FORT PIERCE
ST. LUCIE COUNTY, FLORIDA
SHORE PROTECTION PROJECT

GENERAL REEVALUATION REPORT WITH ENVIRONMENTAL ASSESSMENT
EXECUTIVE SUMMARY

Proposed Action: Re-authorization of the Fort Pierce Shore Protection Project (SPP) for a new 50-year authorization period (2021 – 2070) with an improved project design to improve project performance. Current Federal authorization for the SPP is scheduled to expire in 2020. The currently authorized SPP includes beach nourishment at a two-year frequency in Fort Pierce, St. Lucie County, Florida to mitigate the erosion effects from the federally-maintained Fort Pierce Inlet. The recommended project design includes construction of shore stabilization structures combined with beach nourishment at a four-year frequency.

Location of Action: Fort Pierce Beach, St. Lucie County, Florida

Type of Statement: General Reevaluation Report (GRR) and Environmental Assessment (EA)

Lead Agency: St. Lucie County Erosion District

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Study Purpose and Scope
St. Lucie County, the non-federal sponsor of the currently authorized Fort Pierce SPP, conducted this General Re-Evaluation Report (GRR) to evaluate management alternatives to improve project performance over a 50-year analysis period to support re-authorization of the project. This report is of feasibility scope and contains an engineering appendix suitable for preparing plans and specifications for the project. The selected plans and proposed project cost sharing apportionments presented in the report reflect current data pertinent to shoreline positions, shore ownership and use, real estate valuations, geotechnical investigations, environmental issues, and estimated project costs. This report presents sufficient technical and economic analyses, environmental coordination, and plan formulation to support the project recommendations.

Project Authorization
The Fort Pierce SPP was originally authorized by the River and Harbor Act of 1965 (PL 89-298, 79 Stat. 1089, 1092) in accordance with the recommendations of the Chief of Engineers in House Document (HD) 84, 89th Congress. The authorization provided for the restoration of 1.3 miles of shoreline south of Fort Pierce Inlet and for periodic nourishment as needed for a period of 10 years following initial construction of the project. The U.S. Army Corps of Engineers completed the initial project construction in 1971 and conducted the first nourishment in 1980. Several congressional acts modified the project authorization from 1968 – 1999, with the Water Resources Development Act (WRDA) of 1999 (PL 106-53) providing the current authorization that expires in 2020 (i.e., 50 years from the date of initial project construction).

Location
The study area for this GRR The project, as authorized by the River and Harbor Act of 1965 (PL 89-298, 79 Stat. 1089, 1092), encompasses 1.3 miles extending from the south jetty to the southern end of Kimberly Bergalis Park (Florida Department of Environmental Protection survey monument R-34 southward to R-41). The Water Resources Development Act (WRDA) of 1999 modified the project as originally authorized to incorporate 1 additional mile into the project in accordance with a final approved general reevaluation report. Figure ES.1 presents the entire 2.3-mile study area as currently authorized.
Problems and Opportunities
The Fort Pierce SPP includes 2.3 miles of shoreline immediately south of the federal Fort Pierce Inlet in Fort Pierce, Florida. The project as currently authorized experiences highly non-uniform erosion largely due to inlet effects, with the greatest amount of erosion occurring at the north end of the project area and the erosion rate decreasing towards the south end. Consequently, the authorized design template breaches relatively quickly in the north segment, triggering the need for nourishment at about a two-year frequency. Correcting the imbalance in project evolution can lead to higher nourishment intervals which, in turn, would benefit the socio-economic and environmental elements of the project.

Report Participants and Coordination with agencies and the Public
St. Lucie County and its consultant, Taylor Engineering, Inc., prepared this report, with some geotechnical and real estate information obtained from prior studies conducted by USACE. St. Lucie County will submit this report directly to the Assistant Secretary of the Army (Civil Works), ASA (CW), who will provide the report to Chief of Engineers for review and comment. The Office of Water Project Review (OWPR) will coordinate with the public and state and other federal agencies for comment.

St. Lucie County has held numerous public meetings to solicit comments regarding the Fort Pierce SPP. The most recent meeting was held September 13, 2016 to discuss the latest phase of this GRR effort. St. Lucie County has also coordinated with FDEP for review of the scope of this study.

NED Plan
This report presents a project plan that, based on results of a 50-year analysis period, is economically feasible, environmentally acceptable, and soundly engineered. The plan includes construction of shore stabilization structures to help stabilize the north end of the project and beach nourishment at a four-year nourishment frequency. Table ES-1 presents pertinent project information.
Figure ES.1 Fort Pierce Shore Protection Project Location Map
The selected plan includes beach and dune nourishment along 6,950 ft of shoreline from the Fort Pierce inlet south jetty (R-34) to R-41. The design includes construction of a 130-ft equilibrated berm width and a dune feature with a 20-ft wide dune crest at an elevation of 11.4 ft relative to the 1988 North American Vertical Datum (NAVD88). The project berm will have an elevation of 7.4 ft NAVD and a 1V:10H foreshore slope. A hopper dredge will be used to fill the template with sand from Capron Shoal, an offshore source located approximately 4 miles from the project site.

The plan also includes construction of shoreline stabilization structures at the project’s north end to severe non-uniform erosion rates. Structures alternative includes the baseline beach nourishment, construction of five T-head groins (T1 – T5) within approximately 1,570 ft from the south jetty, construction of T-head weir (W6) approximately 1,800 ft from the south jetty, and construction of a breakwater (B7) approximately 2,070 ft from the south jetty.

**Table ES.1 Fort Pierce Shore Protection Project: GRR 50-Year Analysis Period – Pertinent Data**

| Selected Plan Description | The selected plan includes beach and dune nourishment along 6,950 ft of shoreline from the Fort Pierce inlet south jetty (R-34) to R-41. The design includes construction of a 130-ft equilibrated berm width and a dune feature with a 20-ft wide dune crest at an elevation of 11.4 ft relative to the 1988 North American Vertical Datum (NAVD88). The project berm will have an elevation of 7.4 ft NAVD and a 1V:10H foreshore slope. A hopper dredge will be used to fill the template with sand from Capron Shoal, an offshore source located approximately 4 miles from the project site.

The plan also includes construction of shoreline stabilization structures at the project’s north end to severe non-uniform erosion rates. Structures alternative includes the baseline beach nourishment, construction of five T-head groins (T1 – T5) within approximately 1,570 ft from the south jetty, construction of T-head weir (W6) approximately 1,800 ft from the south jetty, and construction of a breakwater (B7) approximately 2,070 ft from the south jetty. |
| Average Periodic Nourishment Interval | 4 years |
| Average number of Nourishment Events | 13 |
| Average Nourishment Volume | 576,490 cubic yards |
| Initial Construction Cost (Structures and Beach Fill) | $35,219,085 |
| Total 50-Year Project Benefits | $217,340,408 (FY2021 Price Level) |
| Total 50-Year Project Costs | $135,895,551 (FY2021 Price Level) |
| Cost Sharing | 77.76% Federal / 22.24% Non-Federal |
| Benefit-to-Cost Ratio (BCR) | 1.60 (FY2021 Price Level and 2.875% discount rate) |
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1.0 STUDY INFORMATION

1.1 Introduction


1.2 Study Authority

The non-Federal sponsor of the federal shore protection project, St. Lucie County, funded this General Reevaluation Report (GRR) with cost sharing from the Florida Department of Environmental Protection (FDEP).

1.3 Study Purpose and Scope

St. Lucie County requested this General Re-Evaluation Report (GRR) examine a 50-year analysis period to support re-authorization of the project. This report is of feasibility scope and contains an engineering appendix suitable for preparing plans and specifications for the project. The selected plans and proposed project cost sharing apportionments presented in the report reflect current data pertinent to shoreline positions, shore ownership and use, real estate valuations, geotechnical investigations, environmental issues, and estimated project costs. Contingent upon approval of the reporting officer’s recommendations, preparation of plans and specifications and subsequent construction of the project will be subject to availability of Federal and non-Federal sponsor funds and to Department of the Army policy, guidance, and regulations.

This report presents sufficient technical and economic analyses, environmental coordination, and plan formulation to support the project recommendations. This report discusses existing Federal Shore Protection and Navigation Projects in the vicinity of Fort Pierce, Florida, authorized and alternative project features, implementation requirements (Federal and non-Federal), and coastal engineering and geotechnical analyses.

The main text of the report is an overall presentation of findings, which gives the results of the general reevaluation study for storm damage reduction and recreation benefits in the project area. This document presents a broad view of the overall study and provides a generalized description and discussion of project features and purposes, with an integrated Environmental Assessment (EA) that addresses potential project impacts.

The following appendices present supporting data for recommendations presented herein:

- Appendix A contains engineering investigations
- Appendix B contains the cost analysis
- Appendix C contains the economic analysis
- Appendix D contains geotechnical investigations
- Appendix E contains real estate information
- Appendix F contains public access and cost sharing information
- Appendix G contains Environmental Documents
- Appendix H contains Pertinent Correspondence
1.4 Location

The study area for this GRR lies along 2.3 miles of shoreline in Fort Pierce, Florida. The project, as authorized by the River and Harbor Act of 1965 (PL 89-298, 79 Stat. 1089, 1092), encompasses 1.3 miles extending from the south jetty at Fort Pierce Inlet to the southern end of Kimberly Bergalis Park (FDEP survey monument R-34 southward to R-41). The Water Resources Development Act (WRDA) of 1999 modified the project as originally authorized to incorporate 1 additional mile into the project in accordance with a final approved general reevaluation report. Approval of a final general reevaluation report for the Fort Pierce SPP has not occurred since WRDA 1999. Figure 1.1 presents the entire 2.3-mile study area as currently authorized. Figure 1.2, taken from USACE (2014), shows the location of potential borrow areas for the Fort Pierce SPP. Of note, area SL3-R44 contains the currently permitted borrow area and has been used for all recent nourishments since 1999. As evident in the figure, numerous other proven and potential offshore beach quality sand sources lie within about 5 miles of Fort Pierce Inlet.

1.5 Report Participants and Coordination

St. Lucie County and its consultant, Taylor Engineering, Inc., prepared this report, with some geotechnical and real estate information obtained from prior studies conducted by USACE. St. Lucie County will submit this report directly to the Assistant Secretary of the Army (Civil Works), ASA (CW), who will provide the report to Chief of Engineers for review and comment. The Office of Water Project Review (OWPR) will coordinate with the public and state and other federal agencies for comment.

1.6 Existing Federal Projects

1.6.1 Authorized Fort Pierce Shore Protection Project

1.6.1.1 Overview

The original project area — as authorized by the River and Harbor Act of 1965 (PL 89-298, 79 Stat. 1089, 1092) — encompasses 1.3 miles of shoreline extending from the south jetty at Fort Pierce Inlet to the southern end of Kimberly Bergalis Park, or from FDEP reference monument R-34 southward to R-41, in Fort Pierce, St. Lucie County, Florida. As approved by the Water Resources Development Act (WRDA) of 1999, the current Fort Pierce SPP includes 2.3 miles of shoreline extending from the south jetty of Fort Pierce Inlet (R-34) to R-46. WRDA of 1999 modified the project to incorporate the 1 additional mile (R-41 to R-46) into the project in accordance with a final approved GRR; however, no nourishment projects to date have placed fill in this additional mile.

The project was initially constructed in 1971. Data at that time indicated that the project would require periodic nourishment at average intervals of about 5 years. The first nourishment was performed in 1980, and the second nourishment was performed in 1999. Since then, numerous nourishment projects have occurred to combat persistent erosion at the north end of the project area. Since WRDA of 1999, a final general reevaluation report for the Fort Pierce SPP has not been approved. However, the 2006 Limited Reevaluation Report (LRR) authorized a change in the frequency of future nourishments to two-years.
Figure 1.1 Fort Pierce Shore Protection Project Location Map
Figure 1.2 Potential Borrow Areas within St. Lucie County (USACE 2014)
1.6.1.2 Background

The Fort Pierce, Florida Shore Protection Project in St. Lucie County, Florida was authorized by the River and Harbor Act of 1965 (PL 89-298, 79 Stat. 1089, 1092) in accordance with the recommendations of the Chief of Engineers in House Document (HD) 84, 89th Congress. The authorization provided federal participation for the restoration of 1.3 miles of shoreline south of Fort Pierce Inlet and for periodic nourishment as needed for a period of 10 years following initial construction of the project. Data at that time indicated that the authorized project would require periodic nourishment at average intervals of about five years. The seaward slope of the restored beach, as shaped by wave action, was designed as 1 on 20 (1V:20H) from berm crest to MLW, thence 1V:30H to intersection with existing bottom. The authorization allowed for project construction by the non-Federal sponsor with subsequent reimbursement of the Federal share of costs.

Initial construction fill was placed in 1971. The firms Ocean Dredging, Inc. and C.S. Bean, Inc., placed 718,000 cy of fill from an offshore borrow area on 1.3 miles of project shoreline, extending from the south jetty at Fort Pierce Inlet to the southern boundary of Kimberly Bergalis Park (FDEP reference monuments R-34 to R-41). This beach restoration widened the beach an average of 342 ft over the 1.3-mile project length. In 1980, the first nourishment of the project was performed with placement of 346,000 cy of sand from an offshore borrow area.

Section 102 of the 1968 River and Harbor Act (PL 90-483) modified the project authorization to provide for project construction and periodic nourishment by the Secretary of the Army for a period of 10 years following initial construction. The non-Federal sponsor, St. Lucie County, proceeded to construct the project with reimbursement of the Federal share of the cost under the authority of Section 215 of the 1968 River and Harbor Act.

Section 111 of the River and Harbor Act of 1968 (PL 90-483) states "The Secretary of the Army, acting through the Chief of Engineers, is authorized to investigate, study, and construct projects for the prevention or mitigation of shore damages attributable to Federal navigation works. The cost of installing, operating, and maintaining such projects shall be borne entirely by the United States." At that time, the Secretary of the Army had the authority to construct a Section 111 project if the estimated first cost of construction does not exceed $5,000,000, otherwise specific Congressional authorization was required. A Section 111 report was completed in 1982 which defined the damage to the shoreline immediately south of Fort Pierce Inlet that is attributable to the Federal Navigation Project. The report disclosed that the combined effects of the jetties and the required maintenance dredging of the Federal Navigation Project at Fort Pierce Inlet is responsible for about 60% of the erosion that has occurred along 6,900 ft of shoreline immediately south of the inlet. The report and mitigation measures were approved in 1982, per a letter dated October 26, 1982 from A.J. Salem, acting Chief of the Planning Division, to Weldon Lewis, St. Lucie County Administrator. The letter states that “the Section 111 study of the effects of the Fort Pierce Harbor Federal navigation project on the adjacent Atlantic shoreline has been completed and mitigative [sic] measures have been authorized.”

Under the authority of Section 156 of WRDA of 1976 (PL 94-587), the Chief of Engineers extended Federal participation to fifteen (15) years from initial construction. This modification extended Federal participation to 1986, fifteen years after the initial 1971 restoration project.

Section 934 of WRDA of 1986 (PL 99-662) amended Section 156 of WRDA of 1976 to give the Secretary of the Army, acting through the Chief of Engineers, discretionary authority to extend Federal participation to the fiftieth (50th) year after the date of initial construction of a shore protection project. A Section 934 Reevaluation Report, completed and approved in May 1995, found continued nourishment economically and environmentally sound; however, Federal participation was not extended for the following reason. The
President’s Fiscal Year (FY) 1996 budget for the USACE Civil Works program reflected the start of a phase-out of the traditional USACE role in shore protection projects. Consistent with national deficit reduction goals and budget policies, the USACE determined that the State and local communities that directly benefit from the shore protection program should take more responsibility for its fiscal management. Under the new policies proposed for the USACE shore protection program, the current phase of a study, project, or separable element would be completed, but new phases would not be initiated. Therefore, the FY 1996 budget included funding for shore protection projects to complete only the ongoing phase of the project development process or to honor previous contractual agreements. With that, the USACE exercised its discretionary authority to extend Federal participation in periodic nourishment at Fort Pierce, Florida, only if the next nourishment phase was initiated before the end of FY 1995. At the time, the next scheduled nourishment for the Fort Pierce, Florida Shore Protection Project was November, 1996, which was in FY 1997 when budgetary funding was not anticipated. Therefore, extension in Federal participation in periodic nourishment at Fort Pierce was not anticipated or approved at that time.

Although not approved by the USACE as discussed above, Congress added Section 506(a)(2) of WRDA of 1996 (PL 104-303) which authorized the extension of Federal participation in the periodic nourishment for a period of 50 years, beginning on the date of initiation of initial construction of the project. This authorization extended Federal participation until 2020. In 1999 the second nourishment was performed by the Federal government with placement of 830,000 cy of sand.

While the non-Federal sponsor, St. Lucie County, for this shore protection project was obtaining the necessary permits for the 1999 nourishment, they contracted with an engineering firm to assess the authorized project design parameters. A review of existing and historic profile data along the authorized project shoreline indicated that existing beach slopes are generally 1V:10H from the berm out to MLW and thence 1V:20H out to the intersection with the existing profile. In a letter dated July 10, 1997, St. Lucie County requested that the USACE incorporate the changes in the equilibrium slope design into the authorized shore protection project. In a letter dated August 4, 1997, the USACE, Jacksonville District, concurred with the requested change to the authorized shore protection project equilibrium design slopes.

WRDA of 1999 (PL 106-53) Section 313(a) states "IN GENERAL-The project for shore protection and harbor mitigation, Fort Pierce, Florida, authorized by Section 301 of the River and Harbor Act of 1965 (79 Stat. 1092) and Section 506(a)(2) of the Water Resources Development Act of 1996 (110 Stat. 3757), is modified to incorporate 1 additional mile into the project in accordance with a final approved general reevaluation report, at a total cost for initial nourishment for the entire project of $9,128,000, with an estimated Federal cost of $7,073,500 and an estimated non-Federal cost of $2,054,500, at an annual cost of $556,000 for periodic nourishment over the 50 year project life, with an estimated annual Federal cost of $431,000 and an estimated non-Federal cost of $125,000". WRDA of 1999 Section 313(b) states "PERIODIC BEACH NOURISHMENT.-Periodic beach nourishment is authorized for the project in accordance with section 506(a) of the Water Resources Development Act of 1996 (110 Stat. 3757)". The WRDA of 1999 language did the following:

a. Provided Congressional authorization for Federal participation in harbor mitigation as part of the Fort Pierce Florida Construction General (CG) shore protection project and modified that project to incorporate 1 additional mile in accordance with a final approved GRR.

b. Stated that the total cost of initial nourishment for the entire modified project was $9,128,000 with an estimated Federal cost of $7,073,500 and an estimated non-Federal cost of $2,054,500.

c. Authorized periodic nourishment for the (modified CG) project in accordance with section 506(a) of WRDA of 1996; Title V -Miscellaneous Provisions section 506(a) states "IN GENERAL.-The Secretary shall carry out periodic beach nourishment for each of the following projects for a period of 50 years beginning on the date of initiation of construction of the project:…(2) FORT PIERCE, FLORIDA-Project for shoreline protection, Fort Pierce,
Since 1999, frequent nourishment events have occurred to combat persistent erosion. The third nourishment occurred in two phases over a two-year period. The first phase (2003) placed approximately 336,000 cy of sand from the Fort Pierce Inlet south jetty to approximately 2,200 ft farther south (monument R-36). The second phase (2004) placed approximately 406,000 cy of sand, including approximately 45,000 cy of upper beach advance fill (dune). The 2004 project area extended from the Fort Pierce Inlet south jetty to approximately 2,700 ft farther south (roughly halfway between monuments T-36 and T-37). An emergency nourishment project added approximately 616,000 cy of sand to the project area in 2005. This emergency nourishment, a response to the erosive events of Hurricanes Frances and Jeanne during the 2004 hurricane season and several high-energy extra tropical events during the winter of 2004 – 2005, restored the Fort Pierce SPP project area to the 1999 nourishment design conditions. The 2007 nourishment project added approximately 503,800 cy of sand to the project area. The 2009 nourishment project added another 189,600 cy of sand from the Fort Pierce Inlet south jetty to approximately 1,400 ft farther south (monument R-35). The 2012 nourishment project added approximately 499,800 cy of sand to the project area, between the south jetty and approximately 300 ft south of monument R-38 (i.e., R-38.3). Finally, the most recent 2013 post-Hurricane Sandy nourishment project added 436,800 cy between the south jetty and monument R-39.5. Of note, the local sponsor conducted a non-federal emergency truck haul project in 2011 when federal funding constraints delayed the scheduled federal nourishment until 2012, resulting in a 3-year nourishment interval (i.e., 2009 – 2012) rather than the authorized 2-year interval.

In response to the high nourishment frequency, the USACE completed a Limited Reevaluation Report (LRR) in December 2006. The LRR reevaluated the authorized project design with a 13-year analysis period extending from 2008 to 2020, the end of the authorized project life. Approved in September, 2007, the LRR recommended plan changed the nourishment interval from seven to two years and updated the cost sharing arrangement based on the finding of the Section 111 Study for Fort Pierce Inlet (1982). The cost sharing arrangement developed in the LRR provides for 77.76% Federal and 22.24% non-Federal funding.

The authorizing document for this shore protection project (House Document 84/89/1) and the 1978 G&DDM specify a 50-ft wide berm at elevation +10.0 MLW (+7.4 ft NAVD). Subsequent to project authorization, the MHW shoreline has increasingly become the reference shoreline. Accordingly, the Section 934 Report (last revised 1995) specifies a 50-ft seaward extension of the pre-project MHW shoreline position and a corresponding berm elevation of +10.0 MLW (+7.4 ft NAVD). MHW is a convenient elevation to delineate from both aerial photography and beach profile survey data. Also, along reaches of shoreline that have sustained dune overtopping, the beach profile may not extend to the design berm elevation. To facilitate optimization and engineering procedures, shoreline extensions for the general reevaluation of the authorized project are referenced to the MHW shoreline. The change in nomenclature from berm width to MHW extension does not affect the optimization process since seaward translation of the existing beach profile results in a uniform shoreline advance at any arbitrary reference elevation.

1.6.2 Authorized Fort Pierce Harbor Federal Navigation Project

The Fort Pierce Federal Navigation Project maintains the authorized navigable depths of Fort Pierce Inlet, which lies at the northern end of the SPP. Fort Pierce Inlet is a manmade inlet initially cut in 1921, with short jetties constructed shortly thereafter. In 1926, the existing north and south jetties were constructed 900 ft apart and 1,800 ft and 1,200 ft long. The Federal government assumed responsibility for maintaining the inlet and jetties in 1935.
The St. Lucie County Port and Airport Authority is the non-Federal sponsor for authorized modifications to the Federal Navigation Project at Fort Pierce Harbor, which was last modified between June 1995 and April 1996. The currently authorized project is described below.

a. **Entrance Channel.** The entrance channel has a bottom width of 400 ft and project depth of 30 ft. The entrance channel is 1.8 miles long and includes a 0.7-mile long transition at its western (i.e., landward) end.
b. **Interior Channel.** The interior channel has a bottom width of 250 ft and project depth of 28 ft. The interior channel is 1.9 miles long and contains a dogleg with a widener on the south side.
c. **Turning Basin.** The turning basin, located at the western end of the interior channel, has a turning radius of 1,100 ft and project depth of 28 ft.
d. **North Channel Extension.** The 450-ft long north channel extension, located off the north portion of the turning basin, has a bottom width of 250 ft and project depth of 28 ft.
e. **Berthing Areas.** Two berthing areas lie at the western end of the project. One is off the north channel extension, and the other is off the southwest side of the turning basin. The berthing areas were dredged to 28 ft during the last modification in 1995-1996.

Since 1973, maintenance dredged beach quality material from the Federal Navigation Project has been placed on the shoreline south of Fort Pierce Inlet from R-34 – R-37 as follows (USACE 1998; and personal communication with Richard McMillan, Jacksonville District COE 2004):

- 36,100 cy in November 1973
- 49,800 cy in June 1978
- 29,800 cy in February 1987
- 47,800 cy in March 1989
- 28,600 cy in 1990
- 7,200 cy in 1994
- 19,400 cy in 1997
- 164,100 in May 2014

In addition, 120,000 cy of beach quality material dredged during the 1995 – 1996 modification of the Fort Pierce Harbor Federal Navigation Project were placed between R-34 and R-38.

### 1.7 Prior Non-Federal Corrective Action

In 1973, Non-Federal interests began implementing erosion control measures along the study area to provide storm damage protection to upland development. Along the southern study area shoreline, measures implemented in 1973, 1985, 1987, 1988, 1992 (twice) and 1993 have included dune construction, enhancement, and revegetation. Since 1988, a total of 55,200 cy of sand have been placed for dune construction and enhancement. Along the northern study area shoreline, in 1994, three geotextile erosion control tubes were placed within 1,000 ft of the south jetty to stabilize the shoreline and retain a small emergency beach fill of 54,400 cy.

In November 1998, construction was completed on a shore-parallel spur jetty extending southward from the south jetty at Fort Pierce Inlet. The Fort Pierce Inlet Management Plan recommended construction of the spur jetty to provide a barrier to northward moving longshore transported sand entrained in the jetty flow. The spur jetty, located 400 ft west of the seaward end of the south jetty, was designed to trap sediment between itself and the shoreline, thus improving the stability of the beach. An additional benefit included potential reduction of maintenance dredging requirements from the reduced quantity of sand transported around the south jetty and into the inlet and navigation channel. The spur jetty is 200 ft long with a crest
elevation of +6.5 ft National Geodetic Vertical Datum (NGVD) (+5.0 ft NAVD) and a crest width of 15 ft. The top of the spur jetty includes an asphalt walkway to provide public access. The spur jetty footprint covers 0.53 acres (23,000 ft²) of shelly, sand bottom. The armor stone weight ranges from 7.5 tons to 12.5 tons, with 50% of the stones weighing more than 10 tons.

In April 2011, St. Lucie County conducted an emergency beach fill project to protect upland infrastructure when federal funds were unavailable for a scheduled beach nourishment project. The emergency project trucked approximately 63,000 cy of sand from an upland source and placed the fill between the south jetty and R-35.5.

1.8 Prior Studies and Reports

1.8.1 Engineering Documents Relating to the Fort Pierce SPP

Coastal Engineering Study of Fort Pierce Beach, Florida. The Coastal Engineering Laboratory of the University of Gainesville prepared this report, dated September 1958, for the Fort Pierce Beach Erosion District (FPBED). The report provides data on beach erosion and accretion in the FPBED, the quantity of littoral drift, the development and stability of beach and offshore profiles, recommendations for protective measures including an estimate of the amount of material needed for artificial nourishment of the beach, and measures to prevent breakthrough of the barrier island south of Fort Pierce Inlet during extreme storm and tide conditions.

Fort Pierce, Florida Beach Erosion Control Study (House Document (HD) 84, 89th Congress, 1st Session). This document, dated February 10, 1965, comprises the report and transmittal letter from the Secretary of the Army to Congress on the Beach Erosion Control Study of Fort Pierce, Florida, authorized by Section 2 of the River and Harbor Act of July 3, 1930, as amended and supplemented. The report recommended restoration of 1.3 miles of shoreline south of Fort Pierce Inlet with periodic nourishment as needed for a period of 10 years following initial construction of the project. The authorization allowed for project construction by the non-Federal sponsor, St. Lucie County, with subsequent reimbursement of the Federal share of costs.

Coastal Engineering Studies of Hutchinson Island and Fort Pierce Inlet, Florida. Eric A. Sedwick prepared this report in December, 1973, for the Harbor Branch Foundation Laboratory and the Coastal and Oceanographic Engineering Laboratory of the University of Florida. The report presents coastal engineering studies and investigations of Hutchinson Island and Fort Pierce Inlet. Information is provided on beach profiles, beach material distribution, wave climate, weather observations and hydrography and hydrographic studies of Fort Pierce Inlet.

Fort Pierce Inlet, Glossary of Inlets Report #2. Todd L. Walton for the Florida Sea Grant Program prepared this report, dated July 1974. The report provides information about the history of Fort Pierce Inlet, historical shoreline changes and natural forces data such as tides and currents, storm tides, winds and waves.

Beach Erosion Control Monitoring Study, Fort Pierce, Florida. This 1976 report, prepared by the Jacksonville District, USACE, describes the results of a cooperative performance study of the Fort Pierce, Florida Beach Erosion Control Project since its construction by St. Lucie County in 1971. To monitor the stability of the beach fill, beach profile surveys were obtained in 1971 prior to the initial construction of the shore protection project and compared with five post-construction surveys which covered a period of four years (1971 - 1975). Analysis of the survey data indicates that the project was exceeding design performance standards, with an average annual erosion loss of 50,000 cy of sand.
Fort Pierce, Florida Beach Erosion Control Project, General & Detail Design Memorandum (G&DDM). This report, dated April 1978 (last revised November 1978), was prepared by the Jacksonville District, USACE. The report addresses the periodic nourishment provision of the authorized and constructed Fort Pierce, Florida Beach Erosion Control Project to determine if the authorized plan of periodic nourishment would be the most responsive to the local planning objectives and the Water Resource Council’s Principles and Standards objectives. A detailed formulation and evaluation process investigated both structural and non-structural alternatives. Of the alternative plans investigated, the plan providing for continued periodic nourishment provided the optimum solution within the framework of the formulation concepts. The selected plan, therefore, provided for continued nourishment of the beach to re-establish and provide project dimensions (as per HD 84/89/1), with a subsequent nourishment interval of seven years.

Section 111 Detailed Project Report, Fort Pierce, Florida. The Jacksonville District, USACE, prepared this report, dated May 1982. The purpose of this report was to define the damage to the shoreline immediately south of Fort Pierce Inlet that was attributable to the Federal Navigation Project. The report disclosed that the combined effects of the jetties and the required maintenance dredging of the Federal Navigation Project at Fort Pierce Inlet is responsible for about 60% of the erosion that has occurred along 6,900 ft of shoreline immediately south of the inlet.

Fort Pierce, Florida Shore Protection Project Reevaluation Report Section 934 Study with Environmental Assessment. This report, dated August 1993 (last revised May 1995), was prepared by the Jacksonville District, USACE. The report evaluates the Federal interest in extending Federal participation in future nourishment to the fiftieth year after initial construction of the Fort Pierce Beach, Florida Shore Protection Project. The report determined that such continued Federal participation was economically and environmentally sound. The report was approved, however continued Federal participation was not authorized as discussed previously in the “Authorized Shore Protection Project” section of this report. The Section 934 report altered the periodic nourishment to a seven-year frequency, providing 259,700 cy each event.

Navigation Study for Fort Pierce Harbor, Florida - 10196, Final GRR and Supplement to the Final Environmental Impact Statement. This report, dated April 1994 (last revised June 1994), was prepared by the Jacksonville District, USACE. A Feasibility Report and Environmental Impact Statement (EIS) for improvements to the existing Federal project at Fort Pierce Harbor were prepared for the Congress of the United States at the request of local interests. The report and EIS were completed in August 1984 with the Final EIS (FEIS) being filed in September 1986. WRDA 1988 (PL 100-676) authorized the project recommended in the Feasibility Report. A draft General Design Memorandum (GDM) was completed in March 1990 and the final GDM in May 1991. State environmental agencies conducted an initial field reconnaissance of the project area in April 1991. During that fieldwork, a dive survey uncovered significant environmental resources in the project area. Subsequently, State and Federal agencies as well as private organizations requested that the USACE prepare an EIS on those resources. After confirming the significance of those findings, the USACE decided to prepare a Supplement to the FEIS and that the GRR would include the Supplement. Therefore, the GRR placed particular emphasis on the environmental impacts associated with the proposed modifications to navigation features that would provide for safer, more economical access to the existing Federal navigation facilities at Fort Pierce Harbor. Completion of the modifications to the Federal Navigation Project occurred in 1996 (see the Authorized Navigation Project section of this report).

Mapping & Biological Characterization of Nearshore Hardbottom Habitats, Fort Pierce Shore Protection Project, St. Lucie County, Florida. Sea Byte Inc. prepared this report, dated December 6, 1994, for Coastal Technology Corporation. St. Lucie County contracted with Coastal Technology to perform coastal engineering services in conjunction with the Fort Pierce, Florida authorized shore protection project. This
report presents the results of mapping and biological characterization investigations of the hardbottom communities which are located within and adjacent to the authorized shore protection project.

Geotechnical and Borrow Area Investigation, Phase II-Plans and Specifications Level Report. Fort Pierce, Florida Shore Protection Project. Coastal Technology Corporation prepared this report, dated January 31, 1996, for St. Lucie County Erosion District Board. The report provides a plans and specifications level of investigation (compatibility, quantity and limits) on Capron Shoals as a long term source of beach fill for the authorized 1.3-mile Fort Pierce, Florida Shore Protection Project. Reconnaissance level information on five other potential borrow areas is also provided.

Monitoring of Nearshore Hardbottom Habitats South of Fort Pierce Harbor. Continental Shelf Associates, Inc. for Jacksonville District, USACE, prepared this report, dated January 17, 1997. In association with 1995 dredging activities at the Fort Pierce Harbor Federal Navigation Project, placement of sediment occurred on beaches south of Fort Pierce Inlet. In conjunction with this beach placement of the dredged material, monitoring of nearshore hardbottom habitats that are located within the vicinity of this work was required. This report provides the results of the required monitoring activity to determine if any secondary impacts to the nearshore hardbottom communities have occurred due to the beach placement of the dredged material.

Fort Pierce Inlet Management Plan. Coastal Planning & Engineering, Inc. prepared this report, dated January 1996, for St. Lucie County, Florida. The report analyzes Fort Pierce Inlet, pursuant to Florida Statute Section 161.161(b), to determine whether the inlet is a significant cause of beach erosion. The report addresses the extent to which the inlet causes beach erosion and provides recommendations to mitigate the erosive impact of the inlet. The recommendations include inlet sediment bypassing, modifications to channel dredging, construction of a longshore parallel spur jetty along the existing south jetty, disposal of maintenance-dredged material, establishment of feeder beaches, beach restoration and nourishment and innovative technologies. This document provides cost estimates for the mitigative measures and recommended cost sharing among the beneficiaries of the inlet is discussed. The Implementation Plan for the recommendations provided in the Fort Pierce Inlet Management Plan was adopted by the FDEP on May 30, 1997.

Mitigation Plan for Fort Pierce 1.3-Mile Beach Renourishment. Taylor Engineering, Inc. prepared this report, dated November 1997, for the FDEP. The report provides the multi-component mitigation plan for impacts to nearshore hardbottom communities resulting from the nourishment of the authorized Fort Pierce, Florida Shore Protection Project in Spring 1999. The mitigation plan in the report consists of the following components:

a. Construction of three acres of artificial hardbottom;
b. Revegetation of 4,900 linear ft of beach above the mean high water (MHW) line;
c. Removal of exotic vegetation from eight acres of land on Coon Island in Fort Pierce Inlet;
d. Enforcement of sea turtle ordinances.

Fort Pierce, Florida Shore Protection Project Addendum to the Reevaluation Report Section 934 Study. The Jacksonville District, USACE, prepared this addendum report, dated January 1998. The report updated the cost sharing in the Fort Pierce, Florida Shore Protection Project Section 934 Reevaluation Report (last revised May 1995) to ensure it is in full compliance with current policies with respect to cost sharing Engineering Regulation (ER) 1165-2-130 and requirements for public use on private lands. In addition, an updated cost estimate is provided which includes the costs for placement of 800,000 cy of sand onto the project shoreline and costs for the mitigation plan, described in the previous paragraph, that has been approved by FDEP.
Memorandum for Commander CESAJ. The Engineering Research and Development Center, Coastal and Hydraulics Laboratory, Vicksburg Mississippi prepared this memorandum dated March 2000. It was prepared at the request of U.S. Army Engineer District, Jacksonville (CESAJ) in response to Headquarters U.S. Army Corps of Engineers (HQUSACE) comments regarding this GRR document. The memorandum reviews and updates shoreline change analyses and harbor impact analyses presented in this document. The memorandum is attached to Appendix A.

Coastal and Inlet Processes Evaluation: Fort Pierce Inlet and Adjacent Beaches. [for St. Lucie County by Taylor Engineering, Inc., Jacksonville, FL, 2001]. This document details a Taylor Engineering, Inc. engineering evaluation of Fort Pierce Inlet's sediment trapping mechanisms for the St. Lucie County Erosion District. The analysis contains a sediment budget update and inlet improvement recommendations. The document recommends either T-head groins south of the south jetty or T-head groins south of the south jetty in combination with a south jetty extension as the two alternatives that prove most successful at meeting the design objective of the study.

Shore Protection Project, Design Documentation Report, General Reevaluation Report, Fort Pierce Beach, Florida with Engineering and Cost Appendix. [for U.S. Army Corps of Engineers, Jacksonville District by Taylor Engineering, Inc., Jacksonville, FL, 2002]. This report documents engineering and cost analyses addressing the northern segment (FDEP monument R-34 to R-36) of the Fort Pierce Project Area that extends from R-34 to R-41. The document originates from a request by St. Lucie County to the U.S. Army Corps of Engineers (USACE), Jacksonville District, to improve shore protection along the northern section of the authorized project beach. From this request the USACE initiated a Design Documentation Report to conduct an engineering and least cost analysis to evaluate the project design to improve project performance in the northern project segment between the south jetty and R-36. The document recommends a design containing seven nearshore shoreline stabilization structures including six T-head groins and one nearshore breakwater, together with periodic beach nourishment every four years.

