desired beach profile. Equipment would be selected based on its ability to efficiently perform the work and to generate only minimal and acceptable temporary environmental impacts. The sand would be graded, raked and tilled as necessary to comply with recommendations and requirements from regulatory agencies. It is anticipated that initial construction would begin in late-2018 and last approximately 4 to 5 months. Additional details related to the construction plan will be developed during the Preconstruction, Engineering and Design (PED) Phase of this project.

6.6 Real Estate Considerations

The requirements for lands, easements, right-of-ways and relocations, and disposal/borrow areas (LERRDs) include the right to construct a dune and berm system along the shoreline of Edisto Beach within the project limits. Based on project maps, the non-Federal sponsor will be required to acquire approximately 187 Perpetual Beach Storm Damage Reduction Easements over private property where the landward toe of the beach fill material is placed above the mean high water line. Improvements in the project area consist of 80 beach access walkovers throughout the project area and one fishing pier located on the north end of the project. The Storm Damage Reduction Easement does allow owners to construct and maintain walkover structures subject to sponsor approval. Damage to existing structures is not compensable and not creditable as the easement allows for the removal of obstructions within the limits of the easement. The landward construction line of the project will be placed to minimize effects on existing structures and every effort is made during construction to avoid damages to structures. The state of South Carolina claims ownership of all lands seaward of the last line a stable vegetation or all lands below the ordinary mean high water line.

Further details regarding real estate requirements and determinations are provided in Appendix K (Real Estate Plan).

6.6.1 Real Estate Costs

The estimated real estate cost for the project is $989,000. The cost consists of estimated land costs for staging areas and federal and non-federal administrative costs. The cost includes a 26% contingency. Refer to Appendix K for more details regarding the project real estate costs.

6.7 Operation and Maintenance Considerations

Operation, maintenance, repair, replacement, and rehabilitation (OMRR&R) requirements of the sponsors would consist of project inspection 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, and inspection and repair of the groins. 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 $83,000.

6.8 Economics of the Recommended Plan

6.8.1 Recommended Plan— CSDR Benefits

The total expected average annual coastal storm damage reduction benefits (at 3.5% interest rate) for the Selected Plan are estimated to be $2,849,000.

6.8.2 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 fifty percent 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 CSDR benefits, therefore all incidental recreation benefits are being claimed for the project.

To determine the recreation benefits of the tentatively selected plan, an economic value must be placed on the recreation experience at Edisto Beach. The value can then be applied to the expected visitation to the project to determine NED recreation benefits. For this report, unit day values (UDV) were used to determine the economic value of recreation at Edisto Beach.

The UDV are determined using a point system that takes into account the following factors: recreation experience, availability of opportunity, carrying capacity, accessibility, and environmental (esthetics) quality. A good deal of judgment is required in the assessment of point values. A group of planning professionals and experts of the study area made independent judgments of the UDV values which were averaged. The differences in the values were applied to the estimated visitation. The difference in the with and without project values of recreation determine the NED recreation benefits. The source of the value of recreation is obtained from the Economic Guidance Memorandum, 13-03, Unit Day Values for Recreation for Fiscal Year 2013. The details of the UDV calculations for this study are contained in Appendix B.

Based on this analysis, the average annual recreation benefit for the Recommended Plan is $573,200.

6.8.3 Recommended Plan— Total Benefits

Combining the CSDR benefits and the recreation benefits yields a total average annual benefit for the Recommended Plan of $3,467,200.

6.8.4 Recommended Plan—Costs

Determining the economic costs of the Recommended Plan consists of four basic steps. First, project First Costs are computed. First Costs include expenditures for project design and initial construction and related costs of supervision and administration. First Costs also include the lands, easements, and all rights-of-way. Total First Costs are estimated to be $21,129,000 at FY14 price levels. See Table 6.2 for cost breakdown of First Costs. Details regarding determination of this cost are contained in Appendix L (Cost Engineering).

For the economic project cost, the constant dollar cost was used from the Total Project Cost Summary. Neither discounting to present value, nor escalation for anticipated inflation is included in the determination of these costs. As detailed in Appendix B and shown in Table 6.2 and 6.3, the estimated cost is $21,129,000 for initial construction and $10,914,000 for each renourishment. The costs of the renourishments were discounted to the same price level as the initial construction cost to determine total first economic cost. The initial construction cost plus present value of the three renourishment cost were summed to calculate interest during construction. Interest during Construction is computed from the start of Preconstruction Engineering and Design (PED) through the 4 month initial construction period and includes the present value of future planned nourishments. Interest during Construction for the Selected Plan is estimated to be $106,800. The project First Cost plus Interest during Construction represents the Total Investment Cost required to place the project into operation. Total Investment Cost for the Selected Plan (Initial Construction plus renourishments and IDC) is estimated to be $33,252,800.

Next, Scheduled Renourishment Costs are computed. Those costs are incurred in the future for each of the 3 planned renourishments. Neither discounting to present value, nor escalation for anticipated inflation is included in the determination of these costs. As detailed in Appendix B and shown in Table 6.3, the estimated cost is $10,914,000 for each renourishment.

Finally, Expected Annual Costs are computed. Those costs consist of interest and amortization of the Total Investment Cost and the equivalent annual cost of project OMRR&R and beachfill monitoring costs (see sections 6.04 and 6.08). The Expected Annual Costs provide a basis for comparing project costs to expected annual benefits. Expected Annual Costs for the Selected Plan are estimated to be $1,501,000. A summary of the computations involved in each of these four steps is presented in Table 6.1.

Table 6.1: Recommended Plan annual costs (FY14 price level)

Initial Construction	$ 21,129,000
1st Renourishment	$ 6,294,200
2nd Renourishment	$ 3,629,900
3rd Renourishment	$ 2,093,400
Total First Cost	$33,146,400
Interest During Construction	$106,800
Total Project Cost	$33,252,800
Average Annual First Cost	$1,418,000
O&M	$83,000
Total Average Annual Cost	**$1,501,000**

Table 6.2: Recommended Plan Initial Construction First Costs (FY14 price level)

ACCT CODE	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT	CONTINGENCY	TOTAL COST
1	LANDS AND DAMAGES	1	LS	JOB	$785,000	$204,000	$,989,000
10	GROIN EXTENSIONS	1	LS	JOB	$2,120,000	$551,000	$2,671,000
17	BEACH REPLENISHMENT	1	LS	JOB	$12,830,000	$3,336,000	$16,166,000
30	PLANNING, ENGINEERING, AND DESIGN	1	LS	JOB	$839,000	$222,000	$1,061,000
31	CONSTRUCTION MANAGEMENT	1	LS	JOB	$195,000	$51,000	$246,000
	TOTAL FIRST COST				$16,769,000	$4,360,000	$21,129,000

Table 6.3: Recommended Plan Nourishment Cycle Construction Costs (FY14 price levels)

ACCT CODE	ITEM	QUANTITY	UNIT	UNIT PRICE	AMOUNT	CONTINGENCY	TOTAL COST
17	BEACH REPLENISHMENT	1	LS	JOB	$7,911,,000	$2,294,000	$10,206,000
30	PLANNING, ENGINEERING, AND DESIGN	1	LS	JOB	$446,000	$132 ,000	$578 ,000
31	CONSTRUCTION MANAGEMENT	1	LS	JOB	$103 ,000	$31,000	$134,000
	TOTAL FIRST COST				$8,460,,000	$2,454,,000	$10,914,,000

6.8.5 Benefit to Cost Ratio

With expected annual benefits of $3,467,200 and average annual costs of $1,501,000, the benefit to cost ratio for the Selected Plan, is 2.3 to 1. The annual net benefits are $1,966,200.

6.9 Evaluation of Risk and Uncertainty

6.9.1 Residual Risks

The proposed beachfill plan would greatly reduce, but not completely eliminate, future storm damages. The Recommended Plan would reduce coastal storm damages to structures and contents by approximately 62 percent over the 50 year period of analysis. The project is designed to reduce damages from storm waves, direct flooding, and erosion. The project 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 front rows of the island which is where the benefits of the project are being measured. Because the project is not claiming any benefits beyond the first two rows of the island, damages from flooding to structures past the second row have not been calculated. However, in major storm events, those structures could be subject to back bay flooding. 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 severe storm events. Also, the condition of the CSDR project at the time of storm occurrence can affect the performance of the project for that event.

The proposed beachfill 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 damage reduction 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 both with and without the storm damage reduction project.

6.9.2 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 300 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. An example of one of these damage functions is shown in Figure 6.3 below, the entire suite of damage functions used in this study are contained in Appendix B.

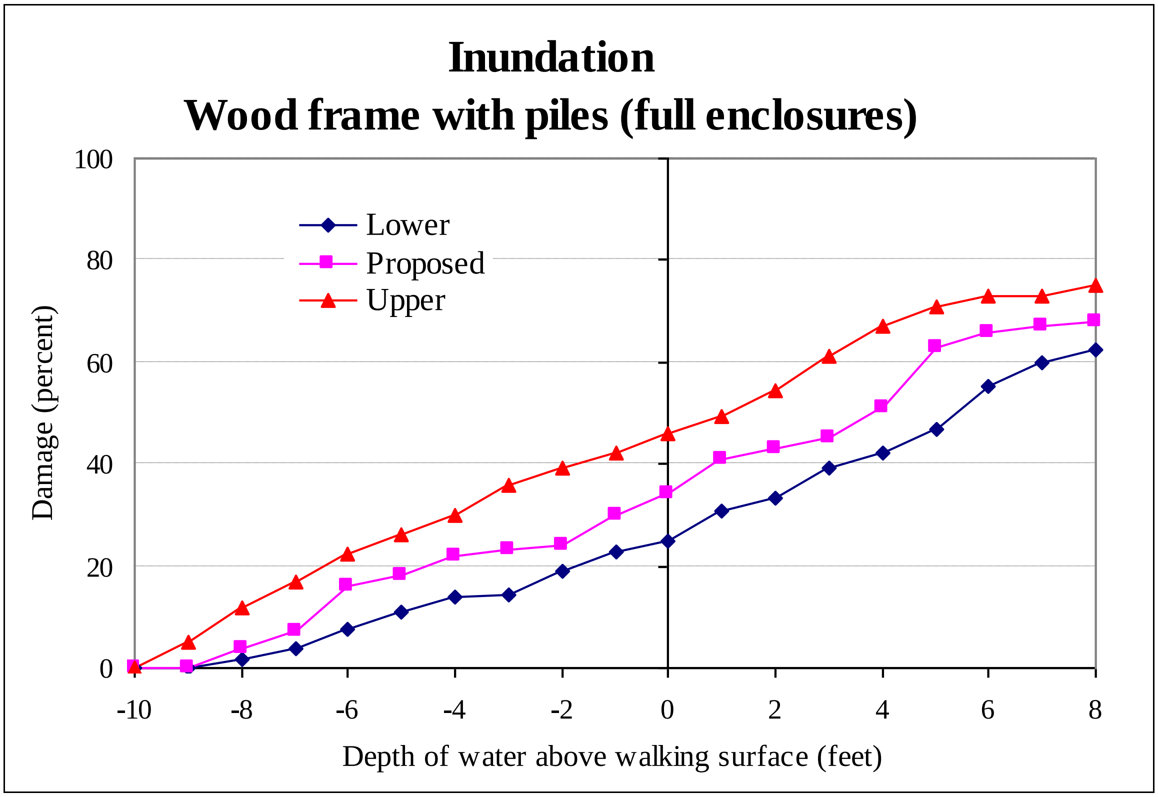

Figure 6.3: Damage functions used to measure erosion damage to fully enclosed structures with piles.

