

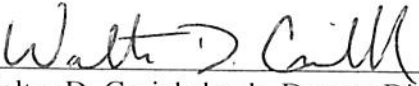


Record of Decision

**Use of OCS Sand Resources in the
Martin County Hurricane and Storm Damage Reduction Project,
Hutchinson Island, Martin County, Florida**

March 2012

**U.S. Department of the Interior
Bureau of Ocean Energy Management**



Walter D. Cruickshank, Deputy Director
Bureau of Ocean Energy Management

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I. Introduction

The U.S. Army Corps of Engineers – Jacksonville District (USACE) and Martin County Board of Commissioners (non-federal sponsor) have requested that the Bureau of Ocean Energy Management (BOEM) authorize the use of Outer Continental Shelf (OCS) sand resources in the Martin County Hurricane and Storm Damage Reduction (HSDR) Project. The Martin County HSDR Project is authorized by the Water Resources Development Act of 1990. The project proponents propose to nourish a 4 mile stretch of Hutchinson Island, Florida, creating a sea-turtle friendly beach template using sand from shoal C1-B, located approximately 5-7 miles offshore southeast Martin County. The Proposed Action considered by BOEM in this Record of Decision (ROD) is entering into a negotiated agreement for the purpose of making available OCS sand for placement on the beach in support of the Martin County HSDR Project. This decision is limited to authorization of the proposed 2012 use of OCS sand for the Martin County HSDR Project. Each subsequent beach fill proposal will require a new negotiated agreement and may require an updated environmental analysis (if warranted).

The environmental impacts of the offshore dredging and the placement of OCS sand along the Martin County shoreline have been evaluated in the 2011 Final Limited Re-evaluation Report (LRR) and Supplemental Environmental Impact Statement (SEIS) prepared by the USACE Jacksonville District with BOEM as a cooperating agency. The SEIS tiers directly from the USACE's 1986 Feasibility Report with Final EIS and 1994 General Design Memorandum with Environmental Assessment. Those previous NEPA documents evaluated a suite of structural and non-structural alternatives to address hurricane and storm damage reduction needs in Martin County, Florida. The placement of beach fill on the eroded beach has previously been selected by the USACE as the preferred plan to provide the needed protection from storms. The Congressionally-authorized project was initially constructed in 1996 using sand from Gilbert Shoal, located in state waters. Nourishment cycles occurred in 2000, 2001, and 2005 following major hurricanes. There is insufficient, beach-compatible quantities remaining in the original authorized borrow area. The SEIS evaluates alternative sources of beach-compatible sand, including upland and offshore sources, to identify and evaluate the impacts of using a new borrow area. The SEIS also considers new environmental information that has become available since the publication of the previous National Environmental Policy Act (NEPA) documents.

BOEM is serving as a cooperating agency for the SEIS because the bureau possesses both the regulatory authority and specialized expertise pertaining to the proposed action. The SEIS was developed to fulfill all Federal agencies' obligations under the NEPA, and the environmental impacts of all connected actions were encompassed in the analysis. BOEM was involved in extensive reviews of preliminary draft documents, provided comments on the Draft SEIS, and

participated in discussions on technical issues, public meetings and consultations with other Federal agencies. BOEM finds that the SEIS adequately evaluates the environmental effects of the Bureau's Proposed Action and reasonable alternatives to its action. BOEM independently reviewed the Draft SEIS and Final SEIS and found that the bureau's comments were adequately addressed. Pursuant to 43 CFR 46.120, BOEM is adopting the SEIS to comply with the requirements of NEPA and the Council on Environmental Quality (CEQ) regulations.

II. Purpose and Need for the Proposed Action

Loss of sand from the Nation's beaches is a serious problem that affects both the coastal environment and local, state, and regional economies. Beach nourishment and other coastal restoration projects are addressing this problem, and sand from the Outer Continental Shelf (OCS) is often used to stem this erosion. The USACE has proposed the Martin County HSDR Project to provide storm damage protection to structures that would otherwise be threatened by chronic shoreline retreat and storm-induced erosion and to maintain an area suitable for recreation and wildlife habitat in a developed beach area. The purpose of BOEM's connected action is to respond to a request from the USACE and Martin County Board of Commissioners to use OCS sand under the authority granted to the Department of the Interior by the Outer Continental Shelf Lands Act (OCSLA). The Proposed Action is necessary because the Secretary of the Interior delegated the authority granted in the OCSLA to BOEM to authorize the use of OCS sand resources for the purpose of shore protection and beach restoration.

III. Authority

The legal authority for the issuance of negotiated noncompetitive agreements for OCS sand and gravel is provided by Outer Continental Shelf Lands Act (OCSLA) (43 U.S.C. 1337(k)(2)). In 1994, OCSLA was amended to allow BOEM to convey, on a noncompetitive basis, the rights to OCS sand, gravel, or shell resources for use in a program for shore protection, beach restoration, or coastal wetlands restoration undertaken by a Federal, State, or local government agency (43 U.S.C. 1337(k)(2)(A)(i)).

In this instance under the Proposed Action, BOEM would enter into a negotiated agreement with the USACE, the lead Federal agency for implementation of the Martin County HSDR Project, as well as Martin County Board of Commissioners, the local sponsor for the project.

IV. Project Location and Setting

Martin County is located on Florida's east coast, approximately 100 miles north of Miami along the south Atlantic. The project area consists of Hutchinson Island, an elongated barrier island approximately 24.5 miles long and generally only a mile or less wide, and the inner shelf area offshore the barrier island. Hutchinson Island is separated from mainland Florida by the Ft. Pierce and St. Lucie Inlets and the Indian River Lagoon. Martin County's ocean-front beaches extend 21.5 miles between St. Lucie County and Palm Beach County, however only 4 miles are being considered for nourishment from the St. Lucie-Martin County boundary south to Stuart Public Park. The project area also includes the diverse inner shelf habitat offshore of St. Lucie and Martin Counties, including the physically dominated surf zone, nearshore sand and hard bottom habitat, and offshore sand borrow areas that were considered for beach fill.

During development of the SEIS, the USACE evaluated several onshore and offshore borrow areas as potential sources of fill material for Hutchinson Island. Three different OCS borrow areas, C1-A, C1-B, and C1-C, were considered in initial project planning. Borrow areas C1-A and C1-C were ultimately eliminated during scoping due to concerns over a greater potential for environmental effects and multiple-use conflicts. The SEIS provides more detail about the basis for elimination of these two alternative areas in Chapter 2.2.3. Mining sand deposits from upland areas can potentially reduce project costs if an adequate source of sand exists near the project area. Several sand mines with a potential source of nourishment material were considered in Glades, Lake, Martin, Palm Beach, Polk, and St. Lucie Counties. The distance between considered sand mines and the project area ranges from 12 to 148 miles.

The USACE identified C1-B, a low-relief, poorly defined shoal complex, as the preferred source of sand in its preferred action alternative in the SEIS to minimize environmental conflicts, while obtaining the necessary volume at reasonable cost. Shoal C1-B is located approximately 5-7 miles southeast of the beach fill area. The water depth in the dredge areas ranges from about 12-15 meters. The coordinates for C1-B are presented in Table 1.

Table 1: Florida State Plane Coordinates Delineating Borrow Area C1-B

Point	Easting (Ft)	Northing (Ft)
1	948093.30	1078737.58
2	948132.39	1080095.24
3	952436.95	1081963.30
4	953836.93	1079763.30
5	951810.11	1076952.30
6	950026.78	1077634.16

V. Alternatives Including the Proposed Action

The SEIS considers a range of alternatives to implement the USACE's previously-selected plan of beach nourishment. The alternatives considered by the USACE in the SEIS include: beach nourishment using C1-B, beach nourishment using a combination of upland sand sources, and no action. In its February 2012 ROD, the USACE selected its preferred alternative to construct the Martin County HSDR Project, including use of OCS sand from C1-B. The USACE and the Martin County Board of Commissioners have requested authorization for use of C1-B for the 2012 beach fill consistent with that preferred alternative. The BOEM has considered two alternatives upon this request and in context of the USACE's decision: (1) the Proposed Action and

(2) No Action. The Proposed Action is the preferred alternative of BOEM after evaluation of the environmental impacts and implementation and enforcement of mitigation measures, as described below. The Proposed Action is limited to entering into a negotiated agreement with the USACE and Martin County Board of Commissioners to use OCS sand from C1-B for the 2012 beach fill.

Proposed Action – Enter into a Negotiated Agreement

BOEM would negotiate an agreement with the USACE and Martin County Board of Commissioners that would allow use of approximately 800,000 (dredging up to 1,000,000) cubic yards (yd³) of OCS sand for sand placement at the Martin County shoreline between the St. Lucie-Martin County line south to Stuart Public Park. The agreement will be in the form of a 3-party Memorandum of Agreement between the USACE Jacksonville District, the Martin County Board of Commissioners, and BOEM. Although USACE plans to conduct maintenance projects, each using a comparable volume about every 13 years for the remaining Congressionally- authorized period through 2046, the Proposed Action is limited to authorization of the use of OCS sand for the 2012 beach fill. Subsequent beach fill projects using OCS sand would require separate negotiated agreements, and updated environmental analyses may be needed. Nourishment is scheduled for 2012 because of accelerated beach erosion in the north segment of the project area and the current availability of funding. Two additional re-nourishments are proposed for 2025 and 2038 at 13-year intervals, but again are not considered for BOEM authorization in this decision. The USACE has committed to implementing the mitigation measures and monitoring requirements identified in this ROD. BOEM will require implementation of the mitigation measures, monitoring, and reporting requirements identified in this ROD that are under its jurisdiction.

The shoal area considered for use is approximately 1,080 acres (1.6 sq. miles). The 2012 dredge cycle is expected to only disturb approximately 125 acres in the northeast quadrant. USACE's description of their proposed action was evaluated on the basis that a hopper dredge will be used to obtain and transport the OCS sand. The dredge is self-propelled and uses large pumps to dredge sediment from the ocean bottom and place it in a hopper. To the extent practicable, dredging is expected to occur in areas that are accreting, avoiding areas subject to erosion. The dredge depth would be approximately 2-3 m. Once the dredge hopper is filled, the dredge would transport the material to a pump-out buoy placed in state waters approximately 0.5-1- miles offshore of the placement area. The dredgers are expected to be equipped with a hopper with a capacity of 4,000 yd³ (3,000 m³). Dedicated pipeline corridors will be established and used in the near-shore to avoid negative impacts to nearshore benthic habitat. The initial discharge of material would occur into a shore-parallel dike that will advance alongshore ahead of the construction template backfill. The dike will help contain the discharge effluent and minimize nearshore turbidity. Heavy construction equipment will be used to shape the dewatering sediment to the sea-turtle friendly design template. A 35-foot-wide protective berm will be constructed at elevation 8.0 feet above Mean Sea Level (MSL), with a 1 foot Vertical :8.5 feet Horizontal foreshore slope to Mean Low Water, then a 1V:20H slope to the existing bottom. The USACE's preferred alternative also includes restoration of the primary dune as needed to an elevation of 12.5 feet above MSL and a dune width of 20 feet.

The construction sequencing for this project is unique in that construction must be completed, including mobilization and demobilization, between November 1st and May 1st to avoid overlap with the sea turtle nesting season. No construction equipment may be stored on the beach outside of this window. The total time for the dredging activities is expected to be about 4 months.

No Action Alternative – Deny Request for Use of OCS Sand

Under BOEM's No Action alternative, an agreement for use of OCS sand would not be negotiated. Under BOEM's No Action alternative, the USACE and Martin County Board of Commissioners would be unable to use OCS sand from the C1-B borrow area, and the feasibility and effectiveness of the Martin County HSDR Project could be jeopardized. If the Martin County HSDR Project is not constructed, the barrier beach can be expected to continue to erode and coastal infrastructure would be increasingly vulnerable to storm damage. Negative impacts to tourism and the local economy would be expected because of a narrowing beach. If the USACE and Martin County Board of Commissioners were to pursue the project or a smaller scale project using different sand resources, several potential, upland borrow areas were identified in the SEIS. The USACE could potentially obtain also sand from another distant OCS area, but such an area and viable source of compatible sand (including any other potential source of OCS sand) has not been identified or evaluated for environmental impacts. Project economics could be severely impacted if the transport distance and resultant construction costs are increased to obtain sand from alternative sources. The USACE evaluated the most reasonable and likely sand sources during the NEPA process.

VI. Environmental Consequences

Table 2.2-5 in the SEIS provides a detailed summary of potential environmental effects that could result from the different alternatives. A concise summary is also provided below for the BOEM alternatives.

Proposed Action

The beach fill is expected to have a beneficial effect in terms of reducing erosion along Hutchinson Island, providing storm damage protection, increasing recreational opportunity, and creating sea-turtle nesting and shorebird friendly habitat. A short-term increase in turbidity during the placement is expected, potentially resulting in a short-term effect on beach and surf zone fauna. To minimize turbidity and nearshore sedimentation, a shore-parallel dike will be constructed during placement operations. Air quality and noise effects would be highly localized and short-term. Upland noise levels will be monitored to ensure they remain below accepted levels. Temporary noise disturbances from construction machinery could adversely affect beach nesting and foraging birds. There also could be adverse effects from a short-term reduction in available food sources during and after the placement of sand on the shoreline. Over the long-term, there would be newly created shorebird nesting habitat.

Dredging the offshore shoals will change shoal topography and could adversely affect benthic communities, fish habitat, seabird foraging areas, but impacts are not expected to be significant because of the abundance of shoals or comparable habitat on a regional scale. No dredging is expected to occur in the vicinity of sensitive hardbottom habitat; a buffer will be established around any such feature to minimize or avoid impacts from other operations. The USACE is implementing several measures to minimize and compensate for any impacts to nearshore hardbottom from fill and pipeline conveyance disturbance, as discussed in the Mitigation section below. Adverse effects are expected to occur to bottom dwelling communities within the dredging area and at the beach fill placement area. However, a rapid recovery would be

expected after the project is completed. Adverse effects on Essential Fish Habitat (EFH) may occur in the dredge area and the fill placement area due to the removal of benthic communities. An impact to fisheries could also occur due to a temporary increase in turbidity in the area of dredging and sand placement.

Potential adverse impacts on marine mammals may occur due to physical disturbance of habitat, vessel strikes, and increased noise from vessels. With the implementation of observer, avoidance requirements, and speed restrictions, impacts will be minimized to the extent possible. Marine mammals may show some avoidance behavior due to underwater noise. Marine mammal observers will be onboard the dredge plant to ensure listed whales are not present within 1 km (0.62 miles) of the dredge to avoid injury from noise and vessel strike.

Adverse impacts, including sublethal and lethal injury, to protected sea turtles, could occur during dredging. The U.S. Fish and Wildlife Service (FWS) and National Marine Fisheries Service (NMFS) have concurred that the Proposed Action will not jeopardize the continued existence of turtle species or modify critical habitat at this time (*see* the U.S. FWS Biological Opinion and NMFS Biological Opinion in the SEIS appendices). Effects will be mitigated using draghead deflectors and observers to avoid dredge-turtle interactions. Any potential adverse impacts on right, fin, humpback whales or manatees, which are threatened or endangered species, will also be mitigated using observers and following speed restrictions.