Fort Pierce, Florida Shore Protection Project Draft GRR and Draft Environmental Assessment. This report, dated September 2004 was prepared for U.S. Army Corps of Engineers, Jacksonville District by Taylor Engineering, Inc., Jacksonville, FL. The draft GRR evaluated project alternatives including shoreline stabilization structures for both 15- and 50-year analysis periods. The recommended plan for the 15-year analysis period (extending from 2006 to the end of the authorized project life) included a beach fill only alternative with a two-year nourishment interval. The recommended plan for the 50-year analysis period (extending from 2006 for an authorized project life of 50 years — 2055) included a beach fill with shoreline stabilization structures (six T-head groins and one submerged offshore breakwater) alternative with a four-year nourishment interval. The present GRR document stems from the ITR process for the September 2004 Draft GRR.

Project Information Report (PIR), Rehabilitation Effort for the Fort Pierce, Florida, Hurricane/Shore Protection Project. The Jacksonville District COE prepared this report, dated 2005, in support of the 2005 Fort Pierce SPP nourishment. The report provides a history of the project and the 2004 hurricane season and summarizes the economics for emergency rehabilitation efforts and the requirements to restore the Federal project.

Fort Pierce, Florida Shore Protection Project Draft LRR and Environmental Assessment. This report, dated December 2006 was prepared for U.S. Army Corps of Engineers, Jacksonville District by Taylor Engineering, Inc., Jacksonville, FL. The draft LRR reevaluated the authorized project design with a 13-year analysis period. The recommended plan for the 13-year analysis period (extending from 2008 to the end of the authorized project life) included a beach fill only alternative with a 50-ft MHW extension and two-year nourishment interval. The LRR recommended plan changes the nourishment interval from seven to two years and updates the cost sharing arrangement based on the finding of the Section 111 Study for
Fort Pierce Inlet (1982). The cost sharing arrangement developed in the LRR provides for 77.76% Federal and 22.24% non-Federal funding. A September 6, 2007 memorandum (Appendix G) from CESAD-PDS-P to CESAJ indicates South Atlantic District approval of the December 2006 Draft LRR.


1.8.2 Environmental Documents Relating to the Fort Pierce SPP

Several agencies and entities have drafted numerous environmental documents regarding the Fort Pierce Shore Protection Project. Several reasons — most relating to proposed changes to the original project authorization — exist for the layers of environmental documents concerning the Fort Pierce SPP. Evaluations leading to additional environmental documentation include:

- Project life-related evaluations, such as extending the authorized project life
- Project area-related evaluations, such as extending the authorized project length
- Project design-related evaluations relating to implementing structural components with the authorized design
- Evaluations responding to a lawsuit concerning unaddressed environmental impacts
- Hardbottom impact evaluations and mitigation plans

The Fort Pierce, Florida Beach Erosion Control Project, General & Detail Design Memorandum (G&DDM) dated April 1978 (last revised November 1978) developed by the Jacksonville District contains a Final Environmental Impact Statement (FEIS) that evaluated ten structural and nine non-structural shore protection alternatives. The G&DDM concluded that continued periodic nourishment with the authorized design template and a nourishment interval of seven years provided the most feasible alternative.


The September 1998 (last revised January 2009) Fort Pierce SPP GRR includes a final EA including a Finding of No Significant Impact (FONSI) dated September 1998. The 1998 GRR evaluates the Federal interest in extending the authorized project an additional 1.0 miles to the south of the originally authorized 1.3-mile project area. The 1998 Final EA references the 1978 FEIS evaluation of the structural and non-structural alternatives at Fort Pierce. The 1998 GRR environmental documentation section includes a Section 404(b) Evaluation Report, a Florida Coastal Zone Management Program Federal Consistency Evaluation Procedure Analysis, U.S. Fish and Wildlife Service Coordination Act Report and Biological Opinion, and a Mitigation Plan prepared by Taylor Engineering, Inc. Taylor Engineering prepared the Mitigation Plan for Florida Department of Environmental Protection Permit No. 0126215-001-JC.

A lawsuit and temporary restraining order halted construction of the scheduled 1999 nourishment at Fort Pierce. Contention arose over the environmental effects — specifically the effect on bryozoan communities — of dredging Capron Shoal as designed in the 1998 GRR. As part of the settlement agreement, Dial Cordy and Associates, Inc. developed an Environmental Impact Study (EIS) for the Jacksonville District USACE. The EIS was finalized (FEIS) in 2002. The EIS evaluated two separate action alternatives and a no-action plan.
The Jacksonville District USACE developed a Draft Environmental Assessment (DEA) and Draft Finding of No Significant Impact (DFONSI) in 2003 to evaluate the addition of groins and one breakwater within the northern portion of the Fort Pierce SPP. The structures intended to efficiently retain enough material in the northern project area and to allow adequate sand migration to minimize negative downdrift effects. Due to a lack of federal funding, economic evaluation concerns, and schedule problems, the 2003 draft GRR document and the DEA and DFONSI components never achieved finalized status. Additionally, the USFWS submitted a Biological Opinion (BO) in June 2003 regarding the Fort Pierce SPP with the inclusion of seven shoreline stabilization structures. The Jacksonville District obtained an updated BO from the USFWS on October 13, 2006 which covers the two-year nourishment interval. More recently, USFWS issued an updated BO on June 27, 2008 that includes the shoreline stabilization structures and also revised the construction window to allow nourishment activities to occur through May 15 from R-37 to R-41 and through May 30 from R-34 to R-37. Finally, on May 14, 2015, USFWS revised the May 2008 BO to allow a one-time extension of the construction window for the 2015 nourishment project and to update certain components of the BO to make them consistent with the 2015 Statewide Programmatic BO.

1.8.3 Analyses and Plans Related to Hardbottom Mitigation Requirements

Mitigation requirements for hardbottom coverage caused by the Fort Pierce SPP have resulted in several analyses and mitigation efforts. This section details mitigation analyses and plans relating to the 1999, 2003, 2004, 2005, and 2007 nourishment events at Fort Pierce.

In 1998, during the permitting process with the state regulatory agency (FDEP), Taylor Engineering conducted engineering and environmental analyses to predict the potential hardbottom impact of the then-upcoming 1999 nourishment project. These analyses suggested the possible burial of 8.9 acres of hardbottom. In response to this expected impact, FDEP required mitigation. FDEP and the local sponsor, St. Lucie County, developed a multi-faceted mitigation project that included removal of exotic vegetation from nearby Coon Island, planting dune vegetation on the nourished dune system fronting the project beach, conducting a shorefront beach lighting survey, and constructing 3.0 acres of artificial hardbottom (surface area of rock) close to the impact site. St. Lucie County completed the first three components of this mitigation project in 1999. Due to problems with severe wave conditions at the mitigation site and performance limitations of the contractor initially selected for artificial hardbottom construction, construction of the mitigation hardbottom remained incomplete by 2003.

Before construction of the 2003 beach nourishment project, Taylor Engineering employed field data (post-1999 project monitoring) to compute the impact of the 1999 project. Using three different methods, Taylor Engineering concluded that the actual impact of the 1999 project totaled 9.6 acres, an excess of 0.7 acre over that predicted before the construction of the 1999 project. Given this finding and the fact that the three acres of mitigation hardbottom required to complete the anticipated mitigation requirement for the 1999 project remained unbuilt by 2003, FDEP asked the local sponsor to immediately build 5.0 acres of artificial hardbottom to complete the mitigation requirements of the 1999 project’s impact to 9.6 acres of hardbottom. The formula for estimating the mitigation area was to consider the area of placed rock 70% of the mitigation area with 30% open (sand) area. This mimics the natural hardbottom, which consists of mixed exposed rock and interspersed sand and shell. The revised requirement of 5.0 acres was broken down as follows: 3.0 acres to complete the 1999 multi-faceted mitigation project, 1.0 acres to compensate for the 0.7 acre of excess hardbottom impact relative to that anticipated when developing the 1999 mitigation plan, and a 1.0-acre penalty for the delay in constructing the originally-mandated (in 1999) mitigation hardbottom. In late 2003, the non-federal sponsor completed the required artificial hardbottom construction.

Prior to the construction of the 2005 nourishment project, Taylor Engineering completed analyses to ascertain the impacts of the 2003 and 2004 projects. In this latest analysis, Taylor Engineering determined that the 2003 and 2004 projects cumulatively had an impact on 9.3 acres of hardbottom — a value similar
to, but smaller than the hardbottom area affected by the 1999 project. Consequently, additional hardbottom impacts from the 2005 and 2007 projects were neither anticipated nor observed. Given these findings, FDEP was satisfied that no additional mitigation was necessary for the 2003, 2004, 2005, and 2007 projects. Sidescan surveys of mitigation construction performed as part of the request to terminate mitigation area compliance surveys found 5.12 acres of deployed rock, an excess of 1.62 acres of deployed rock.
2.0 EXISTING AND FUTURE WITHOUT PROJECT CONDITIONS

2.1 General Setting

This chapter describes current conditions and projected future conditions if a project is not implemented for the 2021–2070 50-year authorization period within the 2.3-mile study area, bordering the Atlantic Ocean immediately south of Fort Pierce Inlet, St. Lucie County, Florida. Information presented in this chapter describes the problems and opportunities and helps forecast future conditions. The future without-project (FWOP) condition described in this study represents the most likely condition of the study area without construction of a Federal project over the above mentioned 50-year period. Storm induced erosion, inundation and wave attack will likely continue in the future, damaging infrastructure, limiting habitat, and jeopardizing storm evacuation and relief efforts in the study area. Without a Federal project, the local sponsor and private homeowners would likely take independent actions to combat erosion and loss of property, with a high risk that these efforts would not be coordinated in a holistic fashion incorporating regional concerns such as sediment movement and environmental/habitat considerations.

Existing ground elevations along Hutchinson Island are generally less than 10 feet above mean low water (MLW). Within the project area the width of the island varies from about one thousand to two thousand (1,000 to 2,000) feet except along the inlet, where the shoreline extends a little less than two miles to the west toward Fort Pierce. Land use within the general project area consists primarily of multifamily homes and small condominium complexes facing either the Indian River Lagoon or the Atlantic Ocean. Commercial land uses (e.g. restaurants, retail businesses, hotels) are also present. The northern end of Hutchinson Island (Fort Pierce Inlet and the project area) provides public parking and beach access. A naturally narrow sandy beach bordered by a low relief, thin line of poorly developed dune system provides little storm surge and erosion protection for waterfront development. Severe storms continue to erode the protective beach along Fort Pierce posing a severe seasonal erosion problem.

The natural beach slope is fairly steep for the Florida Atlantic shoreline, typically about 1 vertical to 8 horizontal, sloping directly from the sand dunes downward to the waterline with very little flat berm width. This type of beach is common along southeast Florida and has relatively coarse grained, carbonate rich, beaches. Several areas of environmentally sensitive nearshore limestone and worm rock formations exist in various densities within the littoral zone throughout the study area.

The biological communities found in the sand substrate of the general project are dominated by crustaceans, mollusks, and polychaete worms, in relatively low densities typical of nearshore and surf zone sand habitats. Nesting sea turtles and shore/seabirds use the sandy beach shoreline within the project area.

The nearshore waters of the project area are composed of sand bottom and hardbottom resources. Hardbottom also exists north and south of the project area. Hardbottom habitats identified in the general nearshore project area are differentiated by the amount of relief above the general floor of the ocean and the number and density of flora and fauna inhabitants. This hardbottom habitat may serve as developmental and foraging habitat for juvenile sea turtles and essential fish habitat (EFH) for coral/hardbottom biota and reef fishes. The offshore project area includes un-vegetated sand bottom and underwater shoals, remnants of prehistoric shorelines. Typical inhabitants include relatively low densities of polychaete worms, bivalves, and nematodes, with some echinoids and small crustaceans.
2.2 Natural (General) Environment

2.2.1 Upland Vegetation

Existing Conditions

Coastal sand dune/beach communities in the project area consist mostly of disturbed systems. The dune community in the project area, largely artificial, exhibits minimal relief and provides limited habitat value. Dominant vegetation in this community comprises sea oats (*Uniola paniculata*), beach morning glory (*Ipomoea imperati*), railroad vine (*Ipomoea pes-caprae*), sea grape (*Coccoloba uvifera*), dune panic grass (*Panicum amarulum*), beach bean (*Canavalia rosea*), and bay bean (*Canavalia maritima*). Inkberry (*Scaevola plumier*), sea lavender (*Mallotonia gnaphalodes*), spider lily (*Hymenocalis latifolia*), beach star (*Remirea maritima*), and coconut palm (*Coco nucifera*) also occur within the project area. Exotic species such as Australian pine (*Casuarina litorea*) continue to invade Florida’s shoreline, including the project beach. Australian pines have very shallow root systems and contribute to destabilization of the shoreline. The National Research Council considers Australian pines and other destabilizing exotic species detrimental to nesting marine turtles by exacerbating erosion and, when fallen, acting as physical barriers for nesting females and hatchlings.

FWOP Conditions (No-Action Alternative)

Continued erosion of the beach with the no-action alternative would result in continued loss of vegetated beach and dune habitats. Additionally, continued erosion could cause landowners to implement alternatives to stabilize the beach with armoring measures such as revetments to protect their property. These measures could result in negative impacts to the dune system by altering the beach profile and displacing vegetation. Shoreline hardening could increase erosion both within the project shoreline and south of the project.

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

Existing Conditions

The project area can be divided up into several habitats: the upper beach and dune, the intertidal beach/swash zone, nearshore environment, and offshore environment, one potential source of sand for beach nourishment.

2.2.2.1 Upper Beach

Highly visible decapod crustaceans of the Fort Pierce supralittoral zone include the ghost crab (*Ocypode quadrata*), mole crab (*Emerita talpoida*), and Atlantic fiddler crab (*Uca pugilator*). These organisms are highly mobile and burrow into the moist sand for refuge (Barnes, 1974). In many tropical and subtropical beaches, the ghost crab genus *Ocypode* typically dominates the invertebrate community in the upper beach area. Examples of other wildlife using beach and dune habitats occurring in St. Lucie County include sea turtles (for nesting), shorebirds (for foraging and resting), and reptiles. Several species of anoles, among them the green anole (*Anolis carolinensis*), the brown anole (*Anolis sagrei*), and the six-lined racerunner (*Cnemidophorus [Aspidoscelis] sexlineatus*), are quite common. Gopher tortoises (*Gopherus polyphemus*), while not plentiful, can often be observed in stable backdune areas. Many different types of snakes also live and feed in dune systems. Eastern diamondback rattlesnakes (*Crotalus adamanteus*), yellow rat snakes (*Elaphe obsoleta quadrivittata*), eastern coachwhip snakes (*Masticophis flagellum*), Florida rough green snakes (*Opheodrys aestivus carinatus*), and coastal dunes crowned snakes (*Tantilla relicta pamlica*) all utilize grassy dunes or more woody areas of backdunes as habitat. Vertebrates include a variety of rodents (e.g. beach mice and rat species) and various nest predators such as raccoons (*Procyon lotor*) and feral (as
well as domestic) cats. Coastal areas, particularly beaches, are important wintering areas for shorebirds such as sanderling (*Calidris alba*), dunlin (*Calidris alpine*), short- and long-billed dowitchers (*Limnodromus griseus* and *Limnodromus scolopaceus*), plovers (*Charadrius* spp. and *Pluvialis* spp.), and willet (*Catoptrophorus semipalmatus*).

### 2.2.2.2 Swash Zone and Nearshore Soft-Bottom

The biological communities in the highly dynamic intertidal swash zone must cope with being aerially exposed during normal tidal cycles as well as being subjected to the high energy of the ocean waves. Typically, these habitats exhibit low species diversity because of the environmentally harsh conditions present. While a portion of this environment comprises hardbottom (worm rock and exposed Anastasia rock formations -see below) the main component of this zone consists of medium to coarse quartz sand and shell hash coarse carbonate/quartz sand bottom with the assemblages of plants and animals that use these soft bottom habitats.

Animals able to successfully adapt to these dynamic conditions are faced with very little competition from other organisms. Mole crabs (*Emerita*), haustoriid amphipods, and bivalves (particularly the Atlantic coquina clam (*Donax variabilis*)) are numerical dominants in the intertidal area (Edgren, 1959). A variety of polychaete worms, another of the few taxa that are adapted to this highly dynamic and stressful environment, can be found within the intertidal zone along the Fort Pierce beaches. These intertidal organisms also provide an important food source for foraging shore and wading birds. Amphipods and isopods, which are frequently washed out of their burrows by receding waves and suspended in the water column, serve as an important food source for a variety of nearshore fishes.

Polychaetes, other amphipod species, and bivalves increase in abundance in the subtidal nearshore areas (Pearse et al. 1942, Dahl 1952, Spring 1981). Gorzelany and Nelson (1987) studied the effects of beach nourishment on intertidal and subtidal infaunal communities in the Indialantic and Melbourne Beach area. The study listed 99 taxa with *Donax* spp. as the numerically dominant group, followed by the polychaete *Haploscoloplos fragilis*, the amphipods *Parahaustorius longimerus* and *Bathyporeia parkeri*, and the polychaete *Paraonis fulgens*. Species richness and density decreased in winter, increased in spring and summer, and decreased in fall. These population shifts did not seem attributable to beach nourishment effects but rather to natural seasonal variations.

### 2.2.2.3 Nearshore Hardbottom

Both nearshore and offshore hardbottom habitats are found along much of the Atlantic coast of Florida and significantly contribute to the high biodiversity found in these areas. Limestone, which forms ridges and rocky outcrops and contributes to live-bottom communities, is found along the entire length of the project area. An algae and sponge dominated community typically occupies the limestone outcrops. Application documents for FDEP Permit No. 0126215-001-JC (1999), which authorized the current shore protection project, estimated 418 acres of hardbottom lie within the inlet area of influence, including the inlet and areas along the shoreline and in the nearshore environment north and south of the inlet mouth. The application estimated an 8.9-acre hardbottom impact from the project and concluded that the impacted area of hardbottom represented “a relatively small portion of the total hardbottom present in the nearshore area of the inlet’s influence” (Taylor Engineering, 1999). In 2013, after a decade of monitoring, FDEP determined that the mitigation reef had met FDEP success criteria for compensation of 9.6 acres of hardbottom impact (Taylor Engineering, 2017).

In the nearshore of the central Florida Atlantic coast, low relief hardbottom areas are constructed by the tropical sabellariid marine bristle worm (*Phragmatopoma lapidosa*). These worms collect sand grains of suitable size and cement them together with a protein mucus (Barnes, 1974) referred to as “wormrock”. Sea
Byte (1994) and Continental Shelf Associates (2002, 2003, 2005a, 2005b) documented the presence of sabellariid worm colonies in the project area. The worm-constructed hardbottom expands as worm larvae settle on existing worm tubes and the entire process is continually repeated. This “worm rock” is somewhat ephemeral, as storm waves and burial by sediments may destroy the structures (CSA International 2009b) and the species typically constructs the worm rock only from early summer through fall. Although *P. lapidosa* is capable of spawning year-round (Eckelbarger, 1976; McCarthy et al. 2003), spawning peaks in summer and fall (McCarthy et al., 2003). Sabellariid worms have an opportunistic life history typified by fast-growth, short time to sexual maturity, and hardiness regarding physical disturbance (McCarthy et al. 2003). Although *P. lapidosa* is quite resilient to turbidity (Main and Nelson 1988), studies evaluating sediment burial tolerance of colonies within St. Lucie and Brevard counties found increased mortality linked to both depth of sediment cover and duration of burial (Main and Nelson 1988, Sloan and Irlandi 2008).

The hardbottom habitat provides two very important functions. First, substantial geological evidence suggests that nearshore hardbottom and/or worm rock are also important in the maintenance and persistence of beaches and barrier islands by dissipating wave energy and retaining sediments, and thus increasing the volume of standing sand on beaches adjacent to large worm rock habitat (Gram 1965; Kirtley 1966, 1967; Multer and Milliman 1967; Kirtley and Tanner 1968; Mehta 1973; Kirtley 1974). Second, the structure provided by nearshore hardbottom and associated worm rock supports locally moderate to high diversities and abundances of algae, fishes, and invertebrate groups including sponges, hydroids, mollusks, crustaceans, bryozoans, ascidians, and cnidarians (Kirtley 1966, Gore et al. 1978, Nelson 1989, Lindeman and Snyder 1999, Coastal Planning and Engineering 2006a). Considered important nursery habitat for juvenile fishes (Sloan and Irlandi 2008), nearshore hardbottom also provides shelter and/or foraging grounds for sea turtles (Ehrhart et al. 1996, Wershoven and Wershoven 1992, Holloway-Adkins 2001, CSA International 2009b). The hardbottom provides attachment area for plants and invertebrates and serves as structural habitat for a wide variety of invertebrates and fishes. Worm rock colonies in the project area are observed more commonly within the first (nearshore) hardbottom outcrop and less commonly on the outer, more scattered rock outcrops.

The algal sponge community present off Fort Pierce is highly characteristic of nearshore rock outcroppings found along the east central and southeast coast of Florida. Marine algae observed included seven species of green algae, dominated by *Caulerpa racemosa*, *Halimeda* sp., and *Padina gymospora*; two species of brown algae, *Dictyota* sp. and *Dictyopteris delicatula*; and three species of red algae including *Bryothamnion seaforthii*, *Hypnea musciformis*, and *Jania rubens*. Common invertebrates observed included the sponges *Cliona lampa*, *Tethya* sp. and *Anthosigmella varians*; several species of unidentified hydroids and the star coral, *Siderastrea radians*; bryozoans; and two species of sea urchins, including *Echinometra lucunter* and *Lytechinus variegates*.

Crevices in these limestone outcrops provide important refuge for commercially important crustaceans such as the stone crab (*Menippe mercenaria*), blue crab (*Callinectes sapidus*), and spiny lobster (*Panulirus argus*). These limestone outcrops form three-dimensional structures that provide the only vertical habitat found along vast expanses of sandy substrate. Large carnivores such as snapper (*Lutianus* sp.), grouper (*Epinephelus* sp.) and sea bass (*Centropristis* sp.) are frequently found around these rocky structures. Smaller reef fishes such as the sheephead (*Archosaura probatocephalus*), porkfish (*Anisotremus virginicus*), and spadefish (*Chaetodipterus faber*) are also commonly seen foraging around the hardbottom habitat. Marine turtles may forage on the hardbottom algal communities.

### 2.2.2.4 Offshore Borrow Area Resources

The area currently selected as the sand source borrow site (Capron Shoal) for the proposed project is located in approximately 25 to 30 feet of water three miles or less offshore, in state waters (Figure 1.1). These
sandbars were formed in the recent geologic past by the migration of relic inlets through the barrier island (Moody 1964). As a tidal inlet migrates, its ebb shoal becomes elongated and eventually detaches from the shoreline due to rising sea level and the landward retreat of the shoreline. Capron Shoal has insufficient resources to provide fill material for the entire 50-year authorization period. There are a number of similar shoal formations in the Atlantic Ocean offshore St. Lucie County. These offshore sand habitats support very similar, diverse communities, although there has been comparatively little research conducted in this environment. The Geotechnical Appendix (Appendix D) provides additional details on potential borrow areas for the Fort Pierce SPP. Dredging of Capron Shoals within state waters has reduced much of the shoal to the surrounding bottom elevation. All future dredging activity of the borrow area in state waters will use the Borrow Area Conservation Plan (Appendix D, Sub-Appendix D-4) to use the remaining resources in Capron Shoals and resources in other shoals (if necessary) in an efficient and minimally impactful way.

Infaunal organisms present in the soft bottoms offshore central east Florida are predominantly common invertebrates including crustaceans, echinoderms, mollusks, polychaetous annelids, and interstitial bryozoans. Infaunal populations exhibit both seasonal and spatial variability in distribution and abundance, due to temperature, sediment topography, bathymetry, and sediment composition, including particle size and organic content (Hammer et al. 2005). Epifaunal invertebrates commonly occurring on the soft bottoms offshore central east Florida include lady crabs (Ovalipes spp.), calico scallop (Argopecten gibbus), calico box crab (Hepatus epheliticus), iridescent swimming crab (Portunus gibbesii), brown shrimp (Farfantepenaeus aztecus), white shrimp (Litopenaeus setiferus), striped sea star (Luidia clathrata), and arrowhead sand dollar (Encope michelini). The distribution on the epifaunal invertebrates listed above exhibit distributions that are depth, temperature, and sediment type-related (Hammer et al. 2005).

There are several available studies of invertebrates and fishes from the open sand habitat in the general proposed project area. Johnson (1982) collected over 188 species of invertebrates in benthic grab samples from the Capron Shoal area off Fort Pierce Inlet. In a study offshore of Hutchinson Island in St. Lucie County, Futch and Dwinell (1977) collected lancelets (sand-dwelling chordates in the subphylum Acrania) in densities as high as 1,750 per m$^2$. Other important invertebrates that utilize these sand areas as habitats are bryozoans. The distribution of encrusting bryozoans extends along sandy continental shelves, providing a food source for crustaceans, echinoderms, and mollusks (Winston and Håkansson 1986). Winston and Hakansson (1986) found at least twelve new species from the Capron Shoal area and described the bryozoan population as adapting to varying interstitial conditions. Brostoff (2002) re-examined the areas around Capron Shoal and found most of these bryozoan species also occur on nearby shoals. That study identified an average of 19 different species located within the samples from the St. Lucie Shoal, with Cupuladria doma the exceedingly dominant species collected. Gilmore et al. (1981) collected 194 species of fishes from open shelf sand habitats to the north in the Indian River County area. Flatfishes, searobins, and cusk eels, along with an assortment of batfishes and skates, dominated the fish fauna in similar habitats.

**FWOP Conditions (No-Action Alternative)**

Continued erosion would reduce the acreage of beach and dune habitat and, hence, reduce the number of species that rely on such habitat. The FWOP Conditions of fish and wildlife resources in the intertidal and subtidal areas and the offshore borrow area resources are not expected to differ from Existing Conditions.
2.2.3 Threatened and Endangered Species

2.2.3.1 Beach Jacquemontia

**Existing Conditions**

Beach Jacquemontia (*Jacquemontia reclinata* or beach clustervine) is an endangered coastal dune plant endemic to the southeastern coast of Florida. This low-growing, creeping vine typically inhabits the lee side of stable, vegetated dunes, disturbed openings in maritime hammocks, coastal strand, and coastal scrub. The species produces somewhat fleshy leaves up to 3 cm long and white, star-shaped flowers. Currently, only a few populations remain along the east coast of Florida from Martin County south to Dade County. The primary threats to its continued existence include habitat loss and fragmentation from coastal development and erosion, and displacement from non-native, invasive species such as Brazilian pepper (*Schinus terebinthifolius)*.

While this species is native to the coastal barrier islands of southeast Florida from Jupiter Island to Key Biscayne (Federal Register 1993), the plan has not been found north of Jupiter Inlet (at the south end of Martin County) since before 1979. The species is currently known only from Dade and Palm Beach Counties. Previous dune vegetation surveys within the past 10 years of the project location and other locations along Hutchinson Island by Taylor Engineering, Inc. has not located any evidence of this species.

**FWOP Conditions (No-Action Alternative)**

The FWOP Conditions for the beach jacquemontia are not expected to be different from the Existing Conditions described above.

2.2.3.2 Marine Turtles

**Existing Conditions**

Five species of sea turtle have been observed in St. Lucie County and associated waters. The County is within the normal nesting range of three species of sea turtles: the loggerhead (*Caretta caretta*, the green (*Chelonia mydas*), and the leatherback (*Dermochelys coriacea*). The loggerhead is currently responsible for the vast majority of nesting, both statewide and in St. Lucie County, although data suggest increasing numbers of green and leatherback turtles nesting statewide. Green and leatherback turtles are both listed as *endangered* under the U.S. Endangered Species Act of 1973 and Chapter 370 of the Florida Statutes. The loggerhead is listed as *threatened*. All species noted above have been documented as nesting on St. Lucie County beaches. The Kemp’s ridley (*Lepidochelys kempi*) and hawksbill (*Eretmochelys imbricata*) are infrequent nesters along the east coast of Florida and have not been recorded as nesting on St. Lucie County beaches. These observations are from the Florida Fish and Wildlife Conservation Commission (FWC) Statewide Nesting Beach Survey (SNBS) program, which has collected and collated data along St. Lucie County beaches since 1980. St. Lucie County data are collected along stretches of beach varying in length from 27.7 to 34.4 km.

EAI (Ecological Associates, Inc.) conducted annual marine turtle nest monitoring for the project beach from 1999 – 2007. During each nesting season, EAI conducted daily marine turtle nest monitoring. Daily nest monitoring began on March 1st of each year and continued until the evaluation of the last marked nest was complete. Table 2.1 contains marine turtle nesting occurrences within the project beach for years 1999 – 15 (data source: Ecological Associates, Inc.)
Nesting data show that much lower nesting densities occur in the area immediately south of the inlet, likely attributed to the high rate of erosion in that area. Nesting density generally increases south of R-36 where erosion is less severe.

**Table 2.1 Marine Turtle Nesting Occurrences within Project Area**

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Number of Nests</th>
<th>Loggerhead</th>
<th>Green</th>
<th>Leatherback</th>
<th>Total</th>
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<tr>
<td>1999</td>
<td>50</td>
<td>0</td>
<td>3</td>
<td>53</td>
<td></td>
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<td>0</td>
<td>2</td>
<td>100</td>
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</tr>
<tr>
<td>2002</td>
<td>102</td>
<td>0</td>
<td>2</td>
<td>104</td>
<td></td>
</tr>
<tr>
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<td>67</td>
<td>2</td>
<td>1</td>
<td>70</td>
<td></td>
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</tr>
<tr>
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<td>0</td>
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<td>2015</td>
<td>58</td>
<td>2</td>
<td>3</td>
<td>63</td>
<td></td>
</tr>
</tbody>
</table>

1Includes only those nests above the recent high tide line and within INBS Zones A, B, and C (R-34 to R-41).

**FWOP Condition (No-Action Alternative)**

In the FWOP, the beach is predicted to continue to erode. This will reduce the shoreline area available for nesting sea turtles. It will also increase turtle nest vulnerability to storm washout, as nests would be located closer to the mean high water line. As adjacent shorelines are currently available for nesting, it is unknown whether the overall nesting would be affected. In addition to increased erosion, it is likely that the length of shoreline hardened by structures would increase. This could further decrease the area available for nesting sea turtles since the proposed hard structures would likely be seawalls and revetments (where permitted) that could negatively impact the width of beach available for nesting if not constructed in conjunction with beach nourishment.
2.2.3.3  Piping Plover

Existing Conditions

The piping plover (*Charadrius melodus*) is a rare to uncommon winter resident that can occur along both the Gulf and Atlantic coasts between September and April. Although found on both coasts, they are more common along the Gulf of Mexico. The piping plover is listed as endangered in Canada and the inland United States, and is threatened along the coast. This small shorebird can occur inland but prefers sandy beaches and tidal mudflats where it forages along the waterline or high up the beach along the wrack line. Piping plovers eat a variety of insects and aquatic invertebrates. Declines have resulted from direct and unintentional harassment by people, dogs, and vehicles; destruction of beach habitat for development; and changes in water level regulation (Haig 1992).

A winter census stated that approximately 20–30 piping plovers occur along the Atlantic coast from Duval County south to Brevard, St. Lucie, and Miami-Dade Counties (Florida Natural Areas Inventory [FNAI] 2001). Ecological Associates, Inc. (EAI) conducted a piping plover survey near St. Lucie Inlet, south of the project area, from January to May 2009 in support of permitting planned dune restoration project at Bathtub Beach Park near the south end of Hutchinson Island. EAI documented one sighting of a piping plover in or near the project area, but its occurrence there is very rare, given the high amount of human use and associated disturbances. Only one solitary bird has been observed on the Atlantic beaches of Hutchinson Island, located a considerable distance from the inlet (personal communication, Robert Ernest, EAI August 2009). A total of 44 Piping Plovers were observed along the South Florida Atlantic Coast during the 2006 International Piping Plover Census, none from Hutchinson Island (Elliot et al 2009). Elliot et al (2015) reported 58 observations on the Atlantic coast in the 2011 international census, with the nearest reported observations south of the project area on St. Lucie inlet sandbars. Designated critical habitat for wintering piping plovers occurs south of the project area on Jupiter Island, Martin County, Florida. No critical habitat is designated within the project area.

FWOP Condition (No-Action Alternative)

The continued erosion of the shoreline in the proposed placement area may reduce some habitat that could potentially be utilized by the plover; however, the infrequent usage of this area by this species suggests the FWOP Conditions would be like the Existing Conditions with respect to the plover.

2.2.3.4  Rufa Red Knot

Existing Conditions

The rufa subspecies of the red knot (*Calidris canutus rufa*), listed as threatened, is a small shorebird that can occur along the Atlantic and Gulf coasts during migration. It is also known to overwinter in low numbers along both coasts. Florida is home to the largest concentration of wintering rufa in the United States, with the main concentration occurring in the greater Tampa Bay region (A.C. Schwarzer et al. 2012). In migration and winter, it prefers coastal mudflats, tidal zones, and sometimes open sandy beaches where it feeds on small invertebrates such as small mollusks, marine worms, and crustaceans (Kaufman 1996). The knot population has declined primarily due to reduced food availability from increased harvests of horseshoe crabs (USFWS, 2015a). Their numbers appear to have stabilized in the past few years, but they remain at low levels relative to earlier decades (USFWS, 2015a). Critical Habitat has not been designated for this species.
Red knots have been observed at Fort Pierce Jetty Park in St. Lucie County (St. Lucie Audubon 2014), and have also been known to occur in St. Lucie Inlet Preserve State Park (FDEP 2014). They may occasionally occur within the study area.

FWOP Condition (No-Action Alternative)

The continued erosion of the shoreline in the proposed placement area may reduce some habitat that could potentially be utilized by the knot; however, the infrequent usage of this area by this species suggests the FWOP Conditions would be like the Existing Conditions with respect to the knot.

2.2.3.5 West Indian Manatee

Existing Conditions

The West Indian manatee (Trichechus manatus) is protected under the Endangered Species Act, the Marine Mammal Protection Act, and Florida State law. The Florida manatee (Trichechus manatus manatus), a subspecies of the West Indian manatee, is most numerous along the coasts of Georgia and Florida, but can also be found in coastal waters of Gulf Coast states. Manatees frequently inhabit shallow areas where seagrasses are present and are commonly found in protected lagoons and freshwater systems. Manatees occasionally use open ocean passages to travel between favored habitats (Hartman 1979). They migrate seasonally, particularly on the east coast of Florida. During the summer months, manatees utilize habitats all along the coast. However, during winter, when water temperatures drop, manatees use warm water refuges such as springs or warm water discharges at power plants. Within St. Lucie County, manatees infrequently use nearshore Atlantic waters, but are found more frequently within protected lagoon areas, especially during the summer months.

FWOP Condition (No-Action Alternative)

The FWOP Conditions for the Florida manatee are not expected to be different from the Existing Conditions described above.

2.2.3.6 Northern Right Whale

Existing Conditions

The northern right whale (Eubalaena glacialis) is a federally-listed endangered species and is protected under the Marine Mammal Protection Act. Just a decade ago, the migratory population within the Atlantic Region was less than 350 animals (Humphrey 1992). Right whales are highly migratory, and summer in the Canadian Maritime Provinces. They migrate southward in winter to the eastern coast of Florida. The breeding and calving grounds for the right whale occur off the coast of southern Georgia and northern Florida. During winter months, right whales are routinely seen close to shore and have been sighted as far south as south Florida, with isolated sightings into the Gulf of Mexico. Offshore of St. Lucie County, the peak probability of right whale occurrence is December through March.

In 2015, the National Oceanographic and Atmospheric Administration expanded critical habitat for the Right Whale from 1,511 nm2 to 8,429 nm2, among other changes extending the critical habitat area south along the entire shoreline of Cape Canaveral and slightly south of the cape long the Atlantic “to 28° N. latitude (approximately 31 miles south of Cape Canaveral, Florida) within the area bounded on the west by the shoreline coast…” (Federal Register 2016). This southerly extension of critical habitat remains well north of the project area and the potential borrow areas for the project.
The FWOP Conditions for the northern right whale are not expected to be different from the Existing Conditions described above.