6.9.3 Risk and Uncertainty in Project Costs

In order to account for uncertainties in the final project costs, which could result from a variety of factors, all costs include an appropriate contingency on top of the actual estimated cost. For this project, a contingency of 26 percent is currently being utilized for initial construction. Due to escalating costs from fuel above escalation indices a contingency of 29 percent is used for future renourishment cycles (Appendix L).

6.9.4 Risk and Uncertainty in Borrow Availability

An estimated 2.4 million cubic yards of borrow material would be needed over the 50 year project. The required project volumes are well below the amount of compatible material (about 7.2 mcy) that has currently been estimated to be available at the offshore borrow location. The overall project is anticipated to utilize only about 25% of the total volume available at the borrow site. Therefore, the risk of running out of material over the 50 year project life is minimal, even if further investigations during PED reveal that less material than originally estimated is actually available at the borrow site.

6.9.5 Risk and Uncertainty in Sea Level Rise Assumptions

Per EC 1165-2-212, a sensitivity analysis on the economics of the Recommended Plan using low (Modified NRC Curve 1) and high (Modified NRC Curve 3) accelerated sea level rise rates was conducted. 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 Recommended Plan was re-run through Beach-*fx* using historical, Curve1, and Curve 3 sea level rise rates. Figure 6.4 displays how the average annual project costs, benefits, and net benefits change under each of these three scenarios. As shown in the figure, as sea level rise accelerates, the project costs increase. However the project benefits increase even more (because with higher sea level rise structures would be subject to even greater potential damages in the FWOP condition), meaning that the project net benefits would actually be the highest under the Curve 3 sea level rise scenario.

6.9.6 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 (base 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 468 plausible storms, as detailed in Appendix A. 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.

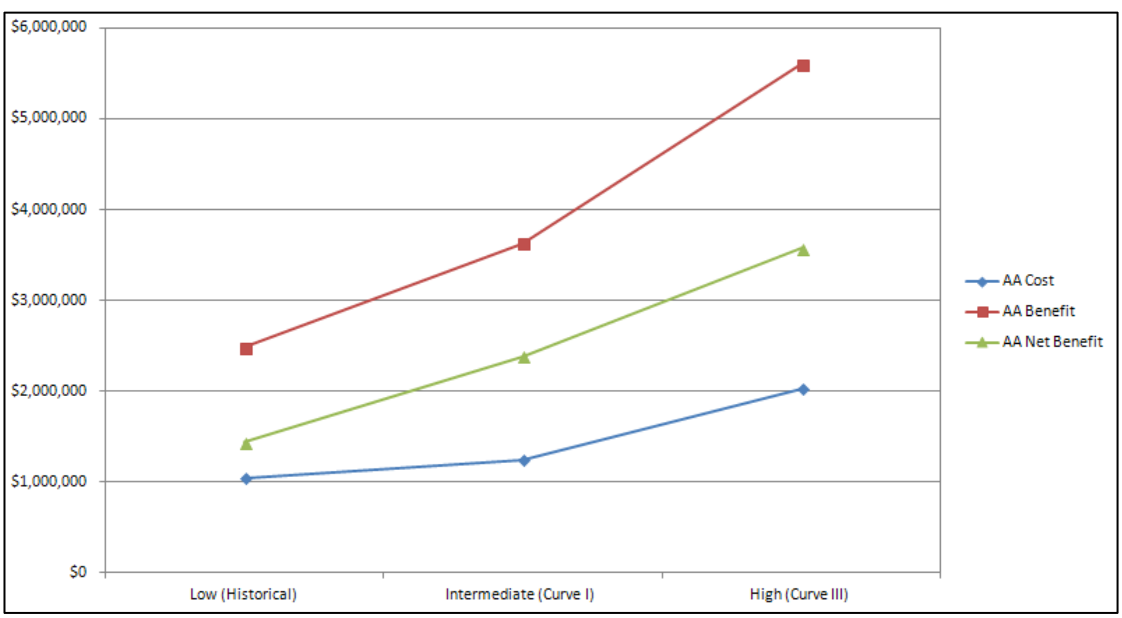

Figure 6.4: Changes in average annual costs, benefits, and net benefits (3.75% interest rate) under three different sea level rise scenarios.

7. ENVIRONMENTAL EFFECTS*

This section describes the probable effects of the proposed project and associated actions on significant environmental resources within the proposed beach placement locations and within the borrow areas. Table 5.6 earlier in the report provides a comparative analysis of environmental impacts associated with beach fill, non-structural, and no action alternatives.

7.1 Dredging Methods

Sediment will be dredged from the borrow areas and placed on the project area beaches utilizing hydraulic dredges. Hydraulic dredges are characterized by their use of a pump to dredge sediment and transport a slurry of dredged material and water to identified discharge areas along the beach. The ratio of water to sediment within the slurry mixture is controlled to maximize efficiency. The main types of hydraulic dredges are cutterhead suction and hopper dredges, and dredging for this project could occur using either dredge plant. Therefore, potential impacts to specific resource categories evaluated throughout this section will consider both of these actions as appropriate. The following paragraphs discuss the specific operating conditions of these dredge types.

7.1.1 Cutterhead Suction Dredge

Cutterhead dredges are designed to handle a wide range of materials, including sands. They are used for new work and maintenance in projects where suitable placement/disposal areas are available and operate in an almost continuous dredging cycle resulting in maximum production, economy, and efficiency. Cutterhead dredges are capable of dredging in shallow or deep water and have accurate bottom and side slope cutting capability. Limitations of cutterhead dredges include relative lack of mobility, long mobilization and demobilization, and inability to work in high wave action and currents.

Cutterhead dredges are rarely self-propelled and; therefore, must be transported to and from the dredge site. Cutterhead dredge size is based on the inside diameter of the discharge pipe which commonly ranges from 6” to 36”. The pipeline associated with CSDR projects is often larger in diameter. They require an extensive array of support equipment including pipeline (floating, shore, and submerged), boats (crew, work, survey), barges, and pipe handling equipment. The cutterhead is a mechanical device that has rotating teeth to break up or loosen the bottom material so that it can be sucked through the dredge.

Moving cutterhead suction dredges is a slow process; therefore, efficiency is maximized by dredging in localized areas with deeper dredge cut volumes where the cutterhead is buried in the bottom. A cutterhead removes dredged material through an intake pipe and then pushes it out the discharge pipeline directly into the placement/disposal site. Most, but not all, cutterhead dredging operations involve upland placement/disposal of the dredged material. Therefore, the discharge end of the pipeline is connected to shore pipe.

When effective pumping distances to the placement/disposal site become too long, a booster pump is added to the pipeline to increase the efficiency of the dredging operation.

7.1.2 Hopper Dredge

The hopper dredge, or trailing suction dredge, is a self-propelled ocean-going vessel with a section of the hull compartmented into one or more hoppers. Fitted with powerful pumps, the dredges suck sediment from the channel bottom through long intake pipes, called drag arms, and store it in the hoppers. Normal hopper dredge configuration has two dragarms, one on each side of the vessel. A dragarm is a pipe suspended over the side of the vessel with a suction opening called a draghead for contact with the bottom. Depending on the hopper dredge, a slurry of water and sediment is generated from the plowing of the draghead "teeth," the use of high pressure water jets, and the suction velocity of the pumps. The dredged slurry is distributed within the vessel's hopper allowing for solids to settle out and the water portion of the slurry to be discharged from the vessel during operations through its overflow system. When the hopper attains a full load, dredging stops and the ship travels to a pump-out location where the dredged material is re-slurried within the hopper and pumped out to the beach disposal area through a series of shore-pipe.

Hopper dredges are well suited to dredging sand. They can maintain operations safely, effectively, and economically in relatively rough seas and because they are mobile, they can be used in high-traffic areas. They are often used at ocean entrances and offshore, but cannot be used in confined or shallow areas. Hopper dredges can move quickly to disposal sites under their own power (maximum speed unloaded - ≤ 17 knots; maximum loaded - ≤ 16 knots), but since the dredging stops during the transit to and from the disposal area, the operation loses efficiency if the haul distance is too far. Based on the review of hopper dredge speed data provided by the USACE's Dredging Quality Management (DQM) program, the average speed for hopper dredges while dredging is between 1-3 knots, with most dredges never exceeding 4 knots. Hopper dredges also have several limitations. Considering their normal operating conditions, hopper dredges cannot dredge continuously. The precision of hopper dredging is less than other types of dredges; therefore, they have difficulty dredging steep side banks and cannot effectively dredge around structures. In order to minimize the risk of incidental takes of sea turtles, the USACE requires the use of sea turtle deflecting dragheads on all hopper-dredging projects where the potential for sea turtle interactions exist.

7.2 Beach Fill Placement Activities

The history of beach fill placement activities, including both disposal of navigation maintenance dredged material and shore protection projects throughout the South Carolina coastline consists of many actions performed by local, State, and Federal entities. The following paragraphs discuss the construction activities associated with placement of sediment on the beach for the purpose of CSDR:

7.2.1 Construction Operations

For hydraulic pipeline and hopper dredge operations that include the placement of dredged material on the beach, a pipeline route is extended from the dredge plant to the beach fill placement location. Prior to the commencement of dredging, shore pipe is mobilized to the beach in segments of varying sizes in length and diameter. The mobilization process usually requires the use of heavy equipment to transport and connect pipe segments from the beach access point to the designated placement area. The placement of shore pipe is generally on the upper beach, away from existing dune vegetation and seaward of the toe of the primary dune. The width of disturbance area required to construct the pipeline route varies depending on the size of pipe used for the project. Site context and environmental features are considered for each project so that construction activities are confined to areas with minimal impact to the environment. Once the heavy equipment and pipe is on the beach and the pipes are connected, heavy equipment operation is generally confined to the vicinity of the mean high water line, away from dune vegetation on the upper beach. Within the active disposal area, heavy equipment operates throughout the width of the beach in order to manage the outflow of sediment and construct target elevations for the appropriate beach profile.

The beach building process typically involves the use of bulldozers and sometimes backhoes to distribute the sediment as it falls out of suspension at the outflow end of the pipeline. The sediment slurry is diffused as it is released from the terminal pipe in order reduce the flow velocity onto the beach and minimize the risk of creating scour holes. Dikes are constructed on one or two sides of the effluent area to allow for extended settlement time of suspended solids in order to reduce turbidity levels in the near shore environment.