Temporary adverse impacts on shorebirds (including temporary sublethal effects to endangered piping plovers), seabirds and migratory birds known to breed, nest, and forage along the shoreline of Hutchinson Island are anticipated. To minimize impacts, the USACE will implement its Migratory Bird and Shorebird Protection Policy and monitor nesting during construction activities. Over the long term, an increase in potential habitat is expected because of the increase in beach area.

Short-term disturbance to the recreational use of beach area is expected, but longer-term improvements outweigh that disturbance. There could be some temporary minor adverse effects on commercial and recreational fishing due to dredge entrainment, sedimentation, and disruption of fish and benthos. No archaeological resources or historic properties are known to be present in the project area.

No Action

Under the BOEM's No Action alternative, use of OCS sands from C1-B would not be authorized. Under the BOEM's No Action alternative, the USACE and Martin County Board of Commissioners could choose to use an upland borrow area for beach fill, which is fully analyzed in the SEIS. The beach area effects are comparable to those described above. Effects associated with transporting upland sand to the beach area would be greater, such as increased traffic and associated air emissions and noise levels owing to the use of heavy trucks. If the USACE chose another borrow area for the beach fill, including any other distant area on the OCS not already considered, the area would need to be thoroughly reviewed and analyzed for environmental impacts. Under the BOEM's No Action, the USACE would likely choose not to, or would otherwise be unable to, undertake, the Martin County HSDR Project at the same scale because of

constraints with project costs or availability of beach compatible sand. Without a beach fill, the environmental impacts of dredging on the C1-B would be eliminated. Other disturbance effects could occur in the vicinity of alternative upland borrow areas. Shorter-term adverse and longer-term beneficial impacts along the shoreline from beach fill would be reduced or eliminated. The remaining impacts would result from needed emergency repairs to the beach using upland fill sources. The Hutchinson Island shoreline would continue to retreat, resulting in a notable decrease in storm damage protection, the continued deterioration of the quality of nesting habitat along the barrier island, as well as loss of recreational beach.

VII. Consultation and Coordination

The proposed project using borrow area C1-B has been fully coordinated with the U.S. FWS, NMFS, U.S. Environmental Protection Agency, Florida Department of Environmental Protection (FDEP), Florida Fish and Wildlife Conservation Commission (FWCC), and other state agencies. The USACE served the role of the lead agency in environmental coordination and consultations with Federal and state agencies. BOEM was an active participant in these efforts, and all resource agencies were notified of BOEM's involvement. Chapter 4.36 of the SEIS demonstrates compliance with all relevant environmental laws and regulations.

The U.S. FWS and NMFS issued Biological Opinions pursuant to consultations concluded in 2010, and the agencies' effect determinations for all protected species in the project area are provided in the SEIS. The USACE conducted remote sensing surveys of the borrow area and nearshore corridors in order to meet compliance with the National Historic Preservation Act (NHPA) and the Abandoned Shipwreck Act. No significant submerged cultural resources or sensitive hard-bottom habitat were identified in the vicinity of shoal C1-B.

Extensive discussions occurred between the USACE, BOEM, and NMFS concerning Essential Fish Habitat. NMFS requested a number of modifications in the dredging operations and monitoring efforts, and the USACE and BOEM complied to the extent possible. The USACE and BOEM did not concur with all of the NMFS recommendations, in particular some of the monitoring suggestions at the borrow area because their implementation would make it too difficult to carry out the project in a cost-effective manner and/or their recommendations were not technically practicable. The consultation was concluded without full agreement on NMFS Conservation Recommendations. The USACE, as the lead agency, responded to the NMFS's Conservation Recommendations per the requirements of 50 CFR 600.920.

Consultations were conducted with the Florida Division of Historical Resources, FDEP, and FWCC. The USACE submitted to the State of Florida a Federal Consistency Determination in accordance with Section 307(c)(1) of the Coastal Zone Management Act (CZMA). The FDEP issued a Joint Coastal Permit Final Order that placed construction conditions on the Martin County HSRD Project.

VIII. Mitigation, Monitoring, and Reporting

Adopted through this ROD and identified below are the means deemed practicable by the USACE and BOEM to avoid, minimize, reduce, or eliminate adverse environmental effects that

could result from the proposed activities. These mitigation, monitoring, and reporting requirements were developed during preparation of the SEIS, through consultation and coordination with Federal and state governmental agencies, and on the basis of Bureau experience with similar beach nourishment projects.

First, mitigation, monitoring, and reporting requirements of the BOEM are identified. The second part summarizes mitigation and monitoring to be implemented by other agencies under other authorities. These are not BOEM-enforceable requirements, but are identified here because they are relevant in addressing impacts to the whole project, including the BOEM's Proposed Action. The USACE, as the lead Federal agency, will be responsible for implementing and enforcing all other mitigation and monitoring commitments in Chapters 2.3 and 4.35 of the Final SEIS and adopted in their ROD. The USACE, in its ROD, has committed to implementing the mitigation measures and monitoring requirements identified in this ROD. These mitigation and monitoring requirements apply to dredging and construction operations, and the USACE will report to BOEM on the implementation and effectiveness of the mitigation. The USACE will use an adaptive management strategy to develop and/or revise mitigation measures for subsequent actions.

BOEM Requirements

The negotiated agreement will stipulate that the USACE is the lead Federal agency on behalf of the Federal government to ensure that activities comply with applicable environmental laws, including but not limited to the ESA, Magnuson-Stevens Fishery Management and Conservation Act (MSA), Migratory Bird Treaty Act, NHPA, and CZMA. The USACE has assumed the role of lead Federal agency for ESA Section 7 compliance concerning threatened and endangered species under the purview of U.S. FWS and NMFS. Likewise, the USACE has assumed the role of lead Federal agency for complying with Section 305 of the MSA, Section 106 of the NHPA, and Section 307 of the CZMA. The USACE will instruct the contractor(s) to implement the mitigation terms, conditions, and measures required by the U.S. FWS, NMFS, and FDEP pursuant to applicable federal and state laws and regulations. The required mitigation terms, conditions, and measures are reflected in the Biological Opinions, Conservation Recommendations, and Joint Coastal Permit Final Order. Copies of all relevant correspondence, monitoring, and reporting related to the above resource agencies concerning these requirements will also be provided to BOEM.

Specific mitigation, monitoring, and reporting required by BOEM is provided in Attachment 1. The terms and conditions in Attachment 1 will be incorporated into the negotiated agreement. Mitigation measures were identified to reduce potential effects to habitat and sand resources in the borrow area, water quality, and cultural resources. The suite of relevant notification and reporting requirements are also summarized in Attachment 1.

Use of Borrow Area

BOEM will require the USACE to continuously record dredge location, draghead depth, and dredge activity data and transmit the data to BOEM on a biweekly basis. Dredge track lines and draghead depths will be provided in a format so that BOEM can ensure the activity is limited to the approved area and dredging cut depths. The USACE will be required to undertake pre- and

post-bathymetric surveys to document the nature of seafloor changes in the C1-B borrow area. BOEM also recommends that the USACE perform additional bathymetric surveys one year and three years after construction to document morphologic changes within the borrow area.

The profile and volume of the shoal will be reduced by dredging. Based on the best available science sponsored by BOEM, the USACE has developed a dredging plan designed to minimize adverse effects to the extent practicable. Dredging will occur preferentially in naturally accreting areas and dredging will be avoided in erosional areas of the shoal to the extent practicable. Dredging will be performed so that the hopper dredge excavates material using relatively shallow, uniform passes with a maximum overall cut depth of 2-3 m. The USACE will use the contour method to the extent possible to maintain the relative profile and shape of the sand ridge. Anchoring, spudding, or other bottom-disturbing activity is otherwise prohibited outside the approved borrow area. The USACE must immediately notify BOEM if dredging occurs outside of the approved borrow area.

Water Quality

The USACE will be required to prepare and implement a marine pollution control plan to address and ensure proper treatment of waste and prevent disposal of debris.

Cultural Resources

No cultural resources have been identified in or within the immediate vicinity of the borrow area. If an unanticipated discovery of archaeological resources occurs on the OCS, the dredge would immediately halt operations within 305 m (1,000 ft) of the area of the discovery. The USACE must report the discovery to BOEM. If investigations determine that the resource is significant, the parties shall together determine how best to protect it.

Additional Notification and Reporting

Prior to construction, the USACE will be required to submit a final construction plan and contract specifications, including design drawings, to the BOEM. During construction, the USACE or their agents, at the reasonable request of the BOEM, will allow BOEM or Bureau of Safety and Environmental Enforcement (BSEE) access at the site of any operation subject to safety and environmental regulations and shall provide the BOEM or BSEE any documents and records that are pertinent to occupational or public health, safety, or environmental protection as may be requested. The USACE will notify mariners of construction activities through a Local Notice to Mariners, report all pollution incidents should any accidentally occur, and report findings of ordnance or munitions on the OCS. Upon completion of construction operations, the USACE will prepare and submit to the BOEM a detailed project completion report, describing all phases of construction, including duration, equipment use, and project costs. The completion report will be accompanied by as-built drawings, dredged and placed volume calculations, pre- and post-bathymetric comparison, and all environmental reports.

Mitigation and Monitoring Adopted by the USACE

In Chapters 2.3 and 4.35 of the SEIS, the USACE identified a comprehensive list of mitigation and monitoring measures by resource and phase of construction. The SEIS includes a comprehensive series of measures to avoid, minimize, reduce, or otherwise monitor effects to water quality, coastal habitat, essential fish habitat (including hardbottom), shorebirds, nesting and in-water sea turtles, marine mammals, and cultural resources. These measures were either proposed by the USACE as design measures or were required by other Federal or State authorities. BOEM is not responsible for the implementation or enforcement of mitigation or monitoring requirements directly required under other Federal or State authorities. Likewise, BOEM does not have jurisdiction over the nearshore pump-out and submerged pipeline conveyance, or beach fill placement. On February 15, 2012, the USACE adopted all mitigation and monitoring components identified in the Final SEIS in its ROD. The USACE committed in its own ROD to implement the same mitigation measures and monitoring requirements identified in this ROD. Key mitigation and monitoring components are identified below.

- To minimize impacts on nesting habitat for shorebirds and sea turtles, the inter-tidal and sub-aerial beach will be restored using sand of a grain size and color comparable to existing beach material and using a design template that promotes successful nesting.
- Sediment control and spill prevention best management practices will be implemented to minimize erosion of placed material, turbidity, and impairment of water quality due to accidental spills from heavy equipment used during construction. A biological monitoring plan has been developed to assess direct, secondary, and long-term effects to subaerial beach and nearshore hardbottom habitat associated with the proposed project. A sedimentation and turbidity monitoring plan has been established to assess, avoid, and/or minimize impacts to reef communities adjacent to the proposed borrow areas during project construction.
- During initial construction in 1995, an estimated 1.3 acres of hardbottom habitat were buried by placement of sand in the construction template. To mitigate for this effect, a nearshore artificial reef was constructed during the summer of 2000 on three sites totaling approximately six acres. Construction of the recommended plan is not anticipated to directly affect hardbottom habitat outside of the initial construction template. The non-federal sponsor has prepared a contingency mitigation plan to be implemented if unanticipated secondary effects were to occur as a result of sand down-drift or post-construction sand equilibration outside of the seaward toe of the beach fill.
- Nesting shorebirds and sea turtles may be adversely impacted by the proposed activities. A training program for construction personnel, routine surveys and remote monitoring for shorebirds, nesting sea turtles, survey and monitoring results reporting, and coordination procedures are non-discretionary mitigation under the terms of the ESA Section 7 Biological Opinion and associated Incidental Take Statement issued by the U.S. FWS. The SEIS contains a complete description of the mitigation measures.

- Protected sea turtles, manatees, and right whales may be adversely impacted by the proposed activities. To avoid entrainment and strike, the USACE will require the use of trained observers for sea turtles and bridge watch for marine mammals. If species are observed, dredging activities will cease in those areas and avoidance buffers be established. Rigid deflectors will be installed on dragheads to minimize entrainment. The USACE will implement all reporting requirements and follow preservation and sampling procedures in the case of incidental take. The SEIS includes all the non-discretionary mitigation under the terms of the ESA Section 7 Biological Opinion and associated Incidental Take Statement issued by NMFS.
- The non-federal sponsor will stabilize dunes using sand fencing and native plants to maximize sand retention and reduce overall frequency and volume requirements for subsequent maintenance.
- The non-federal sponsor will implement a comprehensive biological and physical monitoring program. The biological monitoring program includes construction window, shorebird and sea turtle nesting surveys and avoidance protocols, 3 years of scarp and compaction monitoring, turbidity monitoring, and 2 years of nearshore hardbottom monitoring surveys. The physical monitoring program would consist of data collection, including sub-aerial beach cross-section surveys, subaqueous beach profile surveys, annual lidar surveys and aerial photography, and storm data summaries. The monitoring program would also compare the post-construction data with the preconstruction data and evaluate the performance of the sea-turtle friendly design.

Adoption of All Practical Means to Minimize Environmental Harm

BOEM has determined that all practical means have been adopted to avoid or minimize environmental harm from the Proposed Action.

IX. Environmentally Preferred Alternative

The environmentally preferred alternative from the perspective of this Bureau is BOEM's No Action alternative. Negative environmental impacts would generally be less under the No Action alternative, since no OCS sand would be used and dredging would not occur on the OCS. Therefore no dredging-related changes to the physical, biological, and cultural resources would be expected. However, if the Martin County HSDR Project is not constructed because of BOEM's decision not to authorize access to OCS sand resources, the infrastructure and coastal environment on Hutchison Island would continue to be at risk from storm damage and coastal erosion. The availability and quality of nesting habitat at the southern end of the barrier island would likewise be expected to continue to deteriorate. The environmentally preferred alternative would not meet the USACE's purpose and need, and after consideration of the beneficial and adverse environmental consequences of both alternatives and the available mitigation measures to be implemented under the USACE's Proposed Action, BOEM has decided that the USACE's Proposed Action is the preferable option in this ROD.

X. Bureau Decision

It is my decision to enter into a negotiated agreement with the USACE and Martin County to use OCS sand in the Martin County HSDR Project, implementing the Proposed Action. BOEM finds that the potential environmental effects of the Proposed Action are generally reversible over the long term, because they will be minor to moderate in intensity, localized, and short-lived. Potential longer-term beneficial effects include improved storm damage protection, improved recreational opportunity, and increased nesting and foraging habitat for protected sea turtles and migratory birds, especially with the sea-turtle friendly beach template and nearshore mitigation plan. The USACE has selected the same alternative in part because the estimated benefit to cost ratio for the remaining nourishments in the period of federal participation is 18 to 1. Beach restoration using dredged material from the proposed offshore borrow area C1-B would provide a sufficient amount of beach-compatible sand at a more economical cost and with less transportation complications than beach sand from an upland borrow source or other offshore source. A suite of mitigation and reporting requirements will be incorporated into the negotiated agreement to avoid, minimize, and/or reduce and track any foreseeable adverse impacts. In its ROD, the USACE committed to implement a substantial suite of mitigation measures and monitoring requirements identified herein, including those mandated by the BOEM. This action is taken with the understanding that any proposed use of OCS sand in future beach re-nourishment activities by the USACE and Martin County will require a new negotiated agreement and an updated environmental analysis as warranted.