2.2.3.7 Humpback Whale

Existing Conditions

The humpback whale (Megaptera novaeangliae), federally listed as endangered, is a large baleen whale with a maximum length of about 52 feet (16 meters). Humpback whales range from the Arctic to the West Indies. During summer, at least five geographically distinct feeding aggregations occur in the northern Atlantic (Blaylock et al., 1995). During fall, humpbacks migrate south to the Caribbean where calving and breeding occurs from January to March (Blaylock et al. 1995). Aerial surveys during the Cetacean and Turtle Assessment Program (CETAP) detected only a few humpback whale sightings from New Jersey southward during any season (Winn 1982). However, subsequently there have been numerous sightings and strandings off the mid-Atlantic and southeastern U.S. coast, particularly during winter and spring (Swingle et al. 1993, Wiley et al. 1995). Most of the stranded animals were juveniles, suggesting that the area may provide an important developmental habitat (Wiley et al. 1995). Humpbacks feed largely on euphausiids and small fishes such as herring, capelin, and sand lance, and Blaylock et al. (1995) correlated their distribution largely to prey species distribution and abundance. Calving and breeding occurs in the Caribbean from January to March (Tove 2000). The humpback whale is rarely sighted within the vicinity of St. County during its spring/fall migration. Critical habitat has not been designated for this species.

The FWOP Conditions for the humpback whale are not expected to be different from the Existing Conditions described above.

2.2.3.8 Smalltooth Sawfish

Existing Conditions

The smalltooth sawfish (Pristis pectinata), currently listed as endangered by NMFS, rarely occurs within the project area. This species has become rare along the southeastern Atlantic and northern Gulf of Mexico coasts of the U.S. during the past 30 years, with its known primary range now reduced to the coastal waters of Everglades National Park in extreme southern Florida. Fishing and habitat degradation have extirpated the smalltooth sawfish from much of this former range. There is no designated critical habitat for this species within the project area.

The smalltooth sawfish, distributed in tropical and subtropical waters worldwide, normally inhabits shallow waters (10 m or less), often near river mouths or in estuarine lagoons over sandy or muddy substrates, but may also occur in deeper waters (20 m) of the continental shelf. Shallow water less than 1 m deep appears an important nursery area for young smalltooth sawfish. Maintenance and protection of habitat is an important component of the smalltooth sawfish recovery plan (NMFS 2006). Recent studies indicate that key habitat features (particularly for immature individuals) nominally consist of shallow water, proximity to mangroves, and estuarine conditions. Smalltooth sawfish grow slowly and mature at about 10 years of age. Females bear live young, and the litters reportedly range from 15 to 20 embryos requiring a year of gestation (NMFS 2006a). Their diet consists of macroinvertebrates and fishes such as herrings and mullets. The smalltooth sawfish reportedly uses its saw to rake surficial sediments in search of crustaceans and benthic fishes or to slash through schools of herrings and mullets (NMFS 2006a).
FWOP Condition (No-Action Alternative)

The FWOP Conditions for the smalltooth sawfish are not expected to be different from the Existing Conditions described above.

2.2.3.9 Southeastern Beach Mouse

Existing Conditions

The southeastern beach mouse (Peromyscus polionotus neveiventris) is listed as a threatened species at both the federal and state levels. Beach mice primarily use coastal dune communities containing stands of sea oats for habitat. Grasslands and open sandy areas in the fore-dune area may also be utilized (Humphrey 1992). This subspecies was originally endemic to coastal dunes along the Florida coast from Ponce Inlet (Volusia County) to Hollywood Beach (Broward County). Declines in beach mouse populations have been attributed to loss of habitat due to coastal development and beach erosion. Southeastern beach mice have been historically documented within St. Lucie County (Humphrey 1992). It appears, however, that the southeastern beach mouse may recently have been extirpated from its local range due to erosion of favored habitats.

FWOP Condition (No-Action Alternative)

The FWOP Conditions for the southeastern beach mouse are not expected to be different from the Existing Conditions described above.

2.2.4 Essential Fish Habitat

Existing Conditions

As required by the 1996 amendment to the Magnuson-Stevens Fishery Conservation and Management Act, the South Atlantic Fishery Management Council’s (SAFMC) (1998) Habitat Plan for the South Atlantic Region identifies Essential Fish Habitat (EFH) falling within the following fishery management plans: Shrimp, Red Drum, Snapper, Grouper, Coastal Migratory Pelagics, Golden Crab, Spiny Lobster, Coral and Coral Reefs, and Calico Scallop. These management plans provide a list of managed species that breed, spawn, forage, or grow to maturity in areas designated EFH.

The study area contains the following marine/offshore habitats designated EFH:

- Live/Hardbottom Habitat
- Coral and Coral Reefs
- Artificial and Manmade Reefs
- Sargassum
- Water Column

Managed species that commonly inhabit the inshore and offshore habitats within the study area include pink shrimp (Farfantepenaeus duorarum), and spiny lobster (Panularis argus). Members of the 73-species snapper-grouper complex include sailors choice (Haemulon parra), gray snapper (Lutjanus griseus), mahogany snapper (Lutjanus mahogoni), and porkfish (Anisotremus virginicus). These species utilize the inshore habitats as juveniles and sub-adults and the hardbottom and offshore reef communities as adults. In the offshore habitats, the number of species within the snapper-grouper complex that may be encountered
increases. Coastal migratory pelagic species also commonly utilize the offshore area adjacent to the study area. In particular, king mackerel (*Scomberomorus cavalla*) and Spanish mackerel (*S. maculatus*) are the most common.

**FWOP Condition (No-Action Alternative)**

In the FWOP scenario, the quality of EFH in the study area is not likely to differ from the Existing Conditions.

### 2.2.5 Coastal Barrier Resources

**Existing Conditions**

The Coastal Barrier Resources Act of 1982, as amended, protects undeveloped coastal barriers and related areas by prohibiting direct or indirect federal funding of various projects in these areas that might support development. The Act also established a Coastal Barrier Resources System, consisting of undeveloped coastal barriers and other areas on the coastal U.S. Because of urbanization and the highly-developed nature of Hutchinson Island both north and south of the Fort Pierce Inlet, there is little available terrestrial habitat in the immediate project area to support large numbers of diverse plants and animals. The northern end of Hutchinson Island is not part of the Coastal Barrier Resources System.

**FWOP Conditions (No-Action Alternative)**

The FWOP Conditions are not expected to differ from Existing Conditions.

### 2.2.6 Water Quality

**Existing Conditions**

Waters off the coast of St. Lucie County are classified as Class III Marine waters by the State of Florida. Class III Marine waters are designated as suitable for recreation and the propagation of fishes and wildlife. Turbidity is the major limiting factor in coastal water quality in South Florida. Turbidity is measured in Nephelometric Turbidity Units (NTU), which quantitatively measure light-scattering characteristics of the water. However, this measurement does not address the characteristics of suspended material that creates turbid conditions. According to Hanes et al (1993), the two major sources of turbidity in coastal areas are very fine organic particulate matter and sediments and sand-sized sediments that become suspended around the seabed from local waves and currents. Florida state guidelines set to minimize turbidity impacts from beach restoration activities confine turbidity values to under 29 NTU above ambient levels outside the turbidity mixing zone for Class III Marine waters.

Turbidity values are generally lowest in the summer months and highest in winter, corresponding with winter storm events and the rainy season (Hanes et al. 1993; Coastal Planning and Engineering 1992). Moreover, higher turbidity levels can generally be expected around inlet areas, and especially in estuarine areas, where nutrient and entrained sediment levels are higher. Although some colloidal material will remain suspended in the water column upon disturbance, high turbidity episodes usually return to background within several days to several weeks, depending on the duration of the perturbation (storm event or other) and on the total suspended solids concentration and granulometric distribution. Strict control over water quality is addressed by the FDEP in applying specific water quality monitoring requirements during the dredging and beach fill operations stage.
The FWOP Conditions are not expected to differ from Existing Conditions.

2.2.7 Hazardous, Toxic, and Radioactive Waste

Existing Conditions

The coastline within the project area is located adjacent to predominantly residential, commercial, and recreational areas. There are no known industrial activities that produce hazardous, toxic, and/or radioactive wastes adjacent to the project site or discharge effluents near the shoreline and no known records of such activities in the past. Sediments within the littoral zones of the project area, as well as sediments from the borrow areas, are composed of particles of a large grain-size. Normally, contaminants do not adhere to materials with such properties. Sediments in the potential borrow sites are sufficiently removed from shipping lanes or other potential contaminant sources. Hence, they are unlikely to have been contaminated by pollutants.

The FWOP Conditions are not expected to differ from Existing Conditions.

2.2.8 Air Quality

Existing Conditions

Fort Pierce lies within the Southeast Florida Intrastate Air Quality Region, as established by 40 CFR Part 81.49. St. Lucie County has been designated by U.S. Environmental Protection Agency (EPA) (40 CFR Part 81.310) as being in attainment with National Ambient Air Quality Standards for ozone, nitrogen dioxide, carbon monoxide; total suspended particulates, and sulfur dioxide that are better than national standards. USEPA has not made a designation for lead in southeastern Florida.

Ambient air quality along coastal St. Lucie County is generally good due to prevalent ocean breezes from the northeast through the southeast. The urbanization of the City of Fort Pierce and the popularity of the beaches area all contribute to a large number of motorized vehicles and vessels being in the project area at any given time. Because of the sea breezes that are usually present along the Fort Pierce shore, airborne pollutants are readily dispersed. No air quality permits are required for this project.

The FWOP Conditions are not expected to differ from Existing Conditions.

2.2.9 Noise

Existing Conditions

Ambient noise levels in the project area are seasonal in nature with higher levels expected during the winter tourist season. Due to urbanization and development found along the shoreline, the shoreline along Fort Pierce is a favorite recreational area for both residents and tourists. The Fort Pierce Inlet, which provides access to the Atlantic Ocean from the Indian River Lagoon Estuary, is a busy waterway for both commercial and recreational watercraft.
The major noise-producing sources include breaking surf, beach and nearshore water activities, adjacent residential and commercial areas, and boat and vehicular traffic. The density of all these activities can be expected to contribute to noise in the surrounding area.

**FWOP Conditions (No-Action Alternative)**

While a decrease in beach visitation may occur, the FWOP Conditions are not expected to differ substantially from Existing Conditions.

2.2.10 **Aesthetic Resources**

**Existing Conditions**

Aesthetic resources are those natural and cultural features of the environment that elicit a pleasurable response in the observer, most notably through visual perception. Consequently, aesthetic resources are commonly referred to as visual resources, i.e., features that can be seen. Historically, the project area consisted of light sandy beige beaches with natural sand dunes contrasting strikingly with the deep hues of the panoramic Atlantic Ocean. Currently, the project area has a narrow beach eroded by strong winds and waves. Sand dunes in the project areas have been eroded and few trees can be found along the project. Three locally managed beach parks located in the project area also appear to be affected by erosional forces. There is no area within the vicinity of the project that has been designated under 40 CFR 81.407 as a Class I Federal Area, where visibility is an important value.

**FWOP Conditions (No-Action Alternative)**

The aesthetics of the study area would decline in the FWOP Condition due to continued erosion of beach and dune system and associated impacts to upland properties.

2.2.11 **Recreation Resources**

**Existing Conditions**

The minimal amount of commercial development has contributed to the retention of much of the natural appearance of the area, and residents and visitors have mentioned that the area has retained the overall atmosphere of “Old Florida” as it existed prior to the extensive development of the tourist industry along much of the remainder of the Florida east coast. This atmosphere appeals to many recreationists who prefer to avoid the pace characteristic of the more heavily developed resort areas.

Recreational usage along the beaches within the project area includes shore-based water sports such as scuba diving, snorkeling, surfing, surf fishing, and kayaking, as well as sunbathing, picnicking, and exercising. Several boat launches and marinas at Fort Pierce facilitate sport fishing and recreational boating. Shallow, nearshore hardbottom areas are conducive to scuba diving and lobster fishing. Fishermen are often seen on boats in the inlet, within the Indian River Lagoon, and in nearshore and offshore areas. Fishing from the jetties is popular.

There are no state or national wildlife refuges, management areas, forests, wilderness areas, trails, estuaries, or research reserves within the project area. However, the Fort Pierce Inlet State Park, on the northern side of the inlet has camping and picnicking facilities.
The currently authorized shore protection project has helped maintain the recreational resources throughout the study area (R-34 to R-46), as longshore dispersion of the beach fill has greatly increased the beach widths to the south. The recreation resources will severely decline throughout the study area due to continued erosion and narrowing of the beach if beach nourishment does not occur.

2.2.12 Navigation

Existing Conditions

Although there is some commercial shipping associated with the Port of Fort Pierce, most of the vessel traffic in the Fort Pierce area is associated with recreational boating and fishing. While most of the concentrated vessel traffic is within the Indian River Lagoon and the Fort Pierce Inlet, private and chartered fishing boats can be found in the vicinity of nearshore and offshore reefs and shoals. The proposed borrow area is located away from commercial shipping routes. Boating in the area is associated mainly with recreational and commercial fishing, including the harvesting of shrimp and scallops.

FWOP Conditions (No-Action Alternative)

The FWOP Conditions are not expected to differ from Existing Conditions.

2.2.13 Historic Properties

Existing Conditions

Documented exploration and transportation activities along Florida’s east coast date from the second half of the 16th century. Because of over 400 years of navigation in the Bahama Channel, several hundred shipwrecks have been identified in the waters off the state’s southeast coast. Remains of recorded and unrecorded shipwrecks may be located in the area affected by the proposed Fort Pierce SPP.

Archival research and field investigations have been conducted for the study area, and coordination with the Florida State Historic Preservation Officer (SHPO) is complete. Results of the investigation of Capron Shoal are included in the draft report Submerged Historic Properties Survey Capron Shoal Borrow Site, Fort Pierce Beach Erosion Control Project, St. Lucie County, Florida, December 4, 1997. Mid-Atlantic Technology and Environmental Research completed the fieldwork and prepared the report under contract to the USACE.

One magnetic target was identified during the remote sensing survey. Analysis indicated that the target’s magnetic signature does not have characteristics similar to historic shipwreck sites. It was concluded that the target probably was a single modern object and not likely to represent a resource eligible for inclusion in the National Register of Historic Places.

Based on archival research and consultation with SHPO, no significant historic properties are known to exist on the beach segment proposed for nourishment. No additional fieldwork is proposed for either the borrow area or beach at Fort Pierce.

FWOP Conditions (No-Action Alternative)

The FWOP Conditions are not expected to differ from Existing Conditions.
2.2.14 Public Safety

Existing Conditions

Issues of public safety within the project area primarily relate to beach- and water-related recreation, including sun exposure and injuries or drowning from high surf or run-outs. The City of Fort Pierce staffs most public beach parks with lifeguards during periods of normal to high beach use. Crime and related activities are of a low to moderate nature and are not considered to be of a significant nature.

FWOP Conditions (No-Action Alternative)

The FWOP Conditions are not expected to differ substantially from Existing Conditions; however, continued erosion of the beach may result in decreased beach visitation, which may affect public safety statistics for the area.

2.3 Physical Environment (Conditions)

The study area consists of an open sandy coast subject to frequent storm events, including nor’easters and tropical storm activity. Shorefront properties include residential, commercial, and recreational properties. Many factors influence the coastal processes characteristic to the Fort Pierce, St. Lucie County, Florida shoreline, including winds, tides, currents, waves, storm effects, and sea level rise. Human-related (anthropogenic) factors include other shore protection projects, navigation projects, and development. The following paragraphs briefly describe the role of each of these factors and their contribution to beach erosion in Fort Pierce.

2.3.1 Study Reaches

Existing Conditions

The Florida Department of Environmental Protection (FDEP) has designated a single critically eroded reach (R-34 to R-46) extending 2.3 miles south of the inlet at Fort Pierce. The FDEP defines a critically eroded area as “a segment of the shoreline where natural processes or human activity have caused or contributed to erosion and recession of the beach or dune system to such a degree that upland development, recreational interests, wildlife habitat, or important cultural resources are threatened or lost”. The study area consists of this single 2.3-mile reach.

Future Without-Project Conditions (No-Action Alternative)

The FWOP Conditions are generally not expected to differ from Existing Conditions.

2.3.2 Geology

Existing Conditions

Fort Pierce is located at the north end of Hutchinson Island, part of a chain of sand barrier islands extending from Cape Canaveral to Palm Beach. These barrier islands rarely exceed one mile in width or 20 feet in elevation. The Indian River, a shallow lagoon approximately two miles wide, separates Hutchinson Island from the mainland. During high seas and storms, the ocean may overwash the island, spreading sands into the lagoon in a fan or delta shape.
Offshore of Hutchinson Island, the continental shelf extends along the coast for the entire length of the state (350 miles). The shelf, containing terraces and submerged beach sand ridges of Pleistocene and Holocene ages, reaches nearly 80 miles wide offshore of Jacksonville and thins to only a few miles wide offshore of Miami. The wave climate and littoral processes create a generally linear sandy coastline, locally modified by inlets (e.g., Fort Pierce Inlet).

The barrier islands, characterized by dunes and shore parallel ridges, were formed from waves and longshore currents reworking marine and fluvial sediments. The islands typically consist of quartz sediment, which represents reworked Pamlico Sand that migrated southward, and carbonate sediment originating from local calcite-producing plants and animals as well as from reworked carbonate materials from offshore Pleistocene formations (Duane and Meisburger 1969).

Future Without-Project Conditions (No-Action Alternative)

The geology of the FWOP Condition is expected to change in accordance with Existing Conditions.

2.3.3 Native Beach

Existing Conditions

Given the numerous beach nourishment projects constructed with offshore borrow material from Capron shoal since 1999, characterization of the native beach sediment must rely on available historic data as opposed to newly collected data, which would characterize the beach fill material rather than the native beach. Several investigations conducted by USACE have collected and analyzed samples from the beach south of Fort Pierce Inlet to characterize the native beach sediments. Additionally, Coastal Planning and Engineering, Inc. (CPE), on behalf of St. Lucie County, collected beach samples along a shoreperpendicular profile at FDEP reference monument R-36 within the project area during May 1991. These data show that the native Fort Pierce beach consisted of poorly sorted, fine to medium grained, olive colored (Munsell color 5Y 5/4) sand with nearly 50% carbonate. The Geotechnical Appendix provides more details.

Future Without-Project Conditions (No-Action Alternative)

The FWOP Conditions of the native beach are not expected to vary from the Existing Conditions.

2.3.4 Sand Sources

Existing Conditions

Numerous investigations have explored potential sand sources in state and federal waters offshore St. Lucie County over the past 50 years and identified sand sources that have supported the Fort Pierce SPP since 1971. Most recently, USACE (2014) quantified the sand needs for a 50-yr period and available sand sources to support planned beach nourishment projects in St. Lucie County as part of a broader study that also included Martin, Palm Beach, Broward, and Miami-Dade counties. While several potential offshore borrow areas exist offshore Fort Pierce and northern St. Lucie county in general, two nearby sources — Capron Shoal and Shoal A — provide a sufficient volume for the next 50-year authorization period. Capron Shoal, the currently permitted borrow area that has provided sand for the nourishment projects from 1999–2015, lies approximately 3 miles southeast of the project area. The permitted borrow area currently contains approximately 5,970,000 cy of beach quality sand; however, USACE (2014) evaluated a larger portion of the shoal and estimates an available volume of 12,000,000 cy. Shoal A, located approximately two miles northeast of the project area, contains approximately 15,000,000 cy of beach quality sand (USACE, 2014).
In general, the beach-quality material encountered within Caprol Shoal and Shoal A is similar to the native beach sand described above, though Capron Shoal has a slightly larger mean grain size than the native beach. The Geotechnical Appendix provides more details.

Future Without-Project Conditions (No-Action Alternative)

In the future, it is possible that the above sand sources could be mined for sand by another agency or for another project; however, no such plans presently exist.

2.3.5 Shoreline Change and Erosion Rates

Existing Conditions

An analysis of historical St. Lucie County shoreline positions provides information on regions of shoreline erosion and accretion. 1883–2002, represented by mean high water (MHW) shoreline positions provided by FDEP, is the longest period with data covering the entire Fort Pierce study area. This period includes the construction of the inlet and jetties, the construction of a 200 ft long spur jetty on the south side of the south jetty in 1997, three major beach fills (1971, 1980, 1999), and several smaller beach fills. The shoreline change trends include accretion north of the inlet and erosion to the south; on average, the shoreline advanced seaward 569 ft (4.8 ft per year) north of the inlet and receded landward -138 ft (-1.2 ft per year) south of the inlet. Of note, beach fill operations totaling approximately 2.34 million cy south of the inlet during this period helped stabilize the shoreline and reduce the measured erosion rate.

The initial restoration in 1971 and the first nine nourishments (in 1980, 1999, 2003/2004, 2005, 2007, 2009, 2012, 2013, and 2015) comprise approximately 90% of the total amount placed. Smaller placement operations, mainly from channel dredging, prevailed in the 1980s and 1990s with the last occurrence in spring 2014. Analysis of annual monitoring data indicates the 2005, 2007, 2009, and 2012 projects performed relatively consistently, based on MHW shoreline changes, in the first years post-construction. Following each project, severe erosion occurred adjacent to the south jetty (R-34 to R-36), and the erosion magnitude generally decreased southwards from the inlet. The average shoreline retreat in the project area ranged from -56 ft to -82 ft for these projects. The control area results indicate the shoreline has remained relatively stable on a year-to-year basis. With reference to the 2013 physical monitoring report (Trudnak and Greer, 2013), the control area shoreline from R-42 to R-46 has advanced seaward approximately 142 ft relative to 1999 baseline (pre-project) conditions due to longshore dispersion of the fill material from the project area. Thus, the large magnitude of shoreline advance occurred primarily following the 1999 project and the frequent subsequent nourishments have helped maintain the shoreline position.

The Engineering Appendix contains more shoreline erosion details.

Future Without-Project Conditions (No-Action Alternative)

If beach nourishment no longer occurred in the project area, the beach width is expected to rapidly narrow within the study area. Initial recession rates would likely resemble the recent shoreline changes discussed above. Recession rates are expected to be greatest at the north end initially; however, as the in-situ beach fill erodes from north to south, the high recession rates would progress southwards reflecting a lack of sediment supply from the north. As the sediment supply from the beach fill diminishes, the recession rates would likely decrease and approach the historic recession rates. The 1999 pre-construction survey from R-34 to R-46 represents a severely eroded beach that would be subject to continued background and storm-induced erosion in the FWOP scenario.
2.3.6 Winds

Existing Conditions

Local winds provide the primary mechanism for the short period waves predominantly experienced at Fort Pierce. Three primary mechanisms cause these winds. The first mechanism, predominant southeast trade winds during the summer months, occurs from Fort Pierce’s location within the sub-tropical climatic band. The second mechanism occurs more frequently during the winter months. Primarily between December and March, frontal weather patterns driven by cold Arctic air masses can reach South Florida; these fronts typically generate southwest winds that veer to the northwest before the frontal passage and to the northeast behind the front. This post-frontal "northeaster" behavior can produce severe weather conditions that cause severe beach erosion. The third mechanism, daily onshore-offshore breezes caused by differential heating of land and water masses are common, although not as intense as the winds mentioned above. These diurnal winds typically blow perpendicular to the shoreline and generally do not induce any appreciable sediment movement.

The Engineering Appendix provides additional detail on winds.

Future Without-Project Conditions (No-Action Alternative)

The FWOP Conditions of winds are comparable to the Existing Conditions.

2.3.7 Waves

Existing Conditions

Dissipation of energy as waves enter the nearshore zone and break provides the principal forcing mechanism for sediment transport that affects beach conditions. Wave height, period and direction, combined with the magnitude and phasing of the tidal hydrograph as well as storm surge, in some cases, are the primary factors that influence the shape of the project beach and dune system.

Local wind patterns primarily cause the waves experienced at Fort Pierce. The daily onshore-offshore breeze discussed above generates shore-perpendicular waves; although frequent, these waves are not large because of the short duration of the driving winds. The summer prevailing trade winds produce waves from the southeast, the primary driving force behind the northward littoral drift thought to occur during the summer months. Large waves produced by tropical disturbances, including hurricanes, and by fall/winter "northeasters" cause the most beach erosion at Fort Pierce.

The study area, exposed to the open ocean toward the north-northeast and east, is vulnerable to the above-mentioned frontal activity that can cause destructive northeasters, as well as to long-period swells from more distant northeast and east events. The proximity of the Bahama Banks (Little Bahama Bank and the Great Bahama Bank) to the South Florida coast mostly prevents large open-ocean waves from the southeast from impacting the shoreline. Land masses and the relatively shallow water depths, averaging approximately 30 ft, across the Bahama Banks block or significantly reduce due to bottom friction any southeast swells. However, the fetch (65-70 miles) between the western edge of the Bahama Banks and Fort Pierce allows ample distance for the generation of shorter-period wind waves in the deep waters of the Florida Straits. During severe storms such as hurricanes and tropical storms, high wind velocities can generate large, damaging waves over the relatively short distance between the Bahamas and Florida.

The Engineering Appendix provides additional detail on waves.
Future Without-Project Conditions (No-Action Alternative)

The FWOP Conditions of waves are comparable to the Existing Conditions.

2.3.8 Astronomical Tides

Existing Conditions

Astronomical tides, created by the gravitational pull of the moon and sun, at Fort Pierce are semidiurnal, meaning two high tides and two low tides occur per tidal day (24 hours 50 minutes). The National Oceanic and Atmospheric Administration (NOAA), which regularly publishes tide tables for selected locations along the coastlines of the United States and around the world, maintains a tide station (Station #8722212) at the Fort Pierce Inlet south jetty. The data from Station #8722212 indicates a relatively small mean tide range of 2.56 feet and a spring tide range of 3.59 feet occurs at the study area. The mean tide range represents the average difference between Mean High Water (MHW) and Mean Low Water (MLW) during an entire lunar cycle (27.3 days). The spring tide range represents the average difference between MHW and MLW during a tidal cycle when the moon is new or full range, which increases the tidal range.

The Engineering Appendix provides additional detail on winds.

Future Without-Project Conditions (No-Action Alternative)

The FWOP Conditions of tides are comparable to the Existing Conditions.

2.3.9 Currents

Existing Conditions

The Florida Gulf Stream represents the most significant ocean current that exists off the east coast of Florida. Except for intermittent local reversals, the Gulf Stream flows northward. The average annual current velocity equals approximately 28 miles per day, varying from an average monthly low of about 17 miles per day in November to an average monthly high of approximately 37 miles per day in July.

Longshore currents driven by the longshore energy flux of obliquely breaking waves provide the primary currents in the active beach zone at Fort Pierce. The magnitude of these currents relate to the approach wave angles and the magnitude of the waves. At Fort Pierce, the strongest waves generally approach from the north, and the net littoral drift is directed southwards.

Future Without-Project Conditions (No-Action Alternative)

The FWOP Conditions of currents are comparable to the Existing Conditions.

2.3.10 Storm Effects

Existing Conditions

Fort Pierce lies in a region of significant hurricane activity, resulting in potential for relatively frequent tropical system impacts during hurricane season. Most hurricanes and tropical storms traversing northward through the Atlantic within several hundred miles of the east coast are capable producing large swells that can reach the study area and cause significant erosion. However, with their longer duration and more frequent occurrence, northeasters during from fall – spring cause most of the erosion within the project.
area. The Fort Pierce coastline, exposed to the open ocean toward the northeast, is vulnerable to wave attack from distant storms as well.

Several named storms have significantly impacted the project area in recent years, the most severe of which occurred during the 2004 and 2005 hurricane seasons. In August 2004, Hurricane Charley impacted the study area, followed by hurricanes Frances, Jeanne, and Ivan and a strong northeaster in September 2004. Of these storms, hurricanes Frances and Jeanne were considered 100-year storm events and caused considerable erosion and overwash along the Florida coastline, particularly in St. Lucie County. Hurricanes Frances and Jeanne made landfall only three weeks apart and within 2 miles of each other. In 2005, hurricanes Dennis (July), Katrina (August), Ophelia (September), Rita (September), and Wilma (October) impacted the Fort Pierce area. Following a relatively quiet seven-year period, Hurricane Sandy caused considerable erosion in 2012. Most recently, Hurricane Matthew, followed by weeks of northeaster conditions as well as waves form Hurricane Nicole, severely eroded the Fort Pierce beach.

The Engineering Appendix discusses a historic storm analysis that identified from available records 35 tropical cyclones during the 120-year period from 1886 – 2005 and 57 extratropical storms during the 12-year period from 1994 – 2006.

Future Without-Project Conditions (No-Action Alternative)

The FWOP Conditions of storm effects are comparable to Existing Conditions.

2.3.11 Storm Surge

Existing Conditions

Storm surge equals the rise of the ocean surface above its astronomical tide level due to storm forces. The increased elevation relates to a variety of factors, including waves, wind shear stress, and atmospheric pressure. Consideration of storm surge is essential for a complete assessment of shoreline response and coastal storm risk, as an increase in water depth may increase the potential for coastal flooding and allow larger waves to attack the shore, increasing the potential for shoreline recession, beach erosion, and dune overtopping. The major threats to the shoreline of Fort Pierce include surge and waves caused by northeasters, tropical storms, and hurricanes. Historical information and theoretical models allow estimation and prediction of storm surge elevations for various storms. The Florida Division of Emergency Management has produced storm-surge maps for all of Florida’s coastal counties.

The Engineering Appendix provides additional detail on storm surge.

Future Without-Project Conditions (No-Action Alternative)

The FWOP Conditions of storm effects are comparable to Existing Conditions.

2.3.12 Sea Level Change

Existing Conditions

Future sea level rise in the project area could adversely affect shoreline behavior. Most recording stations around the world have indicated that the mean sea level (MSL) has steadily risen over the past century, and most scientists believe this trend will continue. To incorporate the direct and indirect physical effects of projected future sea level change on design, construction, operation, and maintenance of coastal projects, the U.S. Army Corps of Engineers (USACE) has provided guidance in the form of Engineering Regulation,
ER 1100-2-8162 and Engineering Technical Letter (ETL) 1100-2-1. The guidance requires three estimates: a Baseline (or “Low”) estimate, which is based on historic sea level rise and represents the minimum expected sea level change; an Intermediate estimate; and a High estimate representing the maximum expected sea level change.

The study area is located approximately 111 miles from the NOS gage #8723170 at Miami Beach, Florida, and approximately 122 miles from NOS gage #8721120 at Daytona Beach Shores, Florida. Due to the project area being situated roughly halfway between both gauges, a linear interpolation between the Miami (2.39 mm/yr) and Daytona (2.32 mm/yr) gages provides a reasonable estimate at Fort Pierce; the resulting historical sea level change rate equals 2.36 mm/yr for the project area. Given a project base year of 2021, a table of sea level change rates was produced for each of the three required scenarios through the 50-year planning horizon. Figure 2.1 plots the results.

The Engineering Appendix provides additional detail on sea level rise.

Future Without-Project Conditions (No-Action Alternative)

The estimated range of potential sea level rise for the project area equals 0.04 to 2.32 feet above the current level by 2070.

2.3.12.1 Shoreline Change Resulting from Sea level Rise

As relative sea level rises, the beach faces increased flooding and profile recession. Bruun (1962) proposed a formula to estimate the rate of shoreline recession based on the local rate of sea level rise. Bruun’s approach assumes the beach profile, in response to a rise in sea level, will attempt to reestablish the same bottom depths relative to the surface of the sea that existed before the sea level rise. As a result, the beach profile shape relative to the mean water level will also reestablish, meaning the existing beach profile will translate landward and upward. If the longshore littoral transport in and out of a given shoreline area match, then the quantity of material required to reestablish the nearshore slope must come from erosion of the shore. Of note, Bruun’s procedure does not account for short-term profile adjustments in response to changes in water level; therefore, this procedure only applies to long term (equilibrium) estimates of shoreline change. Figure 2.2 plots estimates of shoreline recession for the low, intermediate, and high sea level rise scenarios.

The Engineering Appendix provides additional detail on shoreline change resulting from sea level rise.

2.3.12.2 Volume Change Resulting from Sea Level Rise

Engineering Manual (EM) 1110-2-3301 (USACE 1995) provides guidance on calculating beach volume based on berm height, depth of closure, and translation of the shoreline. Figure 2.3 plots estimates beach volume loss for the low, intermediate, and high sea level rise scenarios.
Figure 2.1 Relative Sea Level Change
Figure 2.2 Projected Shoreline Recession from Sea Level Rise

Figure 2.3 Projected Volume Loss from Sea Level Rise
2.3.13 Effects of Other Coastal Storm Risk Management (CSRM) and Navigation Projects

Existing Conditions

Other CSRM Projects

Besides the Fort Pierce SPP, no other Federal large-scale beach nourishment projects have been constructed along the study area, nearby north of the inlet, or immediately south of the study area. However, USACE has placed beach quality dredged materials from the Fort Pierce Harbor Maintenance Dredging Project within the study area on a couple of occasions from 1973-2014 (Section 1.6.2). Additionally, St. Lucie County has conducted several small-scale emergency truck-haul projects in the project area, the largest of which placed approximately 62,000 cy of sand along a 1,500-ft stretch of shoreline immediately south of the inlet in 2013 when federal funds were unavailable for a scheduled SPP nourishment.

The Engineering Appendix provides additional details on the above projects.

Other Navigation Projects

As discussed in Section 1.6.2, the Fort Pierce Federal Navigation Project maintains the authorized navigable depths of Fort Pierce Inlet, which lies at the northern end of the SPP. Small-scale dredging projects occurred frequently during the 1970s-1990s. However, lack of federal funding for maintenance of shallow draft harbors has prohibited projects since 1997, except for the 2014 project which USACE conducted with post-Hurricane Sandy emergency recovery funds.

Future Without-Project Conditions (No-Action Alternative)

The FWOP Conditions of other CSRM and navigation projects are comparable to the existing conditions described above.

2.4 Built Environment

2.4.1 Hurricane Evacuation Routes and Zones

Existing Conditions

National Scenic Highway, Florida State Road A1A (SR A1A) is the only evacuation route and a major north-south thoroughfare for the region. Within the project area, this highway is a major evacuation route, but is set back from the shoreline to avoid damages in most instances.

Future Without-Project Conditions (No-Action Alternative)

In the FWOP condition, the Florida Department of Transportation (FDOT) would continue to operate and maintain SR A1A.

2.4.2 Public Access and Parking

Existing Conditions

Federal participation in CSRM projects involving placement of sand is limited to shorelines open to public use. As described in Engineering Regulation (ER) 1105-2-100 and ER 1165-2-130, cost sharing for any recommended plan is based on shoreline ownership, use, and the availability of public access. USACE
policy in ER-1105-2-100 states: “Lack of sufficient parking facilities for the general public (including nonresident users) located reasonably near and accessible to the project beaches may constitute a restriction on public access and use, thereby precluding eligibility for Corps participation…Generally, parking on free or reasonable terms should be available within a reasonable walking distance of the beach…Reasonable access is access approximately every one-half mile or less.”

The project area contains four shorefront public parking areas—including Jetty Park (near R-34), Porpoise Beach Access (near R-36), South Beach Park (R-38), and Kimberly Bergalis Memorial Park (R-40)—none of which are separated by more than one-half mile. Chapter 3, Plan Formulation and the Recommended Plan, provides additional information.

Future Without-Project Conditions (No-Action Alternative)

In the FWOP condition, existing parking will be sufficient for public recreational use of the beach.

### 2.5 Economic Environment

**Existing Conditions**

Data regarding existing economic conditions with the project area were collected for economic modeling purposes. St. Lucie County mapping resources, site visits, contractors, and USACE (2014) provided the coastal assets information discussed below. The planning process for the Fort Pierce Shore Protection Project (SPP) estimated storm damage reduction and prevention of land loss benefits using Beach-fx, an economic planning model developed by USACE.

#### 2.5.1 Damage Effects – Structures and Contents Value

Beach-fx employs an event-driven life-cycle Monte Carlo simulation approach to model beach response over time as storms, natural recovery, and management methods alter the beach profile. The model estimates damage and costs based on probabilistic seasonal storm generation, beach profile response to storms, shoreline changes due to long-term background erosion, effects of beach management activities (e.g., emergency and planned beach nourishments), and other factors. The model requires identifying damage elements (DE), or anything of value that can incur damage (e.g., buildings, infrastructure, pools, patios), to determine structural damage resulting from inundation (flooding), erosion, and wave attack on a lot-by-lot basis.

Beach-fx handles economic considerations at the DE level. These considerations include extent of damage, cost to rebuild, and time to rebuild. The study area contains 19 DE types and 374 total damage elements. USACE Real Estate professionals provided updated depreciated replacement costs for all of the damage elements in July 2014; an uncertainty of +/- 15% was assigned to these costs. The value of structure contents was assumed equal to 50% of the structure value for all habitable structures per ER 1105-2-100; non-habitable structures (e.g., pools, dune walkovers, park facilities) were assigned zero contents value. The damage elements included:

- 101 multi-family residential buildings (includes 4 DE types)
- 54 single-family residential buildings (includes 3 DE types)
- 9 commercial and public buildings
- 12 cabanas, restrooms, poolhouses
- 24 pools, spas, and hot tubs
- 36 sheds with roof and walls
• 27 pavilions with roof and no walls
• 3 isolated elements with no roof or walls
• 37 parking lots
• 41 roads (includes 2 DE types)
• 14 paved/structured recreational outdoor spaces
• 2 tennis courts
• 14 public beach access walkovers

2.5.2 Structure Inventory

The economic value of the existing structure inventory within the study area represents the depreciated replacement costs of damageable structures (i.e., damage elements) and their associated contents along the coastline. The damage element inventory includes 374 damageable structures with an overall estimated value of $119.2M, with structure and content valuations of $84.9M and $34.3M. Table 2.2 summarizes the overall distribution of value by reach. Of note, the above values include only the first two floors of multi-story deep pile foundation buildings.