7.3 Wetlands

The proposed borrow area for the project is between 1.5 and 2.5 miles offshore; therefore, dredging operations would not be expected to adversely affect wetlands of the study area. Beach nourishment operations would not be expected to adversely affect wetlands either.

7.4 Sand and Mud Flats

Neither the dredging operation nor the beach placement will have any adverse effects on sand and mud flats near the project vicinity. The South Edisto River inlet flats could experience faster accretion than at present due to the greater updrift supply of sand. If this occurs than the flats would be expanded. Since direct burial will not occur there are no concerns about the recolonization/recovery of the flats.

7.5 Nearshore Ocean

Oceanic nekton are active swimmers and are distributed in the relatively shallow oceanic zone. Any entrainment of adult fish, and other motile animals in the vicinity of the borrow area 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 (Pullen and Naqvi 1983). Impacts to the nekton community of the nearshore ocean will be temporary and minor.

7.6 Maritime Shrub Thicket

The majority of maritime shrub thicket (maritime forest) occurs along the inlet reach of the proposed project and at the Edisto Beach State Park reach. The upland construction limit of the project avoids impacting this valuable and rare habitat.

7.7 Beach and Dune

The proposed project consists of a 21,820 ft long main beachfill, with a berm profile and dune construction across the entire area. Where existing dunes are less than 14 ft elevation, the constructed dune will cover existing vegetation. All constructed dunes will be vegetated with native dune grasses to mitigate any impacts to existing vegetation. The constructed beach berm and dune profile would result in a seaward movement of the shoreline.

Project construction and periodic nourishment would not be expected to have an adverse effect on wildlife found along the beach or that uses the dune areas. 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 construction and periodic nourishment events. Vegetation of constructed dune areas would be expected to increase the amount and quality of habitat available to mammal and avian species dependent on those areas and mitigate impacts to existing vegetation.

Project construction would result in disturbance and removal of some of the existing vegetation along the seaward side of the existing dune. However, construction would be followed by measures designed to stabilize the constructed dunes. Dune stabilization would be accomplished by planting vegetation on the dune during the optimum planting seasons and after the berm and dune construction. 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. Planting would be accomplished during the season best suited for the particular plant. Periodic nourishment of the project would involve placing material along the berm and dune as needed. Additional dune planting during renourishment would occur if necessary. Therefore, minimal impacts to dune vegetation would be expected from implementing the project.

Using GIS, it was determined that roughly 5.96 acres of dune habitat along the Atlantic facing shoreline and 7.63 acres along the inlet facing shoreline will be impacted by direct burial during the construction process (e.g., dune fell within project footprint). These impacts will be mitigated by the planting of native vegetation along the entire length of the constructed dune. The use of native vegetation will provide an environmental enhancement to the beach front while helping to stabilize the constructed dune. Plantings will be done in a matrix fashion and consist of native vegetation including but not limited to sea oats, Bitter panicum, and American beachgrass (Bogue variety). While the analysis shows that approximately14 acres of dune habitat will be impacted, there are extensive dunes adjacent to the inlet portion of the project area, which will aid in the establishment of a healthy dune community on the constructed dune system.

The placement of sediment along the study area would be expected to directly affect ghost crabs through burial (USACE 2004, Lindquist and Manning 2001, Peterson et al. 2000, Reilly and Bellis 1983). Because ghost crabs are vulnerable to changes in sand compaction, short-term effects could occur from changes in sediment compaction and grain size. According to Hackney et al. (1996), management strategies are recommended to enhance recovery after beach nourishment are (1) timing activities so that they occur before recruitment and, (2) providing beach sediment that favors prey species and burrow construction. Ghost crabs are present on the project beach year-round (Hackney et al. 1996), therefore, direct effects from burial could occur during the proposed construction time frame of December 1 to March 31. However, the peak larval recruitment time frame would be avoided and, because nourished sediment will be compatible with the native beach, it is expected that ghost crab populations would recover within one year post-construction (USACE 2004, Lindquist and Manning 2001, Peterson et al. 2000, Reilly and Bellis 1983). Because ghost crabs recover from short-term effects and because recommended management strategies to avoid long-term effects would be followed, no significant long-term impacts to the ghost crab population would be expected.

7.8 Surf Zone Fishes

The surf zone is a dynamic environment, and the community structure of organisms that inhabit it (e.g., surf zone fishes and invertebrates) is complex. Representative organisms of both finfish and the invertebrate inhabitants they consume exhibit similar recruitment periods, typically spring through summer. The anticipated construction time frame for the project is between November 1 and April 30, which would avoid a majority of the peak recruitment and abundance periods of surf zone fishes and their benthic invertebrate prey source. Disposal operations along the beach can result in increased turbidity and mortality of intertidal macrofauna, which serves as food sources for finfish species. However, during disposal operations, the dredged material slurry is managed through the construction of dikes to allow for a larger settling time and reduction of turbidity loads into the surf zone environment. Even though turbidity reduction practices are used, feeding activities of some species could be interrupted in the immediate area of beach sand placement. These affects will be temporary and minor and should return to normal shortly after dredging concludes.

7.9 Anadromous Fishes

Similar to other fish, anadromous fishes are active swimmers, not at the mercy of the currents. Any entrainment of adult fish, and other motile animals in the vicinity of the borrow area 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 (Pullen and Naqvi 1983). Since these species spawn in freshwater (except for the catadromous American eel) the potential for egg and larval entrainment is minimal.

7.10 Benthic Resources

7.10.1 Beach Zone

Beach nourishment may have negative effects on intertidal macrofauna through direct burial, increased turbidity in the surf zone, or changes in the sand grain size or beach profile. While beach nourishment may produce negative effects on intertidal macrofauna, they would be localized in the vicinity of the nourishment operation.

In a 1999 Environmental Report on the use of Federal offshore sand resources for beach and coastal restoration, U.S. Department of Interior, Bureau of Ocean Energy Management (BOEM) (Previously Minerals Management Service (MMS) provided the following assessment of potential effects on beach fauna from beach nourishment:

> *"Because benthic organisms living in beach habitats are adapted to living in high energy environments, they are able to quickly recover to original levels following beach nourishment events, sometimes in as little as three months (Van Dolah et al. 1994, Levisen and Van Dolah 1996). This is again attributed to the fact that intertidal organisms are living in high energy habitats where disturbances are more common. Because of a lower diversity of species compared to other intertidal and shallow subtidal habitats (Hackney et al. 1996), the vast majority of beach habitats are re-colonized by the same species that existed before nourishment (Van Dolah et al. 1992, Nelson 1985, Levisen and Van Dolah 1996, Hackney et al. 1996)."*

Construction and subsequent nourishments will occur during the winter months when possible. Because of this, beach nourishment would therefore be completed before the onshore recruitment of most surf zone fishes and invertebrate species. To assure compatibility of nourishment material with native sediment characteristics and minimize impacts to benthic invertebrates from the placement of incompatible sediment, all sediment identified for use for this project has gone through compatibility analysis to assure compatibility with the native sediment. Historically, SC beaches have seen rapid recovery (one to six months) of beach sediment characteristics and infauna (Bergquist et. al, 2008; Van Dolah Et al., 1992; Van Dolah et. al., 1994; Jutte et al., 1999). In summary, only temporary effects on intertidal macrofauna in the immediate vicinity of the beach nourishment project would be expected as a result of discharges of nourishment material on the beach.

7.10.2 Nearshore Ocean

The post-dredge infilling rate and quality and type of the material are contributing factors to the recovery of the area dredged. A change in the hydrologic regime as a consequence of altered bathymetry may result in the deposition or scour of fine sediments, which may result in a layer of sediment that differs from the existing substrate. Benthic organisms within the defined borrow area dredged for construction and periodic nourishment would be lost. However, recolonization by opportunistic species would be expected to begin soon after the dredging activity stops. 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. Rapid recovery would be expected from recolonization from the migration of benthic organisms from adjacent areas and by larval transport. SCDNR has recommended the use of ebb-tidal shoal complexes on the downdrift end of beaches in order to assist in the faster recovery of the borrow area. In addition, if a hopper dredge is used at the borrow area, impacts will likely be minimized (SCDNR, 2009a).

7.11 Hardbottom Resources

Results of a cultural and hardbottom resource survey performed in 2013 determined that there were no areas of hardbottom habitat located within the proposed borrow area and a 0.25 mile buffer surrounding the area. Hardbottom resources will not be affected by the proposed project.

7.12 Essential Fish Habitat

The proposed project will involve impacts to marine and estuarine water column and unconsolidated bottom. The overall magnitude of these impacts is expected to be short term and minor under the dredging operations to be employed. Recolonization of both the borrow area and beach face are expected to occur within 1 to 2 years, or faster. The use of best management practices should limit the extent and duration of turbidity impacts, which will temporarily alter fish dynamics in the vicinity of the construction activities. Overall, the impacts to EFH and HAPC related to the proposed beach project at Edisto Beach will be temporary and will not result in significant effects on managed species. A summary of EFH categories and potential impacts from the project is shown in Table 7.1. For more details on EFH please see Appendix G.

Table 7.1: EFH categories and potential project impacts.

Habitat Type	Habitat Name	Project Area	Potential Impacts	
			Dredging at borrow site	Beach Placement
Estuarine	Estuarine Emergent Wetland (tidal marsh)	Yes	No	No
Estuarine	Estuarine Scrub/shurb mangroves	No	No	No
Estuarine	Sea grass	No	No	No
Estuarine	Oyster reefs and shell banks	Yes	No	Yes
Estuarine	Intertidal flats	Yes	No	No
Estuarine	Palustrine emergent and forested wetland	No	No	No
Estuarine	Aquatic beds	No	No	No
Estuarine	Estuarine Water Column	Yes	No	Yes
Estuarine	Unconsolidated Bottom	Yes	Yes	Yes
Marine	Live/Hard bottoms	No	No	No
Marine	Coral and coral reefs	No	No	No
Marine	Artificial/manmade reefs	No	No	No
Marine	Sargassum	No	No	No
Marine	Surf Zone	Yes	No	Yes
Marine	Marine water column	Yes	Yes	Yes

7.13 Avian Species

Although the project area is heavily developed and sustains recreational use, migratory shorebirds can still use the project area for foraging and roosting habitat. Beach nourishment activities could temporarily affect the roosting and intertidal macro-fauna foraging habitat; however, recovery often occurs within one year if nourishment material is compatible with native sediments. Since shorebirds focus their foraging in intertidal areas, and the amount of intertidal habitat will not be reduced by the project, there will be no impact to foraging habitat. Similarly, since shorebirds roost in areas of high beach as well as marsh, and the project will result in an increase in dry beach habitat, the project will benefit shorebird roosting. Additionally, because (1) areas of diminished prey base are temporary and isolated, (2) recovery occurs within one year if material is compatible, and (3) adjacent unaffected foraging and roosting habitat would be available throughout the project, it would not be expected that foraging and roosting habitat would be significantly affected by implementing the proposed action.