Record of Decision Attachment

The following mitigation measures and reporting requirements will be required by the BOEM to avoid, reduce, or eliminate environmental impacts associated with the Proposed Action (herein referred to as the “Project”). Mitigation measures in the form of terms and conditions are added to the negotiated agreement and are considered enforceable as part of the agreement.

Plans and Performance Requirements

The USACE will provide BOEM with a copy of the Project’s “Construction Solicitation and Specifications Plan” prior to solicitation and construction (herein referred to as the “Plan”). No activity or operation authorized by the negotiated agreement (herein referred to as the Memorandum of Agreement or MOA) at C1-B shall be carried out until the BOEM has had an opportunity to review the Plan, thus ensuring that each activity or operation is conducted in a manner that is in compliance with the provisions and requirements of the MOA. BOEM recommends that the USACE include the MOA as a reference document in the advertised Plan. The USACE will ensure that all operations at C1-B are conducted in accordance with the final approved Plan and all terms and conditions in this MOA, as well as all applicable regulations, orders, guidelines, and directives specified or referenced herein.

The dredging method of removing sand from C1-B will be consistent with the NEPA and authorizing documents, as well as project permits. The USACE will allow BOEM to review and comment on modifications to the Plan that may affect the project area, including the use of submerged or floated pipelines to directly convey sediment from the borrow area to the placement site. Said comments shall be delivered in a timely fashion in order to not delay the USACE’s construction contract or schedule.

If dredging and/or conveyance methods are not wholly consistent with those evaluated in relevant NEPA documents and environmental and cultural resource consultations, and authorized by the Joint Coastal Permit (JCP), additional environmental review may be necessary. If the additional NEPA, consultations, or permit modifications would impact or otherwise supplement the provisions of the MOA, an amendment may be required.

Prior to the commencement of construction, the USCAE shall provide a summary of the construction schedule. The USACE, at the reasonable request of BOEM or BSEE, shall allow access, at the site of any operation subject to safety regulations, to any authorized Federal inspector and shall provide BOEM or BSEE any documents and records that are pertinent to occupational or public health, safety, or environmental protection as may be requested.

Environmental Responsibilities and Environmental Compliance

The USACE is the lead agency on behalf of the Federal government to ensure the Project complies with applicable environmental laws, including but not limited to the Endangered Species Act (ESA), Magnuson-Stevens Fishery Management and Conservation Act, Migratory Bird Treaty Act, National Historic Preservation Act, and Coastal Zone Management Act.

The USACE will serve as the lead federal agency for ESA Section 7 compliance concerning protected species under the purview of U.S. Fish and Wildlife Service (FWS) and National

Marine Fisheries Service (NMFS). The USACE will instruct its contractor(s) to implement the mitigation terms, conditions, and measures required by the U.S. FWS, NMFS, Florida Department of Environmental Protection, and BOEM pursuant to applicable federal laws and regulations. The required mitigation terms, conditions, and measures are reflected in the Biological Opinions, Conservation Recommendations, and Consistency Determination/JCP. Copies of all relevant correspondence, monitoring, and reporting shall be provided to the BOEM within 14 days of issuance at dredgeinfo@boem.gov (including but not limited to observer, Florida DEP, and dredging reports).

The USACE is responsible for compliance with the specific conditions of the JCP.

Pre-Construction Notification of Activity in or near the Borrow Area

The USACE will invite BOEM to attend a pre-construction meeting that describes the USACE's and/or its agents' plan and schedule to construct the Project.

The USACE will also notify the BOEM at dredgeinfo@boem.gov of the commencement and termination of operations at C1-B within 24 hours after the USACE receives such notification from its contractor(s) for the Project. BOEM will notify the USACE in a timely manner of any OCS activity within the jurisdiction of the DOI that may adversely affect the USACE's ability to use OCS sand for the Project.

Dredge Positioning

During all phases of the Project, the USACE will ensure that the dredge and any bottom disturbing equipment is outfitted with an onboard global positioning system (GPS) capable of maintaining and recording location within an accuracy range of no more than plus or minus 3 meters. The GPS must be installed as close to the cutterhead or draghead as practicable or use appropriate instrumentation to accurately represent the position of the cutterhead or draghead. During dredging operations, the USACE will immediately notify BOEM at dredgeinfo@boem.gov if dredging occurs outside of the approved borrow area.

Anchoring, spudding, or other bottom disturbing activities are not authorized outside of the approved borrow area on the OCS.

The USACE will provide BOEM with all Dredging Quality Management (DQM) data acquired during the project using procedures jointly developed by the U.S. Army Corps of Engineers' National Dredging Quality Management Data Program Support Center and the BOEM. The USACE will submit the DQM data, including draghead depth, to dredgeinfo@boem.gov biweekly. A complete DQM dataset will be submitted within 45 days of completion of the Project. If available, the USACE will also submit Automatic Identification System (AIS) data for vessels qualifying under the International Maritime Organization's (IMO) International Convention for the Safety of Life at Sea.

Dredge Operation

Dredging will occur preferentially in naturally accreting areas of C1-B and dredging will be avoided in erosional areas of the shoal to the extent possible. Dredging will be performed so that

the hopper dredge excavates material using relatively shallow, uniform passes to an overall cut depth not to exceed that permitted under the Florida Joint Coast Permit Final Order addressing sand compatibility requirements. The USACE will use the contour method to maintain the relative profile and shape of the sand shoal complex to the extent practicable to avoid creating deep depressions or pits.

Submittal of Production and Volume Information

The USACE, in cooperation with the dredge operator, shall submit to the Bureau on a biweekly basis a summary of the dredge track lines, outlining any deviations from the original Plan. A color-coded plot of the cutterhead or drag arms will be submitted, showing any horizontal or vertical dredge violations. The dredge track lines shall show dredge status: hotelling, dredging, transiting, or unloading. This map will be provided in PDF format.

The USACE will provide at least a biweekly update of the construction progress including estimated volumetric production rates to the Bureau.

The biweekly deliverables will be provided electronically to dredgeinfo@boem.gov.

The project completion report, as described below, will also include production and volume information, including Daily Operational Reports.

Local Notice to Mariners

The USACE shall require its contractor(s) for the Project to place a notice in the U.S. Coast Guard Local Notice to Mariners regarding the timeframe and location of dredging and construction operations in advance of commencement of dredging.

Marine Pollution Control and Contingency Plan

The USACE will require its contractor(s) and subcontractor(s) to prepare for and take all necessary precautions to prevent discharges of oil and releases of waste and hazardous materials that may impair water quality. In the event of an occurrence, notification and response will be in accordance with applicable requirements of 40 C.F.R. 300. All dredging and support operations shall be compliant with U.S. Coast Guard regulations and the U.S. Environmental Protection Agency's Vessel General Permit, as applicable. The USACE will notify BOEM of any occurrences and remedial actions and provide copies of reports of the incident and resultant actions at dredgeinfo@boem.gov.

Encounter of Ordinance

If any ordinance is encountered while conducting dredging activities at C1-B, the USACE will report the discovery within 24 hours to Mr. Steve Textoris, Chief, BOEM Leasing Division, at (703) 787-1215 and dredgeinfo@boem.gov.

Bathymetric Surveys

The USACE will provide the BOEM with pre- and post-dredging bathymetric surveys of C1-B. The pre-dredging survey will be conducted within the 30 days prior to dredging. The post-

dredging survey will be conducted within 30 days after the completion of dredging. Additional bathymetric surveys are recommended in the years 2013 and 2015. Hydrographic surveys will be performed in accordance with the USACE Hydrographic Surveying Manual EM 1110-2-1003, providing one hundred percent seamless coverage using interferometric swath or multibeam bathymetry. Single beam bathymetry will not satisfy this requirement. All bathymetric data shall be roll, pitch, heave, and tide corrected using accepted practices. Survey lines of the specific dredge area, within Borrow Area C1-B, will be established at intervals necessary to provide 100 percent coverage. Three equidistant cross-tie lines will be established parallel to the principal survey baseline. All survey lines will extend at least 100 m beyond the edge of the dredge areas. All data shall be collected in such a manner that post-dredging bathymetry surveys are compatible with the pre-dredging bathymetric survey data to enable the latter to be subtracted from the former to calculate the volume of sand removed, the shape of the excavation, and nature of post-dredging bathymetric change.

Copies of pre-dredging and post-dredging hydrographic data will be submitted to the BOEM via dredgeinfo@boem.gov within thirty (30) days after each survey is completed. The delivery format for data submission is an ASCII file containing corrected x, y, z data. The horizontal data will be provided in the North American Datum of 1983 (NAD '83) Florida State Plane, U.S. survey feet unless otherwise specified. Vertical data will be provided in the North American Vertical Datum of 1988 (NAVD '88), U.S. survey feet, unless otherwise specified. An 8.5x11" plan view plot of the pre- and post-construction data will be provided showing the individual survey points, as well as contour lines at appropriate elevation intervals. These plots will be provided in PDF format. Survey metadata will also be provided.

Archaeological Resources

Onshore Prehistoric or Historic Resources

If the USACE discovers any previously unknown historic or archeological remains while accomplishing the activity on Hutchinson Island, the USACE will notify the BOEM of any finding. The USACE will initiate the Federal and State coordination required to determine if the remains warrant a recovery effort or if the site is eligible for listing in the National Register of Historic Places.

Offshore Prehistoric or Historic Resources

In the event that the dredge operator discovers any archaeological resource while conducting dredging operations in C1-B or in the vicinity of pump-out operations, the USACE shall require that dredge and/or pump-out operations be halted immediately within 305 m (1000 ft) of the area of discovery. The USACE shall then immediately report the discovery to Mr. James F. Bennett, Chief, Division of Environmental Assessment, BOEM, at (703) 787-1660. If investigations determine that the resource is significant, the parties shall together determine how best to protect it.

Project Completion Report

A project completion report will be submitted by the USACE to BOEM within 120 days following completion of the activities authorized under this MOA. This report and supporting materials should be sent to Mr. Steve Textoris, Chief, Leasing Division, BOEM,

381 Elden Street, HM 3120, Herndon, Virginia 20170 and dredgeinfo@boem.gov. The report shall contain, at a minimum, the following information:

- the names and titles of the project managers overseeing the effort (for the USACE, the engineering firm (if applicable), and the contractor), including contact information (phone numbers, mailing addresses, and email addresses);
- the location and description of the project, including the final total volume of material extracted from the borrow area and the volume of material actually placed on the beach or shoreline (including a description of the volume calculation method used to determine these volumes);
- ASCII files containing the x, y, z and time stamp of the cutterhead or drag arm locations;
- a narrative describing the final, as-built features, boundaries, and acreage, including the restored beach width and length;
- a table, an example of which is illustrated below, showing the various key project cost elements;

	Cost Incurred as of Construction Completion (\$)
Construction	
Engineering and Design	
Inspections/Contract Administration	
Total	

- a table, an example of which is illustrated below, showing the various items of work construction, final quantities, and monetary amounts;

Item No.	Item	Estimated Quantity	Final Quantity
1	Mobilization and Demobilization		
2	Beach Fill		
3	Any beach or offshore hard structure placed or removed		

- a listing of construction and construction oversight information, including the prime and subcontractor(s), contract costs, etc.;
- a list of all major equipment used to construct the project;
- a narrative discussing the construction sequences and activities, and, if applicable, any problems encountered and solutions;
- a list and description of any construction change orders issued, if applicable;
- a list and description of any safety-related issues or accidents reported during the life of the project;
- a narrative and any appropriate tables describing any environmental surveys or efforts associated with the project and costs associated with these surveys or efforts;

- a table listing significant construction dates beginning with bid opening and ending with final acceptance of the project by the USACE;
- digital appendices containing the as-built drawings, beach-fill cross-sections, and survey data; and
- any additional pertinent comments.

Environmental and Reporting Compliance

The USACE will designate in advance of construction a single point of contact responsible for facilitation of compliance with all MOA requirements. The contact information will be provided to BOEM at least 30 days in advance of dredging and construction operations at dredgeinfo@boem.gov.

Failure to reasonably comply with these requirements may be a basis for BOEM to refer compliance issues to BSEE for appropriate enforcement measures. Failure to comply with these requirements in a timely and responsible fashion may delay future requests from the USACE and Martin County Board of Commissioners to BOEM for an authorization to use OCS sand resources for the Martin County HSDR Project.

**FINAL
SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT**

**MARTIN COUNTY HURRICANE AND STORM
DAMAGE REDUCTION PROJECT
HUTCHINSON ISLAND, MARTIN COUNTY, FLORIDA**

Contract No. W912EP-07-C-0034

LEAD AGENCY: Jacksonville District, U.S. Army Corps of Engineers

**COOPERATING AGENCY: Bureau of Ocean Energy Management, Regulation,
and Enforcement (formerly Minerals Management Service)**

Prepared for:

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August 2011

FINAL SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT

August 2011

MARTIN COUNTY HURRICANE AND STORM DAMAGE REDUCTION PROJECT HUTCHINSON ISLAND, MARTIN COUNTY, FLORIDA

LEAD AGENCY: Jacksonville District, U.S. Army Corps of Engineers

COOPERATING AGENCY: Bureau of Ocean Energy Management, Regulation, and Enforcement (formerly Minerals Management Service)

This Final Supplemental Environmental Impact Statement (SEIS) describes the proposed plan and the alternatives evaluated for the Martin County Hurricane and Storm Reduction Project (HSDR) (formerly referred to as the Beach Erosion Control Project or Shore Protection Project). The beach nourishment project authorizes construction of a protective and recreational beach along 4 miles of shorefront southward from the St. Lucie County line to near the limit of Stuart Public Beach Park (R-1 to R-25). The authorized project was initially constructed in 1996 with a planned periodic renourishment interval of 11 years. Federal participation (cost-sharing) is authorized for 50 years from date of initial construction and expires in 2046. During the initial project authorization and planning process, a range of both nonstructural (NS) and structural (S) measures were evaluated, and placement of beach fill on the eroded beach to offer protection from storms and inclusion of periodic nourishment for future protection was selected as the preferred plan. However, the previously approved borrow area has been fully utilized. Therefore, this SEIS evaluates potential sources of beach-compatible sand including three offshore borrow areas (C1-A, C1-B, and C1-C) which lie primarily on the Federal Outer Continental Shelf (OCS) approximately 3 to 7 miles offshore Martin and St. Lucie Counties and several upland sand sources. The total sand needed for the remainder of the 50-year life of the project is estimated to be between 2.4 and 4.0 million cubic yards (mcy). The next renourishment phase is scheduled for 2012 and will involve the placement of approximately 787,800 cubic yards (cy) of material along the 4-mile project area. The preferred alternative, offshore borrow area C1-B, addresses the federal and local planning objectives, anticipated beach erosion losses, and considers the needs of the study area. To offset direct and secondary impacts to nearshore hardbottom located within the limits of the project fill area, nearshore artificial reef was created within three areas totaling 6 acres. Biological, sedimentation, and turbidity monitoring during all phases of project construction will be implemented to ensure protection of resources within and adjacent to the fill and borrow areas.



U.S. Army Corps
of Engineers
Jacksonville District

For more information, contact Paul DeMarco, U.S. Army Corps of Engineers, Planning Division, P.O. Box 4970, Jacksonville, Florida 32232-0019, phone (904) 232-1897 or facsimile (904) 232-3442.