Table 2.2 Distribution of Structures & Structure Value by Study Reach

<table>
<thead>
<tr>
<th>Reach</th>
<th>Structure Value ($)</th>
<th>Content Value ($)</th>
<th>Total Structure Value (%)*</th>
<th>Number of Damage Elements</th>
<th>Percent of Damage Elements (%)*</th>
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</thead>
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<tr>
<td>Reach 1</td>
<td>$1,936,410.00</td>
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<td>8.0%</td>
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<tr>
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<td>$2,218,295.00</td>
<td>6.6%</td>
<td>24</td>
<td>6.4%</td>
</tr>
<tr>
<td>Reach 4</td>
<td>$33,327,539.00</td>
<td>$14,394,451.34</td>
<td>39.2%</td>
<td>135</td>
<td>36.1%</td>
</tr>
<tr>
<td>Reach 5</td>
<td>$36,674,991.00</td>
<td>$13,511,988.20</td>
<td>43.2%</td>
<td>161</td>
<td>43.0%</td>
</tr>
<tr>
<td>Total</td>
<td>$84,919,761.00</td>
<td>$34,266,819.88</td>
<td>100.0%</td>
<td>374</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

*Percentage totals may not add up to 100% due to rounding

Future Without-Project Conditions (No-Action Alternative)

2.5.3 Beach-fx Model Setup

The Economic Appendix provides a complete description of the Beach-fx model set up. Model input includes information describing meteorologic, coastal morphology, economic, and management measures data and processes. The model estimates future damages resulting from background erosion and storm impacts. The FWOP damages represent the base condition against which potential project alternatives are compared. The difference between with- and without-project damages indicates the storm damage reduction benefits.

2.5.4 Beach-fx Model Assumptions

• **Start Year:** The year in which the simulation begins is 2020.
• **Base Year:** The year in which the benefits of a constructed federal project would be expected to begin accruing is 2021.
• **Period of Analysis:** 50 years (2021-2070)
• **Discount Rate:** 2.875% FY2017 Federal Water Resources Discount Rate

• **Damage Functions:** For the vast majority of structures within this study the damage functions used were those developed by the Institute for Water Resources (IWR), within the Coastal Storm Damage Workshop (CSDW), Coastal Storm Damage Relationships Based on Expert Opinion Elicitation in 2002. However, the various high-rise buildings located within the project area proved to be the exception since the IWR wave damage function did not adequately address these structures. Empirical evidence on the performance of high-rise structures during major hurricanes was used for the analysis for high-rise structures.

• **Coastal Armor:**
  - No properties in the project area currently contain coastal armor.
  - For all lots in the study area, state permit requirements for the coastal construction control line (CCCL) for armor construction determine if a lot is able to be protected by armor, or not, once erosion reaches the seaward edge of the lot. In St. Lucie County, due to the restrictions of the CCCL, it was assumed that no local armoring would occur.

• **Number of Times Rebuilding Allowed:** The term “rebuilding” for Beach-fx modeling purposes refers to repairing part of a structure as opposed to rebuilding the entire structure. In Florida, rebuilding on lots meeting a minimal setback restriction is common practice following storms. Accordingly, the number of rebuilds within the model was set to 99 times to place limited restriction on rebuilding.
  - Beach-fx condemns a lot when the seaward toe of the dune erodes back as far as the centroid of the lot; condemned properties cannot be rebuilt.

• **Vacant Lots:** Existing vacant lots will remain vacant up to the base year and throughout the project life.

• **Future value of structures:** The future structure inventory and values are the same as the existing condition. This conservative approach neglects any increase in value due to future development. Due to the uncertainty involved in projections of future development, using the existing inventory is considered conservative for Florida where coastal development has historically increased in density and value.

2.5.5 **Beach-fx Future Without Project Damage Results**

• **Structure Damage:** Economic losses resulting from the structures situated along the coastline being exposed to wave attack, inundation, and erosion damages. Structure damages account for approximately 70% of the damages for the future without-project (FWOP) damages.

• **Contents Damage:** The material items housed within the aforementioned structures (usually air conditioned and enclosed) that are potentially subject to damage. Content damages are approximately 30% of the total damages.

2.5.5.1 **Spatial Distribution of Without-Project Damages**

FWOP damages in Reach 1–3 are greater than each reach’s proportional length of the project area. Conversely, FWOP damages in Reaches 4–5 are lower than each reach’s proportional length. These results reflect the high background erosion rates and eroded beach conditions in the north end of the project, which makes upland properties more vulnerable to storm damage. Reaches 4–5 are characterized by a wider berm and much lower background erosion rates.
2.5.5.2 FWOP Damages in Alternative Sea Level Rise (SLR) Scenarios

The FWOP condition was modeled for three Sea Level Rise (SLR) scenarios. Evaluating sea-level rise (SLR) is a vital component in the planning process. To ensure alternatives are selected based on risk-informed analysis, the FWOP condition was evaluated based on the three sea level rise scenarios discussed in Section 2.3.12. The baseline, intermediate, and high levels equal 0.0077 ft/yr, 0.0176 ft/yr, and 0.0464 ft/yr at Fort Pierce. Beach-fx model results indicated a difference of less than 1% under the intermediate and high sea level rise scenarios.
3.0 PLAN FORMULATION BACKGROUND AND OBJECTIVES

3.1 Plan Formulation Rationale

The "Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies" (The Principles and Guidelines, or P&G) are the principal guidelines for planning by Federal agencies involved in water resource development. Plan formulation involves developing and evaluating alternative plans to address a given problem. Four accounts are established to simplify evaluation and display of effects of alternative plans. These four accounts encompass all significant effects of a plan on the human environment as required by the National Environmental Policy Act of 1969 (NEPA). They also encompass social well-being as required by Section 122 of the 1970 Flood Control Act. The national economic development account is included, since it is the primary Federal objective. Other information that is required by law or that will have a material bearing on the decision-making process is included in the other accounts listed below:

a. National Economic Development (NED). This account displays changes in the economic value of the national output of foods and services.
b. Environmental Quality (EQ). This account displays non-monetary effects on significant natural and cultural resources.
c. Regional Economic Development (RED). This account registers changes in the distribution of regional economic activity that result from project construction. Evaluations of regional effects are to be carried out using nationally consistent projections of income, employment, output, and population.
d. Other Social Effects (OSE). This account registers project effects from perspectives that are relevant to the planning process, but are not reflected in the other three accounts.

A plan that reasonably maximizes net NED benefits, consistent with the Federal objective, is the goal of the Federal plan formulation and analysis process. This plan will be identified as the NED plan. The NED plan must also meet the test of four additional criteria:

a. Completeness. The extent to which a given modification of the authorized project provides and accounts for all necessary investments or other actions to ensure the realization of storm damage reduction.
b. Effectiveness. The extent to which a given modification of the authorized project contributes to a solution to the shoreline erosion and storm damage problems and achieves protection from storm damages.
c. Efficiency. The extent to which a given modification of the authorized project is the most cost effective means of providing storm damage protection, consistent with protecting the Nation's environment.
d. Acceptability. The viability of a given modification to the authorized project and it's acceptance by the non-Federal project sponsor, state entities and the public, and compatibility with existing laws, regulations, and public policies.

3.2 Problems and Opportunities

3.2.1 Problems

Both long-term recession and storm-induced damages threaten upland development at Fort Pierce. Shoreline recession has rendered upland development at Fort Pierce increasingly vulnerable to damages from tropical and extra-tropical storms. Sea level rise, various coastal storms, and inlet effects have exacerbated the erosion pressures in the project area. Following the construction of the Fort Pierce Inlet in
1930, the shoreline south of the inlet began to experience considerably increased erosion and shoreline recession, while the shoreline north of the inlet experienced increased accretion. Therefore, to some extent, the erosion is attributable to construction of the jetties and navigation channel at Fort Pierce Inlet. Furthermore, this “erosive” beach profile configuration allows larger and larger waves to erode the shoreline as the profile steepens. This erosion makes upland properties, structures, and infrastructure susceptible to storm damage and results in loss of natural habitat and recreational opportunities.

3.2.2 Opportunities

Formulation and implementation of appropriate shore protection measures, including structural and/or non-structural management measures, could mitigate for the erosive mechanisms as well as result in a net benefit to the national economy. Appropriate management measures could result in storm damage reduction, restoration of habitat, and preservation of existing recreation opportunities and tourism levels, benefiting local, state, and federal stakeholders.

3.3 Constraints

3.3.1 Planning Constraints

Constraints are specific restrictions on the planning process, designed to avoid undesirable changes between without and with project future conditions. The planning constraints for this study include: (1) avoid conflict with Federal regulations, as stated in Federal law, USACE regulations and Executive Orders, specifically the Coastal Barrier Resource Act (CBRA), Clean Water Act and Coastal Zone Management Act; (2) avoid and/or minimize impacts to marine hardbottom resources over a 50-year planning horizon (2021-2070); and. (3) avoid impacts to sea turtle nesting habitat including the placement of fill during construction and/or nourishment during nesting season over a 50-year planning horizon (2020-2070).

3.3.2 Local Constraints

Local and state laws, such as Florida State statutes, are not a constraint to NED formulation. However, they may be considered in the selection of a Locally Preferred Plan (LPP).

3.4 Objectives

3.4.1 Federal Objective

The Federal objective, as stated in the P&G, is to contribute to national economic development (NED) consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements. In other words, economic benefits to the Nation must exceed project costs, without unnecessary sacrifice of environmental resources. The Federal objective is to maximize net benefits to the nation, and as such, it does not seek to identify specific targets within objectives. Although each project and project setting presents unique problems and opportunities, the USACE applies a consistent set of decision criteria to participation in project planning and construction. There are three basic criteria:

(1) That there be an economically justified and environmentally acceptable project. Widespread use of benefit-cost analysis as a test of a project's economic worth is generally considered to have grown out of the Flood Control Act of 1936. In this Act, Congress required that the USACE recommend a project only "if the benefits to whomsoever they may accrue are in excess of the estimated costs and if the lives and social security of people are otherwise adversely affected." If there is an economically justified project, decisions on whether and to
what extent there should be Federal participation are guided by a concept of the Federal interest that has evolved from legislation, from precedent in project authorization and construction, and from Administration budget priorities.

(2) Federal participation must be otherwise warranted. Federal participation is limited in circumstances where there are special and local benefits that accrue to a limited number of identifiable beneficiaries. The Federal government does not participate in facilities, which produce outputs incidental to basic project purposes.

(3) The project must meet current Administration budget priorities. The Administration does not budget for a project unless a significant proportion of the project outputs have a high budget priority.

3.4.1.1 Planning Objectives

Planning objectives reflect the problems and opportunities in the study area and, thus, are more specific than the Federal and non-federal objectives. The following study objectives have been developed based on the study area problems, opportunities, goals, and Federal and state objectives and regulations.

- Objective 1: Maintain the functionality of the currently authorized SPP, but increase the nourishment interval from two years to a minimum of four years by implementing shore stabilization structures. Inherent in this objective is the continuation of the current SPP objectives, which include:
  - Reduce storm damages to property and infrastructure within the project area over a 50-year planning horizon (2021 – 2070).
  - Maintain environmental quality in the project area and adjacent areas, including sea turtle and nearshore hardbottom habitat and aesthetics, over a 50-year planning horizon (2021 – 2070).
- Objective 3: Maintain recreational use of beach and nearshore areas in the project area including beach going, surfing, fishing, and wildlife viewing over a 50-year planning horizon (2021 – 2070).

3.4.1.2 Federal Environmental Objectives

The USACE complies with all environmental laws and executive orders. The USACE considers carefully and seeks to balance the environmental and development needs of the Nation in full compliance with NEPA and other authorities provided by Congress and the Executive Branch. Alternative means of meeting competing demands generated by human water resource needs are examined and their environmental values examined fully, along with the economic, engineering and social factors.

Public participation is encouraged early in the planning process to define environmental problems and elicit public expression of needs and expectations. Contact of municipal, county, state and other Federal agencies occurs early for their views and provided timely information before making recommendations. Significant environmental resources and values that would likely be affected, favorably as well as adversely, by alternatives being considered are identified early in the planning process. All plans are formulated to avoid to the fullest extent practicable any adverse impact on significant resources.

Unavoidable significant adverse impacts are mitigated as required by Section 906(d) of the Water Resources Development Act of 1986. Section 906(d) requires the Secretary of the Army to include in reports submitted to Congress for authorization of construction a specific plan to mitigate fish and wildlife losses or a determination that the project will have a negligible effect on fish and wildlife. The NEPA document in this report describes the environmental impacts of the plan recommended herein and summarizes compliance with the Federal statutes and regulations.
Participation in shore protection projects is limited to beach restoration and protection, not beach creation or improvement unless such improvement is needed for engineering purposes. The term "restoration" was substituted for "improvement" in the amendment of July 28, 1956 (P.L. 826, 84th Congress, 70 Stat. 702) so that the basis for Federal concern became "restoration and protection" as opposed to creation of new lands (House Report No. 2544 and Senate Report No. 2691, 84th Congress). Accordingly, Federal participation in restoration is limited to the historic shoreline. It does not provide for Federal cost sharing in extending a beach beyond its historic shoreline unless required for protection of upland areas.

In addition, the Federal cost share is reduced proportionately to the extent that a project protects private shores from beach erosion and land loss. Section 103(d) of the 1986 Water Resources Development Act specifically prohibits Federal participation in project costs assigned to benefits to privately owned shores, where use of such shores is limited to private interests, or to prevention of losses of private lands.

### 3.4.1.3 Federal Project Purposes

Authorization of shore protection projects has occurred for a variety of purposes: beach erosion control, shore/shoreline protection, hurricane/hurricane wave protection and storm protection. The WRDA of 1986 now assigns costs of Federal projects to appropriate project purposes. Projects that provide shore protection receive a 65% Federal share. Project reaches that provide for recreation receive a 50% Federal share. Projects that provide for separable recreation are not Federally cost shared. The costs for construction projects or measures for beach erosion control and water quality enhancement are assigned to either shore protection, or recreation. The Federal government does not participate in any work relating to recreation facilities at shore protection projects. Current Department of Army policy does not view recreation as a high priority output or primary project output. This policy precludes Federal funds to support construction of shore or hurricane protection projects which depend on separable recreation benefits for economic justification, or for which incidental recreation benefits are greater than 50% of the total benefits unless the project is economically justified based on primary outputs alone, or based on the combination of primary benefits and an equivalent amount of incidental recreation benefits.

### 3.4.1.4 Additional Federal Guidelines

Sections above describe the general Federal objectives dealing primarily with broad planning guidelines. Other general study objectives assure that any new project recommended for construction, or proposed modifications to existing shore protection projects are formulated to:

a. meet the specific needs and concerns of the general public within the project area;
b. be part of or developed in conjunction with a "systems approach." Alternative plans that consider a broad range of possible impacts including impacts that occur on larger scale, were developed. The “systems approach” allows optimization of the combined effectiveness and economic efficiency of the shore protection, navigation maintenance and dredged material disposal programs;
c. respond to expressed public desires and preferences;
d. be flexible to accommodate changing economic, social, and environmental patterns and changing technologies;
e. integrate with and be complementary to other related programs in the study area, and;
f. be implementable with respect to financial and institutional capabilities and public consensus.

### 3.4.1.5 Mitigation of Shore Damage Due to Federal Navigation Projects

Mitigation for the impacts of Federal Navigation Projects on adjacent shorelines is addressed by Section 101(c) of the WRDA of 1986 and Section 111, River and Harbor Act of 1968 as amended by Section 940
of the WRDA of 1986, and Section 214 of the WRDA of 1999. WRDA 1986 section 101(c) states that "Costs of constructing projects or measures for the prevention or mitigation of erosion or shoaling damages attributed to Federal navigation works shall be shared in the same proportion as the cost sharing provisions applicable to the project causing such shoaling or erosion. The non-Federal interests for the project causing the erosion or shoaling shall agree to operate and maintain such measures."

3.4.2 State of Florida’s Planning Objectives

3.4.2.1 Coastal Management Program

Florida’s Coastal Management Program was established under the Coastal Management Act of 1978 (Chapter 380.20, Florida Statutes) and approved by the Federal Coastal Zone Management office in 1981 (Pilkey et al., 1984). Florida does not regulate its coastal zone through one comprehensive law, but rather through 28 state statutes (http://www.leg.state.fl.us/statutes/). The Florida Department of Community Affairs is the lead state agency for the implementation of the Federal coastal zone management act.

3.4.2.2 Beach and Shore Preservation

The Beach and Shore Preservation Act (Chapter 161, Florida Statutes) is Florida’s primary statute for developing and implementing the state’s strategic beach management plan, regulating coastal construction seaward of the mean high water, and regulating activities seaward of the coastal construction control lines. The act, which is administered by the Florida Department of Environmental Protection (FDEP) Bureau of Beaches and Coastal Systems (BBCS) was first passed in 1965 and has since been significantly amended.

3.4.2.3 Coastal Construction Control Lines

In the Beach and Shore Protection Act, the legislature asserted that Florida’s beaches and coastal barrier dunes are among the state’s most valuable natural resources and that these resources should be protected from “imprudent construction which can jeopardize the stability of the beach-dune system, accelerate erosion, provide inadequate protection to upland structures, endanger adjacent properties or interfere with public beach access” (Section 161.053, Florida Statutes). To ensure that such “imprudent construction” does not take place, the statute charges the FDEP to define and establish Coastal Construction Control Lines (CCCL). These lines define the landward limit of the active beach-dune system and vary from a few to several hundred feet inland of mean high water. The specific location of the line is a function of the predicted storm surge and erosion resulting from a 100-year storm. The FDEP has established control lines on a county-by-county basis for Florida’s 24 sandy beach counties (Section 161.053, Florida Statutes). Nine of Florida’s 33 coastal counties are not considered predominantly sandy beach counties and do not, therefore, have CCCL’s. The non-sand beach counties, stretching from Wakulla to Pasco County, located on the Big Bend, and Monroe County in southern Florida (Balsillie 1988), are regulated pursuant to Section 161.052, Florida Statutes.

Florida is one of the first states to develop a coastal construction control line program. This program was initiated through legislative action in 1970. The primary goal of this program was the control of coastal construction to curtail impactive and imprudent development. Included in this effort was the establishment of a coastal monument program for survey and documentation purposes. Control monuments established approximately every 1,000 ft along the coastal shoreline of all beach front areas are generally located on the shoreward side of existing dune lines away from normal shoreline erosion forces. These monuments serve as the starting reference for beach survey purposes. Massive primary monuments are located further landward and serve as primary monuments for all controlled survey work. All monuments are tied to the State Plane coordinate system.
Using numerical modeling storm programs and engineering expertise, including historical shoreline studies and recent survey data, the State has established coastal construction control lines that reflect the determined 100-year storm impact location along each stretch of beachfront property. Acceptance of this line goes through an elaborate review process that culminates in a regulatory line for construction purposes.

The CCCL defines the FDEP’s jurisdictional area of construction for regulation of construction activities. Prior to building or excavating seaward of the control line, a permit must be obtained from the FDEP. The primary purposes of this permitting program are to 1) ensure that construction seaward of the control line is designed and sited to protect beaches and dunes from adverse impacts, 2) ensure that construction seaward of the line does not result in accelerated erosion on adjacent land, and 3) ensure that habitable structures seaward of the line are designed to withstand the forces associated with a 100-year return interval storm. The storm damage modeling in Appendix E applies damage functions that consider the CCCL program requirements.

Before granting a construction permit, the FDEP must consider shoreline stability and the impact of storm tides, design features of the proposed structures or activities and potential impacts of the building or activities, including cumulative effects, on the beach-dune system. The department may grant a coastal construction control line permit in areas where a "reasonably continuous" line of existing construction located seaward of the control line is not "unduly threatened by erosion" (Section 161.053, Florida Statutes).

The Beach and Shore Preservation Act also regulate construction of shore protection devices below mean high water (Section 161.041, Florida Statutes). Prior to building such a structure, the FDEP must issue a coastal construction permit. A coastal construction permit is necessary for any coastal construction or reconstruction or change to existing structures, or any construction or physical activity undertaken specifically for shore protection purposes.

Florida's Administrative Code (Chapter 62B-33) standards and regulations for construction seaward of the control line include provision which specify that all habitable structures must be pile-supported, and elevated above the projected 100-year storm surge. All structures shall be designed in accordance with the applicable wind standards contained in Chapter 16 of the Florida Building Code. The code also requires that existing beach topography must be protected, the maximum effort must be made to protect all native stabilizing vegetation, structures must be located as far landward as possible and all construction must be designed to minimize erosive effects.

Before setting control lines, the FDEP must hold a public hearing in the affected county. Consideration of the results of the hearing must occur prior to determining the location of the control line (Section 161.053, Florida Statutes). Once the department has established CCCL's, public records document their location (Section 161.053, Florida Statutes).

To determine the appropriate location of a control line, the state considers long- and short-term erosion rates, existing upland development, and expected impacts of a 100-year storm. The state contracts with the Florida State University Beaches and Shores Resource Center to assess the impacts of predicted hurricane storm tides. The center uses the storm tide model developed by Dr. Robert Dean to predict water levels, wave heights, and dune and bluff erosion accompanying a 100-year storm event (Balsillie, 1988).

For each control line study, stereoscopic aerial photographs are taken. These are then reproduced to provide detailed maps with a 1:100 scale (Balsillie, 1988). Comparing these maps to historical maps, beach profile surveys, and photographs determines long-term erosion rates. For a typical county, five to six surveys, dating from the mid-1800s to the present, are used to compute erosion rates (National Research Council 1990).
To measure shoreline change over relatively short time periods, the state has established over 3,400 concrete monuments at 1,000-ft intervals along the coastline (National Research Council, 1990). These monuments are in turn referenced to a system of larger monuments that are located farther inland. As part of the state's ongoing CCCL delineation and monitoring program, beach profiles are periodically measured from the control line monuments. In addition, the state also conducts post-storm surveys that provide Florida with a comprehensive pre-and post-storm database (Balsillie 1988).

3.4.2.4 Erosion Setbacks

The 1985 State Comprehensive Growth Management Act (Chapter 85-55, Laws of Florida) amended the Beach and Shore Preservation Act to include a construction setback provision for all sandy beach counties. The amendment prohibits the FDEP from granting most coastal construction permits on land that will be seaward of the seasonal high water line within 30 years (Section 161.053, Florida Statutes). The 30-year erosion projection cannot, however, extend landward of an established CCCL (Section 161.053, Florida Statutes).

The FDEP can grant coastal construction permits for shore protection structures, piers, and minor structures seaward of the 30-year erosion projection. The FDEP will permit construction of a single-family residence seaward of the line only if the parcel was platted prior to adoption of the amendment, the landowner does not own another parcel adjacent to and landward of the parcel proposed for development and the structure is located landward of the frontal dune and as far landward as practicable (Section 161.053, Florida Statutes). In addition, repairs or reconstruction of a building cannot "expand the capacity of the original structure seaward of the 30-year erosion projection" (Section 161.053, Florida Statutes). The department can, however, issue a permit for landward relocation of a damaged or existing structure if the relocation will not damage the beach-dune system (Section 161.053, Florida Statutes).

The FDEP uses long-term erosion rates to delineate the location of the 30-year erosion projection. FDEP must also consider the presence of shore protection structures and beach renourishment projects in determining the appropriate location of the erosion projection (Section 161.053, Florida Statutes).

3.4.2.5 Coastal Building Zone

The 1985 Growth Management Act further amended the Beach and Shore Preservation Act to establish a coastal building zone extending landward of coastal construction control lines. Within the coastal building zone, strict building codes ensure that all major structures are designed and constructed to withstand the forces of and erosion caused by a 100-year storm event (Florida Atlantic University 1986).

For mainland beaches, barrier spits, and peninsulas lying within Florida's sandy beach counties, the coastal building zone extends from the seasonal high water line to 1,500 ft landward of the coastal construction control line. On barrier islands, the entire island or the area from the seasonal high water line to a maximum of 5,000 ft inland from the control line is included in the building zone (Section 161.54, Florida Statutes). All land areas within the Florida Keys, regardless of island size, also lie within the coastal building zone (Florida Atlantic University 1986). In counties that lack CCCLs, the coastal building zone is equivalent to the National Flood Insurance Program's V-zone. (The Federal Emergency Management Agency (FEMA) defines the V zone, which is a coastal high hazard area, as a special flood hazard area that extends from offshore to the inland limit of a primary frontal dune or any area subject to high velocity wave action from storms or seismic sources associated with a 1% change of occurrence).

Within the coastal building zone, major structures must conform to the state minimum building code, be designed to withstand all anticipated loads resulting from a 100-year storm, and be constructed and located in compliance with NFIP regulations (Section 161.55, Florida Statutes). The statute defines major structures
to include houses, mobile homes, commercial and public buildings, and all other construction that has the potential to substantially affect the coastal zone (Section 161.54, Florida Statutes). Minor structures, such as dune walkways, tennis courts, and gazebos, need not meet these standards, but must be designed to "produce the minimum adverse impact on the beach and the dune system" (Sections 161.54 and 161.55, Florida Statutes).

3.4.2.6 Erosion Control Program

In 1986, the Florida legislature amended the Beach and Shore Preservation Act to address the statewide problem of beach erosion through a "state-initiated program of beach restoration and beach renourishment" (Section 161.101, Florida Statutes). The legislature declared that "beach erosion is a serious menace to the economy and general welfare of the people of this state and has advanced to emergency proportions" (Section 161.088, Florida Statutes). Correspondingly, the legislature concluded that state management was necessary to ensure proper management and protection of Florida's beaches (Section 161.088, Florida Statutes). Although the state had funded and participated in coastal erosion control projects since 1965, most of these projects were locally initiated and were not part of a comprehensive state plan (Florida Atlantic University, 1986).

The statute directs the FDEP to develop and maintain a comprehensive long-term management plan for restoration of Florida's critically eroding beaches (Section 161.101, Florida Statutes). The plan must: 1) ensure the geographic coordination and sequencing of prioritized projects, 2) reduce equipment mobilization and demobilization costs, 3) maximize the quantity of beach-quality sand into the system, 4) extend the life of beach nourishment projects and reduce the frequency of renourishment, and 5) promote inlet sand bypassing to replicate the natural flow of sand interrupted by inlets and ports (Section 161.091, Florida Statutes). The plan, known as the Strategic Beach Management Plan, is updated annually to address changing conditions in the coastal system.

State funds for erosion control projects are available from Florida's Erosion Control Trust Fund (Section 161.091, Florida Statutes). The fund provides money for erosion control; hurricane protection; and beach preservation, restoration, and nourishment projects (Section 161.091, Florida Statutes). The state can pay up to 50% of the actual cost of restoring a critically eroding beach, while the local government in which the project occurs must provide the balance of the funds (Section 161.101, Florida Statutes). The level of state funding is directly related to the amount of public beach access and parking located within the project area.

For a project to be eligible to receive state funding, it must be located in an area designated by the FDEP as critically eroded, and identified in the Strategic Beach Management Plan. In addition, the proposed project must be: 1) designed to protect, preserve, maintain, or enhance the coastal system; 2) cost effective, with tangible benefits, which exceeds costs; 3) designed to provide a net positive enhancement to the environment and protect historically established habitat; and 4) consistent with local comprehensive plans and Chapters 161, 253, 258, and Part IV of Chapter 373, Florida Statutes.

3.4.2.7 Erosion Control Line

Property rights of State and private upland owners in beach restoration project areas are set forth in Florida Statute 161.141. The statute proclaims that the Legislature hereby declares that it is the public policy of the state to cause to be fixed and determined, pursuant to beach restoration, beach renourishment, and erosion control projects, the boundary line between sovereignty lands of the state bordering on the Atlantic Ocean, the Gulf of Mexico, or the Straits of Florida, and the bays, lagoons, and other tidal reaches thereof, and the upland properties adjacent thereto; except that such boundary line shall not be fixed for beach restoration projects that result from inlet or navigation channel maintenance dredging projects unless such projects involve the construction of authorized beach restoration projects. However, prior to construction of such a
beach restoration project, the board of trustees shall establish the line of mean high water for the area to be restored; and any additions to the upland property landward of the established line of mean high water which result from the restoration project shall remain the property of the upland owner subject to all governmental regulations and shall not be used to justify increased density or the relocation of the coastal construction control line as may be in effect for such upland property. Such resulting additions to upland property shall also be subject to a public easement for traditional uses of the sandy beach consistent with uses, which would have been allowed prior to the need for such restoration project. It is further declared that there is no intention on the part of the state to extend its claims to lands not already held by it or to deprive any upland or submerged landowner of the legitimate and constitutional use and enjoyment of his property. If an authorized beach restoration, beach renourishment, and erosion control project cannot reasonably be accomplished without the taking of private property, then such taking shall be made by the requesting authority by eminent domain proceedings.

3.4.2.8 Inlet Management

In order to manage the erosion of adjacent beaches as a result of improved navigational inlets, the Florida Legislature passed the Declaration of public policy relating to improved navigation inlets (Section 161.142, Florida Statutes). In this statute, the Legislature recognized the need for maintaining navigation inlets to promote commercial and recreational uses of coastal waters and their resources. The Legislature further recognized that inlets alter the natural drift of beach-quality sand resources, which often results in these sand resources being deposited around shallow outer-bar areas instead of providing natural nourishment to the downdrift beaches. Therefore:

a. All construction and maintenance dredgings of beach-quality sand should be placed on the downdrift beaches; or, if placed elsewhere, an equivalent quality and quantity of sand from an alternate location should be placed on the downdrift beaches.

b. On an average annual basis, a quantity of sand should be placed on the downdrift beaches equal to the natural net annual longshore sediment transport.

c. Construction waterward of the coastal construction control line on downdrift coastal areas, on islands substantially created by the deposit of spoil, located within 1 mile of the centerline of navigation channels or inlets, providing access to ports listed in Section 403.021(9)(b), Florida Statutes, which suffers or has suffered erosion caused by such navigation channel maintenance or construction shall be exempt from the permitting requirements and prohibitions of subsections (2), (5), and (6) of Section 161.053, Florida Statutes. The timing and sequence of any construction in such coastal areas shall comply with 44 C.P.R. part 60 and shall provide protection to nesting sea turtles and hatchlings and their habitats and to native salt-resistant vegetation and endangered plant communities.

d. The provisions of subsections (1) and (2) shall not be a requirement imposed upon ports listed in s.403.021(9)(b).

Erosion control of downdrift beaches must also be balanced with the importance of maintaining the water depths needed to conduct deepwater commercial navigation in the channels, ports and turning basins of Florida. This premise was set forth in Florida Statute 403.021.9(a) and 9(b).

9(a). The Legislature finds and declares that it is essential to preserve and maintain authorized water depth in the existing navigation channels, port harbors, turning basins, and harbor berths of this state in order to provide for the continued safe navigation of deepwater shipping commerce. The department shall recognize that maintenance of authorized channel depths is an ongoing, continuous, beneficial, and necessary activity; and it shall develop a regulatory process which shall enable the ports of this state to conduct such activities in an environmentally sound, expeditious, and efficient manner.
9(b). The provisions of paragraph (a) apply only to the port waters, spoil disposal sites, port harbors, navigation channels, turning basins, and harbor berths used for deepwater commercial navigation in the ports of Jacksonville, Tampa, Port Everglades, Miami, Port Canaveral, Fort. Pierce, Palm Beach, Port Manatee, Port St. Joe, Panama City, St. Petersburg, and Pensacola.

All improved inlet projects are evaluated in order to determine the possible erosion problems associated with their construction. Inlet management is incorporated into the State's beach management plan in Chapter 161.161, Florida Statutes.

a. The division shall develop and maintain a comprehensive long-term management plan for the restoration of the state’s critically eroding beaches. The beach management plan shall:

(1) Address long-term solutions to the problem of critically eroding beaches in this state.
(2) Evaluate each improved coastal beach inlet and determine whether the inlet is a significant cause of beach erosion. With respect to each inlet determined to be a significant cause of beach erosion, the plan must include:

a) The extent to which such inlet causes beach erosion and recommendations to mitigate the erosive impact of the inlet, including, but not limited to, recommendations regarding inlet sediment bypassing; modifications to channel dredging, jetty design, and disposal of spoil material; establishment of feeder beaches; and beach restoration and beach nourishment; and
b) Cost estimates necessary to take inlet corrective measures and recommendations regarding cost sharing among the beneficiaries of such inlet.

The Florida Department of Environmental Protection in partnership with St. Lucie County have adopted the following implementation actions following a study of Fort Pierce Inlet, under the provisions of Section 161.161, Florida Statutes.

a. Initial restoration of 2.3 miles of beach south of the inlet.
b. Placement of all beach compatible maintenance or offshore dredged material on downdrift beaches. Material shall be placed on beach in areas of greatest need.
c. Placement of supplemental material from upland sources, or dredged from nearshore north of the inlet, or form seaward of depth of closure on the beaches south of the inlet such that the combined total of material from all sources equals or exceeds 130,000 cy on an average annual basis at a minimum.
d. Improvement of the south jetty to incorporate a spur jetty or other measures to reduce backflow or material into the inlet
e. The sediment budget contained in the study report is adopted as an interim measure and shall be formally validated or redefined in subsequent revisions of the plan based on a comprehensive monitoring plan by December 31, 2001.
f. Implement a comprehensive inlet, beach, and offshore monitoring program subject to approval of the Department.
g. Evaluate possible alternatives to facilitate bypassing of sand from the shoreline north of the inlet to the downdrift beaches.

3.4.2.9 Coastal Barrier Regulations

In the 1981 Coastal Barrier Executive Order (E.O. 81-105), the governor of Florida recognized the value of coastal barriers and set forth three requirements for state agencies that plan for, manage, and regulate the coastal zone. The governor directed that:
a. Acquisition of coastal barriers was a priority; 
b. Federal and state money was not to be used to subsidize growth or post-disaster redevelopment on hazardous barriers; and 
c. Agencies were to manage growth in a manner consistent with the evacuation capabilities of coastal barriers (Florida Atlantic University, 1986).

The executive order did not provide state agencies with any specific powers to carry out its directives, but rather set for the overall policy for state actions on coastal barriers. Subsequently, in the 1985 Growth Management Act, the legislature enacted specific amendments to discourage growth and unwise development on coastal barriers (Sections 380.27 and 163.178, Florida Statutes). In particular, the act directed that state funds could not be used to build bridges or causeways to barrier islands that were not already accessible (Florida Atlantic University 1986).

3.4.2.10 Coastal Acquisition

Florida has one of the largest state acquisition programs in the country in terms of money spent and land purchased (Florida Atlantic University 1986). Acquisition of coastal land is among the key components of the state's land protection program. Florida's Save Our Coasts program, authorized under the Land Acquisition Trust Fund (Sections 375.041, Florida Statutes), provides monies specifically for acquisition of coastal properties. Enacted in 1981, the Save Our Coasts program authorized a $200 million bond issue for purchase of sandy beaches, barrier islands, and beach access points. Through July 1986, the program had purchased 2,713 acres of coastal land, representing 13 miles of shoreline (Florida Atlantic University 1986). The state's coastal acquisition efforts target areas where the local government is willing to make a financial contribution to purchase the land and to manage it after it is acquired. Parcels in areas with a need for additional recreational beaches and sites susceptible to repeated erosion are also the focus of the acquisition program (Glassman 1983).

3.4.3 Local Comprehensive Planning

The Local Government Comprehensive Planning Act of 1975 (Chapter 163) requires that all local governments prepare, adopt, and implement comprehensive plans that address community growth and development needs (Pilkey et al. 1984). In the 1985 Growth Management Act, the Florida legislature strengthened the Planning Act in coastal areas and required that local, regional, and state comprehensive plans be consistent with each other. Under the Planning Act, coastal localities must include a "coastal management element" in their local plans (Godschalk et al. 1989). This section of the plan must be based on an inventory of the beach-dune system and existing coastal land uses and an analysis of the effects of future land uses on coastal resources (Florida Atlantic University 1986).

Within the plan's coastal element, local governments must address disaster mitigation and redevelopment, designation of coastal high-hazard areas, beach protection, and shoreline use. The local plans must fulfill, among others, the following primary objectives:

a. Protection of coastal resources;

b. Limitation of public expenditures that subsidize development in coastal high-hazard areas;

c. Direction of population away from coastal high-hazard areas;

d. Management of development and redevelopment in coastal high-hazard areas to minimize risks to life and property; and

e. Protection and enhancement of beach-dune systems (Florida Atlantic University, 1986; Godschalk et al. 1989).
If a local plan does not meet the requirements of the Growth Management Act, state funds to that jurisdiction may be curtailed (Godschalk et al. 1989). Furthermore, the state cannot issue funds to increase the capacity of local infrastructures unless improvements are consistent with the coastal management element in the local plan. The state can also restrict a locality from receiving post-disaster Federal assistance. The state may choose not to include local projects on all state applications to the Federal Emergency Management Agency unless the municipality has adopted hazard mitigation and prevention plans (Godschalk et al. 1989). The St. Lucie County Comprehensive Plan 2015 outlines unique features of the area, key coastal elements and related goals, objectives and policies, as well as existing and future land use.