7.14 Coastal Barrier Resources

As stated earlier in the report, the Town of Edisto Beach lies between two Coastal Barrier Resources Systems (CBRS) units, the Edisto Complex Unit (M09 and M09P) and the Otter Island Unit (M10) (Figure 3.9). Unit M09P is an “Otherwise Protected Area” (OPA) and is not a part of the CBRS. Through coordination with the USFWS it has been determined that the proposed borrow site that would be used for a nourishment project is not located in the CBRS (USFWS, letter dated Jan 27, 2010). Additionally, the proposed project would not be expected to cause any additional erosion concerns for Otter and Pine Islands (the two resources within ACE Basin that are in the area of potential effects). Research by Coastal Science and Engineering has shown that no erosion has occurred south of Edisto Beach as a result of the relatively short groins on the beach (CSE 2013). Since the amount of proposed lengthening of the southernmost groins is minimal (~20 – 60 feet) and the groin cells will be completely filled with sand, there will be no appreciable erosion to Otter or Pine Islands.

7.15 Threatened and Endangered Species

The following subsections present a summary of the effect determination for each threatened or endangered species relevant to this project and the summary of protective measures from the Biological Opinion.

7.15.1 Sea Turtles

Currently, there is very little suitable sea turtle nesting habitat in the project area. Upon completion of the project, the total area of suitable nesting habitat would be approximately 70 acres.

Loggerhead sea turtle nesting activities have been recorded within the project area. The placement of sand and construction activities associated with the placement of that sand on this reach of beach could adversely affect any existing sea turtle nests and sea turtles attempting to nest. The extent of nesting on Edisto Island beach is somewhat irregular when compared with many other beaches along the coast; however, it does average approximately 14 nests per mile (despite the high erosion rate and resultant damage). Placement of the dredged material is anticipated to occur during the months of November through April; however, it is possible that the start of construction work would be delayed until nesting season or that completion of the project would be delayed and construction will extend into the nesting season. If any construction work occurred during sea turtle nesting season, the following precautions would be taken to minimize the effects to sea turtles:

- If any construction of the project occurs during the period between May 1 and September 15, the dredging contractor will provide nighttime monitoring along the beach where construction is taking place to ensure the safety of female turtles attempting to nest. Cease construction activities if a sea turtle is sighted on an area of beach scheduled for fill until the turtle returns to the ocean. A buffer zone around the female will be imposed in the event of an attempt to nest.
- If any construction of the project occurred during the period between May 1 and September 15, daily nesting surveys would be conducted starting either May 1 or 65 days prior to the start of construction, whichever is later. These surveys would be performed between sunrise and 9:00 A.M. and will continue until the end of the project, or September 15, whichever is earlier. Any nests found in the area that would be impacted by construction activities would be moved to a safe location. The nesting surveys and nest relocations would only be performed by people with a valid South Carolina DNR license.
- If all construction occurs during the period September 15 to April 30, no nesting surveys will be performed.
- For construction activities occurring during the period May 1 through October 31, staging areas for equipment and supplies would be located off of the beach to the maximum extent possible.

- For construction activities occurring during the period May 1 through October 31, use of heavy equipment would be limited to the area undergoing renourishment or dune building and shaping.
- For construction activities occurring during the period May 1 through October 31, all on-beach lighting associated with the project would be limited to the minimum amount necessary around active construction areas to satisfy Occupational Safety and Health Administration (OSHA) requirements.
- For construction activities occurring during the period May 1 through October 31, use predator proof trash receptacles to minimize presence of species that prey upon hatchlings.
- The USFWS and SCDNR must be notified immediately if a sea turtle, nest, or hatchlings are impacted by the construction.
- For construction activities occurring during the period May 1 through October 31, hold a preconstruction meeting between the contractor, USFWS, and SCDNR
- If a hopper dredge is used, in order to minimize the risk of incidental takes of sea turtles, the USACE requires the use of sea turtle deflecting dragheads on all hopper-dredging projects where the potential for sea turtle interactions exist.

Immediately after completion of the project, the USACE will perform tilling in order to reduce compaction associated with newly placed sand. Visual surveys for escarpments along the project area will be made immediately after completion of the project and prior to May 1 for 3 subsequent years, if needed. Results of the surveys will be submitted to the USFWS prior to any action being taken. Since the project should not occur during the sea turtle nesting season, escarpment leveling will not be performed until immediately prior to the nesting season. The USFWS will be contacted immediately if subsequent reformation of escarpments exceeding 18 inches in height for a distance of 100 feet occurs during nesting and hatching season. This coordination will determine what appropriate action must be taken. An annual summary of escarpment surveys and action taken will be submitted to the USFWS.

Adherence to the above precautions should minimize the effects to nesting loggerhead sea turtles and emerging loggerhead sea turtle hatchlings. The monitoring and relocation program will minimize potential adverse affects to nesting sea turtles. Completion of the project will recreate lost habitat and protect existing turtle nesting habitat as well as the structures on the island. However, because of the possibility of missing a sea turtle nest during the nest monitoring program or inadvertently breaking eggs during relocation, it has been determined that the proposed project may adversely affect the loggerhead sea turtle for beach placement activities. This determination has been made per USFWS ESA Consultation Handbook and states that, "in the event the overall effect of the proposed action is beneficial to the listed species, but also is likely to cause some adverse effects, then the proposed action "is likely to adversely affect" the listed species." Since leatherback nesting has been documented in the past but is not common, the proposed project may affect but is not likely to adversely affect the leatherback sea turtle for beach placement activities. There will be no effect on all other sea turtle species for beach placement activities.

Should the schedule necessitate work during the sea turtle nesting time period, in order to minimize impacts to nesting sea turtles a beach monitoring and nest relocation program for sea turtles will be implemented. This program will include daily patrols of sand placement areas at sunrise, relocation of any nests laid in areas to be impacted by sand placement, and monitoring of hatching success of the relocated nests. Sea turtle nests will be relocated to an area suitable to both the USFWS and the SCDNR. The Town of Edisto Beach will perform any necessary maintenance of beach profile (tilling and shaping or knocking down escarpments).

During construction of this project, staging areas for construction equipment will be located off the beach to the maximum extent practicable. Nighttime storage of construction equipment not in use shall be off the beach to minimize disturbance to sea turtle nesting and hatching activities. In addition, all dredge pipes that are placed on the beach will be located as far landward as possible without compromising the integrity of the existing or reconstructed dune system. Temporary storage of pipes will be off the beach to the maximum extent possible. Temporary storage of pipes on the beach will be in such a manner so as to impact the least amount of nesting habitat and will likewise not compromise the integrity of the dune systems (placement of pipes perpendicular to the shoreline will be recommended as the method of storage).

Dredging operations have also been known to negatively impact sea turtles; these effects are the result of hopper dredges and not hydraulic cutterhead dredges. Therefore, the proposed dredging activity will have no effect on sea turtles if performed by a cutterhead dredge and is likely to adversely affect several species of sea turtle (i.e., loggerheads, greens, and Kemp's ridleys) if performed by a hopper dredge. Since all in water dredging activities are addressed and covered by reference in the 1997 NMFS SARBO, no additional sea turtle consultation with NMFS is required.

During construction of this project, all on-beach lighting associated with the project will be limited to the immediate area of active construction only. Such lighting will be shielded, low-pressure sodium vapor lights to minimize illumination of the nesting beach and nearshore waters. Red filters will be placed over vehicle headlights (i.e., bulldozers, front end loaders). Lighting on offshore equipment will be similarly minimized through reduction, shielding, lowering, and appropriate placement of lights to avoid excessive illumination of the water, while meeting all U.S. Coast Guard and OSHA requirements. Shielded, low pressure sodium vapor lights will be highly recommended for lights on any offshore equipment that cannot be eliminated.

USFWS has concurred with the USACE Biological Assessment effect determinations and has issued an Incidental Take Statement as per section 7(b)(4) and section 7(o)(2) of the ESA provided that certain terms and conditions are met. The terms and conditions are outlined within Appendix M (USFWS Biological Opinion), and will be implemented upon construction of this project. Formal consultation will need to be reinitiated if critical habitat for the Northwest Atlantic population of the loggerhead sea turtle is officially designated.

7.15.2 Piping Plovers

All construction activities will avoid USFWS designated critical habitat areas. Direct loss of nests from the disposal of the dredged material should not occur, as the species is not known to nest in the project area. Potential piping plover foraging habitat on the beach during the winter months may be altered as beach food resources may be affected by placement of material along the project area, however they are not known to occur on Edisto Beach. Such disruptions will be temporary and of minor significance. Since only a small portion of the foraging habitat is directly affected at any point in time during pump out and adjacent habitat is still available, overall direct loss of foraging habitat will be minimal and short-term.

Any shorebird habitat area originally existing along the length of the island has suffered severe erosion. Dredged material will likely help restore the habitat lost to erosion in this area while the protective berm is being constructed. The placement of dredged material into the intertidal zone will provide additional foraging habitat for the wintering piping plover. For these reasons, it has been determined that the proposed project not affect the piping plover. Additionally, since the project is far enough removed from areas of Piping Plover Critical Habitat, it will have no affect on critical habitat.

7.15.3 Red Knot

Placement of the dredged material is anticipated to occur during the winter months. Direct loss of nests from the disposal of the dredged material will not occur, since the species does not nest in the project area. Red knot foraging distribution on the beach during the spring and fall migrations and winter months may be altered as beach food resources may be affected by placement of material along the project area; however, this impact is expected to be minor since most birds use areas outside of the immediate project area. In addition, previous studies of beach nourishment projects have shown a short term impact to the beach and surf zone infaunal community with a recovery within six months (SCDNR, 2009b). Due to the expected short term impacts to the beach infaunal community and since the number of red knots in the immediate project area is limited, it has been determined that the proposed project may affect but is not likely to adversely affect the rufa red knot.

7.15.4 Sturgeon

Atlantic sturgeon have been taken by hopper dredges in the past and to lesser extent mechanical (including cutterhead/pipeline) dredges. Therefore, the proposed dredging activity will have no effect if performed by a cutterhead dredge and may affect, likely to adversely affect the Atlantic sturgeon if performed by a hopper dredge. Since USACE has initiated consultation with NMFS on a new regional Biological Opinion, no additional Atlantic sturgeon consultation with NMFS is required.

Since shortnose sturgeons rarely inhabit coastal ocean waters, and tend to stay closer to the freshwater/saltwater divide, it is unlikely that the shortnose sturgeon occur in the project area along the beachfront of Edisto Beach. However, should it occur, its habitat would be only minimally altered by the proposed project. Any shortnose sturgeon in the area should be able to avoid being taken by a slow moving pipeline dredge or hopper dredge. Although hopper dredges have been known to impact shortnose sturgeon, dredging for this project will occur in offshore environments, outside of its habitat range. Therefore, impacts from dredges are not anticipated, but are covered by reference in the 1997 NMFS SARBO. For beach placement activities it has been determined that the proposed project would have no effect on shortnose sturgeon.