SUMMARY

FINAL SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT ON MARTIN COUNTY HURRICANE AND STORM DAMAGE REDUCTION PROJECT HUTCHINSON ISLAND, MARTIN COUNTY, FLORIDA

Need or Opportunity. Martin County is located on Florida's east coast 100 miles north of Miami and due east of Lake Okeechobee. The coastline consists of the Hutchinson Island area, which is an elongated barrier island approximately 24.5 miles long and generally only a mile or less wide. Hutchinson Island is separated from the mainland of Florida by the Ft. Pierce and St. Lucie Inlets and the Indian River Lagoon. Martin County's ocean front beaches extend for 21.5 miles between St. Lucie County and Palm Beach County.

The coastline of Martin County is low-lying and vulnerable to storm surge and other storm event damages. The problem along the project area is one of sand erosion and lowering of the beach profile with subsequent recession of the shoreline and dunes. The purpose and need for the shore protection project is to reduce both storm damage and beach erosion along the ocean shoreline of Martin County. Hurricanes and severe "northeasters" have caused considerable erosion and damage to shoreline structures within the project area. Along parts of the shoreline, erosion of beaches and dunes has made seawalls, buildings, and other structures vulnerable to severe storm damage.

The Martin County Hurricane and Storm Damage Reduction Project is designed to provide storm damage protection to structures that would otherwise be threatened by chronic shoreline retreat and storm-induced beach erosion while maintaining an area suitable for recreation and wildlife habitat. The beach nourishment project authorizes construction of a protective and recreational beach along 4 miles of shorefront southward from the St. Lucie County line to near the limit of Stuart Public Beach Park (R-1 to R-25). The authorized project was initially constructed in 1996 with a planned periodic renourishment interval of 13 years. Federal participation (cost-sharing) is authorized for 50 years from date of initial construction and expires in 2046. The total amount of sand needed for the remainder of the 50-year life of the project is estimated to be between 2.4 and 4.0 million cubic yards (mcy). The next renourishment phase is scheduled for 2012 and will involve the placement of approximately 787,800 cubic yards (cy) of material along the 4-mile project area.

Fill material for initial project construction and subsequent renourishment events was obtained from Gilbert Shoal, a borrow area located approximately 3,000 feet offshore of the barrier island. However, this previously approved borrow area has been fully utilized; therefore, a new borrow area needs to be identified to provide enough beach-compatible sand for the remaining period of federal cost-sharing participation.

Alternatives. The scope of this SEIS considers alternative sand sources for fill material for the authorized beach nourishment project, evaluates the potential effects that may result from the use of a new borrow area, and re-evaluates the potential effects of entire beach nourishment project in light of new available environmental information. This SEIS tiers from the existing 1986 *Feasibility Report with Final SEIS* and the 1994 *General Design Memorandum (GDM) with Environmental Assessment (EA)* that was prepared during initial evaluation and authorization of the Martin County Shore Protection Project [U.S. Army Corps of Engineers (USACE) 1994]. During the initial planning process, a full range of both nonstructural (NS) and structural (S) measures were evaluated. This current SEIS does not re-consider all of the alternatives, it only evaluates potential sources of beach-compatible sand which will yield enough sand to last for the remaining period of federal cost-sharing participation for the authorized project. Alternatives considered in detail in this SEIS include three offshore borrow areas (C1-A, C1-B, and C1-C) which lie primarily on the Federal Outer Continental Shelf (OCS) approximately 3 to 7 miles offshore Martin and St. Lucie Counties and several upland sand sources.

1986 FR with SEIS and 1994 GDM Alternatives. As mentioned previously, a range of both nonstructural and structural measures were evaluated in the 1994 GDM (USACE 1994) to reduce beach, land, and property losses resulting from erosion, storms, and hurricanes along Hutchinson Island. They consisted of the No Action Alternative, seven nonstructural solutions, and eight structural solutions. The alternatives were evaluated for the potential to contribute to the project objectives and consistency with project constraints. Several alternatives were not evaluated further than the initial screening due to a combination of economic viability, effectiveness, and/or political or social acceptance. The screening process eliminated those alternatives that did not respond to the needs of the problem area or to the overall planning objectives from further consideration and detailed evaluation. The federal planning objectives, as determined by the Principles and Guidelines, are to address the erosion problem by identifying and selecting the best course of action. The local planning objectives were incorporated in the overall screening process based upon the expressed desires of the local sponsor. Only those alternatives that warranted consideration based upon the overall planning objectives were brought forward for further evaluation. Various methods of hardened shore protection, such as revetments and seawalls, were eliminated from further consideration because such measures would not function well in the study area, would not solve the erosion problem, and would not provide enhanced recreational and sea turtle nesting benefits. The nonstructural alternatives would minimize environmental impacts and would help to alleviate economic impacts on oceanside property owners, but would not meet study objectives because the beaches in the project area would continue to erode and result in a loss of recreational benefits and sea turtle nesting habitat.

Analysis of the economic feasibility of the various shore protection alternatives in Florida most often indicates that beach nourishment represents the optimum solution to the erosion problems within the framework of federal guidelines. Beach fill alternative designs are formulated to provide various levels of protection to development,

prevention of loss of land, and recreational benefits. Since the beach nourishment alternative (S-3) offered a better course of action and opportunities to address the National Economic Development (NED) objective, it was carried forward for more detailed evaluation.

Supplemental EIS Alternatives: The additional alternatives discussed in the SEIS are a subset of the preferred alternative, Beach Nourishment (S-3), that was selected and authorized based on the initial planning and screening process (as described in the previous section). Sufficient quantities of beach-quality sand were available from the previously approved nearshore borrow area (Gilbert Shoal) for the 1996, 2001, 2002, and 2005 beach nourishment projects. However, that borrow area has been fully utilized; therefore, alternate sand sources are being evaluated in this SEIS to meet future nourishment requirements for the remaining life of the federal cost-sharing portion of this project which expires in 2046. The alternatives considered in the SEIS include:

- No Action Alternative
- S-3A: Beach Nourishment Using an Offshore Sand Source (Borrow Areas C1-A, C1-B, and C1-C)
- S-3B: Beach Nourishment Using an Upland Sand Source

Preferred Alternative. Beach Nourishment Using Offshore Borrow Area C1-B is selected as the Preferred Alternative because it addresses the erosion problem within the project area and fulfills Martin County's goals and objectives. Beach restoration using dredged material from the proposed offshore borrow area C1-B would provide a sufficient amount of beach-compatible sand at a more economical cost and with less transportation complications than beach sand from an upland borrow source. This site is located further away from shore than proposed borrow sites C1-A and C1-C, and wave analysis modeling results indicate that dredging this site for fill material would not result in unacceptable impacts to the wave climate and shoreline sediment transport from dredging this area. In addition, based on survey results, no submerged cultural resources or hardbottom resources have been identified within C1-B.

Major Findings and Conclusions. The authorized Martin County Hurricane and Storm Damage Reduction Project will be in the national interest and can be constructed while protecting the environment from unacceptable impacts. Federal and county objectives (benefits) include: (1) reducing expected storm damages through beach nourishment and other project alternatives; (2) re-establishing beaches as suitable recreational areas; (3) maintaining suitable beach habitat for nesting sea turtles, invertebrate species, and shorebirds; and (4) maintaining commerce associated with beach recreation in Martin County. This SEIS considers possible adverse impacts to the beach, nearshore hardbottom resources, and offshore sand borrow area resources and adjacent habitat. Significant issues addressed include potential long-term and cumulative effects on protected species, water quality, essential fish habitat (EFH), fish and wildlife resources, benthic communities, sediment transport, wave modification, cultural and socio-economic resources, and aesthetics and recreation.

Measures will be taken to avoid, minimize, and compensate for adverse impacts associated with obtaining offshore source material and nourishing 4 miles of shorefront. To offset direct and secondary impacts to nearshore hardbottom located within the limits of the beach fill project area (R-1 to R-25), 6.0 acres of nearshore artificial reef was created at three separate sites located approximately 900 feet offshore monuments R-12, R-18, and R-20. A biological monitoring plan has also been developed to assess direct, secondary, and long-term effects to nearshore hardbottom habitat associated with the proposed project. A sedimentation and turbidity monitoring plan has been established to assess, avoid, and/or minimize impacts to reef communities adjacent to the proposed borrow areas during project construction. The National Marine Fisheries Service (NMFS) and the Florida Fish and Wildlife Conservation Commission (FFWCC or FWC) comments have been addressed in the Final SEIS. Specific conditions as required in the Florida Department of Environmental Protection (FDEP) permit will also be followed accordingly to help minimize and avoid environmental impacts.

Issues Raised by the Public and Agencies. A Notice of Intent (NOI) to prepare the Draft SEIS for the Martin County Hurricane and Storm Damage Reduction Project located in Martin County, Florida was published in the Federal Register on June 1, 2007. The NOI was mailed to interested and affected parties by letter dated June 1, 2007, and coordination with relevant federal, state, and local agencies was conducted by USACE and Martin County. Issues of concern raised by respondents to the NOI are summarized below.

The Florida State Historic Preservation Office (SHPO) raised concerns that known and unidentified shipwreck sites within and adjacent to the proposed Martin County borrow areas may be impacted by sand-borrowing activities.

FDEP stated in their response to the NOI that, at this stage, the proposed activities are consistent with the Florida Coastal Management Program (FCMP); however, concerns raised by other reviewing agencies must be addressed prior to project implementation.

The Caribbean Conservation Corporation urged USACE to consider avenues for adequately funding an assessment of an alternate beach design template for the next renourishment. This is part of an effort that has been going on for more than a decade to adjust the traditional beach nourishment design template to ameliorate some of its negative effects on nesting sea turtles. The proposal is to construct alternating traditional and turtle friendly segments so that monitoring may be implemented in a controlled environment to scientifically verify the performance of the turtle friendly template, without compromising storm damage reduction benefits. This effort is supported by FDEP, Martin County, and the U. S. Fish and Wildlife Service (USFWS) among others.

The Town of Jupiter Island supports a study to identify new borrow sites for beach-compatible sand as long as sites would be developed and utilized in a non-exclusive manner so other municipalities could also access the sites.

NMFS raised several issues that require detailed evaluation, including the potential for significant adverse effects from excavation of offshore shoals on shoreline and living marine resources. NMFS also noted that mining the shoal for sand might alter the local wave climate and accelerate erosion that could affect EFH. Lastly, NMFS expressed concern that excavation of offshore borrow areas and placement of fill in nearshore areas could adversely affect hardbottom habitat, including corals and worm reefs colonized by *Phragmatopoma lapidosa*.

Public response originated primarily from St. Lucie County residents from Jensen Beach and Nettles Island who are opposed to the project. Their concern is that Martin County will be using sand resources that should be reserved to renourish St. Lucie County beaches along Hutchinson Island, which are also badly eroded.

Issues of concern raised by state and federal protection agencies relevant to the proposed renourishment project are addressed in this Final SEIS.

Areas of Controversy. Controversial issues raised by interested agencies and other parties during review of the Draft SEIS and the public meeting have addressed and incorporated into the Final SEIS.

Unresolved Issues. With the exception of the new borrow area location, the proposed Martin County Hurricane and Storm Damage Reduction Project does not include any areas that have not been previously used during past renourishment activities performed in Martin County. USACE and Martin County are committed to avoiding, minimizing, and mitigating for adverse effects during construction activities. Biological, sedimentation, and turbidity monitoring during all phases of project construction will be implemented to ensure protection of resources within and adjacent to the fill and borrow areas.

**FINAL SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT
ON
MARTIN COUNTY HURRICANE AND STORM
DAMAGE REDUCTION PROJECT
HUTCHINSON ISLAND, MARTIN COUNTY, FLORIDA**