### 3.4.4 Ongoing Studies

The State of Florida and the local sponsor, St. Lucie County, are examining the potential for construction and routine maintenance dredging of a sediment impoundment basin within Fort Pierce Inlet to help bypass sand to the downdrift (south) beach. The study will require coordination between the USACE, the State of Florida, and the local sponsor. A successful bypassing operation would support federal regional sediment management objectives and provide supplemental sand resources to the shore protection project. The bypassing volumes may also reduce the nourishment interval and the volume of sand required from offshore sand sources.

### 3.5 Identification of Management Measures (EA: Alternatives including the Proposed Action)

The alternative plans considered were developed through a three-step process as follows:

a. Identification and preliminary assessment of possible solutions. This step does not include costs and benefits computations.

b. Development and assessment of intermediate-level-of-detail alternatives. This step includes computations of unit price costs and benefits and general discussion of potential environmental impacts.

c. Development and assessment of detailed alternative plans. This step includes computations of cost code of account level cost estimates, including the costs of lands, easements, rights-of-way, and mitigation. This step also includes detailed benefits computations and discussion of Federal and non-Federal cost allocation.

Each step was iterative in the process of identifying and selecting the best course of action. Each alternative was considered in light of other projects within each reach or problem area. During the first step of preliminary identification and assessment of alternatives, the alternatives developed included traditional type projects, programs that could be carried out by non-Federal interests, and structural (S) as well as non-structural (NS) alternatives. Each plan in the array was screened based on its ability to satisfy the planning objectives. Viable plans were carried forward into the intermediate level of detail and analysis, and were developed sufficiently to assess generalized benefits, costs and impacts. Those plans meriting closer evaluation were carried into the third step entailing the development and analysis of alternative plans at a detailed level.

Table 3.1 presents an evaluation of possible solutions considered in the first step of project formulation. Many of the alternatives were not retained for intermediate analysis because they did not fully address the planning objectives. Planning objectives considered in the preparation of this table include the local objectives and the accounts required by the Water Resources Council’s “Principles and Guidelines.” The alternatives considered in initial plan development are discussed in the following sections. In each case, consideration of the ability to permit the design alternative was included in the plan development. Permitting considerations included hardbottom effects, structure location, and structure effects on wildlife.
Table 3.1 Initial Assessment of Alternative Plans – 50-Year Analysis Period

<table>
<thead>
<tr>
<th>Possible Measures</th>
<th>Sponsor Planning Objectives</th>
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<th>Federal Objectives</th>
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<td></td>
<td>RB</td>
<td>SDR</td>
<td>TBE</td>
<td>NED</td>
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<tr>
<td>Nonstructural Measures (NS)</td>
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<tr>
<td>NS-1 No Action</td>
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<td>O</td>
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<tr>
<td>NS-2 Construction Control Line</td>
<td>O</td>
<td>P</td>
<td>O</td>
<td>O</td>
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<td>NS-3 Moratorium on construction</td>
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<td>P</td>
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<tr>
<td>NS-4 Establish a no-growth program</td>
<td>O</td>
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<tr>
<td>NS-5 Relocation of structures</td>
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<td>NS-6 Flood proofing of structures</td>
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<tr>
<td>NS-7 Condemnation of land and structures</td>
<td>O</td>
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<tr>
<td>NS-8 Acquisition of Land and Structures</td>
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<td>Structural Measures (S)</td>
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<td>S-1 Seawalls</td>
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<td>S-2 Revetments</td>
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<td>S-3 Sand Covered Soft Structures</td>
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<td>S-4 Beach Nourishment</td>
<td>F</td>
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<tr>
<td>S-5 Groins and/or Breakwaters</td>
<td>P</td>
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<td>P</td>
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<tr>
<td>S-6 Dunes and Vegetation</td>
<td>P</td>
<td>P</td>
<td>P</td>
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</table>

Notes:
1. RB – Provision of recreation beach
2. SDR – Reduction of hurricane and storm damage
3. TBE – Protection of tourism-based economy
4. NED – National Economic Development
5. EQ – Environmental Quality
6. OSE – Other Social Effect
7. RED – Regional Economic Development

3.5.1 Non-Structural (NS) Alternative Plans

NS-1 No-Action. The no-action alternative perceives the continuation of existing conditions (no re-authorization of the SPP) and provides no solutions to existing problems. However, it also avoids any undesirable effects that may be associated with structural or non-structural plans of improvement. This option, although not favored by the non-Federal sponsor, is considered in relation to the effects of other alternatives. Continued erosion of the beach with the no-action alternative would result in continued loss of vegetated beach and dune habitats. Additionally, continued erosion could cause landowners to implement alternatives to protect their properties with armoring measures such as revetments. These measures could result in negative impacts to the dune system by altering the beach profile and displacing vegetation. Shoreline hardening could increase erosion both within the project shoreline and south of the project.

NS-2 Construction Control Line. A construction control line would not affect existing development and could only be effective in the unforeseeable future as buildings are razed and destroyed by storms. However, this alternative is acknowledged and included in the nonstructural combination plan, and plans are...
developed around it. A coastal construction control line that does not prohibit construction, but does provide stringent structural restrictions, has been established by the State of Florida for all of the Fort Pierce study area. NS-2 would have environmental effects similar to those of the No Action alternative (NS-1).

NS-3 - Moratorium on Construction. A moratorium on construction is rejected by the non-Federal sponsor and local interests since the desired growth of the area is oriented towards tourism and recreation and promoting a stable construction industry. NS-3 would have environmental effects similar to those of the No-Action alternative.

NS-4 - Establish a No-Growth Program. The establishment of a no-growth program is rejected by local interests. Growth in the area, particularly in connection with beach activities, is needed to provide economic depth to the communities. This alternative is therefore excluded from detailed studies.

NS-5 - Relocation of Structures. This alternative would allow the area to continue to erode until an equilibrium shoreline was reached. Structures affected by the erosion would be relocated to a suitable upland location. However, structures which cannot be economically or physically moved from the area of erosion would have to be abandoned and new structures would have to be provided for the existing residents. In addition, implementation of this alternative would result in the loss of valuable recreational beach as shoreline recession continues and would necessitate the condemnation of the land and structures in this area. This alternative is implicitly incorporated into the storm damage benefit analysis in that once condemned by the storm damage model, such upland development is removed from inventory. NS-5 would have environmental effects similar to those of the without-project alternative.

NS-6 - Flood Proofing of Structures. Flood proofing of existing structures and regulation of flood plain and storefront development are considered part of building code modifications and are not considered as separate alternatives.

NS-7 - Condemnation of Land and Structures. This alternative would allow the shoreline to erode in the area with a loss of land until shoreline equilibrium was established. This alternative is excluded as it fails to meet the planning objectives.

NS-8 - Acquisition of Land and Structures. This measure would allow the shoreline to erode in the study area with a loss of land. Structures within the area vulnerable to storm damage would be identified for acquisition. Structures on the acquired parcels would be demolished and natural areas restored. Such parcels would become public property and would reduce the number of structures vulnerable to storm damages. NS-5 would have environmental effects similar to those of the without-project alternative.

3.5.2 Structural (S) Alternative Plans

S-1 - Seawalls. The construction of sheet pile seawalls would provide a significant degree of protection; however, this would be accomplished at the expense of a recreational beach, resulting in substantial economic loss to the area. Reflecting wave energy off seawalls and bulkheads typically results in a steepening of the offshore profiles with resulting hazardous bathing conditions due to increased undertow and runouts. Accordingly, construction of seawall is not carried forward as an implementable project feature. Environmental effects of seawalls would include significant reduction or elimination of turtle nesting habitat, reduced shorebird habitat, and separation of dune habitat from the beach, eliminating or dramatically curtailing biotic exchanges that would otherwise occur.

S-2 - Revetments. Revetments have been placed on similar beaches to protect critically damaged or eroding areas. These measures have provided temporary relief but have not reduced the erosion of the beaches. The hardening of the beach in one area will merely transfer the location of the problems further down the beach.
High initial costs of revetment construction, increased permitting issues, and adverse effects on coastal processes eliminate this alternative from further consideration. Environmental effects of revetments would include significant reduction or elimination of turtle nesting habitat, reduced shorebird habitat, and separation of dune habitat from the beach, eliminating or dramatically curtailing biotic exchanges that would otherwise occur.

S-3: Sand Covered Soft Structures: This management measure includes construction of a dune composed of geotextile sand-filled forms (typically tubes or bags) covered with sand. This forms a sand dune with a structured core. When storm erosion causes the structured geotextile core to become exposed, the soft structure acts as armoring to prevent erosion from reaching further inland. Sand depth over the geotextile core would be maintained to an adequate depth to allow the dune to function as habitat and not inhibit sea turtle nesting.

S-4 - Beach Nourishment. This alternative would provide initial beach fill and future nourishment of a fill template of appropriate dimensions to serve as a buffer against wave attack. Nourishment of the beach would be undertaken periodically to maintain the recreational and erosion control features within design dimensions. Dimensions of the beach fill would be based on economic optimization of benefits provided with consideration to cost, as well as the potential environmental impacts. Beach nourishment material is anticipated to be available in adequate quantities from offshore and/or in combinations of other sources such as navigation dredging, upland disposal areas, etc. Beach nourishment is carried forward into the intermediate alternative analysis.

Beach nourishment may result in a variety of short term impacts associated with construction including turbidity from the sand slurry pumped onto the beach, disturbance of shorebirds, elimination of turtle nesting habitat in the area of construction during the construction activity, damage to existing turtle nests in the construction footprint, burial of invertebrates living on the beach, and damage to invertebrates and vertebrates captured during collection of sand for placement on the beach. Risks to humans include injury from construction activities. These short-term impacts can be minimized by management of the slurry water to allow settling of the majority of suspended solids, monitoring of water quality to maintain ambient turbidity standards (typically 29 NTU above background in the receiving ocean water), daily monitoring for and as necessary relocating of turtle nests, and monitoring shorebird activity. Proper information signs and public education should minimize construction accidents with recreational beach goers.

The downcurrent (indirect) effects of beach nourishment may focus on nearshore hardbottom over which the sand passes or remains for long enough periods to eliminate the hardbottom communities occurring on that substrate. Burial of these habitats would result in loss of hardbottom habitat for whatever period the sand remains. When the additional sand moves farther away and becomes more dispersed, those impacts are diluted and finally reduced to the point of insignificance, but this may occur of relatively long periods (many months or years). The transport process whereby nourished beaches erode is likely slow enough for sand infauna in the nearshore to respond without significant negative impacts but moving upward with the accreting sand and reproducing in sufficient numbers to maintain populations in the affected areas.

S-5 – Groins and/or Breakwaters. Project designed groins or a groin field in the problem area would help hold a beach in front of existing development and prevent further losses of land. The construction of groins would have to be supplemented with nourishment so that adjacent beaches would not be starved of sand. Shoreline stabilization structures consisting of six T-head groins and one submerged breakwater comprise the structural layout of the Fort Pierce Shore Protection Project Design Documentation Report — DDR — (Taylor Engineering, Inc., 2002) that was found to maintain the design shoreline for four years. T-head (composite) groins consist of a head section designed as a breakwater and a stem section designed as a groin. T-head groins offer benefits over traditional groins by requiring a shorter shore-perpendicular length to hold the same shoreline position (Hanson and Kraus, 2001) and benefits over traditional breakwaters in
requiring less armor stone with construction closer to shore. Having a shorter shore-perpendicular length will keep the structures close to shore and from extending into the ephemeral hardbottom in the nearshore. Also, the “head” section at the seaward end of the groin can significantly reduce offshore losses and optimization of the head section to match the predominant incident wave angle can improve project performance in terms of shoreline stabilization and fill retention (Bodge 1998). Notably geotextile groins placed near the south jetty in 1994 performed well in holding the fill in place and to reduce the periodic nourishment requirements. Groin construction — from here on referred to as shoreline stabilization structures — is carried forward into the intermediate alternative analysis.

Breakwaters or groins combined with nourishment would, over a long period of time reduce the amount of sand placed on the beach and potentially extend the period between required nourishment projects. To the extent that this occurs, short term impacts (described above for Alternative S-3) would occur less frequently, and thus reduce overall long-term impacts to the system.

Properly designed breakwaters or groins are engineered to withstand a certain level of storm with a certain probability of survival. In general, a certain percentage of the materials that make up the structure may “roll off” the structure during the most extreme event for which the structure was design, but are not expected to move great distances. However, once the design conditions are exceeded, which may occur in an extremely rare event (such as a strong hurricane), partial destruction of the structure may occur. The loose rocks that make up the structure could end up on the beach or in the general nearshore area where they would have an aesthetic impact and could, particularly on a high-density turtle-nesting beach, interfere with nesting. A turtle digging a nest and encountering a rock would have to abandon that site and move to another.

S-6 - Dunes and Vegetation. The presence of dunes is essential if a beach is to remain stable and able to accommodate the vagaries wrought by unpredictable storms and extreme conditions of wind, wave, and elevated sea surface. Dunes maintain a vast sand repository that, during storms, has a sacrificial element attached to it. Storms with low surges are unable to erode the dune, thus subaerial sand is mostly retained. However, larger storms with attendant high waves and elevated water levels typically erode the dune. Such storms have erosion potentials dependent on their climate and the characteristics of the affected beach. The dune sacrifices a portion of its sand during these storms to satisfy the erosion potential while protecting the lands and property on its landward side. In so doing, the dune system provides a measure of public safety and property protection not otherwise provided. Proper dune vegetation on dunes increases sand erosion resistance by binding the sand together via extensive root masses penetrating deep into the sand. Further, such vegetation promotes dune growth through its sand trapping action when significant wind action transports sand landward into the vegetation. This alternative is carried forward into the intermediate alternative analysis

Enhancement, replacement, or creation of planted dunes would have short term impacts associated with disturbance of the project construction footprint on the upper beach and dune zone. Burial of infauna of the upper beach, burial or harm to plants and animals living in the dune zone may be expected. However, these short-term impacts would be offset by the long-term benefit of an increased dune zone. In particular, turtle and possible shorebird nesting habitat increases would result from the activity. Most of same minimization practices as applied for Alternative S-3 would minimize and avoid impacts to both the humans and wildlife.

3.6 Intermediate Assessment of Alternative Plans

The previous paragraphs describing the possible solutions eliminated all but one non-structural and four structural alternatives. The no-action plan (NS-1) is the single non-structural alternative to be carried forward into intermediate plan formulation for consideration and comparison. The structural alternative plans to be carried into the intermediate assessment include beach nourishment (S-4), shoreline stabilization
structures (S-5), and dunes and vegetation (S-6). The intermediate plan formulation process follows the NED guidelines described below.

3.6.1 NED Plan Formulation

NED principles are utilized by the Federal government for the economic evaluation of all water resource projects. The NED principles articulate a framework to assist in making project scope and implementation decisions. For the purpose of Fort Pierce shore protection, NED principles are used to determine the total net benefits of the project. From this information, the NED plan is formulated and net benefits are maximized.

The NED plan for the Fort Pierce Shore Protection Project has been developed in accordance with ER 1105-2-100 Section 6-1 by adopting the procedures and policies of the Water Resource Council's (WRC) Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies, Chapter II - National Economic Development (NED) Benefit Evaluation Procedures (March 10, 1983).

NED is the increase in the net value of the national output of goods and services, expressed in monetary units. "Contributions to NED are the direct net benefits that accrue in the planning area and the rest of the nation. Contributions to NED include increases in the net value of those goods and services that are marketed, and also those that may not be marketed." (Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies, p. 1, March 1983)

U.S. Army Corps of Engineers projects produce outputs that benefit the nation, but these projects also expend the nation's resources. The NED principle is used to determine which utilization of the nation's resources will produce the greatest benefits to the nation. As such, the NED principle is a matter of law, policy and interpretation rather than one of economic fact or theory, although it is a policy firmly rooted in economic theory.

The Water Resource Council (WRC) has established evaluation principles intended to ensure proper and consistent planning by Federal agencies. These principles, as defined in the "Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies", are as follows:

a. Various alternative plans are to be formulated in a systematic manner to ensure that all reasonable alternatives are evaluated.

b. A plan that reasonably maximizes net national economic development benefits, consistent with the Federal objective, is to be formulated. This plan is to be defined as the NED plan.

c. Other plans which reduce net NED benefits in order to further address other Federal, State, local, and international concerns not fully addressed by the NED plan should also be formulated.

d. Plans may be formulated which require changes in existing statutes, administrative regulations, and established common law, such required changes are to be identified.

e. Each alternative plan is to be formulated in consideration of four criteria: completeness, effectiveness, efficiency, and acceptability. Appropriate mitigation of adverse effects is to be an integral part of each alternative plan.

f. Existing water and related resources plans, such as State water resources plans, are to be considered as alternative plans if within the scope of the planning effort.

The planning process leads to the identification of alternative plans that could be recommended or selected. The culmination of the planning process is the selection of the recommended plan or the decision to take no action. The selection should be based on a comparison of the effects of alternative plans (ER 1105-2-
100 Section 5-11.a). The basis for selection of the recommended plan should be fully reported (ER 1105-2-100 Section 5-11.b(4)). In presenting the NED plan, all reports must include appropriate information and data (ER 1105-2-100 Section 5-16.b). Concise, understandable displays are also helpful during the planning process and provide documentation in compliance with NEPA (ER 1105-2-100 Section 5-9.a.1).

Under the NED principle, the best, or NED, plan is the one that maximizes net benefits. The USACE traditionally expresses benefits and costs in monetary terms as equivalent annual values. Thus, maximizing annual net NED benefits is formally equivalent to selecting a plan with the maximum equivalent annual benefits and maximum net present value (NPV). The plan recommending Federal action is to be the alternative plan with the greatest net economic benefit, which is also consistent with protecting the Nation's environment (Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies, p. 1, March 1983).

3.6.2 Development and Analysis of Intermediate Alternative Plans

3.6.2.1 No-Action Plan (NS-1)

The no-action plan is referred to in the economic analysis as the future without-project (FWOP) condition. The FWOP condition assumes that short-term and long-term erosion will continue into the future at the same rates as they have over the period of record. Structures predicted to be condemned before the base year of the project are removed from the without- as well as the with-project SDM inventories; no such structures existed within the project however. State of Florida coastal zone management regulations are implemented to determine future without-project coastal armoring activities. The average annual equivalent damage predicted for the no-action plan is used as a benchmark in the comparison of intermediate alternative plans. Predicted with-project damages are subtracted from the damages expected under the no-action plan, to determine the benefits of each alternative plan. There are no costs associated with the no-action plan.

The no-action plan for the study area considers the highly variable shoreline recession rate based on shoreline changes between 1971 and 2004. The background erosion rate within the 1.3-mile project area is 53,000 cy/yr without considering material placed from navigation projects or beach fills. Shoreline erosion rates between R-34 and R-37 exceed 12 ft/yr, and erosion rates from R-37 to R-41 exceed 5 ft/yr. Shoreline recession and erosion will likely continue. There is an estimated $85 million in structural improvements susceptible to storm damage in the 1.3-mile combined study area. This does not include infrastructure such as roads and utilities. The economic analysis results in Appendix C indicates that approximately $119 million (FY2021 present value) in storm damage will occur in the study area over the 50-year period of analysis, or an average annual equivalent of $4.5 million. Local efforts to stop the storm and erosion damage have included dune construction, enhancement and re-vegetation; geotextile tube erosion control installation to hold a small emergency beach fill (54,400 cy); construction and repair of coastal armor; and construction of a shore-parallel spur jetty along the existing south jetty at Fort Pierce Inlet, and various other emergency beach fill projects constructed via truck haul of sand from upland sources.

This alternative avoids any undesirable effects that may be associated with construction of the authorized project. However, if steps are not taken to counteract the erosion and provide an appropriate level of storm damage protection, continuing erosion and recession of the shoreline will likely occur with subsequent loss of valuable property and damage to structural improvements along the shoreline.
3.6.2.2 Beach Nourishment (S-3)

Beach nourishment consists of initial construction of a beach fill design template (with requisite advance nourishment) along a specified length of shoreline and the subsequent nourishment of that shoreline at a predetermined interval.

The reliability of the benefit analysis pivots on assumptions pertaining to the engineering, economic, environmental, and political aspects of the alternative plans. To determine structural values, the St. Lucie County Property Appraiser’s Office, the Jacksonville District Real Estate Division, and Taylor Engineering, Inc. created an inventory of each affected structure within the study area. The structural inventory defined each by type, value, number of floors, and the lot sizes which each occupied.

Storm Damage Benefits. Economic justification of beach nourishment in Fort Pierce relates to the protection of structural improvements and land located along the first 500 ft landward of the ECL for development along the project shoreline. Review of shorefront development indicates a mix of residential and commercial development. The economic evaluation determines the justification of Federal participation based on the benefits generated versus the cost of providing the authorized level of protection along the project shorefront.

Primary and incidental benefits categorize the benefits resulting from the beach nourishment. Primary benefits accrue through the prevention of storm damages to coastal development and existing protective structures. Engineering Regulation (ER) 1105-2-100 provides guidance for the inclusion of incidental project benefits, such as recreation. This document states that “recreation benefits produced as a benefit of the basic project may exceed 50% of the total project benefits, but economic justification must be demonstrated on the basis of recreation benefits limited to 50% of total project benefits.” This study calculated and applied recreation benefits.

The Economics Appendix gives a full account of the USACE Beach-fx model used to predict damages and costs for the with- and without-project conditions. The storm damage reduction benefit (which includes the effects of long-term recession) equals the difference between the expected annual damages under the without-project conditions minus the expected annual damages under the with-project conditions. The analysis of the average annual benefits, which the project will provide with respect to shore protection, yielded the damages projected for a 50-year economic life of the project.

Loss of Land. Loss of land benefits are claimed at privately-owned shorefront parcels in the region landward of the pre-project mean high water shoreline (ECL). Beach nourishment (S-3), by eliminating the loss of land associated with the no-action plan (NS-1), results in a design shoreline at or seaward of the pre-project mean high water shoreline. Determination of the market value of the land losses is based on the value of nearshore upland. Nearshore upland is sufficiently removed from the shore to lose its significant increment of value because of its proximity to the shore, when compared to adjacent parcels more distant (inland) from the shore. USACE Jacksonville District investigated recent vacant nearshore land sale near the project area for both residential and commercial properties and recommended $25/sq ft in 2014.

Environmental Concerns. As stated in the 2002 Environmental Impact Statement (EIS) for this project, plan formulation and the authorized project included all practicable means to avoid or minimize adverse environmental impacts. The 1999 project — which applied the authorized template with a 50 ft MHW extension — had an impact on approximately 9.6 acres of hardbottom. As noted above, FDEP has concluded that St. Lucie County mitigation efforts have compensated for those hardbottom impacts. The county constructed mitigation in excess of the requirements and is committed to monitoring for additional impact that may have occurred after the period considered in the FDEP approval.
The primary source of sand — Capron Shoal located approximately 4 miles offshore Fort Pierce beach — features a highly dynamic sandy bottom. Temporary impacts such as increased turbidity and mortality of resident infauna and epibenthos would result at the borrow site. The 2002 EIS addresses the environmental concerns of using Capron Shoal as the borrow area for the Fort Pierce SPP.

The currently permitted Capron Shoal borrow area has insufficient sand to nourish the beach for the full 50-year project period. Therefore, other portions of the shoal or different shoals must be dredged to provide the additional material. The 2012 South Hutchinson Island EIS addressed the question of impact to the ecosystem associated with the shoals offshore Hutchinson Island, noting that the shoals are associated with a very diverse fish community which may use the shoals in as-yet understood but significant life-cycle activities. Fishes may use shoal features as guideposts during migrations, local movements, or spawning. At intermediate scales (tens to hundreds of square meters), different parts of individual shoals may represent different foraging areas or shelter from predators or waves and currents. Gilmore (2009) synthesized unpublished information and data and interviewed local anglers to determine the importance of the east Florida sand shoals, including the St. Lucie Shoal, to fishes. The report inferred from the various data sources that more than 200 species potentially use shoals for orientation, refuge, spawning, and feeding sites. Interviews with anglers confirmed that shoals served as aggregating points for small pelagic fishes such as menhaden, Spanish sardine, thread herring, and false pilchard. These species are important prey for numerous managed species, particularly from the coastal pelagic and highly migratory groups.

Kelley et al. (2004) modeled the removal of an estimated 24 million cm (31.4 million cy) with an excavation depth of 4.6 m (15 feet — all of St. Lucie Shoal in federal waters). After determining that this dredging would cause unacceptable effects on the wave climate, they determined that the shoal — if reduced in elevation by fewer than 2.3 m (7.5 feet) — would yield 12 million cm (15.7 million cy) of sand without causing significant impacts on longshore sediment transport.

The 2009 South Hutchinson Island EIS Appendix Q developed an analysis similar to that of Kelley et al. (2004) by assessing possible changes in potential shoreline erosion due to wave climate changes at the shoal translating to the shoreline (Appendix Q). This analysis demonstrated that under unrealistically high (average maximum) wave climate changes, the proposed project and the 50-year cumulative effect of project dredging would not cause a significant change. They showed that the change in wave energy could (assuming the average maximum waves occurred continuously over the 50-year period) remove as much as a foot of shoreline width, or about 0.24 inch / year. The estimated erosion rate falls well within the error of measurement for such changes and as such, does not represent a significant impact.

Dibajnia and Nairn (2011) summarized field investigations and modeling studies of more than 180 offshore shoals and identified significant trends in “shoal behavior and morphologic evolution”. They provided offshore dredging guidelines to protect and maintain the integrity of ridge and shoal found on the outer coastal shelf. Maintenance of ridge and shoal integrity would help minimize unknown but likely impacts of shoal dredging on the very diverse fish community that uses this environment. Recommended BMPs include how and where within a shoal to dredge and at what elevations and shoal heights dredging would have minimal or greater impacts.

3.6.2.3 Shoreline Stabilization Structures (S-4)

A design with shoreline stabilization structures (groin field and/or breakwaters) in the problem area would help hold a beach south of the south jetty in the area of increased erosion. The structures will prevent erosion in front of existing development and prevent further loss of land on its updrift side through sand impoundment. However, any beaches present on the downdrift side would likely suffer associated sand losses. Nourishment would supplement the construction of groins to minimize negative effects to the adjacent beaches. For this reason, shoreline stabilization structures, in combination with beach fills, are
considered as a method to help hold the fill in place and to reduce the periodic nourishment requirements. This analysis considers two alternatives: (1) T-head groins and (2) offshore breakwaters to help maintain a design shoreline. The ability to develop certain shoreline extensions within the T-head groin compartments makes their implementation at Fort Pierce more attractive than standard groins. A similar project at Ocean Ridge, FL employed a T-head groin with field periodic beach fills to hold the design shoreline on the downdrift side of a jettied inlet.

3.6.3 Six Stabilization Structures with Uniform Design Beach and Non-Uniform Advance Fill

The DDR (Taylor Engineering 2002) calls for seven shoreline stabilization structures constructed between R-33.8 and R-36. However, in an attempt to minimize down drift impacts, the design alternative evaluated herein consists of six T-head groins with the southernmost acting as a weir groin designed to lessen the sediment trapping capacity. In addition, the current T-head groin field design removes the sheet-pile within the structures as called for in the DDR to make the structures more permeable. Removal of the sheet-pile also makes the design more flexible in terms of being able to modify structure performance through modification of the structure height. The beach fill template matches that of the no-structure alternative. The beach nourishment construction template initially buries all six structures. Figure 3.1 shows the locations and configurations of the seven structures.

![Figure 3.1 Locations of T-Head Groins (T1–T5), Weir T-Head (W6), and Breakwater (B7) for Alternative S-4](image)

Though the seven-structure alternative was thoroughly designed based on empirical equations and supported by similar projects that have proven successful, current practice requires use of numerical models to simulate the performance of the project. To that end, Taylor Engineering developed MIKE21 Flexible Mesh (FM) Version 2016 two-dimensional hydrodynamic, wave, sediment transport, and shoreline morphology models to simulate water surface elevation, flow velocity, sediment (sand) transport, erosion, deposition, and shoreline movement in the study area. As discussed in the Engineering Appendix, the model results show this alternative will likely prove successful.
3.6.4 Three Submerged Breakwaters with Uniform Design Beach and Non-Uniform Advance Fill

Another alternative consisted of placing three shore-parallel submerged, offshore rubble-mound breakwaters near the Ft Pierce south jetty. The breakwaters were located between 500 and 700 ft offshore in a water depth of roughly -13 ft-NAVD. The breakwaters design is intended to maintain the design shoreline with minimal impacts to nearshore currents and hard-bottom. The nearshore breakwater alternative included a beach fill template that matches the no-structure alternative discussed above; the fill does not reach the submerged structures. During a prior phase of this GRR, Taylor Engineering performed shoreline change modeling with the USACE’s GenCade model. The model applies the framework of the USACE’s GENERalized Model for SIMulating Shoreline Change (GENESIS), which is based on longshore transport calculations, with additional capabilities that the GENESIS model alone does not have. Figure 3.2 shows the representation of the breakwaters within the GenCade model with the beach fill shoreline in green and the red dots indicating the design shoreline at R-monuments R-34–R-37.

As discussed further in the Engineering Appendix, the breakwater alternative induces less volume change in the vicinity of the breakwaters but slightly more erosion than the no-structure alternative when considering the entire project area. Given this information, the GenCade model predictions indicate that the submerged, broad-crested breakwaters result in little change to the shoreline and volume changes in their vicinity. Given the cost of the structure construction and the cost of mitigating for hard-bottom impacts, the breakwater alternative does not provide an economically viable alternative. This study does not evaluate this alternative further.

Figure 3.2 GenCade Representation of Submerged Broad-Crested Breakwater with Beach Fill Alternative
3.6.4.1 Dunes and Vegetation (S-5)

Planting vegetation — sea oats — along the berm will serve to stabilize the material within the berm thereby increasing the erosion resistance and storm damage reduction capability of the berm. Based on performance of the currently authorized project, dunes alone will not survive the severe erosion within the project area. Additionally, under current analysis procedures, the environmental restoration action of vegetating the dunes does not increase the net benefits of the project. Therefore, the dunes and vegetation alternative is removed from consideration as an alternative for the Federal project. However, evaluation of the beach nourishment alternative considers the storm damage reduction effect of various dune configurations, as discussed in the next section.

3.7 Detailed Assessment of Alternative Plans (EA: Direct, indirect, and cumulative impacts)

The previous section addressed intermediate plans, designs, and cost estimates. The alternative plans carried into the detailed assessment include the no-action plan (NS-1), beach nourishment (S-3), and Shoreline Stabilization Structures (S-4). The development and assessment of detailed alternative plans for beach nourishment (S-3) were undertaken in this final phase of plan formulation. Alternative S-4 includes seven shoreline stabilization structures constructed between R-33.8 and R-36 as recommended in the DDR.

Federal shore protection projects realize primary benefits through the prevention of storm damages to coastal development, infrastructure, and existing coastal armor. Additional primary benefits include those derived from the stabilization of the shoreline, which prevents loss of land in the project area and reduction in emergency action efforts (e.g., dune nourishment or coastal armoring). The benefits and costs of shoreline protection and storm damage reduction projects are highly uncertain. Future damages (and benefits) depend on the sequence of storms, their characteristics, property inventory, erosion, wind, wave effects and a multitude of other factors.

The detailed assessment of alternatives estimated storm damage reduction and prevention of land loss benefits using Beach-fx, an economic planning model developed by the USACE. This model employs a 50-year life-cycle Monte Carlo simulation approach that accounts for the above-mentioned uncertainties to a certain degree. Beach-fx simulates a project life cycle (e.g., 50 years) by determining beach and structure response to a set of storms (the events driving the process). The model determines the associated damages for each structure within the study area throughout the project’s life-cycle. The model repeats this life cycle simulation many times over (e.g., 100 life cycle simulations) to produce a probability distribution of expected damages, and difference between with- and without-project damages indicates the storm damage reduction benefits.

This economic benefits analysis examined the direct benefits of the currently authorized project and potential project alternatives within the 1.3-mile project area (R-34–R-41) and the indirect benefits within the mile-long segment (R-41–R-46A) immediately downdrift. The latter segment lies within the current 2.3-mile long federally authorized project area (R-34 – R-46A) but, to date, has not directly received beach fill from any nourishment projects. The analysis calculated the average annual storm damage benefits provided by the project for a 50-year authorization period (2021–2070).

3.7.1 Alternative Development: Beach Nourishment (S-3)

As mentioned, the currently authorized Fort Pierce SPP includes beach nourishment in Reaches 1–4 every two years. Thus, the nourishment-only FWP scenario simulated the current project with the intent of identifying the nourishment template.
The currently authorized project design beach fill template, established for the 1999 nourishment project and all subsequent nourishments, is based on 50-ft seaward extension of the 1999 pre-construction MHW shoreline. The construction template includes a berm at elevation 7.4 ft NAVD, which resembles the native beach characteristics, plus advance nourishment placed seaward of the design template; no dune was originally authorized. Accordingly, this study began evaluating berm widths varying from 80 ft to 140 ft in 10-ft increments to identify the optimum width. However, it quickly became apparent that the model was not providing reasonable results without inclusion of a dune, which is a crucial component of a beach’s storm damage reduction potential. Hence, the model simulations were adjusted to identify an optimum dune configuration. The simulations varied the dune crest elevation from 11.4 ft NAVD to 13.4 ft NAVD in 1-ft increments and, for each elevation scenario, varied the dune crest width from 10 ft to 30 ft in 10-ft increments. Results indicated a dune crest elevation of 12.4 ft NAVD and width of 20 ft provided the optimum balance of cost and storm damage protection. With the optimum dune identified for the 80-ft berm case, the berm widths were re-evaluated. Upon, identification of the optimum berm width, the dune configuration was once again re-evaluated, and the results remained unchanged. The following list provides a chronology of final simulations:

- 80-ft berm with 10, 20, or 30-ft dune widths and 11.4 ft, 12.4 ft, or 13.4 ft NAVD elevation
  - 9 simulations; 20-ft wide at 12.4 ft NAVD identified as optimum
- Optimum dune with berm widths varied from 80 to 140 ft (10-ft increments)
  - 7 simulations; 130-ft identified as optimum
- Optimum dune with 120-140-ft berm in reaches 1-3 and 50-130 ft berm in Reach 4
  - 12 simulations; 130-ft berm in Reaches 1-3 and 60-ft berm in Reach 4 identified as optimum
- Optimum berm with varied dune widths and elevations for verification
  - 9 simulations; 130-ft berm in Reaches 1-3 and 60-ft berm in Reach 4 with 12-ft wide dune at elevation 12.4 ft NAVD identified as optimum

Of note, with the performance of the current SPP from 1999–2016 well-documented, this study evaluated the Beach-fx results against annual monitoring and project construction data to verify that the model reasonably matched actual performance. As discussed in the Engineering Appendix, the model provides reasonable results.

### 3.7.2 Alternative Development: Shoreline Stabilization Structure (S-4)

The high nourishment frequency of the current SPP is due to high rates of non-uniform erosion at the project’s north end. Thus, the FWP scenario with structures aims to stabilize the northern portion of the project area to achieve a more uniform erosion rate which theoretically will lengthen the nourishment interval. Beach-fx is not designed to directly evaluate structures. Thus, this study simulated structures by altering the planform change rates to represent the structures’ effect of retaining fill material. The Engineering Appendix provides numerical modeling results that demonstrate the structures will retain sufficient fill in Reaches 1–3 without causing excessive erosion in Reach 4 over a 4-yr period. Thus, this study attempted to simulate structures by modifying the Reach 1–3 planform change rate to achieve a 4-yr nourishment cycle. The simulations initially used the optimum dune and berm configurations identified for the nourishment-only simulations and altered the berm widths in 10-ft increments until model results revealed an optimum design. The model indicated a uniform berm with of 130 ft and a 20-ft wide dune at elevation 12.4 ft NAVD in Reaches 1–4 provided the optimum balance of cost and storm damage reduction.
3.7.3 Future With-Project Alternative Comparison

The optimum designs for alternatives S-3 and S-4 describe above were modeled in Beach-fx using full life-cycle simulations (100 simulations) in order to calculate coastal storm damage management (CSRM) benefits and costs. Additionally, comparison of results included land loss benefits (see Section 4.2) calculated external to the model. Comparing these FWP alternatives to the FWOP conditions discussed in Section 2.5 yielded the project benefits. Tables 3.2 and 3.3 summarize the results. With superior net benefits, the structures with 4-year nourishment alternative becomes the preferred alternative and the NED Plan.