Endangered species observers (ESOs) on board hopper dredges, as well as trawlers, will be responsible for monitoring for incidental take of shortnose and Atlantic sturgeon species. For hopper dredging operations, dragheads as well as all inflow and overflow screening will be inspected for sturgeon species following the same ESO protocol for sea turtles. Furthermore, all ESOs on board trawlers will be capable of identifying shortnose and Atlantic sturgeon as well as following safe handling protocol as outlined in Moser *et. al.* 2000.

7.15.5 Whales

Since the construction is anticipated to be scheduled during the right whale migration period, personnel will be advised that there are civil and criminal penalties for harming, harassing, or killing right whales. The Contractor may be held responsible for any whale harmed, harassed, or killed as a result of vessel collisions or construction activities. Failure of the Contractor to follow these specifications is a violation of the Endangered Species Act and could result in prosecution of the Contractor under the Endangered Species Act or the Marine Mammals Protection Act. The time when most right whale sightings occur is December, January, and February. The Contractor will be instructed to take necessary precautions to avoid any contact with whales. If whales are sighted within 1000 feet of the borrow area, all appropriate precautions shall be implemented to ensure protection of the whale. In addition, the Contractor will stop, alter course, or maneuver as necessary to avoid operating moving equipment (including watercraft) any closer than this distance.

7.15.6 Manatees

Since the habitat and food supply of the manatee will not be significantly impacted, overall occurrence of manatees in the project vicinity is infrequent, all dredging will occur in the offshore environment and precautionary measures for avoiding impacts to manatees, as established by USFWS, will be implemented for transiting vessels associated with the project, the proposed action is not likely to adversely affect the west Indian manatee.

Should a change in the schedule necessitate work during the manatee migration period, personnel will be advised that there are civil and criminal penalties for harming, harassing, or killing manatees. The Contractor may be held responsible for any manatee harmed, harassed, or killed as a result of vessel collisions or construction activities. Failure of the Contractor to follow these specifications is a violation of the Endangered Species Act and could result in prosecution of the Contractor under the Endangered Species Act or the Marine Mammals Protection Act. The standard manatee conditions apply annually from 1 June to 30 September, however in order to take precaution for the early and late sightings noted by SCDNR reporting, these protective measures would be implemented if construction occurs between April 1 – October 31. The Contractor would be instructed to take necessary precautions to avoid any contact with manatees. If manatees are sighted within 100 yards of the dredging area, all appropriate precautions would be implemented to insure protection of the manatee. The Contractor would stop, alter course, or maneuver as necessary to avoid operating moving equipment (including watercraft) any closer than 100 yards of the manatee. Operation of equipment closer than 50 feet to a manatee shall necessitate immediate shutdown of that equipment.

7.16 Cultural Resources

There are no properties along the beachfront of Edisto that are either on the National Registry or listed to be included on the National Registry of Historic Places. Therefore, the placement of sands on the beach will have no impact on any historic properties. Additionally, the borrow area was surveyed using a magnetometer, side scan sonar and a sub-bottom profiler. This study determined that the entire Edisto Beach study area has the slight possibility of containing eroded prehistoric archaeological sites, particularly Middle Archaic sites because the area was an exposed paleocoastal or paleoestuarine configuration at times when people may have been in the area. Two areas of potential paleolandscape settings were identified and recommended for avoidance or further investigation. One area includes an exposed paleolandscape with multiple logs that has one feature of possible upright postes indicating a possible shallowly buried structure in the northeastern quadrant of the study area. The second is a buried paleolandscape feature with horizontal margins in the far southeastern corner. Both areas will be avoided using a buffer with a radius of 1,500 feet placed around the center points (Figure 7.1). A letter of concurrence from the SC Institute of Anthropology and Archaeology can be found in Appendix I (Correspondence). Any inadvertent discovery of potential archaeological materials (i.e., wood structures, prehistoric lithics, ceramics, etc) dredging up during construction should be reported to their office and construction should cease until further inspections reveal the source of the material.

7.17 Water Quality

Dredging in the selected borrow area would involve mechanical disturbance of the bottom substrate and subsequent redeposition of suspended sediment and turbidity generated during dredging. Factors that are known to influence sediment spread and turbidities are grain size, water currents and depths. During construction, there would be elevated 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 construction/maintenance 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 hug the shore and be transported with waves either up-drift or down-drift depending on wind conditions. Because of the low percentage of silt and clay in the borrow areas (less than 10 percent), turbidity impacts would not be expected to be greater than the natural increase in turbidity and suspended material that occurs during storm events from erosion and riverine input. Any increases in turbidity in the borrow area 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 in the surf zone when dredging ends.

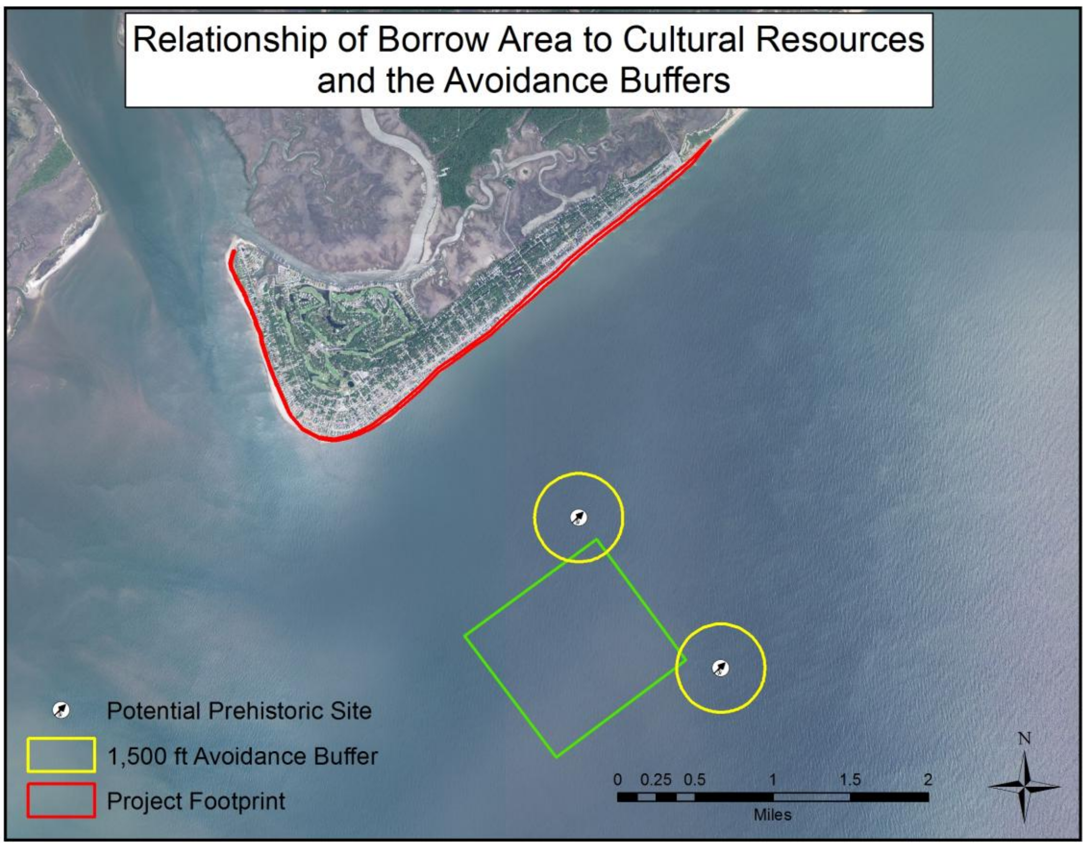

Figure 7.1: Relationship of borrow area to cultural resources and avoidance buffers.

A 401 Water Quality Certification is not needed for this project. SCDHEC has temporarily waived these certifications and states the following:

> *"Groins and beach renourishment activities have very few water quality impacts. As a general rule, the concerns and comments that the Department receives during a 401 Water Quality Certification review for these activities are directed towards the issue of threatened or endangered species. These activities will still*

require comments from the US Fish and Wildlife Service and/or the National Marine Fisheries Service which have jurisdiction over threatened and endangered species before the Corps can issue their 404 permit. Therefore, the Department has a reasonable assurance that these concerns will be addressed. Further, the Department's OCRM office will still continue to issue direct permits for alteration of the critical area for these activities that also provide a means to address the threatened or endangered species concerns."

Pursuant to Section 404 of the Clean Water Act, the effects associated with the discharge of beach fill material into waters of the United States are discussed in the Section 404(b)(1) (P.L. 95-217) evaluation in Appendix H.

7.18 Air, Noise, and Aesthetics

Temporary increases in exhaust emissions from construction equipment are expected during the construction and periodic renourishment of Edisto Beach; however, the pollution produced would be similar to that produced by other large pieces of machinery and would be readily dispersed. All dredges must comply with the applicable EPA standards. The air quality in Colleton County, South Carolina, is designated as an attainment area. A conformity determination is not required for this project because of the following reasons: 1) it is located in an attainment area; 2) the direct and indirect emissions from the project fall below the prescribed de minimus levels; and 3) the ambient air quality for Colleton County has been determined to be in compliance with the National Ambient Air Quality Standards.

Noise in the outside environment associated with beach construction activities would be expected to minimally exceed normal ambient noise in the project area. However, construction noise would be attenuated by background sounds from wind and surf. In-water noise would be expected in association with the dredging activities. Specifically, noise associated with dredging could occur from (1) ship/machinery noise—noise associated with onboard machinery and propeller and thruster noise, (2) pump noise—noise associated with pump driving the suction through the pipe, (3) collection noise—noise associated with the operation and collection of material on the sea floor, (4) deposition noise—noise associated with the placement of the material within the barge or hopper, and (5) transport noise—noise associated with transport of material up the suction pipe.

Reine et al (2012) found that the majority of underwater sounds produced by hydraulic cutterhead dredging operations were of relatively low frequency (< 1000 Hz). Their study was conducted during rock fragmentation and therefore represented a worst case scenario. The source level was estimated to be between 170 and 175 dB re 1uPa@1-m. These sound levels decreased with increasing distance from the source. The authors determined that the area of influence was limited to less than 100 m from the source. At 100 m, received levels were less than 150 dB re 1uPa rms. NMFS is developing new guidelines for determining sound pressure level thresholds for fish and marine mammals. However, based on existing studies, the NMFS current thresholds for determining impacts to marine mammals is between 180 and 190 dB re 1 uPa for potential injury to cetaceans and pinnipeds respectively, and 160 dB re 1 uPa for behavioral disturbance/harassment from an impulsive noise source, and 120 dB re 1 uPa from a continuous source. Reine et al (2012) found that the 120 dB re 1uPa proposed threshold was exceeded by ambient noises in their study area. Based on reviews by Popper et al (2006) and Southall et al (2007) it is unlikely that underwater sound from conventional dredging operations can cause physical injury to fish species.

Many of the homes along the beach front of Edisto are single story homes with patios or decks that are on the ground or low to the ground. The construction of a dune system ranging in height from 14 feet NAVD 83 to 15 feet NAVD 83 will likely impede the view of the beach and ocean for many of the beach front residents.

7.19 Hazardous, Toxic, and Radioactive Waste

The USACE's 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. In addition, the sediment is predominantly sand and shell hash which organic and inorganic contaminants typically don't adhere to. The probability of the areas being contaminated by pollutants is low.