TABLE OF CONTENTS

SUMMARY..... i

LIST OF FIGURES xii

LIST OF TABLES xiv

ACRONYMS AND ABBREVIATIONS xvi

1. PROJECT PURPOSE AND NEED 1

1.1. GENERAL PROJECT LOCATION 1

1.2. PROJECT AUTHORITY 1

 1.2.1. INITIAL AUTHORIZATION..... 1

 1.2.2. SUPPLEMENTAL APPROPRIATION 5

 1.2.3. PROJECT HISTORY 5

1.3. NEED AND PURPOSE OF PROPOSED ACTION..... 6

1.4. AGENCY GOAL OR OBJECTIVE..... 7

 1.4.1. FEDERAL AND COUNTY OBJECTIVES 7

 1.4.2. PLANNING OBJECTIVES 7

1.5. RELATED ENVIRONMENTAL DOCUMENTS..... 8

1.6. PUBLIC INVOLVEMENT 9

 1.6.1. SCOPING PROCESS..... 9

 1.6.2. DRAFT SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT (DSEIS) PUBLIC
 COMMENT PROCESS 10

 1.6.3. DSEIS COMMENTS..... 12

1.7. MAJOR DIFFERENCES BETWEEN THE DSEIS AND FSEIS 13

1.8. IMPACT MEASUREMENT 13

1.9. PERMITS, LICENSES, AND ENTITLEMENTS..... 14

2. ALTERNATIVES 15

2.1. ALTERNATIVES PREVIOUSLY CONSIDERED 15

 2.1.1. ALTERNATIVES DESCRIPTION..... 17

 2.1.2. ISSUES AND BASIS OF CHOICE..... 20

 2.1.3. ALTERNATIVES ELIMINATED FROM DETAILED EVALUATION 21

 2.1.4. ALTERNATIVES NOT WITHIN THE JURISDICTION OF LEAD AGENCY 24

 2.1.5. PREFERRED ALTERNATIVE – BEACH NOURISHMENT..... 24

2.2. SUPPLEMENTAL EIS ALTERNATIVES 25

 2.2.1. DESCRIPTION OF ALTERNATIVES..... 25

 2.2.1.1. No Action Alternative..... 25

 2.2.1.2. Beach Nourishment Using an Offshore Sand Source (S-3A) 25

 2.2.1.3. Beach Nourishment Using an Upland Sand Source (S-3B) 34

 2.2.2. ISSUES AND BASIS OF CHOICE..... 40

 2.2.3. ALTERNATIVES ELIMINATED FROM FURTHER EVALUATION..... 40

 2.2.4. PREFERRED ALTERNATIVE – BEACH NOURISHMENT USING OFFSHORE BORROW
 AREA C1-B..... 49

2.3.	MITIGATION AND MONITORING	54
2.3.1.	MITIGATION	54
2.3.2.	MONITORING.....	57
2.3.2.1.	ONSHORE MONITORING	59
2.3.2.2.	NEARSHORE MONITORING	60
2.3.2.3.	TURBIDITY MONITORING.....	60
3.	AFFECTED ENVIRONMENT	59
3.1.	GENERAL ENVIRONMENTAL SETTING.....	61
3.1.1.	PROJECT LOCATION	61
3.1.2.	STORM EVENTS	63
3.1.3.	WINDS.....	66
3.1.4.	WAVES.....	66
3.1.5.	TIDES	69
3.1.6.	CURRENTS	71
3.1.7.	STORM SURGE	71
3.1.8.	SEA LEVEL RISE.....	73
3.1.9.	GEOLOGY AND GEOMORPHOLOGY OF STUDY AREA.....	73
3.1.9.1.	C1-B Borrow Area Sediment Characteristics	77
3.1.9.2.	Native Beach Sediment Characteristics.....	79
3.1.9.3.	Borrow Area Compatibility with Native Sand.....	80
3.2.	VEGETATION	81
3.3.	THREATENED AND ENDANGERED SPECIES.....	82
3.3.1.	SEA TURTLES.....	86
3.3.1.1.	Nesting Habitat	86
3.3.1.2.	Inner Shelf Habitat.....	89
3.3.2.	MARINE MAMMALS	92
3.3.2.1.	Florida Manatee.....	92
3.3.2.2.	Humpback Whale	93
3.3.2.3.	North Atlantic Right Whale	94
3.3.2.4.	Other Whales.....	94
3.3.3.	SMALLTOOTH SAWFISH	96
3.3.4.	PIPING PLOVER.....	96
3.4.	NEARSHORE HARDGROUNDS AND ARTIFICIAL REEFS	98
3.4.1.	NEARSHORE HARDGROUNDS	98
3.4.2.	ARTIFICIAL REEFS.....	107
3.5.	OFFSHORE HARDBOTTOM	116
3.6.	FISH AND WILDLIFE RESOURCES	119
3.6.1.	BIRDS	119
3.6.1.1.	Migratory Bird Policies.....	119
3.6.1.2.	Habitat and Monitoring Results.....	120
3.6.2.	NEARSHORE FISH AND BENTHIC FAUNA	123
3.6.3.	OFFSHORE FISH AND BENTHIC FAUNA.....	128
3.6.4.	MARINE MAMMALS	129
3.6.4.1.	Whales.....	130
3.6.4.2.	Dolphins	131
3.7.	ESSENTIAL FISH HABITAT	134
3.7.1.	ESSENTIAL FISH HABITAT TYPES	137
3.7.1.1.	Sargassum.....	137
3.7.1.2.	Sandy Shoals	137
3.7.1.3.	Nearshore Hardbottom	138
3.7.1.4.	Artificial Reefs	138
3.7.1.5.	Offshore Marine Habitats Used for Spawning and Growth to Maturity.....	139
3.7.1.6.	Nearshore Shelf/Oceanic Waters and Shallow Subtidal Bottom.....	139
3.7.1.7.	Ocean High-Salinity Surf Zone.....	139
3.7.1.8.	Water Column.....	139
3.7.2.	MANAGED SPECIES	139
3.7.2.1.	Coastal Pelagic Fishes.....	139
3.7.2.2.	Penaeid Shrimp	140

3.7.2.3.	Red Drum	141
3.7.2.4.	Snapper-Grouper Complex (Reef Fishes)	142
3.7.2.5.	Spiny Lobster.....	143
3.7.2.6.	Sailfish.....	144
3.7.2.7.	Dolphin and Wahoo	144
3.7.2.8.	Highly Migratory Species.....	145
3.7.2.9.	Bluefish.....	146
3.8.	COASTAL BARRIER RESOURCES.....	146
3.9.	WATER QUALITY.....	147
3.10.	HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE.....	147
3.11.	AIR QUALITY.....	147
3.12.	NOISE	148
3.13.	AESTHETIC RESOURCES	148
3.14.	RECREATION RESOURCES.....	148
3.15.	NAVIGATION.....	149
3.16.	CULTURAL RESOURCES	150
3.17.	SOCIOECONOMICS.....	152
3.17.1.	DEMOGRAPHICS.....	152
3.17.2.	ECONOMICS.....	152
3.17.2.1.	Tourism.....	152
3.17.2.2.	Fishing	153
4.	ENVIRONMENTAL EFFECTS.....	156
4.1.	GENERAL ENVIRONMENTAL EFFECTS.....	156
4.1.1.	BEACH FILL AREA.....	156
4.1.2.	OFFSHORE BORROW AREA.....	158
4.2.	VEGETATION	159
4.2.1.	PREFERRED ALTERNATIVE, BEACH NOURISHMENT USING OFFSHORE BORROW AREA C1-B	159
4.2.2.	BEACH NOURISHMENT USING AN UPLAND SAND SOURCE.....	160
4.2.3.	NO ACTION ALTERNATIVE (STATUS QUO)	160
4.3.	THREATENED AND ENDANGERED SPECIES.....	160
4.3.1.	PREFERRED ALTERNATIVE, BEACH NOURISHMENT USING OFFSHORE BORROW AREA C1-B	160
4.3.1.1.	Sea Turtles	160
4.3.1.1(a)	Nesting Habitat	160
4.3.1.1(b)	Inner Shelf Habitats.....	167
4.3.1.2.	Marine Mammals	170
4.3.1.3.	Smalltooth Sawfish.....	172
4.3.1.4.	Piping Plovers	173
4.3.2.	BEACH NOURISHMENT USING AN UPLAND SAND SOURCE.....	173
4.3.3.	NO ACTION ALTERNATIVE (STATUS QUO)	174
4.4.	HARDGROUNDS.....	174
4.4.1.	PREFERRED ALTERNATIVE, BEACH NOURISHMENT USING OFFSHORE BORROW AREA C1-B	174
4.4.2.	BEACH NOURISHMENT USING AN UPLAND SAND SOURCE.....	176
4.4.3.	NO ACTION ALTERNATIVE (STATUS QUO)	176
4.5.	WILDLIFE RESOURCES.....	176
4.5.1.	PREFERRED ALTERNATIVE, BEACH NOURISHMENT USING OFFSHORE BORROW AREA C1-B	176
4.5.1.1.	Shorebirds and Migratory Birds.....	177
4.5.1.2.	Benthic Infauna	178
4.5.1.3.	Non-Threatened Marine Mammals.....	181
4.5.2.	BEACH NOURISHMENT USING AN UPLAND SAND SOURCE.....	181

4.5.3.	NO ACTION ALTERNATIVE (STATUS QUO)	181
4.6.	FISH AND ESSENTIAL FISH HABITAT ASSESSMENT	182
4.6.1.	PREFERRED ALTERNATIVE, BEACH NOURISHMENT USING OFFSHORE BORROW AREA	
	C1-B	182
4.6.1.1.	Nearshore Hardbottom Habitat	182
4.6.1.2.	Nearshore Sand Bottom Habitat	183
4.6.1.3.	Offshore Shoal Habitat	183
4.6.1.4.	Managed Fisheries	185
4.6.2.	BEACH NOURISHMENT USING AN UPLAND SAND SOURCE	187
4.6.3.	NO ACTION ALTERNATIVE (STATUS QUO)	187
4.7.	CURRENTS AND CIRCULATION	187
4.7.1.	PREFERRED ALTERNATIVE, BEACH NOURISHMENT USING OFFSHORE BORROW AREA	
	C1-B	187
4.7.2.	BEACH NOURISHMENT USING AN UPLAND SAND SOURCE	188
4.7.3.	NO ACTION ALTERNATIVE (STATUS QUO)	188
4.8.	CULTURAL RESOURCES	189
4.8.1.	PREFERRED ALTERNATIVE, BEACH NOURISHMENT USING OFFSHORE BORROW AREA	
	C1-B	189
4.8.2.	BEACH NOURISHMENT USING AN UPLAND SAND SOURCE	190
4.8.3.	NO ACTION ALTERNATIVE (STATUS QUO)	191
4.8.4.	NATIONAL HISTORIC PRESERVATION ACT OF 1966 (INTER ALIA)	191
4.9.	SOCIOECONOMIC	191
4.9.1.	PREFERRED ALTERNATIVE, BEACH NOURISHMENT USING OFFSHORE BORROW AREA	
	C1-B	192
4.9.2.	BEACH NOURISHMENT USING AN UPLAND SAND SOURCE	192
4.9.3.	NO ACTION ALTERNATIVE (STATUS QUO)	193
4.10.	AESTHETICS	193
4.10.1.	PREFERRED ALTERNATIVE, BEACH NOURISHMENT USING OFFSHORE BORROW AREA	
	C1-B	193
4.10.2.	BEACH NOURISHMENT USING AN UPLAND SAND SOURCE	193
4.10.3.	NO ACTION ALTERNATIVE (STATUS QUO)	194
4.11.	RECREATION	194
4.11.1.	PREFERRED ALTERNATIVE, BEACH NOURISHMENT USING OFFSHORE BORROW AREA	
	C1-B	194
4.11.2.	BEACH NOURISHMENT USING AN UPLAND SAND SOURCE	194
4.11.3.	NO ACTION ALTERNATIVE (STATUS QUO)	195
4.12.	COASTAL BARRIER RESOURCES	195
4.13.	WATER QUALITY	195
4.13.1.	PREFERRED ALTERNATIVE, BEACH NOURISHMENT USING OFFSHORE BORROW AREA	
	C1-B	195
4.13.2.	BEACH NOURISHMENT USING AN UPLAND SAND SOURCE	196
4.13.3.	NO ACTION ALTERNATIVE (STATUS QUO)	196
4.14.	HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE	196
4.15.	AIR QUALITY	197
4.15.1.	PREFERRED ALTERNATIVE, BEACH NOURISHMENT USING OFFSHORE BORROW AREA	
	C1-B	197
4.15.2.	BEACH NOURISHMENT USING AN UPLAND SAND SOURCE	198
4.15.3.	NO ACTION ALTERNATIVE (STATUS QUO)	199
4.16.	NOISE	199
4.16.1.	PREFERRED ALTERNATIVE, BEACH NOURISHMENT USING OFFSHORE BORROW AREA	
	C1-B	199
4.16.2.	BEACH NOURISHMENT USING AN UPLAND SAND SOURCE	199
4.16.3.	NO ACTION ALTERNATIVE (STATUS QUO)	199
4.17.	PUBLIC SAFETY	199

4.18. ENERGY REQUIREMENTS AND CONSERVATION	200
4.19. NATURAL OR DEPLETABLE RESOURCES.....	200
4.20. SCIENTIFIC RESOURCES.....	201
4.21. NATIVE AMERICANS	201
4.22. RE-USE AND CONSERVATION POTENTIAL	201
4.23. URBAN QUALITY.....	201
4.24. SOLID WASTE.....	202
4.25. DRINKING WATER	202
4.26. CUMULATIVE IMPACTS.....	202
4.26.1. CUMULATIVE ACTIVITIES SCENARIO	207
4.26.1.1. Past Conditions and Activities.....	207
4.26.1.2. Present/Ongoing Activities.....	207
4.26.1.3. Reasonably Foreseeable Future Activities	208
4.26.2. CUMULATIVE IMPACTS BY RESOURCE.....	210
4.26.2.1. Threatened and Endangered Species	210
4.26.2.2. Nearshore Hardbottom	213
4.26.2.3. Fish and Wildlife Resources	214
4.26.2.4. Essential Fish Habitat	215
4.26.2.5. Water Quality.....	215
4.26.2.6. Currents and Circulation	216
4.27. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES.....	216
4.27.1. IRREVERSIBLE.....	216
4.27.2. IRRETRIEVABLE	216
4.28. UNAVOIDABLE ADVERSE ENVIRONMENTAL EFFECTS	217
4.29. LOCAL SHORT-TERM USES AND MAINTENANCE/ENHANCEMENT OF LONG-TERM PRODUCTIVITY.....	217
4.30. INDIRECT EFFECTS	217
4.31. COMPATIBILITY WITH FEDERAL, STATE, AND LOCAL OBJECTIVES.....	218
4.32. CONFLICTS AND CONTROVERSY	218
4.33. UNCERTAIN, UNIQUE, OR UNKNOWN RISKS	218
4.34. PRECEDENT AND PRINCIPLE FOR FUTURE ACTIONS	218
4.35. ENVIRONMENTAL COMMITMENTS	218
4.35.1. SEA TURTLES.....	219
4.35.2. RIGHT WHALES AND MARINE MAMMALS.....	220
4.35.3. MANATEES	221
4.35.4. SHOREBIRDS AND MIGRATORY BIRDS	223
4.35.5. NEARSHORE HARDGROUNDS	224
4.35.6. QUALITY ASSURANCE FOR BEACH FILL SEDIMENT AND DREDGING ACTIVITIES	225
4.36. COMPLIANCE WITH ENVIRONMENTAL REQUIREMENTS	225
4.36.1. NATIONAL ENVIRONMENTAL POLICY ACT OF 1969	225
4.36.2. ENDANGERED SPECIES ACT OF 1973.....	225
4.36.3. FISH AND WILDLIFE COORDINATION ACT OF 1958	225
4.36.4. NATIONAL HISTORIC PRESERVATION ACT OF 1966 (INTER ALIA)	226
4.36.5. CLEAN WATER ACT OF 1972	226
4.36.6. CLEAN AIR ACT OF 1972	226
4.36.7. COASTAL ZONE MANAGEMENT ACT OF 1972.....	226
4.36.8. FARMLAND PROTECTION POLICY ACT OF 1981.....	226
4.36.9. WILD AND SCENIC RIVER ACT OF 1968	226
4.36.10. MARINE MAMMAL PROTECTION ACT OF 1972	227
4.36.11. ESTUARY PROTECTION ACT OF 1968	227
4.36.12. FEDERAL WATER PROJECT RECREATION ACT	227
4.36.13. FISHERY CONSERVATION AND MANAGEMENT ACT OF 1976	227
4.36.14. SUBMERGED LANDS ACT OF 1953	227

4.36.15. COASTAL BARRIER RESOURCES ACT AND COASTAL BARRIER IMPROVEMENT ACT OF 1990	227
4.36.16. RIVERS AND HARBORS ACT OF 1899	227
4.36.17. ANADROMOUS FISH CONSERVATION ACT	227
4.36.18. MIGRATORY BIRD TREATY ACT AND MIGRATORY BIRD CONSERVATION ACT	228
4.36.19. MARINE PROTECTION, RESEARCH AND SANCTUARIES ACT	228
4.36.20. MAGNUSON-STEVENSON FISHERY CONSERVATION AND MANAGEMENT ACT	228
4.36.21. EXECUTIVE ORDER 11990, PROTECTION OF WETLANDS	228
4.36.22. EXECUTIVE ORDER 11988, FLOOD PLAIN MANAGEMENT	228
4.36.23. EXECUTIVE ORDER 12898, ENVIRONMENTAL JUSTICE	228
4.36.24. EXECUTIVE ORDER 13089, CORAL REEF PROTECTION	228
4.36.25. OUTER CONTINENTAL SHELF LANDS ACT	229
5. LIST OF PREPARERS.....	230
5.1. PREPARERS	230
5.2. REVIEWERS	231
6. PUBLIC INVOLVEMENT	232
6.1. SCOPING AND DRAFT SEIS.....	232
6.2. AGENCY COORDINATION.....	232
6.3. LIST OF STATEMENT RECIPIENTS (DRAFT SEIS).....	233
6.4. COMMENTS RECEIVED AND RESPONSE	233
7. REFERENCES	234