**Table 3.2 Structure Damages by Reach (Present Value FY2021)**

<table>
<thead>
<tr>
<th>Reach</th>
<th>Category</th>
<th>Representative FWOP</th>
<th>2-Year Nourishment</th>
<th>Structures with 4-Year Nourishment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reach 1</td>
<td>Structure</td>
<td>$7,705,310</td>
<td>$289,225</td>
<td>$0</td>
</tr>
<tr>
<td></td>
<td>Contents</td>
<td>$1,331,611</td>
<td>$33,032</td>
<td>$0</td>
</tr>
<tr>
<td>Reach 2</td>
<td>Structure</td>
<td>$16,431,869</td>
<td>$1,025,042</td>
<td>$20,737</td>
</tr>
<tr>
<td></td>
<td>Contents</td>
<td>$7,097,802</td>
<td>$510,862</td>
<td>$10,368</td>
</tr>
<tr>
<td>Reach 3</td>
<td>Structure</td>
<td>$7,586,325</td>
<td>$6,570</td>
<td>$4,363</td>
</tr>
<tr>
<td></td>
<td>Contents</td>
<td>$3,221,378</td>
<td>$3,285</td>
<td>$2,181</td>
</tr>
<tr>
<td>Reach 4</td>
<td>Structure</td>
<td>$28,893,070</td>
<td>$269,089</td>
<td>$81,149</td>
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<tr>
<td></td>
<td>Contents</td>
<td>$12,928,077</td>
<td>$73,025</td>
<td>$32,063</td>
</tr>
<tr>
<td>Reach 5</td>
<td>Structure</td>
<td>$23,361,814</td>
<td>$231,052</td>
<td>$231,052</td>
</tr>
<tr>
<td></td>
<td>Contents</td>
<td>$10,463,462</td>
<td>$72,384</td>
<td>$72,384</td>
</tr>
<tr>
<td>Total Combined</td>
<td></td>
<td>$119,020,718</td>
<td>$2,513,566</td>
<td>$454,297</td>
</tr>
</tbody>
</table>

**Table 3.3 Comparison of FWP Alternatives**

<table>
<thead>
<tr>
<th>Description</th>
<th>Present Value (100 Iterations)</th>
<th>AAEQ</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2-Year Nourishment</td>
<td>Structures with 4-Year Nourishment</td>
</tr>
<tr>
<td>CSRM Benefit</td>
<td>$116,507,152</td>
<td>$118,566,420</td>
</tr>
<tr>
<td>Land Loss Benefit</td>
<td>$60,459,872</td>
<td>$60,479,606</td>
</tr>
<tr>
<td>Total Benefits</td>
<td>$176,967,024</td>
<td>$179,046,026</td>
</tr>
<tr>
<td>Total Cost</td>
<td>$125,683,774</td>
<td>$73,367,796</td>
</tr>
<tr>
<td>Net Benefits</td>
<td>$51,283,250</td>
<td>$105,678,230</td>
</tr>
</tbody>
</table>

1Based on preliminary costs from Beach-fx

3.8 Recommended Plan

The NED plan becomes the Recommended Plan unless the non-federal sponsor chooses to pursue a Locally Preferred Plan (LPP) which differs from the NED plan. An LPP is subject to requirements described in ER 1105-2-100. There is no LPP for this study at this time, although the nonfederal sponsor still has the option to pursue one. Therefore, the NED plan is chosen as the Recommended Plan.
3.8.1 Description of the NED Plan

The NED plan for the Fort Pierce SPP consists of shore stabilization structures and a protective dune and berm. The structures design includes seven shoreline stabilization structures — six T-head groins and nearshore breakwater — constructed between R-33.8 and R-36. The nourishment template includes a 20-ft wide dune crest at elevation 12.4 ft NAVD and a 130-ft wide berm at elevation 7.4 ft NAVD along the entire project area, extending from the Fort Pierce Inlet south jetty to R-41.

As the NED Plan would represent a continuation of the currently authorized project, the initial nourishment of the NED Plan is a typical nourishment project but would also include construction of the shoreline stabilization structures. The average construction volume over 100 iterations of each nourishment project is 576,490 cubic yards (cy). The life-cycle modeling provided by Beach-fx results in more resilient and adaptable plans that account for the inherent uncertainty in simulating future events. Traditionally, in CSRM studies, a fixed nourishment interval is defined and optimized for a 50-year period of Federal participation. In Beach-fx, rather than having a fixed nourishment interval, nourishment events are triggered when specific criteria are met. The triggers were set up to simulate a point at which the berm extension erodes to at least half its equilibrated width. Based on these parameters, the average time interval between nourishment events over all 100 iterations is 4 years. In reality, this interval could vary depending on erosion and storm events. The Engineering Appendix provides more information about the nourishment triggers.

Upon completion of the Beach-fx simulations and evaluation of the results to identify the NED Plan, this study refined the project costs independent from Beach-fx. The Cost Engineering Appendix discusses these refined cost estimates, which are used to calculate the benefit to cost ratio of the NED Plan. The refined cost estimate is based on the same unit nourishment costs, non-construction costs, and contingency applied in Beach-fx, but calculated in accordance with the project schedule. Additionally, as discussed in the following sections, evaluation of the NED Plan must consider recreation and land loss benefits, calculated external to Beach-fx, in addition to the CSRM benefits provided by the model. Table 3.4 provides a description of the NED Plan based on the refined cost and benefit estimates.

### Table 3.4 NED Plan Description

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average Number of Nourishment Events</td>
<td>1 initial construction and 12 nourishment events</td>
</tr>
<tr>
<td>Average Volume</td>
<td>576,490 cy</td>
</tr>
<tr>
<td>Average Periodic Nourishment Interval</td>
<td>4 years</td>
</tr>
<tr>
<td>Construction Duration</td>
<td>Approximately 3 months</td>
</tr>
<tr>
<td>Total Project Cost (including contingency)</td>
<td>$135,895,551 (FY2021)</td>
</tr>
<tr>
<td>Cost Sharing</td>
<td>Federal: 77.76%; Non-Federal 22.24%</td>
</tr>
<tr>
<td>Benefit-to-Cost Ratio</td>
<td>1.60 (FY2021 Price Level and 2.875% discount rate)</td>
</tr>
</tbody>
</table>

3.8.2 NED Plan Sand Source

The NED Plan will require approximately 10,075,000 cubic yards of sand over a 50-year period. As detailed in the Geotechnical Appendix, the currently permitted Capron Shoal borrow area combined with other nearby proven sand resources are more than adequate to meet the estimated project volume.
3.8.3 Benefits of the NED Plan

3.8.3.1 CSRM benefits

The Fort Pierce SPP study area is highly susceptible to hurricane and storm damage. This is particularly true for the northern section of the project that currently experiences extreme beach fill erosion rates. Beach-fx modeling has demonstrated that, in the absence of a federal project, significant economic damage from coastal forces can be expected to occur over the next 50 years. The model results suggest the NED Plan is highly effective, protecting upland property from 99% of all damages in the project life. Considering the currently authorized project allowed minimal damage during Hurricanes Frances and Jeanne in 2004, the Beach-fx results are in-line with expectations. Total CSRM benefits in the NED Plan amounted to $118,566,420 (PV) or $4,499,369 AAEQ.

3.8.3.2 Land Loss Benefits

Additional primary storm damage reduction benefits include those derived from the stabilization of the shoreline which prevents loss of land in the study area. ER-1105-2-100 states that loss of land should be computed as the market value of the average annual area expected to be lost. The Beach-fx model does not compute land loss; thus, the land loss reduction benefit must be calculated external to the model and added to the structure and contents damage benefits to obtain the total storm damage reduction benefits of the project.

Calculation of land loss benefits requires (1) the square footage of the land lost each year, which derives from Beach-fx output, and (2) the market value of land in the project footprint. The Jacksonville District Real Estate Department estimated a nearshore land value of $25.00 per square foot for the Fort Pierce study area; the Economics Appendix provides additional details. Based on these data, the total present value of land loss benefits over the 50-year authorization period is $60,479,606, or $2,295,085 AAEQ.

3.8.3.3 Recreation Benefits

According to federal guidance, incidental recreation benefits that result from the construction of a project can be calculated and added to overall project benefits in CSRM studies. Recreation benefits are not to be used in plan formulation, but they can constitute up to 50% of total benefits for project justification. This study applied the user day value (UDV) method, developed by the USACE, to estimate the recreation experience value, or “willingness to pay”. Calculating the recreation benefit, based on the FWP and FWOP user day values and annual visitation, for each year and summing these annual benefits over the 50-year authorization period results in a total recreation benefit present value of $38,294,382 (FY2021), or $1,453,199 AAEQ.

3.8.3.4 Summary

Based on the CSRM, land loss, and recreation benefits and refined project costs, the NED Plan yields $1.60 in benefits for every $1.00 spent (i.e. BCR is 1.60). Table 3.5 provides a summary of the benefits with- and without the recreation benefit.
Table 3.5 NED Plan Economic Summary

<table>
<thead>
<tr>
<th>Description</th>
<th>Present Value (FY2021 Dollars)</th>
<th>AAEQ (FY2021 Dollars)</th>
<th>Without Recreation</th>
<th>With Recreation</th>
</tr>
</thead>
<tbody>
<tr>
<td>CSRM Benefit</td>
<td>$118,566,420</td>
<td>$4,499,369</td>
<td>$4,499,369</td>
<td></td>
</tr>
<tr>
<td>Upland Land Loss Benefit</td>
<td>$60,479,606</td>
<td>$2,295,085</td>
<td>$2,295,085</td>
<td></td>
</tr>
<tr>
<td>Recreation Benefit</td>
<td>$38,294,382</td>
<td>0</td>
<td>$1,453,199</td>
<td></td>
</tr>
<tr>
<td>Total Benefits</td>
<td>$217,340,408</td>
<td>$6,794,454</td>
<td>$8,247,652</td>
<td></td>
</tr>
<tr>
<td>Total Cost</td>
<td>$135,895,551</td>
<td>$5,156,976</td>
<td>$5,156,976</td>
<td></td>
</tr>
<tr>
<td>Net Benefits (Total Benefits-Cost)</td>
<td>$81,444,857</td>
<td>$1,637,478</td>
<td>$3,090,676</td>
<td></td>
</tr>
<tr>
<td>Benefit Cost Ratio (Total Benefits/Total Cost)</td>
<td>1.60</td>
<td>1.32</td>
<td>1.60</td>
<td></td>
</tr>
</tbody>
</table>

3.8.4 NED Plan Cost Sharing

Section 103(d) of the Water Resources Development Act of 1986 (Public Law 99-662) specifies that the cost of construction measures for shore protection projects are cost shared at 65% Federal and 35% non-Federal, and separable recreation projects are cost shared at 50% Federal and 50% non-Federal. Cost sharing for beach erosion control measures must also consider shore ownership and use. WRDA 99 Section 215(a) modified periodic nourishment cost sharing percentages for projects authorized for construction after December 31, 1999. However, because the entire 1.3-mile project was authorized for construction before December 31, 1999, WRDA 99 cost sharing percentages do not apply.

An analysis of shoreline ownership and use resulted in a Federal participation rate of 44.4% and non-Federal rate of 55.6%. However, the 1982 Section 111 Study for Fort Pierce attributes 60% of the erosion along the 1.3-mile shoreline south of the south jetty to the Fort Pierce Harbor Federal Navigation Project. WRDA 1999 Section 313(a) provides Congressional authorization for Federal participation in harbor mitigation as part of the Port of Fort Pierce "project for shore protection and mitigation." Therefore, 60% of the project costs, apportioned to the Fort Pierce Harbor Federal Navigation Project become a Federal cost. The remaining 40% of the project costs are apportioned between the Federal government and St. Lucie County in accordance with the authorized Federal Fort Pierce, Florida Shore Protection Project. Application of these principles results in an overall cost sharing of 77.76% Federal share and 22.24% non-Federal share. The Public Access and Cost Share Appendix provides additional details.

3.8.5 NED Plan Costs

The NED Plan total project cost including contingency (20%) and non-construction costs (20%) is $135,895,551 (present value FY2021), as shown in Table 3.6. The Cost Engineering Appendix provides additional details.
Table 3.6 NED Plan Total Project Costs (FY16)

<table>
<thead>
<tr>
<th>Construction Year &amp; Event</th>
<th>Contract Cost Total (FY2021 Dollars)</th>
<th>AAEQ (FY2021 Dollars)</th>
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3.9 Operation and Maintenance Considerations

3.9.1 Project Monitoring

Post-construction physical monitoring of the project is necessary to assess project performance and to ensure that project functionality is maintained throughout the 50-year authorization period. Typical post-construction monitoring activities include collection and analysis of beach profile surveys of the placement area and downdrift control area annually for three and then biennially until the next nourishment event; St. Lucie County conducts such monitoring for the currently authorized project. Pre-construction and immediate post-construction beach profile surveys and borrow area bathymetric surveys are also required to verify that beach placement and dredging activities proceeded in compliance with applicable permits; however, such costs typically fall under construction costs. The above-mentioned total project costs include post-construction physical monitoring.
4.0 EFFECTS OF THE NED PLAN

This chapter presents the scientific and analytic evaluation of effects that would result from implementing the NED Plan. Section 2 includes the effects resulting from the “No-action alternative,” or the “Future Without-Project Conditions.” The following sections discuss anticipated changes to the existing environment including direct, indirect, and cumulative effects as a result of the NED Plan, or the “Future With-Project Conditions.”

4.1 Natural (General Environment)

4.1.1 General Environmental Effects

Future With-Project (NED Plan)

In accordance with permits issued by the State of Florida, the USACE and non-federal sponsor have previously placed beach quality material from the designated offshore borrow site along this shoreline. The NED Plan proposes to continue use of the same borrow site to support continued beach restoration at an improved frequency of four years. The beach placement area is identical to the currently authorized project. Previously identified impacts to hardbottom resources within this area have been mitigated by the non-federal sponsor.

The beneficial effects of continued sand nourishment along the proposed project area include establishing a buffer beach to protect upland infrastructure and populations against storms and flooding. Beach nourishment also creates additional habitat for beach flora and fauna as well as more space for recreational activities. The proposed project would likely produce more favorable environmental conditions than exist at present, although construction operations would produce some temporary adverse effects. These effects would be primarily temporary in nature, and most affected resources would return to pre-construction conditions either immediately after dredging (with respect to resources such as aesthetics and noise) or within one or two years (with respect to sea turtle nesting and benthic resources).

4.1.2 Vegetation

Future With-Project (NED Plan)

The plan would result in minor, short-term impacts to herbaceous dune vegetation that inhabits the upper beach and foredune. Fill placement would not occur landward of the dune crest. The proposed beach nourishment would help stabilize and protect the dune vegetative communities from storm surge and erosion. Adding sand to the system would promote further dune habitat development. If needed, the plant community could be reestablished by planting a mix of native dune species that, depending on nursery availability, may include sea oats (Uniola paniculata), beach sunflower (Helianthus debilis), railroad vine (Ipomoea pes-caprae), and dune panic grass (Panicum amarum).

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

Future With-Project (NED Plan)

Effects that could potentially affect fish and wildlife resources include:

- Alteration (burial) of exposed nearshore hardbottom and associated epibenthos during and subsequent to nourishment activities.
• Disturbance of the sand bottom habitats and associated macroinfauna of the shoal borrow area and beach fill sites during nourishment activities.
• Modification of the Capron Shoal feature.
• Turbidity.
• Underwater noise and vibration from dredging activities.
• Construction noise.

Alteration (Burial) of Exposed Nearshore Hardbottom

As mentioned, previously identified impacts (9.6 acres) to hardbottom resources within the project area have been mitigated by the non-federal sponsor; these impacts include 8.9 acres of anticipated impacts and 0.7 acre of unanticipated impacts. Additionally, the non-federal local sponsor continues to conduct annual hardbottom monitoring and coordinate with the regulatory agencies to identify any additional impacts requiring mitigation. Analysis of the NED plan indicated the four-year nourishment interval would decrease sand placement volume by approximately 50% over the long term, as compared to the currently authorized project, and individual project fills would remain within the original (1996) project equilibrium toe of fill. Therefore, the NED Plan is not expected to require mitigation in addition to that already accomplished by the non-federal sponsor.

Disturbance of Sand Bottom Habitats

Dredging activities within the offshore shoal borrow area and pump out activities at the project site would continue to impact the demersal and pelagic fish species, macrofaunal invertebrates, and infaunal benthiic invertebrates. The potential disturbances to the sand bottom habitats include anchoring of the hopper barge during pump out activities, vibrations caused from the pump out activities, and placement of the pump out and conveyance pipes. Injuries to infaunal invertebrates and any motile macrobenthic invertebrate species would most likely occur during entrainment as part of the dredging operations. Some benthic infaunal invertebrates would survive and recolonize parts of the submerged beach fill area, but any exposed on the new beach berm are not anticipated to survive nourishment activity.

Greene (2002) summarized a number of studies of benthic invertebrate recovery rates. These studies show that benthic invertebrate communities’ recovery can occur in as few as two weeks but often with an assemblage dissimilar to the preconstruction infaunal community composition. Recovery of the populations typically occurs two to seven months after nourishment, given that organisms living in the high-energy beach environment, especially the intertidal area, are adapted to disturbances. Recovery of organisms in soft-sediments typically occurs through larval transport and post-settlement life-stages (juveniles and adults) and varies with the season, habitat, and the species’ life history characteristics. Active dredging operations during project activities would displace motile macrobenthic invertebrates and especially demersal and pelagic fish species that use the soft bottom habitats (shoal areas and beach fill areas) unless these groups avoid the dredging areas. Dredging activities would restrict motile macrobenthic invertebrates and demersal/pelagic fishes from feeding on the infauna and flora living in and on the soft bottom habitat.

Numerous studies have examined the impacts to the infaunal communities of borrow areas including (but not limited to) Turbeville and Marsh (1982), Byrnes et al. (2003), Hammer et al. (2005), Byrnes et al. (2004), and Burlas et al. (2001, 2002). Those studies determined that the community composition, diversity, and abundance recovered to pre-dredge condition within two years.

Wilber and Stern (1992) found that while borrow sites may remain in an early successional stage for two to three years, within those years the sites they considered still developed infaunal biomass that provided a food source for fish and macrocrustaceans. In addition, Turbeville and Marsh (1982) examined an offshore
dredging operation off Hillsboro Beach in 1972. They determined that although the faunal similarity analysis indicated a qualitative change in the fauna of the borrow area had occurred, the change was not detrimental. They concluded that the offshore dredging operations conducted caused no observable adverse effects in terms of reduced numbers of species, reduced faunal abundance, or reduced species diversity within the borrow area.

Hammer et al. (2005) found that physical, chemical, and biological factors influence the composition of benthic assemblages. Although excavation of sand borrow areas can expose underlying sediments and change the sediment structure and composition, their research found that the vertical sediment composition in the borrow pits offshore of central Florida tended to be uniform. Therefore, recolonization would likely proceed if, as proposed for the South St. Lucie County Beach Restoration Project, dredging does not cut below the depth of the adjacent grade. In addition, warmer waters (e.g., the Atlantic Ocean waters of central Florida including St. Lucie County) may shorten infaunal recolonization time.

Hammer et al. (2005) also determined that dredging at the sand borrow sites located in central east Florida would not likely adversely affect pelagic fish populations unless dredging disrupts specific spawning, aggregation, or migratory areas. Impacts from routine dredging operations and accidents would be avoided and minimized with the appropriate management of dredging operations and use of best management practices.

In regards to the above-mentioned South St. Lucie County Beach Restoration Project, infaunal sampling (CSA, 2011) included the St. Lucie Shoal borrow area, the refuge patch, and an adjacent sand habitat reference site. The analysis of these data indicated that although more total organisms occurred within samples collected at the borrow area sites (11,553) than in the reference site samples (6,268), the same taxa occurred in both locations in similar percentages. The density of organisms per m² within the three sampled areas were also similar with 33,483 organisms per m² for the reference sites, 49,372 organisms per m² for the borrow area sites, and 45,641 organisms per m² for the refuge patch sites. The primary difference in the numbers occurred because of greater numbers of annelids and other taxa sampled in the reference site. In addition, the percentage of organism groupings differed significantly between the refuge patch and the other two sites (the borrow area site and reference site). Such differences are typical of benthic infauna distribution, characterized by patchiness and wide variability in numbers of individuals. The results of this sampling effort indicated that with the excavation of a portion of the St. Lucie Shoal, although the infaunal community would experience impacts, numerous organisms would remain within the refuge patch and the surrounding area to provide feeding opportunities for demersal/pelagic fishes and for recovery of the organisms within the dredged area. Given the proximity of St. Lucie Shoal to the borrow resources for the Fort Pierce SPP, the above results are applicable to this study.

The temporal duration of construction would be short. Technical literature suggests that soft bottom infaunal invertebrate assemblages typically recover relatively rapidly (two to three years). While recovery of the infaunal invertebrate assemblage takes place, feeding opportunities would be present in the surrounding areas.

Modification of the Capron Shoal Feature

Offshore sand shoal habitats have been shown to provide fundamental ecological functions for demersal/pelagic fish species and motile macrobenthic invertebrates that include categories of spawning, shelter, or foraging. Offshore shoal habitats have been identified as important benthic habitats along the eastern U.S. and South Florida. Vasslides and Able (2008) found the richest fish assemblages at study sites off the coast of southern New Jersey associated with sand ridges in the 9–14 m depth range. Recent studies by Gilmore (2009) have determined that as many as 200 species of fish use sand shoal habitats within their
life cycle, particularly during their cross-shelf migration, an important phase to the demersal reef fish population. These shoal habitats also function as aggregating points for small pelagic fishes, important prey for numerous managed species, particularly from the coastal pelagic and highly migratory groups.

The currently permitted borrow site the project is limited to the portion of Capron Shoal located within state waters. Capron Shoal has been highly modified by prior dredging activity. Future dredging activity will follow the guidelines identified in the Borrow Area Conservation Plan (Appendix D, Sub-Appendix D-4) to avoid and minimize further impacts. A similar conservation plan will also be implemented should or when Capron Shoal is no longer a viable borrow area and another shoal is proposed as a project sand source. Modification of the Capron Shoal feature could impact the demersal/pelagic fish and invertebrate assemblages that use this feature. Depending on the dredging design and execution, this action could alter this shoal structure permanently and could affect the local ecological processes occurring at this location.

**Turbidity**

Several activities during construction are anticipated to affect water quality. The main source of water quality impacts — borrow area dredging and sand placement on the beach face — would produce turbidity at the borrow site and along the shoreline. Even if it does not kill fish, turbidity has been shown to have negative impacts during extreme natural events (Robins 1957). The nearshore hardbottom fish assemblages would most likely avoid any extreme turbidity conditions. Impacts may occur to fishes in planktonic stages of development and to some juveniles related to turbidity. However, past offshore dredging efforts by USACE, while monitored closely, have not produced visible kills of juvenile fishes. Most fishes able to do so would likely avoid the area until the water quality returns to acceptable levels.

At the borrow site, the proposed borrow material has a composite silt content of less than 2%. The borrow area dredging design leaves a 2-ft buffer of beach compatible fill intact; thus, the exposed top layer of sediment after dredging should be similar to the existing top layer of the shoal. Mobile species would move out of the dredge area during dredging activities due to the short-term disruption to the area from the construction activities. Once dredging ceases, the mobile species are anticipated to return to the area and, based on the geotechnical data, are not expected to experience more turbidity after dredging than prior to dredging. No reports or observations of fish impacts sufficient to harm a species significantly could be identified.

Implementation of proper design and BMPs could reduce the magnitude and extent of impact resulting from proposed project activities, which would likely be limited in extent and short duration.

**Underwater Noise and Vibration from Dredging Activities**

In general, the expected short-term sources and levels of underwater noise and vibration generated during a dredging project should cause only negligible impacts on marine mammals, fish, and other wildlife present in the project area. Wildlife that may visit the project area during the construction period are likely to move from or avoid disturbance caused by construction activities.

**Construction Noise**

In general, the sources and noise generated during the project construction activities would include temporary sources of noise and could result in short-term, minor, adverse effects to shorebirds and seabirds in the vicinity of both the beach fill and borrow area sites. Shorebirds and seabirds that may visit the project area during the construction period are likely to move from or avoid disturbance caused by construction activities.
4.1.4 Threatened and Endangered Species

Future With-Project (NED Plan)

The NED Plan may affect nesting sea turtles. Also, the plan may affect, but is not likely to adversely affect sea turtles in the water, manatees, whales, smalltooth sawfish, piping plover, or the rufa red knot. The terms and conditions of the 1997 NMFS South Atlantic Division Regional Biological Opinion (SARBO), 2008 USFWS Biological Opinion (USFWS, 2008) (updated in 2015; USFWS, 2015b) for the Fort Pierce SPP, and 2013 Programmatic Piping Plover Biological Opinion will be followed for these species. If necessary, additional consultation between the USACE and USFWS will be performed on the rufa red knot. In addition, USACE has determined that the proposed dredging and beach placement could temporarily impact the physical or biological features (PBF) and primary constituent elements (PCE) of loggerhead critical habitat unit LOGG-T-FL-09 during construction. Hatchling egress from the water’s edge to open water and nesting female transit back and forth between the open water and the nesting beach during nesting season could be hindered by the presence of the dredge and pipeline. However, the construction phase would typically last 3 months approximately every 4 years (erosion due to storms could require more frequent events) and the daily construction activity would occur within only a small area at a time. In addition, the SARBO includes conditions that minimize incidental take of turtles. Finally, the placement of sand may increase sea turtle nesting habitat if the placed sand is highly compatible (i.e., grain size, shape, color, etc.) with naturally occurring beach sediments in the area, and compaction and escarpment remediation measures are incorporated into the project (i.e., the project complies with the terms and conditions of the SPBO). Therefore, the project will not destroy or adversely modify loggerhead critical habitat.

4.1.4.1 Sea Turtle Nesting Habitat

Although not permanent residents of sandy beaches, marine turtles are organisms of major concern for the project, as they use the supralittoral zone for nesting and use nearshore hardbottom areas for foraging. Providing compatible beach fill would result in increasing the beach area available to nesting threatened and endangered turtle species.

Of the threatened and endangered species found in coastal St. Lucie County, nourishment activities are more likely to impact sea turtles, simply by their ubiquity during nesting season. Escarpments obstructing beach accessibility, altered beach profiles, different sand color characteristics, and increased sand compaction often hinder nesting success the first year after nourishment (USFWS, 2015a). Impacts of a nourishment project on sea turtle nesting habitat are typically short-term because natural processes rework a nourished beach in subsequent years. Constant wave and current action reworks the beach, and reduces sand compaction and the frequency of escarpment formation while the sun bleaches darker sand (USFWS 2015a).

Nests on nourished beaches generally hatch successfully (Nelson and Dickerson, 1988). Herren (1999) found no significant difference in hatching success in the nourished area in the first or second season after the Sebastian Inlet sand transfer nourishment. EAI (1999) found lower overall hatch success on nourished beaches following construction compared to controls, but the differences were not statistically different. EAI (1999) did show changes in incubation environment, but these changes did not affect the hatching success. Both the Herren and EAI studies point to erosional losses of nests created low on the newly constructed berms as the primary source of impact. A proper relocation program could largely eliminate this source of impact.

The updated 2008 USFWS Biological Opinion (USFWS, 2015b) for the Fort Pierce SPP requires that nourishment activities cease by May 15 in the R-37 to R-41 segment and by May 31 in the R-34 to R-37
segment to avoid the peak nesting season. The project will follow this guidance to avoid and minimize impacts due to nourishment activities.

The project would be constructed in two phases, a beach nourishment followed by construction of the shore stabilization structures groins. T-head groin and breakwater construction would occur on a dry beach, landward of the mean high water line. Building the individual structures one at a time would minimize the construction area. As recommended by the USFWS, the design will include a weir at the intersection of the stem and head on the southernmost T-head groin. This modification will minimize hatchling entrapment behind the T-head by providing a void space for hatchlings to escape through the T-head. Final design details of the groins will be coordinated with the USACE and USFWS to avoid and minimize impacts to marine turtles.

Precautionary measures including installation of hay bales around the perimeter of the T-head groin or breakwater under construction would minimize potential impacts to nesting marine turtles by deterring nesting in these areas. Daily nest monitoring and nest relocation in advance of construction would further minimize impacts to marine turtles. The USACE will consult the USFWS regarding turtle protection by design and by specific actions during construction.

Because the proposed project would use sand with characteristics very similar to the native beach sand, sand quality is unlikely to have negative effects on sea turtle nesting or hatchling emergence. However, the NED Plan may still have negative effects on nesting sea turtles resulting from construction related impacts during and after construction. These impacts could include nesting disturbance, sand compaction, scarp formation, and artificial lighting.

Marine turtle nesting in the project area is dominated by Loggerhead turtles and for all species is characterized by significant variation between years. The data include no evident pattern related to the nourishment events (Figure 4.1). Within a year following the project (construction year up to a year post-construction), impacts to sea turtles associated with the project may include:

- Disturbance of nesting female turtles attempting to nest within the construction area or on adjacent beaches due to construction activities
- Behavior modification of nesting females from beach escarpment formation during a nesting season. Example: Behavioral changes could result in false crawls or selection of marginal or unsuitable nesting areas to deposit eggs.
- Destruction, damage, or burial of existing nests during nourishment activities
- Effects to eggs and hatchlings from changes in the physical and chemical characteristics of the nourished beach. Example: The quality of the placed sand could affect the ability of female turtles to nest, the suitability of the nest incubation environment, and the ability of hatchlings to emerge from the nest.
- Lighting-induced disorientation of hatchling turtles on beaches adjacent to the construction area as they emerge from the nest and crawl to the water
- Alteration (burial) of nearshore exposed hard substrate (feeding grounds to sea turtle juveniles) during and after nourishment activities
USFWS biological opinions for similar projects recognize that placement of sand on a critically eroded beach can enhance sea turtle nesting habitat if the sand placed is highly compatible (i.e., grain size, shape, color, etc.) with naturally occurring beach sediments at the recipient site and compaction and escarpment remediation measures are properly adopted (USFWS, 2015a). State permit requirements for beach nourishment projects usually address avoidance and minimization of potential impacts to nesting turtles and nesting habitat. Permit conditions may include consideration of:

- Sand quality: a major component of the beach nourishment permitting process is to assure the sand placed on the beach is compatible with the natural beach.
- Timing of construction activities: USFWS has jurisdiction over sea turtles (nesting adults, incubating eggs, and hatching young) on the beach. The 2008 USFWS Biological Opinion (updated in 2015) for the Fort Pierce SPP requires that nourishment activities cease by May 15 in the R-37 to R-41 segment and by May 31 in the R-34 to R-37 segment to avoid the peak nesting season in the project area and minimize potential impact to nesting sea turtles. If projects require nighttime construction activities, State permits would restrict nighttime construction to specific areas, usually no more than 500 feet in length.
- Pre-nesting season compaction monitoring, mechanical tilling, and grading of the beach: these activities can greatly reduce or eliminate the effects of increased sand compaction and scarp formation. Post-construction compaction monitoring or tilling before nesting season is a state and federal permit requirement after nourishment activities, and for three years after project completion. State and Federal agencies require tilling the project area beaches if penetrometer
testing demonstrates compaction greater than 500 pounds per square inch at any two adjacent sampling stations or depths. Additionally, leveling of escarpments greater than 18 inches in height or 100 feet in length must occur before nesting season begins.

- Relocation of sea turtle nests: Along the shoreline of Hutchinson Island, USFWS typically requires monitoring and relocating sea turtle nests between March 1 and April 30 if nourishment activities occur during that period.
- Hardbottom impacts: avoidance and minimization of hardbottom impacts also comprise major considerations during review of any beach nourishment permit application.

As natural processes rework the nourishment area and the beach equilibrates, the increase in beach area provided by this alternative could have a long-term benefit on sea turtle nesting south of the project area.

### 4.1.4.2 Inner Shelf Sea Turtle Habitat

Effects associated with offshore dredging that could potentially affect sea turtles include:

- Vessel traffic
- Entrainment by hopper dredge drag heads
- Alteration (burial) of exposed nearshore hardbottom and associated epibenthos during and subsequent to nourishment activities
- Alteration of exposed nearshore hardbottom and associated epibenthos resulting from the sand delivery pipelines
- Turbidity
- Underwater noise and vibration from dredging activities

#### Vessel Traffic

Dredge, dredge support, and construction vessel traffic raises a chance of these vessels colliding with sea turtles. The risk would vary depending upon location, vessel speed, and visibility. Most sea turtles occur within nearshore waters and waters of the continental shelf. All life stages (hatchling, juvenile or subadult, and adult) may occur within the project area. During the hatching season, researchers believe that hatchling turtles leave their nesting beaches and swim offshore to areas of mass convergence. A moving vessel could have difficulty spotting hatchling and juvenile turtles in these areas, especially when the individuals lie within patches of floating *Sargassum*. Adult turtles are generally visible at the surface during periods of daylight and clear visibility.

To reduce the risk of impacts from dredging and vessel strikes, the project would comply with the “Sea Turtle and Smalltooth Sawfish Construction Conditions” (NMFS 2006) and “Vessel Strike Avoidance Measures and Reporting for Mariners” issued by NOAA Fisheries, Southeast Region. Operators and crews receive instructions to maintain a vigilant lookout for turtles during offshore transits and maneuvers. Despite these precautions, turtles could prove very difficult to spot from a moving vessel when resting below the water surface, during nighttime, and during periods of inclement weather. A collision between a sea turtle and a slow-moving vessel may occur. Adult, subadult, and perhaps juvenile turtles are often capable of avoiding moving dredge related vessels when these vessels operate within limited areas at slow to relatively slow speeds.
Entrainment by Hopper Dredge Drag Heads

Entrainment within hopper dredge drag heads could injure or kill sea turtles, particularly within areas of soft sediment in ship channels where turtles are known to bury themselves partially when resting (National Research Council Committee on Sea Turtle Conservation 1990). Sea turtles have also been observed to partially bury themselves in soft sediments that have settled into previous dredge borrow pits (Keith Spring and David Snyder, personal communication: observations of sea turtles using borrow pits off Hobe Sound, Florida). Numerous methods have been implemented to reduce the number of turtle takes during hopper dredge operations, including special turtle deflecting hopper dredge drag heads, relocation trawling, dredging windows, and the implementation of trained protected species observers during dredging operations (SADBO 1997).

The numerous areas of emergent hard substrate in the general project area represent high quality shelter for turtles. The proposed offshore borrow area presents a lower quality refuge, as it is an area of bare sand positioned along the inner continental shelf, proximal to hardbottom habitat.

USFWS- or NMFS-approved protected species observers would be stationed on hopper dredges, which would come equipped with a sea turtle deflecting drag head deflector for use within the proposed borrow site during all dredging operations. Even with these measures in place, incidental take(s) of sea turtles during dredging remains a possibility.

Alteration (Burial) of Exposed Nearshore Hardbottom

As mentioned, previously identified impacts (9.6 acres) to hardbottom resources within the project area have been mitigated by the non-federal sponsor; these impacts include 8.9 acres of anticipated impacts and 0.7 acre of unanticipated impacts. Additionally, the non-federal local sponsor continues to conduct annual hardbottom monitoring and coordinate with the regulatory agencies to identify any additional impacts requiring mitigation. Analysis of the NED plan indicated the four-year nourishment interval would decrease sand placement volume by approximately 50% over the long term, as compared to the currently authorized project, and individual project fills would remain within the original (1996) project equilibrium toe of fill. Therefore, the NED Plan is not expected to require mitigation in addition to that already accomplished by the non-federal sponsor.

Turbidity

Several activities during construction would affect water quality. Dredging and sand placement on the beach face would produce turbidity at the borrow site and along the shoreline. The limited extent and short duration of the reduced water clarity and implementation of proper design and Best Management Practices (BMPs) should reduce the magnitude and extent of temporary impacts of project activities. Turbidity generation would cease at the completion of construction. Past projects used the following FDEP permit water quality standards: A maximum 29 NTU above-background turbidity at the edge of a 150-meter down-current mixing zone. All projects remained within acceptable turbidity limits.

Underwater Noise and Vibration from Dredging Activities

Little is known how turtles may respond to noise from offshore activities. In contrast to marine mammals, relatively little is known about sea turtles’ hearing ability or their dependency on sound, passive or active, for survival cues. Only two species, loggerhead and green sea turtles, have undergone any auditory investigations. The anatomy of the sea turtle ear does not lend itself to aerial conduction; rather, it lends itself to sound conduction through bone and water (Lenhardt, 1982 and Lenhardt and Harkins, 1983).
Auditory testing and behavioral studies show that turtles can detect low frequency sounds (Bartol et al. 1999).

Sea turtles could likely hear low frequency underwater noise from construction activities and possibly experience some disturbance. The main noise sources include vessel engines. The most likely impacts would include short-term behavioral changes such as evasive maneuvers, disruption of activities, or short-term departure from the area.

4.1.5 Marine Mammals

Future With-Project (NED Plan)

Effects associated with the proposed action that could potentially affect listed marine mammals include:

- Vessel traffic
- Turbidity
- Underwater noise and vibration from dredging activities
- Underwater noise and vibration from dredging activities

Vessel Traffic

Dredge, dredge support, and construction vessel traffic associated with the proposed action raises the chance these vessels could collide with listed marine mammals. The risk would vary depending upon location, vessel speed, and visibility. North Atlantic right whales may occur in the project area during the wintering and calving period. Humpback whales may also travel through the middle shelf, offshore of the project area; however, as anticipated, they would not occur within the borrow area or within nearshore waters. Both of these species are large and readily visible at the surface during periods of daylight and clear visibility. Florida manatees may, but are unlikely to, occur within the project area. On-board trained and NMFS-approved protected species observers would be stationed on dredges during all dredging operations, and dredge support vessel operators and crews would receive instructions to maintain a constant lookout for marine mammals during transits and maneuvers.