7.20 Environmental Justice

Executive Order 12898 requires Federal agencies to develop a strategy for its programs, policies, and activities to avoid disproportionately high and adverse impacts on minority and low-income populations with respect to human health and the environment. The USACE is committed to the principles of environmental justice. Although the coastal side of the Town of Edisto Beach is the project, all long-term impacts should be of a positive nature and benefit the residents and visitors with greater recreational opportunities and a higher level of storm protection. There are no minority or low-income populations present in the study area, therefore, the proposed work would not result in adverse impacts to any populations specified in E.O. 12898.

7.21 Cumulative Effects

The Council on Environmental Quality (CEQ) defines cumulative impact as,

> "*the impact on the environment which results from the incremental impact of the action when added to other past, present and reasonably foreseeable actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but*

*collectively significant actions taking place over a period of time (*40 CFR 1508.7)."

The cumulative impacts of the proposed project will be to provide improved and longer-term coastal storm damage reduction for the dwellings and infrastructure of Edisto Beach. In addition, these improved beach conditions, with a more extensive dune development, will increase the area for use by the general public while providing a valuable habitat for the loggerhead turtle. Since the beachfront is currently fully developed, the project will not likely contribute to increased beachfront development. Any new development would have to comply with the State Beachfront Management Act. Cumulative effects of multiple, simultaneous beach nourishment operations could be harmful to fishes of the surf zone. However, because of the high quality of the sediment selected for beachfill and the small amount of beach affected at any time, the proposed activity would not be expected to pose a significant threat. The initial construction and each nourishment interval will utilize varying components of the borrow site with a sequence of temporary impacts to benthic resources over the life of the project. Subsequent intervals of dredging within the borrow area will likely occur in portions not previously been dredged. This cyclic use of borrow areas would result in cumulative effects from space crowded perturbations on a local scale. However, as previously indicated, recovery of these sites is anticipated and will be monitored. Adaptive management will be utilized where practical.

8. PLAN IMPLEMENTATION

This chapter will contain the project implementation schedule, division of plan responsibilities including cost sharing breakout by project purpose, and views of the non-Federal sponsor and any other agencies having implementation responsibilities.

8.1 Project Schedule

Table 8.1 shows the current project schedule following authorization of the project. The schedule assumes expeditious review and approval of the project through all steps, including authorization and funding, and as such is subject to change.

Table 8.1: Project schedule following authorization

Activity	Date
Signed Chief's Report	2014
Start PED	2015
Project Authorization (WRDA)	2016
Sign PPA	2016
Complete Real Estate Acquisition	2016
Pre-Construction Plans and Specs	2017
Award Construction Contract	2018
Begin Initial Construction	2018
Complete Initial Construction	2018
Begin First Renourishment	2034
Complete First Renourishment	2034

8.2 Division of Plan Responsibilities

8.2.1 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 damage reduction and (2) separable recreation. There is no separable recreation component for the Edisto Beach project.

8.2.2 Cost Sharing

All project costs are allocated to the purpose of hurricane and storm damage reduction. Cost sharing for initial construction of the Selected Plan would be consistent with that specified in Section 103(c)(5) of WRDA 1986 as amended by WRDA 1996 (generally 65 percent Federal and 35 percent non-Federal). Non-Federal interests are required to provide all LERRDs necessary for the project. The value of the non-Federal portion of the LERRD is $989,000 and is included in the non-Federal share of initial project construction costs. The remainder of the non-Federal share of initial project construction costs consists of a $6,392,150 cash contribution.

Cost sharing for periodic nourishment (continuing construction) would be consistent with Section 215 of WRDA 99, which requires that such costs be shared 50 percent Federal and 50 percent non-Federal. Annual beachfill monitoring, for the life of the project is also considered part of continuing construction and would be cost shared 50/50 as well. However, shorter-term (5 years), post-construction monitoring required by the State of South Carolina to verify that there are no unanticipated adverse impacts resulting from groin lengthening would be cost shared 65/35.

Annual OMRR&R costs, such as inspection costs and dune vegetation maintenance costs, are 100 percent 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 plan that produces the maximum net benefits, the NED plan, would be the selected plan recommended for implementation. In this case, the plan recommended for implementation is the NED plan. Cost sharing for the recommended plan is shown in Table 8.2 at 2014 price levels.

8.2.3 Financial Analysis

The non-Federal sponsor will need to submit a statement of financial capability to the USACE. This will be obtained from the sponsor at the appropriate time, and be provided in a future submittal of this report.

8.2.4 Project Partnership Agreement

A model PPA, based on the selected plan, will be fully discussed with the non-Federal sponsor at the appropriate time. The non-Federal sponsor has a clear understanding of the type of agreement that must be signed before the start of project construction. The terms of local cooperation to be required in the Project Partnership Agreement (PPA) are described in Section 11, Recommendations.

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 by Congress;
- Construction funds are provided by Congress, apportioned by the Office of Management and Budget (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 ASA(CW).

Table 8.2: Cost allocation and apportionment (2014 price levels)

Initial project construction costs					
		Apportionment %		Apportionment $	
Project purpose	Project first cost	Non-Federal	Federal	Non-Federal	Federal
Coastal storm damage reduction	$21,129,000	35%	65%	$7,395,150	$13,733,850
LERRD credit	$989,000	100%	0%	$989,000	
Cash portion				$6,406,150	$13,733,850
Preconstruction Engineering and Design Costs					
		Apportionment %		Apportionment $	
Project purpose	Project first cost	Non-Federal	Federal	Non-Federal	Federal
Preconstruction Engineering and Design	$400,000	35%	65%	$140,000	$260,000
Total renourishment costs					
		Apportionment %		Apportionment $	
Project purpose	Total Cost (3 renourishments)	Non-Federal	Federal	Non-Federal	Federal
Coastal storm damage reduction	$32,742,000	50%	50%	$16,371,000	$16,371,000
Annual OMRR&R costs					
		Apportionment %		Apportionment $	
	Cost per year	Non-Federal	Federal	Non-Federal	Federal
General repair, maintenance, inspection	$83,000	100%	0%	$83,000	$0

After this report is approved, the project is authorized and the project is budgeted for construction, the USACE will conduct negotiations with the non-Federal sponsor regarding the PPA. The USACE will submit the PPA package to the ASA(CW) for review and approval. The PPA would not be executed until it is approved and construction funds have been budgeted.

8.3 Views of the Non-Federal Sponsor

The Town of Edisto Beach fully supports Recommended Plan. A sponsor letter of support is provided in Appendix I.

9. ENVIRONMENTAL COMPLIANCE AND COMMITMENTS*

Project commitments to minimize and mitigate for environmental impacts are listed in Table 9.1. Table 9.2 summarizes the relationship between the proposed action and various Federal laws and Executive Orders.

Table 9.1: Project environmental commitments.

Sediment Compatibility	(1) Only beach compatible sediment would be placed on the beach as a component of this project. (2) If the dredging operations encounter sand deemed non-compatible with native grain size or sorting characteristics of the native beach, the Charleston District would make the decision on a suitable contingency measure that may include moving the dredge to another site in the borrow area and would notify SCDHEC-OCRM and other resource agencies of such a contingency measure.
Manatee	(3) The Contractor will follow the standard manatee conditions and take necessary precautions to avoid any contact with manatees if construction occurs between April 1 and September 30. If manatees are sighted within 100 yards of the dredging area, all appropriate precautions will be implemented to insure protection of the manatee. The Contractor will stop, alter course, or maneuver as necessary to avoid operating moving equipment (including watercraft) any closer than 100 yards of the manatee. Operation of equipment closer than 50 feet to a manatee shall necessitate immediate shutdown of that equipment.
Large Whales	(4) ESO's would be on board all hopper dredges and would record all large whale sightings and note any potential behavioral effects. The Corps and the contractor would keep the date, time, and approximate location of all marine mammal sightings. They would take care not to closely approach (within 500 yards) any whales, manatees, or other marine mammals during dredging operations or transport of dredged material. An observer would serve as a lookout to alert the dredge operator or vessel pilot or both of the occurrences of such animals. If any marine mammals are observed during dredging operations, including vessel movements and transit to the borrow site, collisions would be avoided either through reduced vessel speed, course alteration, or both.

Sturgeon Species	(5) Endangered species observers (ESOs) on board hopper dredges as well as trawlers will be responsible for monitoring for incidental take of Atlantic and Shortnose sturgeon. For hopper dredging operations, dragheads as well as all inflow and overflow screening will be inspected for sturgeon species following the same ESO protocol for sea turtles. Furthermore, all ESOs on board trawlers will be capable of identifying sturgeon species as well as following safe handling protocol as outlined in Moser *et al.* 2000.
Sea Turtles	(6) The Corps would strictly adhere to all conditions outlined in the most current NMFS Regional Biological Opinion (RBO) for dredging of channels and borrow areas in the southeastern United States. Furthermore, as a component of this project, hopper dredging activities for both initial construction and each nourishment interval would adhere, to the maximum extent practicable, to a dredging window of November 1 to April 31 (USFWS window) to avoid periods of peak sea turtle abundance. Turtle-deflecting dragheads, inflow and overflow screening, and NMFS-certified turtle observers would also be implemented. (7) To determine the potential taking of whales, turtles, and other species by hopper dredges, NMFS-certified observers would be on board during all hopper dredging activities. Recording and reporting procedures would be followed in accordance with the conditions of the current NMFS RBO. (8) Immediately after completion of the project, the Corps of Engineers will perform tilling in order to reduce compaction associated with newly placed sand. (9) Visual surveys for escarpments along the Project area will be made immediately after completion of the project and prior to May 1 for 3 subsequent years, if needed. Results of the surveys will be submitted to the USFWS prior to any action being taken. Since the Project should not occur during the sea turtle nesting season, escarpment leveling will not be performed until immediately prior to the nesting season. The USFWS will be contacted immediately if subsequent reformation of escarpments exceeding 18 inches in height for a distance of 100 feet occurs during nesting and hatching season. This coordination will determine what appropriate action must be taken. An annual summary of escarpment surveys and action taken will be submitted to the USFWS. (10) Local lighting ordinances would be encouraged to the maximum extent practicable to reduce lighting impacts to nesting females and hatchlings.