APPENDICES

APPENDIX A	SECTION 404(b) EVALUATION
APPENDIX B	COASTAL ZONE MANAGEMENT CONSISTENCY
APPENDIX C	PERTINENT CORRESPONDENCE AND RESPONSES TO COMMENTS ON DRAFT SEIS
APPENDIX D	CUMULATIVE EFFECTS ASSESSMENT
APPENDIX E	ESSENTIAL FISH HABITAT ASSESSMENT
APPENDIX F	GEOTECHNICAL REPORT
APPENDIX G	MITIGATION REEF MONITORING REPORTS
APPENDIX H	MARTIN COUNTY HARDBOTTOM EVALUATION REPORTS
APPENDIX I	BIOLOGICAL AND PHYSICAL MONITORING PLANS AND CONTINGENCY MONITORING PLAN
APPENDIX J	BIOLOGICAL ASSESSMENT
APPENDIX K	2009 WAVE REFRACTION ANALYSIS OF BORROW AREA C1-B
APPENDIX L	BIOLOGICAL ANALYSIS AND REVIEW OF SIDESCAN SONAR DATA COLLECTED IN POTENTIAL SAND BORROW AREAS
APPENDIX M	REGIONAL FISHERY RESOURCE SURVEY AND SYNTHESIS IN SUPPORT OF MARTIN COUNTY'S COMPREHENSIVE BEACH AND OFFSHORE MONITORING PROGRAM
APPENDIX N	AIR QUALITY ANALYSIS
APPENDIX O	DIVE SURVEY OF PROPOSED BORROW AREA C1-B

LIST OF FIGURES

Figure 1.2-1	Project Location, Martin County Hurricane and Storm Damage Reduction (HSDR) Project, Hutchinson Island, Florida	3
Figure 1.2-2	Beach Profile and Cross-Section, Martin County HSDR Project, Hutchinson Island, Florida	4
Figure 2.2-1	3-D View of St. Lucie Shoal and Borrow Area “B”; Martin County HSDR Project, Hutchinson Island, Florida	27
Figure 2.2-2	2007 and 2009 C1-B Vibracore Locations, Martin County Hurricane and Storm Damage Reduction Project, Hutchinson, Island, Florida	31
Figure 2.2-3	Area C1-B Potential Targets with 2007 Boring Locations, Martin County Hurricane and Storm Damage Reduction Project, Hutchinson Island, Florida	32
Figure 2.2-4.	Targets B-01 and B-02, Martin County Hurricane and Storm Damage Reduction Project, Hutchinson Island, Florida	33
Figure 2.2-5a	North Pipeline Corridor Location, Martin County Hurricane and Storm Damage Reduction Project, Hutchinson Island, Florida	51
Figure 2.2-5b	South Pipeline Corridor Location, Martin County Hurricane and Storm Damage Reduction Project, Hutchinson Island, Florida	52
Figure 2.2-6.	Conceptual Alternative Template Design (Actual Slope Dependent on Site-Specific Considerations), Martin County Hurricane and Storm Damage Reduction Project, Hutchinson Island, Florida	53
Figure 2.3-1	Extent of Proposed Nourishment, Borrow Areas, and Coastal and Marine Resources, Martin County Hurricane and Storm Damage Reduction Project, Hutchinson Island, Florida	56
Figure 3.1-1	Example of Exposed Coquina Rock Outcroppings Located Approximately 2 Miles South of the Project Area (Bathtub Reef Park).....	62
Figure 3.1-2	2004-2005 Atlantic Basin Hurricane Tracks, Martin County HSDR Project, Hutchinson Island, Florida	65
Figure 3.1-3	Average Direction, Duration, and Velocity of Winds for 8-Year Period at West Palm Beach, Florida; Martin County HSDR Project, Hutchinson Island, Florida	67
Figure 3.1-4	Average Direction, Duration, and Velocity of Winds for 1998-2007 at West Palm Beach, Florida; Martin County HSDR Project, Hutchinson Island, Florida	68
Figure 3.1-5	Wave Height and Period Data for January 1976 and December 1995 at WIS 14m, Martin County HSDR Project, Hutchinson Island, Florida	70
Figure 3.1-6	Storm Surge Frequency Curve, Martin County HSDR Project, Hutchinson Island, Florida	72
Figure 3.1-7	Surficial Sediments and Stratigraphy of Central East Florida; Martin County HSDR Project, Hutchinson Island, Florida	75
Figure 3.1-8	Physiographic Provinces of the Continental Margin Offshore Central East Florida, Martin County HSDR Project, Hutchinson Island, Florida	76
Figure 3.1-9	Borrow Area C1-B—Dredge Depth and Design, Martin County HSDR Project, Hutchinson Island, Florida	78
Figure 3.2-1.	Example of a Typical Well-Established Dune System along the Project Reach, Hutchinson Island, Martin County, Florida	83
Figure 3.2-2.	Typical Planted Sea Oats and Early Recruitment Areas along the Project Reach, Hutchinson Island, Martin County, Florida	84
Figure 3.3-1	Designated Critical Habitats, Conservation Areas, and Mandatory Ship Reporting Zones for North Atlantic Right Whales, Martin County HSDR Project, Hutchinson Island, Florida.....	95

Figure 3.3-2	General Locations of the Designated Critical Habitat for the Wintering Piping Plover, Martin County HSDR Project, Hutchinson Island, Florida	97
Figure 3.4-1a	1997, 2001, 2004, and 2008 Visible Hardbottom, Martin County HSDR Project, Hutchinson Island, Florida	103
Figure 3.4-1b	1997, 2001, 2004, and 2008 Visible Hardbottom, Martin County HSDR Project, Hutchinson Island, Florida	104
Figure 3.4-1c	1997, 2001, 2004, and 2008 Visible Hardbottom, Martin County HSDR Project, Hutchinson Island, Florida	105
Figure 3.4-2	Survey Area Overview Showing Permanent Cross-Shore Transects Established and Surveyed during the Hutchinson Island Shore Protection Project 2010 Hardbottom Baseline Survey; Martin County Hurricane and Storm Damage Reduction Project, Hutchinson Island, Florida	106
Figure 3.4-3.	Number of Fish Species Identified (not Including Unidentified Fry) at Mitigation Reef Sites A, B, and C from 2002-2006, Martin County, Florida.....	108
Figure 3.4-4	Photographs of Artificial Mitigation Reef A	113
Figure 3.4-5	Photographs of Artificial Mitigation Reef B	114
Figure 3.4-6	Photographs of Artificial Mitigation Reef	115
Figure 3.5-1	Sidescan Sonar Coverage, Martin County HSDR Project, Hutchinson Island, Florida ..	118
Figure 3.6-1	Distribution of Potential Reef Habitat, Martin County HSDR Project, Hutchinson Island, Florida.....	125
Figure 3.7-1	Essential Fish Habitat, Martin County HSDR Project, Hutchinson Island, Florida	136
Figure 4.3-1	Annual Number of Loggerhead Turtle Nests along 6 Kilometers of Beach (Zones Z-EE) within the 2005 Martin County Beach Renourishment Project and 4 Kilometers of Control/Natural Beach (Zones K-N)	165
Figure 4.3-2	Annual Loggerhead Turtle Nesting Success along 6 Kilometers of Beach (Zones Z-EE) within the 2005 Martin County Beach Renourishment Project and 4 Kilometers of Control/Natural Beach (Zones K-N)	166

LIST OF TABLES

Table 1.2-1	Nourishments and Hurricanes Affecting the Project Area, 1996-2005	6
Table 1.6-1	Summary of DSEIS Public Comment Topics.....	12
Table 2.1-1	1994 GDM Evaluation of Potential Nonstructural (NS) and Structural (S) Measures to Address Beach Erosion along Hutchinson Island, Martin County, Florida	16
Table 2.2-1	Sand Resource Characteristics at Offshore Borrow Areas C1-A and C1-B.....	28
Table 2.2-2	Sand Mine Locations.....	36
Table 2.2-3	Description of Sand at Multiple Sand Mines	37
Table 2.2-4	Sand Mine Supply and Cost Information (2007 Costs).....	38
Table 2.2-5	Summary of Direct and Indirect Impacts of the Alternative Project Plans	42
Table 2.3-1	Project Physical Monitoring Requirements	58
Table 2.3-2	Project Biological and Environmental Monitoring Requirements.....	58
Table 3.1-1	Averaged Monthly Wave Conditions from 1980 to 1999	69
Table 3.1-2	Native Sediment Moist Munsell Color	79
Table 3.1-3	Native Sediment Characteristics.....	80
Table 3.1-4	Comparison of Borrow Area and Native Beach Sediment Characteristics.....	81
Table 3.3-1	Federally Listed and Candidate Species in Martin County, Florida.....	85
Table 3.3-2	Summary of Sea Turtle Nesting along 21.9 Miles of Coastline in Martin County, Florida, from 2004 to 2009 (FWC 2009b; Martin County).....	87
Table 3.3-3	Summary of Sea Turtle Nesting along Approximately 4 Miles (FDEP Reference Monuments R-1 to R-25) of Shoreline in Martin County, Florida, from 2004 to 2009	88
Table 3.3.4	Sea Turtle Species Potentially Occurring Offshore of East Florida	89
Table 3.3-5	Endangered Marine Mammal Species Potentially Occurring on the Eastern Florida Inner Shelf	92
Table 3.4-1	Hardbottom Acres within Project and Drift Areas, Martin County, Florida	101
Table 3.4-2	Fish Species Census from 2002-2006 for Nearshore Mitigation Reefs A, B, and C, Martin County, Florida.....	109
Table 3.4-3	2006 Benthic Species Census and Abundance for Nearshore Mitigation Reefs A, B, and C, Martin County, Florida.....	112
Table 3.6-1	BCR 31 (Peninsular Florida) 2008 Birds of Conservation Concern List	121
Table 3.6-2	Migratory Birds Observed Daily on the Beach during the 2005 Renourishment Event	122
Table 3.6-3	List of Taxa Identified In Situ by Divers along the Entire Length and within 1 Mile to Each Side of the Quantitative Survey Lines Surveyed on Nearshore Habitat North of the Inlet in Martin County, Florida	126
Table 3.6-4	Marine Mammals Occurring in Project Area	130
Table 3.7-1	EFH Designations, Associated Species Complexes, and Locations.....	135
Table 3.14-1	Public Access Points and Associated Activities along the 4-Mile Project Reach, Hutchinson Island, Martin County, Florida	149
Table 3.17-1	Tourism-Related Tax Revenue	152
Table 3.17-2	Sport Fishing Expenditures in Florida for State Residents and Non-Residents 16 Years and Older.....	153
Table 3.17-3	Economic Contribution of Reef-Related Expenditures to Martin County, Florida, 2003 Residents and Visitors	154

Table 3.17-4	Residents: Demographic Characteristics and Boater Profile of Resident Reef Users in Martin County, Florida, 2003	155
Table 3.17-5	Visitors: Demographic Characteristics of Visitor Reef Users in Martin County, Florida, 2003	155
Table 4.15-1	Estimated Emissions for the Preferred Alternative (tons per year).....	198
Table 4.26-1	Summary of Cumulative Impacts	204
Table 4.26-2.	Summary of Martin and St. Lucie Counties Beach Nourishment Projects	209
Table 5.1-1	List of Preparers.....	230
Table 5.2-1	List of Reviewers.....	231

ACRONYMS AND ABBREVIATIONS

ABI	Applied Biology, Inc.
ATM	Applied Technology and Management, Inc.
ASMFC	Atlantic States Marine Fisheries Commission
BCR	Bird Conservation Region
BMP	best management practice
BOEMRE	Bureau of Ocean Energy Management, Regulation, and Enforcement (formerly MMS)
CAR	Coordination Act Report
CBRA	Coastal Barrier Resources Act
CCCL	Coastal Construction Control Line
CDN	Coastal Data Network
CEQ	Council on Environmental Quality
ceta	Cetacean and Turtle Assessment Program
cm	centimeter
CO	carbon monoxide
CP&E	Coastal Planning and Engineering, Inc.
CSA	Continental Shelf Associates, Inc.
CWA	Clean Water Act
cy	cubic yards
CZMA	Coastal Zone Management Act
DEIS	Draft Environmental Impact Statement
DoN	Department of the Navy
EA	Environmental Assessment
EAI	Ecological Associates, Inc.
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EQ	environmental quality
ERDC	Engineering Research and Development Center
ESA	Endangered Species Act
ETOF	equilibrium toe of fill
EWS	Early Warning System
FCCE	Flood Control and Coastal Emergency
FCMP	Florida Coastal Management Program
FDEP	Florida Department of Environmental Protection
FDS	Florida Department of State
FEMA	Federal Emergency Management Agency
FFWCC/FWC	Florida Fish and Wildlife Conservation Commission
FGS	Florida Geological Survey
FMP	Fishery Management Plan
FMRI	Florida Marine Research Institute
FNAI	Florida Natural Areas Inventory
FWRI	Fish and Wildlife Research Institute
GDM	General Design Memorandum
GRBO	Gulf Regional Biological Opinion
HAPC	Habitat Areas of Particular Concern
hp	Horsepower

HSDR	Hurricane Storm Damage Reduction
m	meters
mm	millimeters
mcm	million cubic meters
mcy	million cubic yards
mhw	mean high water
mlw	mean low water
MMS	Minerals Management Service (now BOEMRE)
msl	mean sea level
NEAQ	New England Aquarium
NED	National Economic Development
NEPA	National Environmental Policy Act
NGVD	National Geodetic Vertical Datum
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
nmi	nautical mile
NOA	Notice of Availability
NOAA	National Oceanographic and Atmospheric Administration
NOI	Notice of Intent
NO _x	nitrates
NRC	National Research Council
NRHP	National Register of Historic Places
NS	nonstructural
NTU	nephelometric turbidity unit
OCS	Outer Continental Shelf
OCSLA	Outer Continental Shelf Lands Act
OSE	Other Social Effects
PCA	project cooperation agreement
PL	Public Law
PM	particulate matter
RBO	Regional Biological Opinion
RED	Regional Economic Development
S	structural
SAFMC	South Atlantic Fisheries Management Council
SDEIS	Supplemental Draft Environmental Impact Statement
SEARCH	Southeastern Archaeological Research, Inc.
SEIS	Supplemental Environmental Impact Statement
SHPO	(Florida) State Historic Preservation Office(r)
SLOPES	(USFWS) Standard Local Operating Procedures for Endangered Species
SO ₂	sulfur dioxide
STWAVE	Steady State Spectral WAVE
TEWG	Turtle Expert Working Group
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
VOC	volatile organic compounds
WIS	Wave Information Studies

FINAL SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT ON MARTIN COUNTY HURRICANE AND STORM DAMAGE REDUCTION PROJECT HUTCHINSON ISLAND, MARTIN COUNTY, FLORIDA

1. PROJECT PURPOSE AND NEED

1.1. GENERAL PROJECT LOCATION

Martin County is located on Florida's east coast 100 miles north of Miami and due east of Lake Okeechobee. The coastal area consists of Hutchinson Island, which is an elongated barrier island approximately 24.5 miles long and generally only a mile or less wide. Hutchinson Island is separated from mainland Florida by the Ft. Pierce and St. Lucie Inlets and the Indian River Lagoon. Martin County's ocean-front beaches extend 21.5 miles between St. Lucie County and Palm Beach County. The project area also includes the diverse inner shelf habitat offshore of St. Lucie and Martin counties, including the physically dominated surf zone, nearshore hardbottom habitat, and offshore sand borrow areas that may be targeted for beach fill. Chapter 3 provides a more detailed description of the project area and resources occurring within the region of interest.