On-board trained and NMFS approved protected species observers would be stationed on dredges during all dredging operations, and dredge support vessel operators and crews would receive instructions to maintain a constant lookout for marine mammals during transits and maneuvers. Educating the contractor and employees on possible environmental impacts and ways to minimize these impacts and implementing the various precautions mandated in the Marine Mammal Protection Act would decrease the possibility of inadvertently harming marine mammals and manatees.

Despite these precautions, these species could prove very difficult to spot from a moving vessel when they are resting below the water surface, during nighttime, and during periods of inclement weather. However, these animals are capable of avoiding moving dredge-related vessels, especially when these vessels operate within limited areas at slow to relatively slow speeds.

Underwater Noise and Vibration from Dredging Activities

Potential effects of the elevated background noise levels caused by operator-generated noise to marine mammals include:

- Limiting the detection by the mammals of natural sounds
• Disturbing their normal behavior, resulting in possible displacement from areas
• Causing temporary or permanent reductions in hearing sensitivity

The potential effects depend on the type of marine mammal involved, because different marine mammals hear at different frequencies. The levels and types of ambient noise also strongly influence the potential area or zone of influence of an operator-generated sound. An animal’s sensitivity to different sounds varies with frequency, and its response to a sound likely depends strongly on the presence and levels of sound in the frequency band or range of frequencies to which it is sensitive. Although underwater noise can affect marine mammals (Richardson et al., 1995), the project does not involve any high-energy sound sources that could cause temporary or permanent auditory damage. In general, the sources and levels of underwater noise and vibration generated during the project should cause only minor impacts on marine mammals. The most likely impacts are temporary behavioral responses such as avoidance or altered diving or swimming behavior.

The North Atlantic right whale uses the project area as part of the species’ migratory route and as potential calving grounds during the winter months; however, these whales are rare to the project area. The humpback whale is rarely present within the vicinity of St. Lucie County during its spring/fall migration. Manatees have been observed along the coast in the shallow, nearshore waters, though only rarely. Marine mammals would likely avoid areas where a dredge is operating. The project area is an extremely small area when compared to the overall waters used for migration and calving. Standard protective measures would be taken during placement activities to ensure the safety of manatees and other marine mammals.

4.1.6 Smalltooth Sawfish

Future With-Project (NED Plan)

Effects associated with the proposed action that may potentially impact smalltooth sawfish include:

• Turbidity
• Underwater noise and vibration from dredging activities
• Entrainment by hopper dredge drag heads

Turbidity

Several activities during construction could affect water quality. The main sources of water quality impacts are borrow area dredging and sand placement on the beach face, which would produce turbidity at the borrow site and along the shore. Turbidity could cause temporary impacts to as much as about one acre of hardbottom habitat. Proper implementation of the approved design and construction BMPs should limit the level and extent of construction-related turbidity. Turbidity generation would cease at the completion of construction. Due to the limited extent and short duration of the reduced water clarity, any potential impacts on smalltooth sawfish should be negligible.

Underwater Noise and Vibration from Dredging Activities

In general, the sources and short-term levels of underwater noise and vibration generated during the project should cause only negligible impacts on smalltooth sawfish. Smalltooth sawfish that may visit the project area during the construction period are likely to move from or avoid disturbance caused by construction activities. These temporary avoidance behaviors should cause negligible impacts on smalltooth sawfish.
Entrainment by Hopper Dredge Drag Heads

The smalltooth sawfish normally inhabits shallow waters (10 m or fewer), often near river mouths or in estuarine lagoons over sandy or muddy substrates, but may also occur in deeper waters of the continental shelf at depths greater than 20 meters (NMFS 2006a). Sawfish encounter a small risk of being entrained in the hopper dredge drag head as it extracts sand from the offshore borrow area. To reduce the risk of impacts from dredging and vessel strikes, the project would comply with the “Sea Turtle and Smalltooth Sawfish Construction Conditions” (NOAA Fisheries 2006b). Mitigation measures would minimize entrainment risks. Measures would include the use of sea turtle deflecting drag head deflector, which would also help deflect smalltooth sawfish.

Disturbances from ongoing activities could displace smalltooth sawfish that may visit the project area during the construction period. These disturbances could result in temporary movement or avoidance of the area, but the species would likely return when the temporary disturbance ended.

4.1.7 Piping Plover and Rufa Red Knot

Future With-Project (NED Plan)

Wintering grounds and migration stopovers for piping plovers and red knots include Hutchinson Island. While coastal development has reduced important beach habitat for wintering bird species, beach nourishment can restore beach habitat for many shore birds. However, during the beach nourishment construction phase, some short-term displacement of foraging and resting birds, including piping plovers and red knots, could occur. During construction activities, displaced species may use habitats with similar characteristics north and south of the project area.

Beach nourishment activities are more likely to affect birds that use the beach for nesting and breeding than birds that use the area for feeding and resting during migration (Greene 2002). Dredges, pipelines, and other equipment along the beach could displace piping plovers or could cause them to avoid foraging along the shore if they are aurally affected (Peterson et al. 2000). If the sand placed on the beach is too coarse or high in shell content, it can inhibit the birds’ ability to extract food particles from the sand (Greene 2002). Fine sediment that reduces water clarity can also decrease the feeding efficiency of birds (Peterson et al. 2000).

Minimal direct impacts to plovers and knots should occur from project construction because motile birds can avoid construction activities. The disposal of sand on the beach may temporarily interrupt foraging and resting activities of shorebirds that use the project beach area. This limited interruption would occur on the immediate area of disposal and last for the duration of construction. A temporary reduction to the prey base for many shorebirds, which includes benthic organisms, would also occur in the project area. Recovery from this short-term reduction should occur within about one year after sand placement.

4.1.8 Beach Jacquemontia

Future With-Project (NED Plan)

In its letter dated December 14, 2011, the USFWS indicated that, based on observations made in January 2010, the endangered beach jacquemontia may occur within the project area. The potential location(s), quantity, and current vegetative state are unknown for beach jacquemontia specimens that may occur within the project area.
The implementation of protective measures would avoid and minimize potential impacts to beach jacquemontia. Protective measures would likely include a pre-construction survey to locate and mark beach jacquemontia growing within or adjacent to the project area. For beach jacquemontia identified outside of the project fill footprint, creation of a minimum 25-foot protective buffer around each individual would exclude construction activities within that area. Measures to minimize potential impacts to beach jacquemontia growing within the project fill footprint may include transplanting individual plants to suitable habitat out of harm’s way. If transplanting is necessary, the USFWS staff must review and approve a detailed plan before initiating transplanting activities. The primary habitat for beach jacquemontia occurs landward of the dune crest on the more stable portions of the dune system; thus, fill placement would not occur landward of the dune crest.

4.1.9 Hardbottom

Future With-Project (NED Plan)

Effects associated with the plan that may potentially affect nearshore hardbottom include:

- Alteration (burial) of exposed nearshore hardbottom and associated epibenthos during and subsequent to nourishment activities
- Alteration of exposed nearshore hardbottom and associated epibenthos resulting from the sand delivery pipeline
- Turbidity

Alteration (Burial) of Exposed Nearshore Hardbottom

As mentioned, previously identified impacts (9.6 acres) to hardbottom resources within the project area have been mitigated by the non-federal sponsor; these impacts include 8.9 acres of anticipated impacts and 0.7 acre of unanticipated impacts. Additionally, the non-federal local sponsor continues to conduct annual hardbottom monitoring and coordinate with the regulatory agencies to identify any additional impacts requiring mitigation. Analysis of the NED plan indicated the four-year nourishment interval would decrease sand placement volume by approximately 50% over the long term, as compared to the currently authorized project, and individual project fills would remain within the original (1996) project equilibrium toe of fill. Therefore, the NED Plan is not expected to require mitigation in addition to that already accomplished by the non-federal sponsor.

4.1.10 Essential Fish Habitat (EFH)

Future With-Project (NED Plan)

Effects associated with the plan that may potentially affect EFH include:

- Alteration (Burial) of Exposed Nearshore Hardbottom
- Disturbance of the sand bottom habitats and associated macroinfauna of the shoal borrow area and beach fill sites during nourishment activities
- Modification of the Capron Shoal feature
- Turbidity
Alteration (Burial) of Exposed Nearshore Hardbottom

As mentioned, previously identified impacts (9.6 acres) to hardbottom resources within the project area have been mitigated by the non-federal sponsor; these impacts include 8.9 acres of anticipated impacts and 0.7 acre of unanticipated impacts. Additionally, the non-federal local sponsor continues to conduct annual hardbottom monitoring and coordinate with the regulatory agencies to identify any additional impacts requiring mitigation. Analysis of the NED plan indicated the four-year nourishment interval would decrease sand placement volume by approximately 50% over the long term, as compared to the currently authorized project, and individual project fills would remain within the original (1996) project equilibrium toe of fill. Therefore, the NED Plan is not expected to require mitigation in addition to that already accomplished by the non-federal sponsor.

Disturbance of the Sand Bottom Habitats

Members of the penaeid shrimp and red drum EFH management groups use soft bottom habitats contiguous with the surf zone and nearshore hardbottom as forage or shelter habitats. Spiny lobsters use soft bottom habitats contiguous with the nearshore hardbottom as foraging areas. The potential disturbances to the sand bottom habitats include anchoring of the hopper barge during pump out activities, vibrations caused from the pump out activities, and placement of the pump out and conveyance pipes.

Modification of the Capron Shoal Feature

Offshore sand shoal habitats have been shown to provide fundamental ecological functions for demersal/pelagic fish species and motile macrobenthic invertebrates that include categories of spawning, shelter, or foraging. Offshore shoal habitats have been identified as important benthic habitats along the eastern U.S. and South Florida. Vasslides and Able (2008) found the richest fish assemblages at study sites off the coast of southern New Jersey associated with sand ridges in the 9–14 m depth range. Recent studies by Gilmore (2009) have determined that as many as 200 species of fish use sand shoal habitats within their life cycle, particularly during their cross-shelf migration, an important phase to the demersal reef fish population. These shoal habitats also function as aggregating points for small pelagic fishes, important prey for numerous managed species, particularly from the coastal pelagic and highly migratory groups.

The currently permitted borrow site the project is limited to the portion of Capron Shoal located within state waters. Capron Shoal has been highly modified by prior dredging activity. Future dredging activity will follow the guidelines identified in the Borrow Area Conservation Plan (Appendix D, Sub-Appendix D-4) to avoid and minimize further impacts. A similar conservation plan will also be implemented should or when Capron Shoal is no longer a viable borrow area and another shoal is proposed as a project sand source. Modification of the Capron Shoal feature could impact the demersal/pelagic fish and invertebrate assemblages that use this feature. Depending on the dredging design and execution, this action could alter this shoal structure permanently and could affect the local ecological processes occurring at this location.

Turbidity

Several activities during construction could affect water quality within the EFH. The main sources of water quality impacts are borrow area dredging and sand placement on the beach face, which would increase turbidity levels at both locations. Turbidity has been shown to negatively impact and sometimes cause fish mortality during extreme natural events of increased turbidity (Robins 1957). The nearshore reef fish assemblages would most likely avoid any extreme turbidity conditions. Proper implementation of the approved design and construction BMPs should limit the level and extent of construction-related turbidity.
4.1.11 Water Quality

Future With-Project (NED Plan)

Implementing the plan would likely cause temporary increases in turbidity levels due to the dredging of sediments at the borrow area and placement of sediments on the beach. Turbidity results from the suspension in the water column of fine grained fractions of the borrow material. Suspended sediments create a visible, turbid plume in the water column. This turbid plume can cause physical or behavior impacts to invertebrates, particularly sessile organisms on the nearshore hardbottom areas. If the borrow material contains only a small portion of fine grained materials, turbidity should diminish rapidly and have little impact on organisms in the area; however, if the fine-grained portion is high, turbidity can linger for longer periods or, in some cases, persist long term. Geotechnical data indicates that the sands in Capron Shoal contain less than 2% fines; therefore, turbidity is anticipated to diminish rapidly.

During project construction, turbidity monitoring would provide information to demonstrate compliance with state water quality standards at the mixing zone boundary. Monitoring would occur at both the borrow area and at material placement locations. Background monitoring at the borrow material placement site would occur approximately 65 m from shore and 150 m up-current from the fill discharge or placement location. Compliance monitoring would occur no more than 65 m from shore within the densest portion of any visible turbidity plume and 150 m down-current of the discharge point.

4.1.12 Hazardous, Toxic and Radioactive Waste

Future With-Project (NED Plan)

The plan is not anticipated to affect hazardous, toxic, or radioactive waste sites or producers in the project area. No impacts associated with the disturbances of such sites are anticipated. The proposed project would not involve placement, use, or storage of hazardous and toxic materials in or near the project area. A potential for hydrocarbon spills exists with dredging and construction equipment in the area, but accident and spill prevention plans delineated in the contract specifications should prevent most spills. The construction contract would include requirements to properly manage, store, and dispose of all materials generated by the project.

4.1.13 Air Quality

Future With-Project (NED Plan)

The short-term impacts from emissions by dredges and other construction equipment associated with the project are not anticipated to affect onshore or offshore air quality significantly. Exhaust emissions from vehicles, vessels, and construction equipment associated with the project would have a temporary and localized effect on air quality. Offshore sea breezes are anticipated to disperse pollutants. This project requires no air quality permits.

An analysis was performed to estimate emissions from a typical project previously completed by USACE and the non-federal sponsor. The analysis included calculation of total project emissions of nitrogen oxides (NOx), sulfur dioxide (SO2), carbon monoxide (CO), volatile organic compounds (VOCs), and particulate matter (PM) less than 10 microns and greater than 2.5 microns. Power requirements, duration of operations, and emission factors for the various equipment types used in project construction provided the basis for estimates of air pollutant emissions resulting from construction of the non-federal sponsor’s preferred alternative. The product of horsepower (hp) rating, activity rating factor (percent of total power), and
operating time provided the estimate of project energy use. The energy use value multiplied by an engine-specific emission factor yielded emission estimates.

Operational data reported in the Martin County FEIS (USACE 2010) for a beach nourishment project of similar size approximately 15 miles south of the proposed project area provided power requirements and duration for each phase of the proposed hopper dredging activity. The hp rating of the dredge plant considered propulsion (3,500 hp), dredging (2,565 hp), pumping (2000 hp), and auxiliary (600 hp). Different rating or loading factors were used for dredging, propulsion, and pumping. The air quality analysis contains the following assumptions:

- Project would dredge 576,490 cubic yards.
- Dredging cycle time (dredging, travel to transfer point, pump-out, and return to dredge site, and idle time) would last five hours.
- Each dredging cycle would move on the order of 2,000 cubic yards of material, requiring approximately 346 loads to excavate enough material to place 500,000 cubic yards of sand on the beach.
- Dredging could last 72 days.
- Distance from dredge site to transfer point would span approximately four miles.
- Crew/supply vessel operation would approach four hours per day.

The analysis assumed that all dredging, hopper transport, and crew/supply vessel activities would occurred over state waters and at the placement site. The beach-fill related estimates assumed the use of up to four bulldozers/pipeline movers and two trucks, each operating 80% of the time for the duration of the project.

Emission factors for the diesel engines on the hopper dredge, barge, and tugboats came from EPA’s Compilation of Air Pollutant Emissions Factors, AP-42, Volume 1 (2002). Derived emission factors for tiered equipment used in beach construction came from NONROAD model (5a) estimates.

Any of the action alternatives may result in small, localized, and temporary increases in concentrations of NOx, SO2, CO, VOCs, and PM (Table 4.1). Because the project is located in an air quality attainment area, the EPA requires no preliminary air quality conformity assessment.

Emissions associated with the dredge plant would provide the largest contribution to the inventory. However, the total project emissions represent a minor percentage of the existing point and nonpoint and mobile source emissions in St. Lucie County (Table 4.1). Prevailing winds would quickly disperse any pollutant released into the atmosphere from the project area. Since the NED Plan is smaller in size, the resulting emissions would be even less significant. The No-action alternative would have no impact on air quality.

4.1.14 Noise

Future With-Project (NED Plan)

Project construction activities could result in short-term minor adverse effects to the noise environment in the vicinity of both the beach fill and borrow area sites. Construction would include temporary sources of noise. This noise has the potential to disturb biological resources such as fishes, sea turtles, marine mammals, and seabirds. Sound would likely dissipate significantly over the three-mile+ distance between the dredging area and shoreline.
Proper maintenance of construction, dredging, and pumping equipment would minimize the noise impacts, and construction activities would likely occur for a short period. Construction noise may have a short-term, minor effect on sound levels in the vicinity of the construction activities.

### Table 4.1 Estimated Emissions of the NED Plan (tons per year)

<table>
<thead>
<tr>
<th>Activity</th>
<th>NOx</th>
<th>SO2</th>
<th>CO</th>
<th>VOC</th>
<th>PM2.5</th>
<th>PM10</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dredge Plant (Hopper)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dredging/Operation</td>
<td>13.1</td>
<td>0.2</td>
<td>3.0</td>
<td>0.3</td>
<td>0.2</td>
<td>0.2</td>
</tr>
<tr>
<td>Turning/Sail</td>
<td>27.6</td>
<td>0.5</td>
<td>6.3</td>
<td>0.7</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Pump-out</td>
<td>7.3</td>
<td>0.1</td>
<td>1.7</td>
<td>0.2</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>Idle/Connect-Disconnect</td>
<td>2.6</td>
<td>0.0</td>
<td>0.6</td>
<td>0.1</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Supporting Offshore Activities</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Beach Fill</td>
<td>5.5</td>
<td>1.0</td>
<td>2.6</td>
<td>0.4</td>
<td>0.4</td>
<td>0.4</td>
</tr>
<tr>
<td>Total Project Emissions</td>
<td>56.1</td>
<td>1.9</td>
<td>14.2</td>
<td>1.7</td>
<td>1.3</td>
<td>1.3</td>
</tr>
<tr>
<td>2002 Countywide Emissions Nonpoint + Mobile</td>
<td>9,509</td>
<td>1,661</td>
<td>70,230</td>
<td>12,636</td>
<td>1,480</td>
<td>6,646</td>
</tr>
<tr>
<td>2002 Countywide Emissions Point and Nonpoint + Mobile</td>
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<td>1,681</td>
<td>70,777</td>
<td>14,162</td>
<td>1,551</td>
<td>6,743</td>
</tr>
</tbody>
</table>

St. Lucie County 2002 emissions from EPA National Emission Inventory [http://www.epa.gov/air/data/](http://www.epa.gov/air/data/)

4.1.15 Aesthetic Resources

**Future With-Project (NED Plan)**

Effects associated with the plan include:

- Presence of construction equipment
- Noise
- Turbidity

The pipeline coming out of the water and along the beach, earthmoving equipment spreading sand along the beach, and associated construction activities would temporarily affect the aesthetics in the project area. Earth moving equipment used to distribute the sand would temporarily create visual disturbance as well as noise and exhaust fumes, which would decrease the overall aesthetic value in the immediate vicinity of the project activities. Earth moving equipment would operate from along the beach front to distribute the sand effectively after initial placement on the beach from the discharge pipes. Sand placement would cause short-term turbidity increases in the nearshore waters, resulting in a change in water color and clarity, and resulting in temporary minor impacts.

Analysis of grain size, color, and hue of the proposed borrow area sand area indicates that the dredged sand would be similar to the existing sand. With restoration of the currently eroded beaches, the overall aesthetic value within the project beach area is anticipated to increase.

The view within the proposed borrow area during project implementation may be affected by the presence and operation of equipment performing dredging and beach fill operations.
With the No-Action alternative, the aesthetic value of the beach is anticipated to diminish as the beachfront erodes and narrows. In addition, the potential for the construction of numerous emergency shoreline armoring structures and other stopgap measures could increase and, if implemented, would diminish the aesthetic value of the area and result in long-term, permanent impacts to the aesthetics of the area.

4.1.16 Recreational Resources

Future With-Project (NED Plan)

Effects associated with the plan include:

- Limited and/or restricted access
- Turbidity

Recreational use of the beaches and coastal waters would temporarily decrease in the immediate vicinity of active nourishment and borrow dredging efforts. Temporary public safety restrictions would keep beachgoers and recreational users from the areas of active construction on the beach and at the borrow site. The active construction areas would shift along the project area beach; recreational users could access areas already nourished. Increased turbidity and resulting decrease in visibility would reduce or eliminate scuba diving and snorkeling in the project construction zone and in the mixing zone down current of the project area beach, where temporary increased turbidity could occur. The project would not likely affect nearshore coastal boating and fishing, which could continue as usual during nourishment activities. Project implementation could result in overall short-term impacts to recreational opportunities.

4.1.17 Cultural Resources and Historic Properties

Future With-Project (NED Plan)

As discussed in Chapter 2, substantial cultural resources work and investigations have been conducted throughout various portions of the project area. Based on archival research and consultation with SHPO, no significant historic properties are known to exist on the beach segment proposed for nourishment. No additional fieldwork is proposed for either the borrow area or beach at Fort Pierce. Because the General Reevaluation Report identifies no proposed or likely future actions that would occur outside the areas already surveyed and researched, the NED Plan will have no effects on cultural resources and historic properties.

4.1.18 Native Americans

Future With-Project (NED Plan)

There are no known Native American properties within the project area and the project should not have any effects to Native Americans.

4.1.19 Public Safety

Future With-Project (NED Plan)

As a public safety measure, beach and water-related recreation in the immediate vicinity of the discharge pipe would be prohibited during project construction. Likewise, water related activities near the dredge
site would also be prohibited during project construction. Recreational access to these areas would return to pre-construction conditions following completion of the project. Long-term effects are not anticipated.

4.1.20 Natural or Depletable Resources

Future With-Project (NED Plan)

No natural energy resources occur within the proposed project area. The sand shoals offshore of the project area include well-developed, shore-face connected and isolated linear shoals with north-to-south orientation. These features, depositional in nature, exhibit varying degrees of morphological change in response to local hydrodynamic conditions. Sand shoals form as an irregularity on the seafloor and then grow in response to local coastal processes (waves, tides, currents). Ongoing formation results in a growing shoal. Shoals may also represent relic structures of past coastal processes no longer in action at a particular site. The sand shoal proposed as a source for beach fill is considered a depletable resource as project dredging would reduce the quantity of shoal sand. The Capron Shoal, the currently permitted offshore borrow site, contains approximately 12 million cubic yards of beach compatible material (USACE, 2014).

Excavation of sediments from borrow sites exposes underlying sediments and can change the sediment structure and composition of the borrow site. This can lead to changed benthic community composition. Benthic species’ ability to perform life functions (e.g. burrowing, feeding, or settling as larvae) varies with sediment quality and members of the current benthic community may or may not have the same success in the physical characteristics of the new sediment as in the existing sediment. In addition, excavation alters the seafloor topography, creating pits that may refill rapidly or remain for extended periods. Studies have shown that some borrow areas located within highly depositional areas have a relatively short filling time, whereas other areas may take up to 12 years returning to pre-dredge topography. In general, shallow dredging over large areas causes less change than smaller deep pits. If borrow pits are excavated in small deep pits, current velocity is reduced at the bottom, which can cause the deposition of fine particulate matter and potentially create a biological assemblage much different in composition than the original (Hammer et al., 2005). These assemblages may not provide the same trophic support as the original benthic community. However, the project dredging design at Capron Shoal does not extend below the surrounding elevations, and the dredge footprint comprises a very small portion of the total benthic habitat area. Predators on the benthic community would still have ample forage area after dredging ends.

Structurally, however, dredging could alter this shoal structure permanently and locally affect the seafloor topography within the borrow site. BMPs applied to the design of the dredging profile of the shoal including avoidance of dredging across the shoal and maintaining a refuge patch at the highest shoal elevations would help minimize the impacts to the shoal habitat. In addition, based on physical geological models of shoal formations, there does not appear to be a mechanism that supports the idea that structural integrity of a shoal feature would “deflate” or “unravel” when subject to repeated dredging events (CSA International et al., 2009a), which has been suggested by Michel et al. (2001). Dibajnia and Nairn (2010) summarizes field and modeling studies of shoal behavior with dredging, indicating that dependent upon dredging location, shoals will reform and retain existing original height after completion of dredging.

However, not all impacts from dredge pits are detrimental. Borrow pits are known to attract numerous fishes and have been known to provide resting places for sea turtles (K. Spring and D. Snyder, personal observations off Hobe Sound, Florida).
4.1.21 Energy Requirements and Conservation

Future With-Project (NED Plan)

Energy requirements for the proposed alternative would be limited to the fuel for the dredging and pumping equipment, labor transportation, and construction equipment associated with beach placement. The use of sand from the proposed borrow areas would require less energy expenditure than obtaining sand from any other distant source.

4.1.22 Irreversible and Irretrievable Commitment of Resources

Future With-Project (NED Plan)

4.1.22.1 Irreversible

An irreversible commitment of resources is one in which the ability to use a resource is lost forever. The use of sand from offshore or upland borrow areas would irreversibly commit those sand resources to this project and preclude their use for future nourishment projects. However, the offshore borrow resources identified for this project far exceed the borrow material volume requirements for the 50-year project authorization period.

Use of sand from offshore borrow areas would also irreversibly preclude its current use as habitat for benthic organisms. However, leaving portions of the existing shoals undisturbed as “refuge patches” can minimize impacts to existing benthic resources and provide for re-colonization of disturbed borrow areas. Sufficient remaining sand reserves within and adjacent to the borrow area would provide for recolonization of benthic organisms. Due to the dynamic nature of nearshore benthic environments, sand used to nourish the beach would eventually disperse in the nearshore areas and create habitat for shallow water benthic communities.

As mentioned, previously identified impacts to hardbottom resources within this area have been mitigated by the non-federal sponsor. These nearshore hardbottom areas are also cyclically covered and exposed due to seasonal and other temporal changes in beach profiles. In view of the natural, highly dynamic fluctuations in exposure and burial of the nearshore rock resource and the modest scale of the proposed beach fill activity, abandonment of the project at any point can be reasonably anticipated to result in the near or wholly complete recovery of existing conditions.

4.1.22.2 Irretrievable

An irretrievable commitment of resources means that opportunities for other uses are foregone for the period of the proposed action. Typically, it refers to the use of renewable resources, including human effort, and to other utilization opportunities foregone in favor of the proposed action.

As mentioned, previously identified impacts to hardbottom resources within this area have been mitigated by the non-federal sponsor through the implementation of a program to construct additional nearshore artificial reef. The success of prior mitigation efforts provides a low-risk, high success probability template for additional mitigation. As noted, impacts of beach restoration on nearshore hardbottom communities are reversible and do not represent an irretrievable commitment of these resources for project use.
4.1.23 Unavoidable Adverse Environmental Impacts

Future With-Project (NED Plan)

The main unavoidable adverse impact of the plan would be impacts to nearshore hardbottom habitat; however, previously identified impacts to hardbottom resources within this area have been mitigated by the non-federal sponsor. Additionally, the non-federal sponsor continues to conduct hardbottom monitoring annually and coordinate with the regulatory agencies to identify any additional impacts that require mitigation. Re-exposure of hardbottom is also possible due to high-energy dynamics of the area and equilibration of beach fill. Recolonization of re-exposed hard substrates by worm rock and turf and macroalgae is probable as these organisms have high recruitment capability.

Other unavoidable adverse impacts of fill projects to the marine environment include:

- Burial of infauna and non-motile epifauna in nearshore sand bottom areas due to placement of beach fill. Recovery would depend on the ability of buried organisms to burrow through the sediment layer and the ability of adjacent populations to recolonize the area. However, the affected area is a small percentage of the total sand bottom habitat in the region.
- Impacts to infaunal communities in the offshore borrow area due to sand removal and habitat alteration. These impacts are reversible, as the affected areas would gradually fill with sand from adjacent areas and be recolonized by infauna.
- Temporary, localized water column turbidity in the offshore borrow area and along the project shoreline. BMPs implemented during construction should reduce the magnitude and extent of turbidity and the project should result in only minor, temporary adverse effects on water quality. Turbidity would be monitored during construction to ensure that turbidity from construction activities conforms to State water quality standards at the mixing zone boundary.
- Temporary, localized air quality and noise impacts due to emissions from offshore and onshore construction equipment.
- Temporary aesthetic/visual impacts due to the presence of construction equipment in the offshore borrow area and along the project shoreline.
- Temporary loss of recreational use of the beach and adjacent nearshore areas during construction. Minor impacts to recreational opportunities would likely occur. The project area comprises a small percentage of the total area available for similar recreational activities in St. Lucie County.

4.1.24 Local Short-Term Uses and Maintenance / Enhancement of Long Term Productivity

Future With-Project (NED Plan)

The plan is expected to produce localized, short-term impacts on nearshore benthic communities and water quality, but it is not expected to cause significant adverse impacts on long-term productivity. Shoreline protection using periodic beach nourishment is an ongoing activity along much of the Florida shoreline. Beach nourishment projects have a temporary and short-term impact on nearshore biological resources and local offshore biological communities when offshore dredging supplies the nourishment sand. Most motile organisms (fishes, crabs, and some sand dwelling organisms) within the offshore borrow area and nearshore fill zone should be able to escape these areas during construction. Less-motile individuals that are unable to escape from construction would be lost, but lost populations of those individuals typically recolonize rapidly after project completion. The plan would produce temporary increases in turbidity but would not result in significant long-term water quality degradation. Short-term reductions in primary
productivity and reproductive and feeding success of invertebrate species and fish are expected. These impacts should not negatively affect the sustainability of these populations given the localized scale of impacts and the creation of mitigation reefs.

4.1.25 Indirect Effects

Future With-Project (NED Plan)

Some prior studies have concluded that beach nourishment projects lead to greater development, tourism, investment, and subsequently greater long-term requirements for shoreline protection (National Research Council Committee on Beach Nourishment and Protection 1995, Pilkey and Dixon 1996, Dean 1999). However, other studies concluded that shoreline development is fostered mainly by economic factors other than public investment in shoreline protection (Cordes and Yezer 1998, Cordes et al. 2001). If allowed to occur, increased shoreline development could result in additional indirect ecological impacts such as adverse effects on sea turtle nesting due to increased artificial lighting, shoreline armoring, etc.

Few sites in the uplands adjacent to the project area remain open for development, so there is little or no opportunity for future development growth adjacent to the project beach. The existing shoreline includes a mix of residential, commercial (lodging), and public park facilities. More importantly, the potential for indirect development effects has been minimized in the design of the selected plan. The non-federal sponsor has delineated the project area to (a) include that portion of the study area that is designated by FDEP as “critically eroded.” The project qualified for state cost-sharing where beach nourishment appears feasible for obtaining of a FDEP permit, but (b) excludes shoreline segments where minimal or no beach-front development exists and where little or no storm damage prevention benefits would be realized via beach nourishment.

4.1.26 Compatibility with Federal, State, and Local Objectives

Future With-Project (NED Plan)

Recognizing the importance of the state's beaches, the Florida Legislature in 1986 adopted a posture of protecting and restoring the state beaches through a comprehensive beach management planning program. Under the program, the FDEP’s Bureau of Beaches and Coastal Systems evaluates beach erosion problems throughout the state seeking viable solutions. The primary vehicle for implementing the beach management planning recommendations is the Florida Beach Erosion Control Program, a program established to work in concert with local, state, and federal governmental entities to achieve the protection, preservation, and restoration of the coastal sandy beach resources of the state. Eligible activities include beach restoration and nourishment activities, project design and engineering studies, environmental studies and monitoring, inlet management planning, inlet sand transfer, dune restoration and protection activities, and other beach erosion prevention activities consistent with the adopted Strategic Beach Management Plan.

The FDEP has classified the project area as “critically eroded,” a level of erosion that threatens substantial development, recreational, cultural, or environmental interests. One way to restore eroded beaches is through beach nourishment where sand is collected from an offshore location by a dredge and is piped onto the beach. A slurry of sand and water exits the pipe on the beach and once the water drains away, only sand is left behind. Bulldozers move this new sand on the beach until the beach matches the design profile. Beach nourishment comprises a preferred way to add sand to a system because it provides a significant level of storm protection benefit for upland properties and includes the relatively few impacts to the coastal system. An additional benefit of beach restoration projects is that such projects quickly restore shorebird and marine turtle habitat.
The St. Lucie County coastline is a valuable resource providing storm protection, recreation, economic value, and wildlife habitat. The preservation of this coastline is a long-term, ongoing non-federal sponsor commitment. The non-federal sponsor’s main objective is to abate ongoing and historical beach erosion; specific non-federal sponsor criteria for plan formulation include optimizing project performance and cost effectiveness — generally consistent with USACE planning regulations for shore protection projects, and minimizing environmental impacts to the extent feasible.

4.1.27 Conflicts and Controversy

Future With-Project (NED Plan)

The long history of the project has included numerous opportunities to consider and resolve the conflicts and controversies that have occurred over the past two decades of activity. Both regulatory agency and public concerns have been successfully managed, and periodic nourishments have been successfully conducted. If or as new conflicts and controversy occur, the local sponsor will work with the community, state and federal regulatory agencies, and the wider public to fully address and reach satisfactory resolution.

4.1.28 Uncertain, Unique, or Unknown Risks

Future With-Project (NED Plan)

The proposed activity is commonly conducted and has previously been permitted and conducted in the project area. To date, no uncertain, unique, or unknown associated with the plan considered in this GRR or in previous projects have been identified and not resolved completely.

4.1.29 Reuse and Conservation Potential

Future With-Project (NED Plan)

There is no potential for reuse associated with the proposed project activities; therefore, this is nonapplicable to the proposed nourishment project. Energy requirements for the proposed alternatives would be confined to fuel for the dredge, labor transportation, and other construction equipment.

4.1.30 Urban Quality

Future With-Project (NED Plan)

No direct permanent impacts related to urban quality are expected as a result of the proposed project. Implementation of the proposed project would indirectly and positively impact urban quality by restoring an eroded beach, by increasing the recreational beach activity, and by increasing the tax revenue and tourism commerce.

The commercial businesses and residential properties along the project beach could benefit from the storm protection afforded by the project and incur less risk of property damage. The presence of construction equipment could temporarily detract from the aesthetics of the environment, possibly temporarily affecting the localized visual aesthetics associated with the project beach.
4.1.31 Solid Waste

Future With-Project (NED Plan)

No impacts related to solid waste are expected due to this project. Precautionary measures anticipated in the contract specifications would identify and require proper disposal of solid wastes. Precautionary measures include proper containment and avoidance of overflow conditions by emptying containers on a regular schedule. Disposal of any solid waste material into Atlantic waters would not be permitted.

4.1.32 Scientific Resources

Future With-Project (NED Plan)

No scientific resources are associated with the NED Plan presented in this GRR.

4.1.33 Drinking Water

Future With-Project (NED Plan)

The project has not in the past effected drinking water, and the NED Plan has no effect on drinking water. Extension of the project life and construction of the proposed project modifications will likewise have no effects on drinking water.

4.2 Cumulative Impacts

Cumulative impacts are those that result from “the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions” (40 CFR 1508.7). Cumulative impacts result from spatial (geographic) and temporal (time) crowding of environmental perturbations. The impacts may result from the accumulation of similar effects or the synergistic interaction of different effects (Council on Environmental Quality 1997).

Table 4.2 summarizes cumulative impacts by identifying the past, present, and reasonably foreseeable future condition of the various resources with and without the project.