Sea Turtles (continued)	(11) If any construction of the project occurs during the period between May 1 and September 15, daily nesting surveys will be conducted starting either May 1 or 65 days prior to the start of construction, whichever is later. These surveys will be performed between sunrise and 9:00 A.M. and will continue until the end of the project, or September 15, whichever is earlier. Any nests found in the area that will be impacted by construction activities will be moved to a safe location. The nesting surveys and nest relocations will only be performed by people with a valid South Carolina DNR license. (12) For construction activities occurring during the period May through October 31, staging areas for equipment and supplies will be located off of the beach to the maximum extent possible. (13) For construction activities occurring during the period May through October 31, the dredging contractor will provide nighttime monitoring along the beach where construction is taking place to ensure the safety of female turtles attempting to nest. A buffer zone around the female will be imposed in the event of an attempt to nest. (14) For construction activities occurring during the period May through October 31, all on-beach lighting associated with the project will be limited to the minimum amount necessary around active construction areas to satisfy Occupational Safety and Health Administration (OSHA) requirements.
Terrestrial Habitat	(15) Land-based equipment necessary for beach nourishment work would be brought to the site through existing accesses. If the work results in any damage to existing accesses, the accesses would be restored to pre-project conditions immediately on project completion. (16) Dune disturbance along the beach would be kept to a minimum. (17) Impacts to martime forest will be avoided. (18) Dune stabilization would be accomplished by planting vegetation on the dune during the optimum planting seasons and after the berm and dune construction. Representative native planting stocks may include sea oats (*Uniola paniculata*), American beachgrass (*Ammophila breviligulata*), and panic grass (*panicum amarum*). (19) To prevent leakage, dredge pipes would be routinely inspected. If leakage is found and repairs cannot be made immediately, pumping of material must stop until such leaks are fixed. (20) The placement of shore pipe is generally on the upper beach, away from existing dune vegetation and seaward of the toe of the primary dune.

Benthic Invertebrates and Borrow Area Recovery	(21) The anticipated construction time frame for initial and periodic nourishment events would avoid peak recruitment and abundance time period for surf zone fishes and benthic invertebrates. (22) Initial construction would be completed over 3-4 months with renourishment every 16 years. With this approach, effects would be expected to be localized, short-term, and reversible. . (23) The Corps' Contractor will ensure that a 1 foot vertical buffer is applied to all borrow area dredging in order to help facilitate faster benthic community recovery. (24) The Corps will work with the Contractor to optimize the size and depth of each nourishment project borrow area to balance environmental and economic considerations. (25) A monitoring program will be implemented to determine impacts to and recovery of the macroinvertebrate community within the borrow site. This program will be coordinated with SCDNR and NMFS. The monitoring program should include, but not be limited to benthic taxonomy, sediment grain size analysis, and post-construction bathymetric surveys.
Cultural and Historic Resources	(26) A buffer of 1,500 ft will be adhered to around the two potential prehistoric sites identified in the cultural resources survey for this project. (27) Any inadvertent discovery of potential archaeological materials (i.e., wood structures, prehistoric lithics, ceramics, etc) dredging up during construction should be reported to both SCIAA and SHPO and construction should cease until further inspections reveal the source of the material.
Native American Tribal Commitments	(28) The Catawba Indian Nation will be notified when the dredging occurs, as per letter correspondence from the Tribal Historic Preservation Officer, Wenonah Haire, dated Sept 9, 2008 (Appendix I)
Water Quality	(29) SCDHEC has waived 401 requirements for beach nourishment and groin projects; therefore, there are no special water quality commitments to adhere to. (30) Temporary dikes would be used to retain and direct flow of material parallel to the shoreline to minimize surf zone turbidities. The temporary dikes would be removed and the beach graded in accordance with approved profiles on completion of pumping activities in that section of beach.
Other Commitments	(31) Sponsor must comply with Federal flood insurance and floodplain management program requirements (ER 1105-2-100, Appendix E, Table E-1) (32) If results of beach profile monitoring determine that the (23) lengthened groins have increased erosion on downdrift beaches,

	USACE must be committed to removing the lengthened section of groins. (33) Placement of rocks to lengthen groins must occur during the winter months outside of sea turtle nesting season unless construction occurs from the land/beach. (34) The seaward ends of the groins should taper down to the bottom to mimic natural contours

Table 9.2: Compliance status of the project as it relates to relevant Federal laws and Executive Orders.

Public Laws

Title of Public Law	US Code	Compliance Status
Abandoned Shipwreck Act of 1987	43 USC 2101	Full Compliance
Anadromous Fish Conservation Act of 1965, As Ammended	16 USC 757 a et seq.	FullCompliance
Archeological Resources Protection Act of 1979, As Amended	16 USC 469	Full Compliance
Bald and Golden Eagle Act of 1972	16 USC 470	Not Applicable
Clean Air Act of 1972, As Amended	42 USC 7401 et seq.	Full Compliance
Clean Water Act of 1971, As Amended	33 USC 1251 et seq.	Full Compliance
Coastal Barrier Resources Act of 1982	16 USC 3501-3510	Full Compliance
Coastal Zone Management Act of 1972, As Ameded	16 USC 1451 et seq.	Full Compliance
Comprehensive Environmental Responses, Compensation and Liability Act of 1980	42 USC 9601	Not Applicable
Endangered Species Act of 1973	16 USC 1531	Full Compliance
Federal Environmental Pesticide Act of 1972	7 USC 136 et seq.	Full Compliance
Fish and Wildlife Coordination Act of 1958, As Amended	16 USC 661	Full Compliance
Flood Control Act of 1944, As Amended, Section 4	16 USC 460b	Full Compliance
Magnuson-Stevens Fishery Conservation and Management Act	16 USC 1801	Full Compliance
Marine Mammal Protection Act of 1972, As Amended	16 USC 1361	Full Compliance
Marine Protection, Research and Sanctuaries Act of 1972	33 USC 1401	Not Applicable
Migratory Bird Conservation Act of 1928, As Amended	16 USC 715	Full Compliance
Migratory Bird Treaty Act of 1918, As Amended	16 USC 703	Full Compliance
National Environmental Policy Act of 1969, As Amended	42 USC 4321 et seq.	Full Compliance
National Historic Preservation Act of 1966, As Amended	16 USC 470	Full Compliance
National Historic Preservation Act Amendments of 1980	16 USC 469a	Full Compliance
Noise Control Act of 1972, As Amended	42 USC 4901 et seq.	Full Compliance
River and Harbor Act of 1888, Sect 11	33 USC 608	Not Applicable
River and Harbor Act of 1889, Sections 9, 10, 13	33 USC 401-413	Full Compliance
River and Harbor and Flood Control Act of 1962, Section 207	16 USC 460	Not Applicable
River and Harbor and Flood Control Act of 1970, Sections 122, 209, and 216	33 USC 426 et seq.	Full Compliance
Submerged Lands Act of 1953	43 USC 1301 et seq.	Full Compliance
Superfund Amendments and Reauthorization Act of 1986	42 USC 9601	Not Applicable
Toxic Substances Control Act of 1976	15 USC 2601	Not Applicable

Executive Orders

Title of Executive Order	Exec. Order Number	Compliance Status
Protection and Enhancement of Environmental Quality	11514/11991	Full Compliance
Protection and Enhancement of the Cultural Environment	11593	Full Compliance
Floodplain Management	11988	Full Compliance
Protection of Wetlands	11990	Full Compliance
Federal Compliance with Pollution Control Standards	12088	Full Compliance
Offshore Oil Spill Pollution	12123	Full Compliance
Procurement Requirements and Policies for Federal Agencies for Ozone-Depleting Substances	12843	Full Compliance
Federal Compliance with Right-To-Know Laws and Pollution Prevention	12856	Full Compliance
Federal Actions to Address Environmental Justice and Minority and Low-Income Populations	12898	Full Compliance
Implementation of the North American Free Trade Agreement	12889	Full Compliance
Energy Efficiency and Water Conservation at Federal Facilities	12902	Full Compliance
Federal Acquisition and Community Right-To-Know	12969	Full Compliance
Protection of Children from Environmental Health Risks and Safety Risks	13045	Full Compliance
Coral Reef Protection	13089	Full Compliance
Invasive Species	13112	Full Compliance
Marine Protected Areas	13158	Full Compliance
Consultation and Coordination with Indian Tribal Governments	13175	Full Compliance
Responsibilities of Federal Agencies to Protect Migratory Birds	13186	Full Compliance

(Items identified as being in "Full Compliance" assumes their compliance status upon completion of the NEPA process; Items identified as being in "Partial Compliance" indicates that concurrence is needed from another Agency, and will be completed prior to the Final Environmental Assessment.)

9.1 Adaptive Management

The purpose of adaptive management is to improve the success of the overall project by proactively incorporating flexibility where significant risk and/or uncertainty exist. It is implemented through a process designed to monitor the success of the action, compare the results to what was expected and make adjustments to improve success. The basic elements of adaptive management are: (1) Assess; (2) Design; (3) Implement; (4) Monitor; (5) Evaluate; and (6) Adjust. Monitoring includes the systemic collection and analysis of data that provides information useful for assessing project performance, determining whether ecological success has been achieved, or whether adaptive management may be needed to realize project benefits.

The Recommended Plan is not burdened by significant risk or uncertainty regarding the performance of the project; however some risks remain. These include: 1) the recovery of the borrow area, 2) the functioning of the extended groins, and 3) use of the beach by nesting sea turtles.

Beach nourishment projects have been well documented and monitored over the years, and the USACE has made numerous efforts to evaluate the impacts of nourishment projects (Myrtle Beach and Folly Beach). Similar to other USACE beach projects, USACE will initiate a monitoring program of the borrow area recovery. SCDNR has been actively involved in monitoring of other borrow sites throughout the state and USACE will work with SCDNR to design a monitoring program to assess the impacts and recovery of the borrow area. Previous research has led the USACE to the selection of the current borrow area and the minimization techniques that will be utilized (described in Table 9.1). If results of this monitoring show that operational changes are recommended, future renourishment projects will be modified. Since this project involves the modification of 23 groins by varying amounts of lengthening, the USACE will work with the Town of Edisto Beach to monitor the condition of the beach to determine if unexpected down-drift impacts are resulting from the project. Changes to the project will be implemented to remain consistent with SCDEC-OCRM regulations for beachfront management. To address the nesting of sea turtles, information will be collected each year from SCDNR and the Town of Edisto Beach volunteer sea turtle program, locally termed the “turtle patrol.” Future renourishment projects will consider any changes that could improve nesting on the beach and still meet the storm damage reduction requirements of the project.

Executive Order 11988 requires federal agencies 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, "each 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."

The Water Resources Council Floodplain Management Guidelines for implementation of EO 11988, as referenced in USACE ER 1165-2-26, require an eight-step process that agencies should carry out as part of their decision-making on projects that have potential impacts to or within the floodplain. The eight steps reflect the decision-making process required in Section 2(a) of the EO. The eight steps and project-specific responses to them are summarized below.

1. Determine if a proposed action is in the base floodplain (that area which has a one percent or greater chance of flooding in any given year). The proposed action is on the beachfront and therefore within the base floodplain. However, the project is designed to reduce damages to existing infrastructure located landward of the proposed project. The damage that would be avoided is caused primarily by erosion during significant storm events.

2. If the action is in the base flood plain, identify and evaluate practicable alternatives to the action or to location of the action in the base flood plain. Chapter 5 of this document presents an analysis of alternatives. Practicable measures and alternatives were formulated and evaluated, including non-structural measures such as retreat, demolition and land acquisition.

3. If the action must be in the flood plain, advise the general public in the affected area and obtain their views and comments.