1.2. PROJECT AUTHORITY

1.2.1. INITIAL AUTHORIZATION

A Congressional Resolution was adopted by the Public Works Subcommittee on May 18, 1973, requesting that the U.S. Army Corps of Engineers (USACE) investigate shore protection alternatives for Martin County, Florida. In June 1986, a *Feasibility Report with Final Environmental Impact Statement* was published and filed with the U.S. Environmental Protection Agency (USEPA). The project was authorized by the Water Resource Development Act of 1990 [Public Law (PL) 101-640]. The authorized plan consisted of construction of a protective and recreational beach along 4 miles of shorefront from the St. Lucie/Martin County line southward almost to the Public Beach Park (R-1 to R-25). (**Figure 1.2-1**). Prior to construction, a *General Design Memorandum (GDM) with Environmental Assessment (EA)* dated June 1994 was prepared. Discretionary authority was used to reduce the federal project length to 3.75 miles (R-1 to R-23) to avoid adverse environmental impacts to nearshore hardbottom habitat from infilling. The project berm was also tapered between R-23 to R-25 to further reduce adverse hardbottom impacts. The plan included restoring the primary dune to an elevation of 12.5 feet above mean sea level (msl) and a top width of 20 feet (**Figure 1.2-2**). In order to maintain the protective beach, advanced nourishment was included in the initial beach fill. The 1994 GDM optimized renourishment at 589,600 cy every 11 years; however, this interval has been revised to 13 years to maximize economics based on an updated erosion rate in the project area, a construction window from November 1 to May 1, and 35 years of remaining federal interest. A project cooperation agreement (PCA) was executed between the Department of the Army and the non-federal sponsor on August 3, 1995. The federal project is authorized for

50 years from the date of initial construction on December 13, 1995. The period of federal participation (cost-sharing) for this project expires in 2046. The total project fill requirement for the remainder of the 50-year life of the Martin County Hurricane and Storm Damage Reduction Project (HSDR) (formerly referred to as the Beach Erosion Control Project or Shore Protection Project) is estimated to be between 2.4 and 4.0 mcy. The next renourishment phase of the authorized project is scheduled for 2012.

The non-federal project sponsor is responsible for lands, easements, rights-of-way, relocations, and suitable borrow and/or disposal areas required for maintenance of the project. The sponsor is required to monitor the project annually to determine losses of nourishment material from the project footprint and assess impacts of project construction on sea turtle nesting. The sponsor is also required to reshape the beach and dune profile using material from within the project area and to maintain vegetation, public dune crossovers, and other project features associated with the beach and dunes.

The sponsor shall also keep access roads, parking areas, and other public-use facilities open and available to all on equal terms. Replacement of dune vegetation following periodic nourishment and replacement of dune crossovers is also a non-federal responsibility. The sponsor has fulfilled all of its non-federal responsibilities to date in accordance with the PCA.

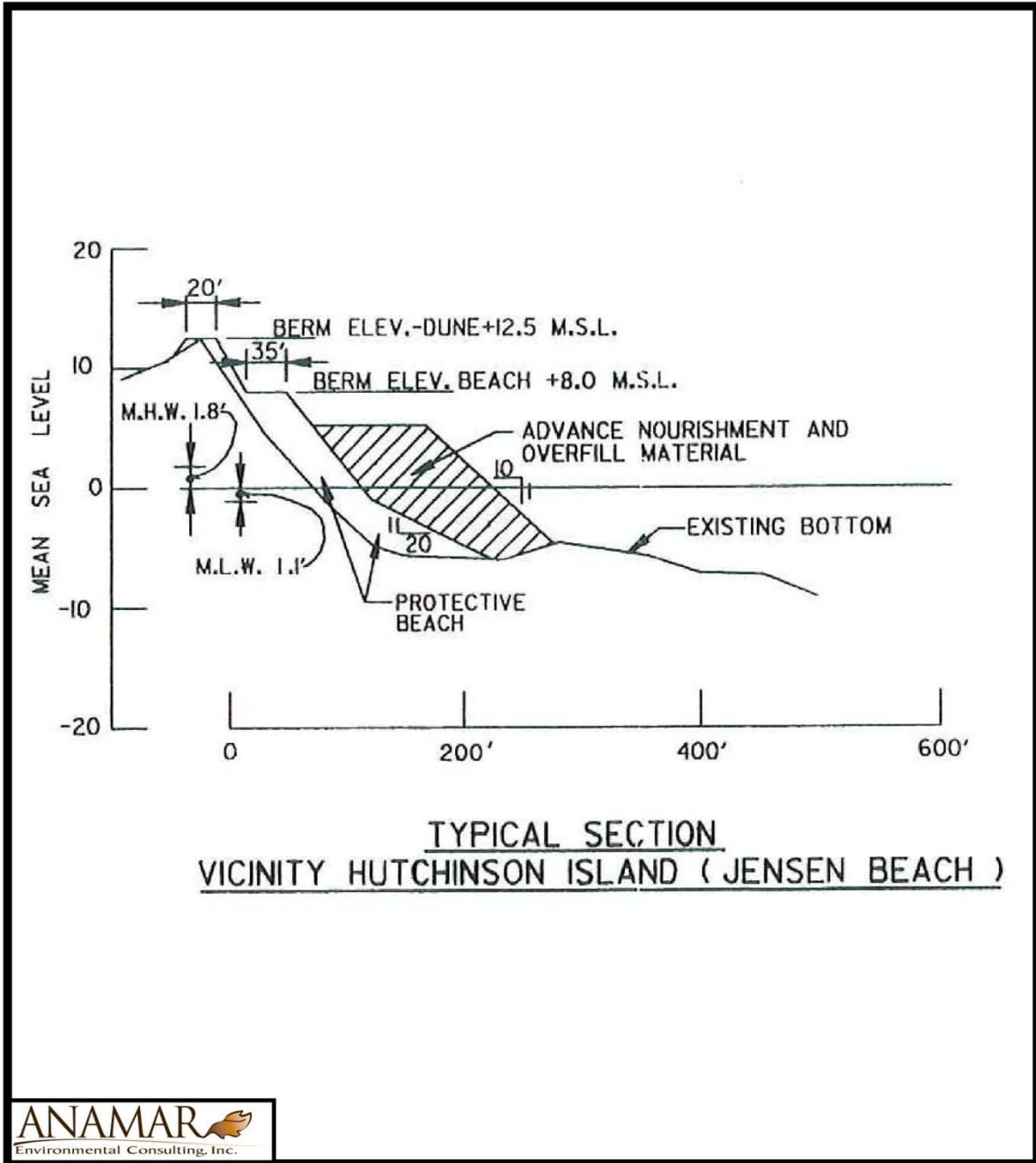


LEGEND

- Range Monuments
- Beach Access Points
- Federal/State Boundary
- ▭ Previous Borrow Area
- ▭ Potential Borrow Sites
- ▨ Shoals

**FIGURE 1.2-1. PROJECT LOCATION
MARTIN COUNTY HURRICANE AND
STORM DAMAGE REDUCTION PROJECT
HUTCHINSON ISLAND, FLORIDA**

This map and/or digital data is for planning purposes only and should not be used to determine the precise location of any feature.
Data provided as-is. Q:\GIS\PROJECTS\SEIS_MARTIN_CO\SEIS\Figure updates 030211\Figure 1.2-1_vicinity_and_plan_view1_020711_2.mxd.mxd. Data sources: NOAA, USACE, USFWS.



**FIGURE 1.2-2.
BEACH PROFILE AND CROSS-SECTION
MARTIN COUNTY HURRICANE AND
STORM DAMAGE REDUCTION PROJECT
HUTCHINSON ISLAND, FLORIDA**

This map and/or digital data is for planning purposes only and should not be used to determine the precise location of any feature. Data provided as-is. Q:\GIS\PROJECTS\SEIS_MARTIN_CO\SEIS\Figure updates\012711\Figure1_2-2_cross_section.mxd.mxd. Data sources: LABINS, FGDL, FDEP, USACE.

1.2.2. SUPPLEMENTAL APPROPRIATION

In a letter dated January 6, 1997, PL 84-99 assistance was requested for the Martin County Shore Protection Project following a severe “northeaster” storm event (USACE 2000). An evaluation of profile volume and shoreline position changes due the storm event was conducted to assess the damages caused by the storm (CP&E 1997). The evaluation determined that the November 1996 storm had resulted in moderate damage to the project area. However, the study also noted that much of the sand lost from the dry beach had been deposited in a nearshore storm bar, and the sand contained in the bar would likely migrate naturally to the beach within an acceptable time frame. The study concluded that the project was not eligible at that time for rehabilitation work under the provisions of PL 84-99. Consequently, no rehabilitation work was proposed.

In a letter dated November 1, 2004, PL 84-99 assistance was requested for the Martin County Shore Protection Project following Hurricanes Frances and Jeanne, which caused significant damage to the project area. Storm damages to the shore protection project resulted in a loss of approximately 269,500 cy of material from the project reach. This loss was deemed significant because it is equal to 45% of the periodic renourishment volume of approximately 590,000 cy (USACE 2005). The request met Flood Control and Coastal Emergency (FCCE) criteria, and emergency rehabilitation of the project area was approved under the authority of PL 84-99. Due to the 2004 hurricane impacts, the project was fully restored in spring of 2005 utilizing sand from the previously approved borrow area (Gilbert Shoal). Approximately 269,500 cy of material were used to restore the project to pre-storm conditions at 100% federal cost using FCCE funds, and approximately 625,500 cy were used to restore to full design conditions using construction general funds (USACE 2006).

In a letter dated February 23, 2006, PL 84-99 assistance was requested to restore the project area to pre-storm conditions as a result of damages incurred during the 2005 hurricane season (USACE 2006). Although significant damage was sustained, the project could not be completed before the next hurricane season began (June 1, 2007) due to lack of available beach-quality sand. Therefore, the project was ineligible for rehabilitation from impacts incurred during the 2005 hurricane season under PL 84-99.

1.2.3. PROJECT HISTORY

Construction of the Martin County HSDR Project occurred between December 13, 1995, and April 10, 1996, with placement of approximately 1.3 mcy of beach-quality sand from Gilbert Shoal, a borrow area located offshore of Stuart Public Beach. The project fill limits extended from the Martin/St. Lucie County line southward for 4 miles (R-1 to R-25). The 1994 GDM optimized renourishment at 590,000 cy every 11 years. However, from 1996 to 2005, the project area was nourished four times (1996, 2001, 2002, and 2005) to address the damage sustained from a series of significant storms, including a strong “northeaster” during project construction in 1996, three hurricanes in 1999, two hurricanes in 2004, and three hurricanes in 2005. The initial 1996 nourishment placed a much greater volume of sand on the beach (advanced nourishment) than the subsequent three nourishment events (**Table 1.2-1**).

The four nourishment events shown in **Table 1.2-1** differ in volume and location. The events in 1996 and 2005 covered the entire project area (R-1 to R-25). The 2001 event nourished most of the southern third of the project length, while the 2002 nourishment provided sand only to the central portion of the project area. The revised planned cycle of a 13-year interval for full beach nourishment is designed to allow for average annual erosion losses based on more current erosion rate data. However, this schedule does not preclude interim projects, such as those conducted in 2001 and 2002, to conduct partial nourishments to address erosional hotspots that may develop during the 13-year interval.

Table 1.2-1. Nourishments and Hurricanes Affecting the Project Area, 1996-2005

Event	Event Date	Cubic Yards
Northeaster (occurred during construction)	March 1996	N/A
Beach Nourishment – Initial Project Construction (R-1 to R-25)	December 1995 - April 1996	1,340,000
Hurricanes Dennis, Floyd, and Irene	Dennis (August 1999) Floyd (September 1999) Irene (October 1999)	N/A
Partial Beach Nourishment (R-16.2 to R-22.3)	January 2001 - Spring 2001	178,000
Partial Beach Nourishment (R-13.5 to R-16.2)	February 2002 - Spring 2002	126,000
Hurricanes Frances and Jeanne	Frances (August 2004) Jeanne (September 2004)	N/A
Full Beach Nourishment (R-1 to R-25.6)	Spring 2005	885,000
Hurricanes Dennis, Wilma, and Katrina	Dennis (July 2005) Katrina (August 2005) Wilma (September 2005)	N/A

Source: Stites et al. (2007), Taylor Engineering (2009c)

1.3. NEED AND PURPOSE OF PROPOSED ACTION

The purpose of the authorized Martin County HSDR Project is to provide storm damage protection to structures that would otherwise be threatened by chronic shoreline retreat and storm-induced beach erosion and to maintain an area suitable for recreation and wildlife habitat by performing periodic beach nourishment along the 4-mile project reach. The project is needed because recreational beach and beach habitat has been severely eroded, and hurricanes and storms present a significant risk to commercial and residential properties and sea turtle nesting habitat.

The authorized period of federal cost-sharing participation for this project is 50 years from initial project construction and expires in 2046. However, the previously approved nearshore borrow area (Gilbert Shoal) for this project has been fully utilized. The 1994 GDM estimated the area to contain approximately 6 mcy of beach quality material and

between 1996 and 2005 approximately 3 mcy was mined from the area. However, state requirements for buffers between sand layers and fines restrictions as well as practical sand thicknesses that can be dredged all contribute to a reduction in volume. As a result, Gilbert Shoal no longer contains a sufficient quantity of beach quality material for the project and is no longer a viable sand source. Therefore, a new borrow area needs to be identified in support of the authorized beach nourishment project. The proposed action evaluated in this Supplemental EIS (SEIS) is to identify and approve an alternative sand source that will provide enough beach-compatible sand for the remaining authorized period of federal cost-sharing participation.

It is important to note that this SEIS tiers directly from the 1986 *Feasibility Report with Final EIS* and the 1994 *GDM with EA* in which a full suite of structural (S) and non-structural (NS) measures were considered. During the initial assessment and evaluation of plans, structural measure S-3, beach fill with periodic nourishment, was selected as the preferred alternative. This SEIS does not re-consider the full suite of alternatives evaluated during the initial planning process. The scope of the SEIS is to evaluate and compare alternative sources of beach-quality sand, including upland and offshore sources, to identify a new borrow area; compare costs associated with mining sand from these sources; assess impacts on the environment and coastal processes from removal of this sand; and address impacts from nourishing the beach with this sand. The SEIS also provides new environmental information that has become available since the publication of the previous National Environmental Policy Act (NEPA) documents.

1.4. AGENCY GOAL OR OBJECTIVE

1.4.1. FEDERAL AND COUNTY OBJECTIVES

- Reduce expected storm damages through beach nourishment and other project alternatives.
- Re-establish beaches as suitable recreational areas.
- Maintain suitable habitat for nesting sea turtles, invertebrate species, and shorebirds.
- Maintain commerce associated with beach recreation in Martin County.
- Obtain beach-quality material in the most cost-effective and environmentally sustainable manner possible.

1.4.2. PLANNING OBJECTIVES

The overall objective for water resource planning is to develop a plan that best satisfies present and projected beach erosion control needs for the area while preserving and/or enhancing natural and recreational resources. The specific planning objectives used to conduct the study included:

1. Determination of the nature and extent of the erosion problems along the Martin County shoreline;
2. Determination of the pertinent factors that influence shoreline erosion along Martin County;

3. Determination of expected growth and future needs of the area;
4. Determination of the existing shorefront condition and recreational needs and the probable impacts on same by alternative measures for preservation and/or enhancement of these resources.