4.2.1 Cumulative Activities Scenario

The study area for this GRR includes 2.3 miles of shoreline immediately south of the federal Fort Pierce Inlet in Fort Pierce, Florida. The project, as authorized by the River and Harbor Act of 1965 (PL 89-298, 79 Stat. 1089, 1092), encompasses 1.3 miles extending from the south jetty at Fort Pierce Inlet to the southern end of Kimberly Bergalis Park (FDEP survey monument R-34 southward to R-41). The project impact area extends from R-34 southward to R-41 into the proposed mixing zone (150 meters from the point of sand discharge). In addition to the coastline, the area includes the offshore borrow area located in a sand ridge (Capron Shoal) approximately 4 miles southeast of the project area. Cumulatively, the project and other similar projects could impact sand shoals approximately three miles offshore.
Table 4.2 Cumulative Impacts Summary

<table>
<thead>
<tr>
<th>Resource</th>
<th>Past and Present (Baseline/Existing Condition)</th>
<th>Future without Project</th>
<th>Future with-Project</th>
</tr>
</thead>
<tbody>
<tr>
<td>Threatened and Endangered Species: Sea Turtles</td>
<td>Five sea turtle species occur in the area (loggerhead, green, hawksbill, Kemp’s ridley, and leatherback). Loggerhead, green, and leatherback turtles nest on area beaches. Juvenile green turtles use nearshore hardbottom areas for feeding (macroalgae), resting, and shelter from predators. Past and current threats to sea turtle populations include artificial lighting, beach armoring, anthropogenic disturbance, trawling, dredging, vessel strikes, fishing gear entanglement, and ingestion of discarded anthropogenic marine debris.</td>
<td>Sea turtle nesting and nearshore habitat use would continue in the area. Project-specific impacts would be avoided, but ongoing threats to sea turtle populations would continue. In the absence of the project, property owners may armor their shoreline to protect their property, which may result in loss of nesting habitat and possible impacts on nearshore hardbottom habitat.</td>
<td>In addition to ongoing threats, the project would result in loss of a small defined area of juvenile developmental habitat (nearshore hardbottom). Sea turtles may be disturbed by turbidity and noise during construction. There is a small risk of sea turtles being struck by a construction vessel or entrained in the hopper dredge draghead; these risks would be minimized through vessel-strike avoidance and dredge related impact mitigation measures. Due to the small spatial extent and short duration of project impacts, no significant cumulative impacts are anticipated.</td>
</tr>
<tr>
<td>Threatened and Endangered Species: Marine Mammals</td>
<td>Three endangered marine mammal species may occur in the area: Florida manatee, humpback whale, and North Atlantic right whale. Only the manatee is common. Past and current threats to marine mammal populations include vessel strikes, fishing gear entanglement, ingestion of marine debris, pollution, and underwater noise.</td>
<td>Marine mammals would continue to occur in the area. Project-specific impacts would be avoided, but ongoing threats to marine mammal populations would continue.</td>
<td>In addition to ongoing threats, marine mammals may be disturbed by turbidity and noise during construction. There is a small risk of marine mammals being struck by a construction vessel or entrainment within a hopper dredge draghead. Mortality of a manatee or North Atlantic right whale would represent a significant cumulative impact due to the small population of these species. The risk would be minimized through vessel-strike avoidance and dredge related mitigation measures.</td>
</tr>
<tr>
<td>Threatened and Endangered Species: Smalltooth Sawfish</td>
<td>The smalltooth sawfish is an endangered species inhabiting shallow, nearshore waters. Historically, its population and range have declined, mainly due to fisheries bycatch. Other past and current threats are habitat loss and degradation, entanglement in marine debris, pollution, and anthropogenic disturbance.</td>
<td>Smalltooth sawfish would continue to inhabit the area. Project-specific impacts would be avoided, but ongoing threats to sawfish populations would continue and may result in further decreases in population size and range.</td>
<td>In addition to ongoing threats, sawfish may be disturbed by turbidity and noise during construction. There is a small risk of sawfish being entrained in the hopper dredge draghead, which would be minimized through mitigation measures. Due to the small spatial extent and short duration of project impacts, the smalltooth sawfish would not likely incur other than minor impacts.</td>
</tr>
<tr>
<td>Nearshore Hardbottom</td>
<td>Two nearshore hardbottom communities occur in the area. One consists of low- to medium-relief habitat with wormrock and supports hydroids, encrusting sponges, macroalgae, and turf algae. The other consists of low-relief coquina ledges with little or no epibiotic cover. These communities have historically been subjected to the dynamics of the nearshore environment including sand movement, scouring, and alternating burial/exposure.</td>
<td>Nearshore hardbottom areas would continue to exist in the area, subject to the natural dynamics of the nearshore environment including sand movement, scouring, and alternating burial/exposure. In the absence of the project, property owners may construct shoreline armoring to protect their property, which may result in impacts to nearshore hardbottom.</td>
<td>Impacts to the nearshore hardbottom from previous beach placement activities have been mitigated. NED Plan is not expected to require additional mitigation.</td>
</tr>
<tr>
<td>Resource</td>
<td>Past and Present (Baseline/Existing Condition)</td>
<td>Future without Project</td>
<td>Future with-Project</td>
</tr>
<tr>
<td>----------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Fish and Wildlife Resources</td>
<td>Nearshore soft bottom habitats including sand shoals support a variety of invertebrates and demersal fishes. Invertebrates using shoals include infaunal and epifauna species represented primarily by annelid worms, gastropods, bivalves, crustaceans, and echinoderms. Most of these species are used as food by demersal fishes.</td>
<td>Project-specific impacts would be avoided, but soft bottom communities would continue to be affected by natural sand movement. In the absence of the project, property owners may armor their shoreline to protect their property, which may result in impacts to nearshore soft bottom communities. Regionally, other sand shoal areas are likely to be used in support of future beach nourishment projects.</td>
<td>In addition to ongoing processes affecting soft bottom fish and wildlife resources, there would be localized effects of dredge and fill activities along the beach and in the offshore borrow area that may persist for a few months to a few years. Major long-term effects are not anticipated because resident fish and wildlife species are wide-foraging or migratory and spend only a portion of their life cycle at the borrow area and beach fill sites.</td>
</tr>
<tr>
<td>Essential Fish Habitat</td>
<td>Managed species and species groups in the project area include <em>Sargassum</em>; coral, coral reefs, and live/hardbottom habitats; penaeid shrimp; spiny lobster; red drum; coastal pelagic fishes; reef fishes; dolphin and wahoo; and highly migratory pelagic species. Habitats of Particular Concern (HAPCs) for coral, coral reefs, and live/hardbottom habitats of the eastern Florida area include the <em>Phragmatopoma</em> worm reefs found in nearshore waters; nearshore hardbottom found in water depths of 0 to 4 m; and hardbottom found in water depths of 5 to 30 m.</td>
<td>Project-specific impacts would be avoided, but the acreage of nearshore hardbottom Essential Fish Habitat (EFH) would fluctuate with natural sand movement. Increased exposure of hardbottom may provide increased habitat for surf zone fishes, increased foraging habitat for green sea turtles, and increased refuge for juvenile fishes. In the absence of the project, property owners may construct armoring to protect their property, which may result in impacts to nearshore EFH.</td>
<td>In addition to ongoing processes affecting nearshore EFH, dredging would affect EFH by altering the sand shoal habitat (e.g., reducing shoal height, creating pits). However, the impact represents a small percentage of the similar habitat in the area.</td>
</tr>
<tr>
<td>Water Quality</td>
<td>The project area consists of Class III waters, which are designated as suitable for recreation, propagation, and maintenance of a healthy, well balanced population of fish and wildlife. The predominant issue that affects water quality in the area is turbidity, which varies significantly under natural conditions (e.g., during storms), sometimes exceeding 29 NTU. Historically, coastal water quality has been affected by unrelated anthropogenic sources such as stormwater and effluent runoff resulting in increased nutrients and freshwater inputs. Urbanization and population growth in the region contributes to coastal water quality degradation.</td>
<td>Project-specific impacts would be avoided, but turbidity would continue to occur intermittently due to storm activity, rainfall, currents, and other natural phenomena. Water quality may deteriorate due to unrelated anthropogenic sources such as stormwater and effluent runoff.</td>
<td>In addition to the ongoing natural and anthropogenic fluctuations in water quality, local, short-term turbidity would occur adjacent to the beach fill sites and offshore borrow area. BMPs would be implemented during construction to reduce the magnitude and extent of turbidity, and adverse effects on water quality are expected to be minor. Turbidity would be monitored during construction to ensure that State water quality standards are met at the mixing zone boundary. Due to the small spatial extent and short duration of project impacts, no long-term effects are expected.</td>
</tr>
</tbody>
</table>
4.2.1.1 Past Conditions and Activities


4.2.1.2 Present/Ongoing Activities

The Fort Pierce Shore Protection Project is authorized until 2020. The last nourishment project occurred in 2015, and the next nourishment is expected to receive federal funding in 2017. Capron Shoal is the currently permitted borrow area. Recreational usage along the beaches within the project area includes shore based water sports such as scuba diving, snorkeling, surfing, surf fishing, and kayaking. Additionally, the area beaches are used for sunbathing, picnicking, and exercising. Boating is a popular recreational pastime for many residents and tourists to the area. Fishing, scuba diving, and snorkeling are often done from boats in nearshore hardbottom areas close to the shore. These shallow nearshore hardbottom areas are attractive areas for scuba diving and lobster fishing as well as angling from small vessels. Angling may occur near the proposed borrow site, although there are no known fish havens near the borrow area.

4.2.1.3 Reasonable Forseeable Future Activities

The proposed Fort Pierce Shore Protection Project re-authorization to 2070 would authorize construction of a protective and recreational beach including beach fill along 1.3 miles of shoreline and T-head groins along approximately the northernmost 2,000 ft of shoreline. The 50-year sand requirement equals 10,075,000 cy. The currently permitted borrow area on Capron Shoal would provide most of this volume requirement, and other portions of Capron Shoal or Shoal A, located approximately two miles northeast of the project area, contain more than enough sand resources to supply the remaining volume.

Regionally, beach nourishment is expected to continue in the coming years, compounding opportunities for recurring impacts. In southeast Florida alone, approximately 100 nourishment events are projected to occur between 1969 and 2050 dredging at least 100,000,000 cubic yards of sediment from an area 4 miles wide by 120 miles long (from Dade County to Martin County) (USACE 1996).
Table 4.3 Fort Pierce Beach Fill Placement History

<table>
<thead>
<tr>
<th>Date</th>
<th>Volume (cy)</th>
<th>Fill Source</th>
<th>Disposal Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jul. 1971</td>
<td>718,000</td>
<td>Nearshore</td>
<td>1.3-mile Project Area</td>
</tr>
<tr>
<td>Jul. 1978</td>
<td>49,800</td>
<td>Channel</td>
<td>Adjacent Beach</td>
</tr>
<tr>
<td>1980</td>
<td>346,000</td>
<td>Nearshore</td>
<td>1.3-mile Project Area</td>
</tr>
<tr>
<td>Dec. 1987</td>
<td>29,800</td>
<td>Channel</td>
<td>Adjacent Beach</td>
</tr>
<tr>
<td>Jan. 1989</td>
<td>47,800</td>
<td>Channel</td>
<td>Adjacent Beach</td>
</tr>
<tr>
<td>Mar. 1990</td>
<td>55,700</td>
<td>Channel</td>
<td>Adjacent Beach</td>
</tr>
<tr>
<td>Nov. 1993–Jan. 1994</td>
<td>7,200</td>
<td>Channel</td>
<td>Adjacent Beach</td>
</tr>
<tr>
<td>1992–1994</td>
<td>14,400</td>
<td>Upland Truck Haul</td>
<td>South Beach</td>
</tr>
<tr>
<td>1995</td>
<td>166,700</td>
<td>Channel</td>
<td>Adjacent Beach</td>
</tr>
<tr>
<td>Mar. 1995</td>
<td>54,400</td>
<td>Upland Truck Haul</td>
<td>Longard Tube Backfill</td>
</tr>
<tr>
<td>Jan. 1998</td>
<td>23,300</td>
<td>Channel</td>
<td>Beach South of Jetty</td>
</tr>
<tr>
<td>Mar. 1999</td>
<td>830,000</td>
<td>Capron Shoal</td>
<td>1.3-mile Project Area</td>
</tr>
<tr>
<td>Apr. 2003</td>
<td>336,000</td>
<td>Capron Shoal</td>
<td>2,200 ft South of Jetty</td>
</tr>
<tr>
<td>Apr. 2004</td>
<td>406,000</td>
<td>Capron Shoal</td>
<td>2,700 ft South of Jetty</td>
</tr>
<tr>
<td>May 2005</td>
<td>616,000</td>
<td>Capron Shoal</td>
<td>1.3-mile Project Area</td>
</tr>
<tr>
<td>Apr. 2007</td>
<td>503,800</td>
<td>Capron Shoal</td>
<td>1.3-mile Project Area</td>
</tr>
<tr>
<td>May 2009</td>
<td>189,600</td>
<td>Capron Shoal</td>
<td>1,400 ft South of Jetty</td>
</tr>
<tr>
<td>Apr. 2011</td>
<td>62,000</td>
<td>Upland Truck Haul</td>
<td>1,200 ft South of Jetty</td>
</tr>
<tr>
<td>Mar. 2012</td>
<td>499,800</td>
<td>Capron Shoal</td>
<td>4,300 ft South of Jetty</td>
</tr>
<tr>
<td>May 2013</td>
<td>436,800</td>
<td>Capron Shoal</td>
<td>5,500 ft South of Jetty</td>
</tr>
<tr>
<td>May 2014</td>
<td>164,100</td>
<td>Fort Pierce Harbor</td>
<td>3,000 ft South of Jetty</td>
</tr>
<tr>
<td>Feb. 2015–May 2015</td>
<td>319,090</td>
<td>Capron Shoal</td>
<td>4,000 ft South of Jetty</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>5,876,290</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The non-federal sponsor provides local sponsorship to the State of Florida for implementing the state Fort Pierce Inlet Management Plan. Part of that sponsorship has included investigations to meet and maintain sand bypassing requirements across Fort Pierce Inlet identified in the sand management plan. In 2004, Taylor Engineering completed a study for the non-federal sponsor to identify an annual bypassing operation that could either meet the state adopted bypassing requirements or, at a minimum, supplement the USACE shore protection project just south of Fort Pierce Inlet (Taylor Engineering 2004). The bypassing operation could buffer high erosion rates seen immediately south of the Fort Pierce Inlet south jetty and maintain the federal beach restoration project’s design template over its nourishment interval. The study identified two alternatives — north jetty sand tightening with mobile sand bypassing plant and north jetty sand tightening with nearshore dredging — as reasonably attractive alternatives to bypass sand across the inlet. The non-federal sponsor has recently completed a feasibility study of a third alternative — construction of a sediment basin in the inlet (Taylor Engineering 2010). An effective deposition basin in the inlet would capture incoming sediments and provide a sand source for bypassing operations. A deposition basin would create an area of deep water, effectively decreasing flow velocities within the basin.
and causing sediment to deposit there, rather than further in the navigation channel and inlet interior. Past experience at several east coast Florida inlets has proven the effectiveness of channel deposition basins as replenishing sand sources for bypassing projects. At Fort Pierce Inlet, a deposition basin within the inlet with periodic dredging could potentially fulfill or supplement sand bypassing volume requirements. The non-federal sponsor’s Board of County Commissioners has recently directed non-federal sponsor staff to move ahead with design and permitting of a sand trap in the northwest corner of the inlet, adjacent to Fort Pierce Inlet State Park. Bypass sand quality would likely equal or exceed that available from other sources (offshore or upland) and might in the long-term serve to improve the general quality of the sand and the nearshore environment along Hutchinson Island. The sand trapped in the impoundment comes from beaches updrift (north) of the inlet rather than from offshore or upland sources, and so provides very similar quality sand to the Hutchinson Island nearshore system that it received prior to construction of the inlet. This sand would ultimately make its way to the south St. Lucie County beaches.

4.2.1.4 Sea Level Change

Potential relative sea-level change must be considered in every USACE coastal activity as far inland as the extent of estimated tidal influence. Future sea-level change is likely to result in both direct and indirect impacts on nearshore marine resources in the project area. Direct impacts could include changes in the areal extent of exposed hardbottom habitat due to sand movement. Indirect impacts could result from increased beach erosion, which may prompt more frequent (and possibly more extensive) beach nourishment projects in the area. The largest uncertainty is predicting the level and types of human activities that may be conducted to protect the shoreline in response to advancing sea level.

USACE Circular No. 1165-2-211 provides estimates of sea level rise ranging from 0.40 ft (0.12 m) to 2.32 ft (0.71 m) over the next 50 years. The U.S. Climate Change Science Program (CCSP 2009) Synthesis and Assessment Product 4.1 (SAP 4.1) Coastal Sensitivity to Sea-Level Rise: A Focus on the MidAtlantic Region details both how sea-level change affects coastal environments and what planners should address to protect the environment and sustain economic growth. SAP 4.1 represents implications of rising sea levels and possible adaptive responses. Many options are available for protecting land from inundation, erosion, and flooding (“shore protection”), or for minimizing hazards and environmental impacts by removing development from the most vulnerable areas (“retreat”). However, policymakers have not decided whether the practice of protecting development should continue as sea level rises, or be modified to avoid adverse environmental consequences and increased costs of shore protection. Most shore protection structures are designed for the current sea level, and retreat policies that rely on setting development back from the coast are designed for the current rate of sea level rise. Those structures and policies would not necessarily accommodate a significant acceleration in the rate of sea-level rise.

4.2.1.5 Conclusions

Ongoing beach restoration activities in the area include the currently authorized project. Long-term monitoring of this project has not revealed cumulative impacts, and FDEP has found the hardbottom mitigation project has reached the anticipated ecological success. Ongoing recreational usage of the nearshore environment includes fishing, boating, diving, snorkeling, and beach recreation activities.

Future sea-level change may result in significant direct and indirect impacts to nearshore marine resources in the project area. Direct impacts could include changes in the areal extent of exposed hardbottom habitat due to sand movement. Indirect impacts could result from increased beach erosion, which may prompt more frequent (and possibly more extensive) beach nourishment projects in the area. Predicting sea level rise and the level and types of human activities that may be conducted to protect the shoreline in response to advancing sea level comprise the largest uncertainties in estimating cumulative impacts.
Over the next 50 years without the project, important factors affecting the nearshore environment are likely to include sea-level change and ongoing, low-impact human uses such as fishing, diving and snorkeling, and boating. If the project is not implemented, property owners may construct revetments or other armoring to protect their property, which may result in indirect impacts to nearshore hardbottom by exacerbating erosion, sand movement and scour.
5.0 PLAN IMPLEMENTATION (EA: COMPLIANCE WITH ENVIRONMENTAL REGULATIONS)

5.1 Project Cooperation Agreement

As of July 8, 1994, an initial draft project cooperation agreement (PCA) is no longer required when submitting draft feasibility reports. The model PCA and possible deviations based on the recommended plan must be fully discussed with the non-Federal sponsor before the Feasibility Review Conference (FRC). The FRC itself would include an agenda item to ensure that this has been accomplished. The non-Federal sponsor then will have a clear understanding of the type of agreement that they will be expected to sign prior to the start of construction. The feasibility report should include the terms of local cooperation in the recommendation section of the report.

No Federal commitments relating to a construction schedule or specific provisions of the PCA can be made to the non-Federal sponsor on any aspect of this project or separable element until:

1. The feasibility report is approved by the U. S. Congress;
2. The project is budgeted as a new construction start, or construction funds are added by Congress, apportioned by the Office of Management and Budget, and their allocation is approved by the Assistant Secretary of the Army for Civil Works (ASA(CW)); and
3. The draft PCA has been reviewed and approved by the office of the ASA(CW).

The PCA will not be executed nor will construction be initiated on this project until the National Environmental Policy Act, the Clean Water Act, the Coastal Zone Management Act, the Endangered Species Act, the Fish and Wildlife Coordination Act, and the National Historic Preservation Act planning phase requirements are met. In the case of the Fort Pierce project, these requirements are met once the Draft Environmental Assessment (DEIS) has been coordinated, comments prepared, and a Final Environmental Assessment submitted to the Environmental Protection Agency for filing.

Final PCA negotiations with the non-Federal project sponsor may be conducted, and the draft PCA package submitted through the USACE higher authority for review and approval by the ASA(CW), once the feasibility report is approved and the project is budgeted for construction. The PCA for this project will be executed only after the feasibility report is approved, and an Appropriations Bill containing funds for the project is enacted into Law. The Chief of Engineers will not allocate Federal construction funds for a project until the ASA(CW) approves the non-Federal sponsor's financing plan and executes the PCA.

5.2 Federal Responsibility

The USACE is responsible for budgeting for the Federal share of construction costs for all future work for Federal projects. Federal funding is subject to budgetary constraints inherent in the formation of the national civil works budget for a given fiscal year. The USACE would perform the necessary preconstruction engineering and design work necessary to enable construction. The USACE would obtain all necessary permits (including State water quality certification) and would construct the project.

5.3 Non-Federal Responsibility

The non-Federal project sponsors would provide up-front cash contribution for initial construction costs of the proposed project. The amount of the non-Federal up-front cash contribution would be based on cost sharing principles reflecting shoreline use and ownership in existence at the time of construction. The non-Federal sponsor shall provide the entire cost of all material placed on undeveloped lands and developed private lands (which are not open to the public). The non-Federal sponsor has acquired a public easement...
on all lands landward of the erosion control line for this project. The costs for lands, easements, and rights-of-way and a portion of the administrative costs associated with land requirements would also be a non-Federal responsibility.

5.4 Other Non-Federal Requirements

Other general non-Federal responsibilities, such as continuing public use of the project beach for which benefits are claimed in the economic justification of the project, and controlling water pollution to safeguard the health of bathers, must also be assumed by the non-Federal sponsor before the project can be constructed. The items of local cooperation are listed in the section of this report entitled “Recommendations” (Section 6.2). The delineation of Federal and non-Federal responsibility will be legally defined in the project cooperation agreement.

The non-Federal project sponsor will be responsible for all costs of operation, maintenance, and rehabilitation and replacement of project features. Assignment of such responsibility has been included as a part of the items of local cooperation for the project.

5.5 Financial Analysis

Financial analysis is required for any plan being considered for USACE implementation that involves non-Federal cost sharing. The ultimate purpose of the financial analysis is to ensure that non-Federal sponsors understand the financial commitment involved and have reasonable plans for meeting that commitment. The financial analysis shall include the non-Federal sponsor’s statement of financial capability, the non-Federal sponsor’s financing plan, and an assessment of the sponsor’s financial capability.

5.6 Study Summary

This report summarizes the feasibility studies conducted for Fort Pierce in the interest of shore protection. Based on these studies, the following conclusions were reached:

a. Storm damage threatens a 6,950-ft segment of the Fort Pierce study area. The amount of shorefront development in Fort Pierce threatened by storms equals approximately $85 million.
b. The most practical and economical means to prevent or reduce structural damages is to construct the shore protection project developed herein. The non-Federal sponsors support construction of the project.

Major environmental considerations taken into account during the formulation of the selected plan included beach (turtle-nesting and shorebird habitats), nearshore (hardbottom habitat), and offshore (shoal habitat) resources, preservation of significant historical cultural resources, and the turtle-nesting season. All available and practicable means and measures have been incorporated into the plan formulation process to ensure that the selected plan is environmentally sound. The Jacksonville District obtained an updated BO from the USFWS on October 13, 2006 which covers the two-year nourishment interval. In 2007, St. Lucie County obtained from the FDEP a 10-year environmental permit (“Joint Coastal Permit”) for beach restoration in the project area.

National Environmental Policy Act of 1969
Environmental information on this authorized project has been compiled and this Environmental Assessment has been prepared. The interested public will be notified of this Environmental Assessment in accordance with the National Environmental Policy Act of 1969.
**Endangered Species Act of 1973**
The USACE initiated formal Section 7 consultation with the USFWS for nesting sea turtles and the manatee by letter dated November 8, 2007. The USACE anticipates a new biological opinion from the USFWS in the spring of 2008. The USACE also reinitiated formal consultation with the National Marine Fisheries Service for sea turtles (in water) by letter dated April 30, 2007. In a letter dated October 1, 2007, the National Marine Fisheries Service responded by stating that the USACE should continue to abide by the conditions of the 1997 South Atlantic Regional Biological Opinion (SARBO) pending completion of the new opinion. The USACE will continue to coordinate with the agencies that administer this act. This project complies with this act.

**Fish and Wildlife Coordination Act of 1958**
Coordination with the USFWS regarding the recommended project is ongoing. Draft versions of the Coordination Act Report (CAR) were sent to the USFWS for review on April 26, 2005 and April 4, 2007. The USFWS is currently preparing the final CAR. This project will include full consideration of USFWS recommendations concerning biological resources. This project complies with this act.

**National Historic Preservation Act of 1966**
Archival research, field investigations, and consultation with the Florida State Historic Preservation Officer (SHPO) were completed in accordance with the National Historic Preservation Act, as amended; the Archeological and Historic Preservation Act, as amended; and Executive Order 11593. Refer to Section 4.16 for the results of SHPO consultation. The project will not affect historic properties included in or eligible for inclusion in the National Register of Historic Places. The project complies with each of these Federal laws.

**Clean Water Act of 1972**
This project will include submittal of a Section 401 water quality certification application to ensure that all state water quality standards will be met. Attachment A of this EA includes a Section 404(b) evaluation. A public notice will be issued to satisfy the requirements of Section 404 of the Clean Water Act. This project complies with this act.

**Clean Air Act of 1972**
The proposed project will not require air quality permits. This project will include coordination with the EPA and will comply with Section 309 of this act.

**Marine Mammal Protection Act of 1972**
This project will incorporate safeguards to protect threatened and endangered species during dredging and disposal operations. These safeguards would also protect marine mammals in the area. The project complies with this act.

**Fishery Conservation and Management Act of 1976**
This project will include coordination with the NMFS and will comply with this act.

**Submerged Lands Act of 1953**
The project area includes submerged lands of the State of Florida. This project will include coordination with the State and will comply with this act.

**River and Harbor Act of 1899**
The proposed project will not obstruct navigable waters of the United States. This project will be subject to public notice, public hearing, and other evaluations normally conducted for activities subject to the act. This project will comply with this act.
Coastal Barrier Resources Act of 1992
The proposed new Federal investment decision for the Fort Pierce Shore Protection Project does not include any recommendations that would result in any new Federal expenditures or financial assistance prohibited by the Coastal Barrier Resources Act (Public Law 97-348); nor were funds obligated in past years for this project for purposes prohibited by this Act.

Coastal Zone Management Act of 1972
The Coastal Zone Management (CZM) Act of 1972, as amended (PL 92-583) requires all Federal activities inside or outside a state’s coastal zone to be consistent with the state’s coastal zone management plan if the activities affect natural resources, land uses, or water uses within the coastal zone. By issuance of State Water Quality Certifications on completed shore protection projects, the State has determined that the authorized projects for which initial construction has been completed were consistent with the State CZM Act. The State will review future project work to determine if it is consistent with the State’s coastal zone management plan prior to any future project construction or future nourishment of previously constructed project features. Note that the current State of Florida permit for the shore protection project requires the local sponsor to provide the State with a sediment bypassing plan. To that end, the State of Florida and the local sponsor are examining the potential for a sediment deposition basin within Fort Pierce Inlet. The study will require coordination between the USACE, the State of Florida, and the local sponsor. A successful bypassing operation would support federal regional sediment management objectives and provide supplemental sand resources to the shore protection project.

Outer Continental Shelf Lands Act of 1953
The Outer Continental Shelf Lands Act (OCSLA) enacted August 7, 1953, as amended, grants the Secretary of the Interior authority to grant, to qualified persons offering the highest competitive, bid leases of any mineral other than oil, gas, and sulfur in any area of the Outer Continental Shelf. The OCSLA was amended by Section 1 of Public Law 103-426, October 31, 1994. The Secretary of the Interior may negotiate the use of Outer Continental Shelf sand, gravel and shell resources for use in a program of, or project for, shore protection, beach restoration or coastal wetlands restoration undertaken by a Federal, State or local government agency; or for a project that is funded in whole or in part by or authorized by the Federal Government. Section 1(a)(2)(B) of the 1994 amendment prohibits the assessment, directly or indirectly, of any fees against an agency of the Federal government.

Any Federal agency that proposes to make use of sand, gravel and shell resources subject to the OCSLA shall enter into a Memorandum of Agreement with the Secretary of the Interior. The Secretary of the Interior is also required to notify the Committee on Merchant Marine and Fisheries and the Committee on Natural Resources of the House of Representatives, and the Committee on Energy and Natural Resources of the Senate on any proposed project for the use of those resources before the use of those resources.

Over 10 million cy of beach quality material has been identified through seismic and core boring investigations of the primary borrow area — Capron Shoal — located within three miles of the Atlantic shoreline and surrounding potential borrow areas (Taylor Engineering, Inc., 2002). Overfill factors of approximately 1.0 were found for various portions of the study area indicating compatibility of this fill material to the native sands.

Anadromous Fish and Conservation Act
This project will not affect anadromous fish and will include coordination with NMFS. This project will comply with this act.
Migratory Bird Treaty Act and Migratory Bird Conservation Act
This project will comply with the Migratory Bird Treaty Act and Migratory Bird Conservation Act in coordination with the USFWS and the FWC. Implementing the Jacksonville District USACE district-wide Migratory Bird Protection Policy (USACE, 1993) will minimize potential impacts. This project will not adversely affect migratory birds.

Magnuson-Stevens Fishery Conservation and Management Act
This project will include consultation with the NMFS to ensure that adverse impacts to EFH do not occur. This project will comply with this act.

E.O 11990 Protection of Wetlands
This project will not affect wetlands as defined by the Order. The project does not apply to the goals addressed in this Executive Order.

E.O. 11988 Floodplain Management
The project is in the base flood plain (100-year flood) and has been evaluated in accordance with this executive order. This project complies with this act.

E.O 12898 Environmental Justice
The proposed project would not result in adverse human health or environmental effects, nor would the activity adversely impact subsistence consumption of fish and wildlife. The project complies with this Executive Order.

E.O. 13089 Coral Reef Protection
The proposed action may affect U.S. coral reef ecosystems as defined in the Executive Order. Implementing precautionary measures during construction will minimize potential adverse effects. Creation of additional artificial hardbottom has successfully mitigated for adverse impacts of the original project and subsequent monitoring has indicated that periodic nourishments have not resulted in additional impacts. The project toe of fill location will remain unaltered for the reauthorized project. This project has and will continue to maintain the hardbottom habitats in the project area and meet the goals and objectives of the Coral Reef Protection Executive Order.

E.O. 13112 Invasive Species
This project would not affect invasive species. This Executive Order is not applicable.

E.O. 11988 Flood Plain Development
The authorized project is in the base flood plain (100-year flood) and has been evaluated in accordance with Executive Order 11988. Relocation of the project outside the flood plain would not be responsive to the problems and needs of the study area and was not considered further. A non-flood plain alternative for the potential development with the project would be to restrict all future development to those areas outside the flood plain or elevated above the flood plain. Potential flood plain development as a result of project implementation would be minimal. The continued project nourishment would have minimum impact on the natural and beneficial values of the flood plain. In the without-project flood plain (that area immediately adjacent to the project), there will be minimal loss of natural resources due to potential development. Implementation of any non-structural plans that would minimize potential damage to or within the flood plain beyond those laws and regulations already adopted by local and State interests are not viable solutions under the planning constraints of this study.
5.7 Flood Plain Management and Flood Insurance Programs Compliance

Section 402 of the Water Resources Development Act of 1986 (PL 99-662) as amended by Section 14 of the Water Resources Development Act of 1988 (PL 100-676) states "Before construction of any project for local flood protection or any project for hurricane or storm damage reduction, the non-Federal interests shall agree to participate in and comply with applicable Federal flood plain management and flood insurance programs.” St. Lucie County is enrolled in and complies with the National Flood Insurance Program (NFIP).

5.8 Public Accessibility

In determination of the Federal interest in cost-sharing, Federal participation is limited to the areas where adequate public parking and access are provided. Federal participation is limited to those shoreline reaches within 1/4 mile from an access point, a reasonable walking distance for a beach visitor. For shoreline reaches farther than 1/4 mile from public parking and/or beach access point, Federal participation will not be provided, unless, public accessibility is improved prior to project construction.
6.0 RECOMMENDATIONS

This study has given consideration to all significant aspects in the overall public interest, including engineering feasibility, economic, social and environmental effects. The selected plan described in this report, including mitigation for the Federal harbor effects, provides the optimum solution for shore protection benefits within the study area that can be developed within the framework of the formulation concepts. Re-authorization of the Fort Pierce Shore Protection Project for the 2021 – 2070 period is recommended at this time, with such modifications as in the discretion of the Commander, HQUSACE, may seem advisable.

Recommendations for provision of Federal participation in the selected plan described in this report would require the project sponsor to enter into a written Project Cooperation Agreement, as required by Section 221 of PL 91-611, as amended, to provide local cooperation satisfactory to the Secretary of the Army. Such local cooperation shall provide the following non-Federal responsibilities:

a) Provide 22.24% of total project costs (which include initial construction and periodic nourishment costs) assigned to shore protection, 50% of total project costs assigned to recreation, 100% of total project costs assigned to privately owned shores (where use of such shores is limited to private interests), and as further specified below.

b) Provide all lands, easements, and rights-of-way, including suitable borrow and dredged or excavated material disposal areas, and perform or ensure the performance of all relocations determined by the Federal Government to be necessary for the initial construction, periodic nourishment, operation, and maintenance of the Project.

c) Provide all improvements required on lands, easements, and rights-of-way to enable the proper disposal of dredged or excavated material associated with the initial construction, periodic nourishment, operation, and maintenance of the project. Such improvements may include, but are not necessarily limited to, retaining dikes, waste weirs, bulkheads, embankments, monitoring features, stilling basins, and dewatering pumps and pipes.

d) Provide, during construction, any additional amounts as are necessary to make its total contribution equal to 22.24% of total project costs assigned to shore protection plus 50% of total project costs assigned to recreation and 100% of total project costs assigned to privately owned shores (where use of such shores is limited to private interests).

e) For so long as the Project remains authorized, operate, maintain, repair, replace, and rehabilitate the completed Project, or functional portion of the Project, 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.

f) Give the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the Non-Federal Sponsor, now or hereafter, owns or controls for access to the Project for the purpose of inspection, and, if necessary after failure to perform by the Non-Federal Sponsor, for the purpose of completing, operating, maintaining, repairing, replacing, or rehabilitating the Project. No completion, operation, maintenance, repair, replacement, or rehabilitation by the Federal Government shall operate to relieve the Non-Federal Sponsor of responsibility to meet the Non-Federal Sponsor's obligations, or to preclude the Federal Government from pursuing any other remedy at law or equity to ensure faithful performance.

g) Hold and save the United States free from all damages arising from the initial construction, periodic nourishment, operation, maintenance, repair, replacement, and rehabilitation of the Project and any Project-related betterments, except for damages due to the fault or negligence of the United States or its contractors.
h) Keep, and maintain books, records, documents, and other evidence pertaining to costs and expenses incurred pursuant to the Project 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.

i) Perform, or cause to be performed, any investigations for hazardous substances as 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 (PL) 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 the initial construction, periodic nourishment, 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.

j) Assume complete financial responsibility, as between the Federal Government and the Non-Federal Sponsor for all necessary cleanup and response costs of any CERCLA regulated materials located in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be necessary for the initial construction, periodic nourishment, operation, or maintenance of the Project.

k) As between the Federal Government and the Non-Federal Sponsor, the Non-Federal Sponsor shall be considered the operator of the project for the purpose of CERCLA liability. To the maximum extent practicable, operate, maintain, repair, replace and rehabilitate the Project in a manner that will not cause liability to arise under CERCLA.

l) Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended by Title IV of the Surface Transportation and Uniform Relocation Assistance Act of 1987 (Public Law 100-17), and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way, required for the initial construction, periodic nourishment, operation, and maintenance of the Project, including those necessary for relocations, borrow materials, and dredged or excavated material disposal, and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act.

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) Provide 22.24% of that portion of total historic preservation mitigation and data recovery costs attributable to shore protection that are in excess of 1% of the total amount authorized to be appropriated for shore protection.

o) Provide 50% of that portion of total historic preservation mitigation and data recovery costs attributable to recreation that are in excess of 1% of the total amount authorized to be appropriated for recreation.

p) Provide 100% of that portion of total historic preservation mitigation and data recovery costs attributable to privately owned shores (where use of such shores is limited to private interests)
that are in excess of 1% of the total amount authorized to be appropriated for privately owned shores (where use of such shores is limited to private interests).

q) Participate in and comply with applicable Federal flood plain management and flood insurance programs.

r) Not less than once each year inform affected interests of the extent of protection afforded by the project.

s) Publicize flood plain information in the area concerned and provide this information to zoning and other regulatory agencies for their use in preventing unwise future development in the flood plain and in adopting such regulations as may be necessary to prevent unwise future development and to ensure compatibility with the protection provided by the Project.

t) For so long as the project remains authorized, the Non-Federal Sponsor shall ensure continued conditions of public ownership and use of the shore upon which the amount of Federal participation is based.

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

v) Prescribe and enforce regulations to prevent obstruction of or encroachment on the Project that would reduce the level of protection it affords or that would hinder operation and maintenance of the Project.

w) Recognize and support the requirements of Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended, and Section 103 of the Water Resources Development Act of 1986, Public Law 99-662, as amended, which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until the non-Federal sponsor has entered into a written agreement to furnish its required cooperation for the project or separable element.

x) At least once annually and after storm events, perform monitoring of the beach to determine losses of nourishment material from the project design section and provide the results of such monitoring to the Federal Government.

6.1 Disclaimers

The recommendations 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 plan nor the perspective of higher review levels within the Executive Branch. Consequently, the recommendations may be modified before they are transmitted to higher authority as proposals for project modifications and/or implementation funding.

The recommendations herein for provision of a shore protection project for Fort Pierce, Florida, do not include any provisions for work which would result in any new Federal expenditures or financial assistance prohibited by the Coastal Barrier Resources Act (Public Law 97-348); nor were funds obligated in past years for this project used for purposes prohibited by this Act.
7.0 REFERENCES


U.S. Army Corps of Engineers. 1976. *Beach Erosion Control Monitoring Study, Fort Pierce, Florida*. Waterways Experiment Station, Coastal Engineering Research Center and Jacksonville District; Florida Department of Natural Resources; and St. Lucie County.