A scoping letter was sent to all Federal and state agencies and local agencies. The Town of Edisto Beach coordinated closely with its residents and constituents including the town's beachfront management committee. A public scoping meeting was held early in the project and a public meeting was held during the public review period for the Integrated Feasibility Report and Environmental Assessment. The electronic versions of the documents were also made available on compact disc and online. The meetings were well attended and a rich diversity of views were expressed in multiple formats.

4. Identify beneficial and adverse impacts due to the action and any expected losses of natural and beneficial flood plain values. Where actions proposed to be located outside the base flood plain will affect the base flood plain, impacts resulting from these actions should also be identified.

The anticipated impacts associated with the Recommended Plan are summarized in Chapters 6 and 7 of this report. The project would not alter or impact the natural or beneficial flood plain values.

5. If the action is likely to induce development in the base flood plain, determine if a practicable non-flood plain alternative for the development exists.

An evaluation of practicable measures and alternatives is presented in Chapter 5 of this report. The project will not encourage development in the floodplain, as development is expected to continue the same as it would in both FWOP and FWP conditions. The project provides benefits for existing development. The project would not change the base flood plain.

6. As part of the planning process under the Principles and Guidelines, determine viable methods to minimize any adverse impacts of the action including any likely induced development for which there is no practicable alternative and methods to restore and preserve the natural and beneficial flood plain values. This should include reevaluation of the "no action" alternative.

There is no mitigation expected to be necessary for the Recommended Plan. The project would not induce development in the flood plain and the project will not impact the natural or beneficial flood plain values. Chapter 5 of this report summarizes the alternative identification, screening and selection process. This process carries the "no action" alternative through the entire assessment and selection process.

7. If the final determination is made that no practicable alternative exists to locating the action in the flood plain, advise the general public in the affected area of the findings.

The Draft Integrated Feasibility Study and EA was provided for public review and a public meeting was be held. Comments received and responses to the comments are provided in Appendix I of the report. Additionally, specific public concerns related to the renourishment interval and the sizes of dunes and some of the groins were addressed at a follow-up meeting in Edisto Beach.

8. Recommend the plan most responsive to the planning objectives established by the study and consistent with the requirements of the Executive Order.

The Recommended Plan is the most responsive to all of the study objectives described in Chapter 4, and it is consistent with the requirements of EO 11988. This project reduces damages caused by erosion, and flooding is not the major problem or concern in the project area.

10. PUBLIC INVOLVEMENT AND AGENCY COORDINATION*

10.1 Public Scoping

The USACE held a public scoping meeting at the Edisto Beach Civic Center on October 29, 2009. A total of 13 people attended this meeting. Most of the dialogue at this meeting focused on USACE processes, potential measurement measures and sources of sand and funding. A questionnaire was available for attendees to fill out; four took advantage of the opportunity (Appendix I). Based on the data produced by the questionnaire, the following conclusions were drawn:

- Most year round residents visit the beach at least three times a week,
- Most use the beach for recreational purposes
- None of those that responded had experienced any storm related property damage.

The overall opinion of the attendees was favorable towards a beach fill project. One attendee expressed concerns that the placement of additional material may accelerate the filling in of St. Helena Sound, causing a navigational problem.

10.2 Resource Agency Opinions

Various resource agencies offered opinions on a variety of management measures that were initially considered. Opinions were initially solicited during a meeting held on January 20, 2010, and several agencies subsequently followed up with letters. These letters, as well as further coordination documentation, are included in Appendix I.

In general, beach fill was the agencies' preferred management measure as it would have minimal environmental impact to existing flora and fauna, assuming appropriate dredging windows were utilized, and it would also potentially increase turtle nesting habitat. The resource agencies were universally against the construction of any new groins and were not in favor of lengthening existing groins.

The draft feasibility report/EA has been submitted to resource agencies for input and consideration. Conservation recommendations and all views/opinions have been presented and considered in the final report/EA.

10.3 Public Opinions

A public meeting was held on August 26, 2013 in association with the public review of the Draft report/EA. The meeting was well attended by local residents and a few special interest groups. Appendix I documents the public meeting and the comments received during that meeting. Generally, the public was in favor of the project. A variety of concerns were expressed related to the height of the dune, groin length determinations and renourishment interval. These concerns have been addressed both within the report and with the comment/responses provided in Appendix I. They were also addressed during a follow up meeting with with the non-Federal sponsor and interested citizens to discuss final resolution of technical issues and general concerns on October 22, 2013.

11. RECOMMENDATIONS

This study addresses the needs for coastal storm damage reduction for the Town of Edisto Beach, SC. The following recommendations include items for implementation by Federal, State, and local governments and agencies, including the structural coastal storm damage reduction project. It is critical to emphasize that the purpose of the project is to reduce damages to structures and contents, not to reduce loss of life and risks to personal safety that can occur during hurricanes and other coastal storms. 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.

On the basis of the conclusions of this study, I recommend the implementation of the Recommended Plan, identified as Alternative 4. The Recommended Plan consists of the following elements: 1) A 15-foot high (elevation), 15-foot wide dune beginning at the northern end of the project (i.e., Reach E15 – the southern end of the park) and extending southward along the beach for 16,530 feet. This dune would be fronted by a 7-foot high (elevation) berm. The first 7,740 feet of berm length would have a width of 75 feet. The width would taper to a 50-foot width over the remaining length of the berm. The width of each end of the berm would taper to match the existing beach profile; 2) Beginning at Reach I4, the dune would transition to a 14-foot high, 15-foot wide dune that extends around the end of the island for 5,290 feet. No berm would be constructed in front of this dune because the existing beach profile provides an adequate berm; and 3) Approximately 1,130 ft of total groin lengthening across 23 of the existing groins. The baseline cost estimate for construction in FY 2018 is $21,129,000.

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 recommended project would be subject to the non-Federal sponsor agreeing to comply with applicable Federal laws and policies, including but not limited to:

a. Provide a minimum of 35 percent, but not to exceed 50 percent of total project costs as further specified below:

1. Provide the required non-Federal share 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, during the first year of construction, any additional funds necessary to pay the full non-Federal share of design costs;

3. Provide all lands, easements, and rights-of-way, including those required for relocations, the borrowing of material, and the disposal of dredged or excavated material; perform or ensure the performance of all relocations; and construct all improvements required on lands, easements, and rights-of-way to enable the disposal of dredged or excavated material all as determined by the Government to be required or to be necessary for the construction, operation, and maintenance of the project;

4. Provide, during construction, any additional funds necessary to make its total contribution equal to at least 35 percent of total project costs;

5. Continue to maintain public access every ½ mile and adequate parking within the project limits in accordance with USACE requirements for participation in cost sharing with the Federal Government for the project.

b. Shall not use funds from other Federal sources, including any non-Federal contribution required as a matching share therefore, to meet any of the non-Federal obligations for the project unless the Federal agency providing the Federal portion of such funds verifies in writing that expenditure of such funds for such purpose is authorized;

c. Not less than once each year, inform affected interests of the extent of protection afforded by the project;

d. Agree to participate in and comply with applicable Federal floodplain management and flood insurance programs;

e. Comply with Section 402 of the Water Resources Development Act of 1986, as amended (33 U.S.C. 701b-12), which requires a non-Federal interest to prepare a floodplain management plan within one year after the date of signing a project cooperation agreement, and to implement such plan not later than one year after completion of construction of the project;

f. 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 protection levels provided by the project;

g. Prevent obstructions or encroachments on the project (including prescribing and enforcing regulations to prevent such obstructions or encroachments) such as any new developments on project lands, easements, and rights-of-way or the addition of facilities which might reduce the level of protection the project affords, hinder operation and maintenance of the project, or interfere with the project's proper function;

h. Comply with all 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. 4601-4655), and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way required for construction, operation, and maintenance of the project, including those necessary for relocations, the borrowing of materials, or the disposal of dredged or excavated material; and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act;

i. For so long as the project remains authorized, operate, maintain, repair, rehabilitate, and replace the project, or functional portions of the project, including any mitigation features, at no cost to the Federal Government, in a manner compatible with the project's authorized purposes and in accordance with applicable Federal and State laws and regulations and any specific directions prescribed by the Federal Government;

j. 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 for the purpose of completing, inspecting, operating, maintaining, repairing, rehabilitating, or replacing the project;

k. Hold and save the United States free from all damages arising from the construction, operation, maintenance, repair, rehabilitation, and replacement of the project and any betterments, except for damages due to the fault or negligence of the United States or its contractors;

l. Keep and maintain books, records, documents, or other evidence pertaining to costs and expenses incurred pursuant to the project, for a minimum of 3 years after completion of the accounting for which such books, records, documents, or other evidence are required, to the extent and in such detail as will properly reflect total project costs, and in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 Code of Federal Regulations (CFR) Section 33.20;

m. Comply with all applicable Federal and State laws and regulations, including, but not limited to: Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d) and Department of Defense Directive 5500.11 issued pursuant thereto; Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army"; and all applicable Federal labor standards requirements including, but not limited to, 40 U.S.C. 3141- 3148 and 40 U.S.C. 3701 – 3708 (revising, codifying and enacting without substantial change the provisions of the Davis-Bacon Act (formerly 40 U.S.C. 276a *et seq.*), the Contract Work Hours and Safety Standards Act (formerly 40 U.S.C. 327 *et seq.*), and the Copeland Anti-Kickback Act (formerly 40 U.S.C. 276c *et seq.*);

n. Perform, or ensure performance of, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), Public Law 96-510, as amended (42 U.S.C. 9601-9675), that may exist in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for construction, operation, and maintenance of the project.

However, for lands that the Federal Government determines to be subject to the navigation servitude, only the Federal Government shall perform such investigations unless the Federal Government provides the non-Federal sponsor with prior specific written direction, in which case the non-Federal sponsor shall perform such investigations in accordance with such written direction;

o. Assume, as between the Federal Government and the non-Federal sponsor, complete financial responsibility for all necessary cleanup and response costs of any hazardous substances regulated under CERCLA that are located in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for construction, operation, and maintenance of the project;

p. Agree, as between the Federal Government and the non-Federal sponsor, that the non-Federal sponsor shall be considered the operator of the project for the purpose of CERCLA liability, and to the maximum extent practicable, operate, maintain, repair, rehabilitate, and replace the project in a manner that will not cause liability to arise under CERCLA; and

q. Comply with Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended (42 U.S.C. 1962d-5b), and Section 103(j) of the Water Resources Development Act of 1986, Public Law 99-662, as amended (33 U.S.C. 2213(j)), which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until each non-Federal interest has entered into a written agreement to furnish its required cooperation for the project or separable element.

The total first cost of the project, at 2014 price levels, is $21,129,000. The Federal share of the total first project cost is estimated at $13,733,850. The non-Federal share of the total first project cost is estimated at $7,395,150. The estimated Total Construction and Nourishment Cost, which includes the project first cost as well as the constant dollar cost at the current price level for all future periodic renourishments is $100,699,000. As previously indicated, the total project benefit-cost ratio is 2.3 to 1, which means that for every dollar spent for the project, 2 dollars and 30 cents are realized in NED benefits from the project.

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

12. POINT OF CONTACT*

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