1.5. RELATED ENVIRONMENTAL DOCUMENTS

Multiple reports, technical documents, and studies were reviewed during preparation of this SEIS including, but not limited to:

1. Challenge Engineering and Testing, Inc. 2007. *Final Report: Vibracore Sampling and Laboratory Testing*. Martin County Offshore Investigations Project. Prepared for U.S. Army Corps of Engineers, Jacksonville District. Geotechnical Branch. November 2007.
2. CSA. 2007. *Baseline Survey of Nearshore Hardbottom Habitats in Martin County, Florida*. CSA International, Jupiter, Florida.
3. CSA. 2011. *Hutchinson Island Shore Protection Project 2010 Hard Bottom Baseline Survey*. CSA International, Jupiter, Florida. January.
4. EAI. 2005. *Martin County Beach Nourishment and Dune Restoration Projects, Results of 2005 Sea Turtle Monitoring*. Ecological Associates, Inc., Jensen Beach, Florida. 11 pp. + tables, figures, and appendices.
5. EAI. 2006. *Martin County Monitoring Area, Hutchinson Island, Florida; Results of 2005 Sea Turtle Monitoring*. Ecological Associates, Inc., Jensen Beach, Florida. 15 pp. of figures and tables.
6. Gilmore, R.G., Jr. 2008. *Regional Fishery Resource Survey and Synthesis in Support of Martin County's Comprehensive Beach and Offshore Monitoring Program. Final Report*. Prepared for Martin County Engineering Department, Stuart, Florida. December 2008.
7. Hammer, R.M, M.R. Byrnes, D.B. Snyder, T.D. Thibaut, J.L. Baker, S.W. Kelley, J.M. Côté, L.M. Lagera, Jr., S.T. Viada, B.A. Vittor, J.S. Ramsey, and J.D. Wood. 2005. *Environmental Surveys of Potential Borrow Areas on the Central East Florida Shelf and the Environmental Implications of Sand Removal for Coastal and Beach Restoration*. Prepared by Continental Shelf Associates, Inc. in cooperation with Applied Coastal Research and Engineering, Inc., Barry A. Vittor & Associates, Inc., and the Florida Geological Survey for the U.S. Department of the Interior, Minerals Management Service, Leasing Division, Marine Minerals Branch, Herndon, VA. OCS Study MMS 2004-037, 306 pp. + apps.
8. Harris, L.E. 2002-2006. *Monitoring of Martin County Nearshore Mitigation Reefs*. Performed for Martin County Engineering Department. Stuart, Florida.
9. Southeast Archeological Research, Inc. (SEARCH). 2008. *Historic Assessment and Submerged Cultural Resources Remote Sensing Survey of Four Borrow Areas for Martin and St. Lucie Counties Shore Protection Projects, Florida*.

10. Taylor Engineering, Inc. 2009. *FDEP Joint Coastal Permit Application*. Prepared for Martin County Engineering Department, Stuart, Florida. April 2009.
11. USACE. 1986. *Feasibility Report with Environmental Impact Statement: Beach Erosion Control Study, Martin County, Florida*. September 1985. Jacksonville District, South Atlantic Division.
12. USACE. 1994. *Martin County, Florida Shore Protection Project General Design Memorandum with Environmental Assessment*. June 1994. Jacksonville District, South Atlantic Division.
13. USACE. 2000. *PL 84-99 Rehabilitation Evaluation Report for the Martin County, Florida Shore Protection Project*. Prepared in February 2000 for USACE Jacksonville District by Coastal Systems International, Inc.
14. USACE. 2005. *Project Information Report: Rehabilitation Effort for the Martin County Hurricane/Shore Protection Project*. Prepared for Public Sponsor, Martin County Board of County Commissioners, Stuart, Florida. 2/24/2005.
15. USACE. 2006. *Project Information Report: Rehabilitation Effort for the Martin County Erosion Control and Hurricane Protection Project, Martin County, Florida*. Department of the Army, U.S. Army Corps of Engineers Jacksonville District, Jacksonville, FL, 18 September 2006.
16. USACE. 2009. *Wave Refraction Analysis, Martin County Borrow Area "B"*. U.S. Army Corps of Engineers Jacksonville District, Jacksonville, FL.
17. USFWS. 2005. *Biological Opinion: Martin County Shore Protection Project*. South Florida Ecological Services Office, Vero Beach, Florida. January 5, 2005. Service Log No: 4-1-05-F-10476.
18. USFWS. 2007. *Regional Biological Assessment for Beach Activities along the Atlantic and Gulf Coast of Florida*.

1.6. PUBLIC INVOLVEMENT

The proposed project was coordinated with the following agencies: U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), U.S. Environmental Protection Agency (USEPA), Florida State Clearinghouse, Florida Fish and Wildlife Conservation Commission (FFWCC or FWC), Florida Department of Environmental Protection (FDEP), Florida State Historic Preservation Officer (SHPO), and other interested parties. Issues of concern raised by state and federal agencies relevant to the proposed nourishment project have been incorporated into this SEIS for detailed evaluation. The proposed action involves evaluation for compliance with guidelines pursuant to Section 404(b) of the Clean Water Act (CWA); application (to the State of Florida) for Water Quality Certification pursuant to Section 401 of the CWA; certification of state lands, easements, and rights of way; and determination of Coastal Zone Management Act consistency.

1.6.1. SCOPING PROCESS

NEPA regulations require an early and open process for determining the scope of issues that should be addressed prior to implementation of a proposed action. The

scoping process as outlined by the Council on Environmental Quality (CEQ) was initiated to involve federal, state, and local agencies, affected Indian tribes, and other interested persons and organizations. On June 1, 2007, USACE published a Notice of Intent (NOI) to prepare a draft SEIS for the Martin County HSDR Project. The scoping letter was published and distributed to agencies, and requested their comments and concerns regarding environmental and cultural resources, study objectives, important features within the described project area, and suggested improvements. Copies of the scoping letter, NOI, the list of addresses used for distribution, and letters of response are included in Appendix C, Pertinent Correspondence.

The following is a summary of the responses to the scoping letter from agencies, local interests, and organizations regarding concerns and issues related to the proposed project:

- Florida SHPO response to the NOI raised concerns that both known and unidentified shipwreck sites within and adjacent to the proposed borrow areas may be impacted by sand-borrowing activities.
- FDEP responded that, at this stage, the proposed activities are consistent with the Florida Coastal Management Program (FCMP); however, concerns raised by other reviewing agencies must be addressed prior to project implementation.
- The Town of Jupiter Island supports a study to identify new borrow sites for beach-compatible sand as long as sites are developed and utilized in a non-exclusive manner, whereby other municipalities could also access the sites.
- NMFS raised several issues that require detailed evaluation, including the potential for significant adverse effects from excavation of offshore shoals on shoreline and living marine resources. NMFS also noted that mining the shoal for sand may alter the local wave climate, thereby accelerating erosion that could affect EFH and habitat areas of particular concern (HAPC). Lastly, NMFS expressed concern that excavation of nearshore borrow areas and placement of fill in nearshore areas could adversely affect hardbottom habitat, which includes corals and worm reefs colonized by the reef building polychaete, *Phragmatopoma lapidosa*.
- General public response was mostly from Jensen Beach and Nettles Island residents who are opposed to the project. Their concern is that Martin County will be depleting sand resources located within St. Lucie County that should be reserved to renourish St. Lucie County beaches, which are also critically eroded.

1.6.2. DRAFT SUPPLEMENTAL ENVIRONMENTAL IMPACT STATEMENT (DSEIS) PUBLIC COMMENT PROCESS

The DSEIS public review process provides the opportunity for stakeholders (including government agencies, special interest groups, and private citizens) to evaluate the DSEIS and assist in determining whether it adequately addresses environmental issues of concern expressed during the scoping process. The DSEIS public comment period began when the Notice of Availability (NOA) was published in the *Federal Register* on November 5, 2010 (USEPA 2010). Throughout the 60-day public comment period,

comments on the DSEIS were received and compiled for consideration during the preparation of the Final Environmental Impact Statement (FEIS).

The local sponsor sent media releases to local paper(s) announcing the notice of the availability of the SDEIS and the date, time, and location of the public workshop. A list of federal, state, and local elected officials, agencies, and organizations, as well as individuals who were mailed the notice of availability is provided in Appendix C. The DSEIS (hard copy or electronic copy) was also sent to the following:

- U.S. Environmental Protection Agency, Office of Federal Activities, EIS Filing Section, Ariel Rios Building (South Oval Lobby), Room 7220 1200 Pennsylvania Avenue, NW Washington, DC 20004 (5 hard copies)
- Blake Library, 2351 S.E. Monterey Road, Stuart, Florida 34996 (two hardcopies posted at reference desk)
- Lauren P. Milligan, Environmental Manager, Florida State Clearinghouse, Florida Department of Environmental Protection, 3900 Commonwealth Blvd, M.S. 47, Tallahassee, FL 32399-3000 (12 CDs)

An electronic version of the document was posted on the public access project website: http://www.saj.usace.army.mil/Divisions/Planning/Branches/Environmental/DocsNotices_OnLine_MartinCo.htm

The Martin County HSDR Public Project Workshop on the DSEIS was conducted on December 16, 2010 at the Indian River State College Chastain Campus, Wolf Center, 2400 SE Salerno Road, Stuart, Florida 34997 from 6:30 to 8:00 PM. The meeting began with a short presentation that provide a brief history of the purpose and need of the proposed action and alternatives. Then, attendees were invited to visit several poster stations set up around the room and talk with key personnel to find out more details about specific aspects of the project. Poster stations included:

- Project Overview: Project description and why is beach renourishment important along the Treasure Coast (economics, quality of life, storm damage), EIS/NEPA process, and timeline
- Sea Turtle Protection: Nesting habitat, historical use, turtle-friendly beach fill design, monitoring plan
- Sand Source/Modeling/Geotechnical Surveys: Sand samples, bathymetry and wave analysis results, video footage
- Nearshore Habitat/Monitoring Requirements: Nearshore hardbottom, mitigation reefs, Essential Fish Habitat

This meeting style provided interested persons an opportunity to review information, ask questions about the proposed action and alternatives, and voice their specific concerns to project representatives. All attendees were encouraged to sign in for the attendance record. According to the attendance record, the public meeting was attended by 31 persons (not including USACE and Martin County personnel and contractors participating in or facilitating the public meeting). The public was provided opportunities

to submit written comments by mailing or emailing them to the USACE project manager or by submitting a comment card at the public meeting.

1.6.3. DSEIS COMMENTS

During the 60-day comment period, a total of 12 people from the local community and key personnel from USEPA, Audubon of Florida, NMFS, Coastal Working Group, and Bureau of Ocean Energy Management, Regulation, and Enforcement (BOEMR, formerly MMS) submitted comment cards and letters. Appendix C includes copies of all written comments and USACE responses. **Table 1.6-1** presents a categorization of the comment received during the DSEIS public review process.

Table 1.6-1 Summary of DSEIS Public Comment Topics

Comment Category	Comment Topic	Number of Commentators Addressing Topic ¹
General Questions/Comments	Where does sand go when it erodes from beach?	1
	Will we find out comment made by public?	1
	Why is there no discussion of impact on Intracoastal Waterway?	1
	Lessons learned from negative impacts of previous nourishment projects (i.e, New Jersey, Bathtub Beach)?	1
	Why “borrow” from a shoal that protects the beaches by breaking up kinetic energy in waves that erode the coastline?	1
	Are nearshore areas south of project going to be monitored?	1
	Why not use material from St. Lucie Inlet for beach nourishment?	
	Concern regarding long-term and unavoidable impacts	2
	Concern about lack of mitigation	2
Alternatives/Project Description	Analysis of alternatives is narrow	
	Recommend eliminating C1-A and C1-C from project design	
Water Resources	Impacts on water quality	1
Biological Resources	Impacts to nearshore hardbottom	2
	Sediment compatibility and the effect of temperature on sea turtle nesting	1
	Impacts on fish, shorebirds, and/or infauna	1
Vegetation	Lack of recent vegetation data	1
Cultural Resources	Include in appendix of FSEIS any updated cultural assessment surveys, correspondence with State Archeologist and SHPO, and concurrence letter	1
Socioeconomics	Impacts on local economy (i.e, surf shops, bait/tackle shops)	6
Recreation/tourism	Impacts to surfing, tourism, birdwatching	5
Permit Compliance	Demonstrate full compliance with Florida Coastal Management Program (FCMP) and Coastal Zone Management Act (CZMA)	1
Construction Template	Support of turtle-friendly template	2
Offshore Borrow Areas	Support non-exclusive use of offshore borrow areas	1
	Incorporate dredging BMPs	
Monitoring	Conduct more robust monitoring for all phases of construction and turtle-friendly beach template	5

¹ This column denotes the number of commenters addressing the topic. A single commenter may have addressed more than one topic.

1.7. MAJOR DIFFERENCES BETWEEN THE DSEIS AND FSEIS

Several of the comments received by the USACE during the DSEIS review period led to revisions to the body of the DSEIS in order to complete the FSEIS. Revisions to the text included minor clarifications and inclusion of updated and additional information. No major changes to the document content were warranted or conducted as a result of public comment and review. None of the changes made to the text are believed to have profound effect on the findings and conclusions that were presented in the DSEIS. The most significant modifications were to:

- Chapter 2, Alternatives has been re-organized to clarify that this SEIS tiers from previous NEPA documents and does not re-consider the full suite of alternatives. The proposed action in this SEIS is to identify a new borrow area and considers alternative sand sources to meet the needs for the remaining period of federal cost-sharing participation for the authorized beach nourishment project.
- Addition of more in-depth discussion in Chapters 3 and 4 on marine mammals, shorebirds, and migratory birds and potential effects of proposed action.
- Sea turtle nesting data has been updated with most recent survey results.

1.8. IMPACT MEASUREMENT

This section summarizes the means and rationale for measuring and comparing impacts of the proposed action and alternatives. Section 4.0, Environmental Effects, provides a more detailed discussion of impact measurement and comparison.

This SEIS considers the effects on federally listed threatened and endangered species and EFH with particular concern for nearshore hardbottom habitat. Other issues include health and safety, water quality, aesthetics and recreation, fish and wildlife resources, cultural resources, socio-economic resources, and any other issues identified through additional scoping and public involvement.

Cultural resources surveys in the proposed borrow areas were conducted by a professional underwater archaeologist using modern remote sensing technology that included magnetometer data, sidescan sonar data, and depth recorded capabilities. No cultural resources were identified in borrow area C1-B.

NMFS recommends that the EFH assessment include the results of an on-site inspection, input from recognized fishery experts on the habitat and species effects, a literature review, an analysis of alternatives to the proposed action, and analyses of the borrow site using methods similar to those recommended in Kelley et al. (2004).

The Minerals Management Service (MMS) conducted initial studies on the physical and environmental effects of the excavation of sands from these offshore shoals. Results are presented in a report titled: *Environmental Surveys of Potential Borrow Areas on the Central East Florida Shelf and the Environmental Implications of Sand Removal for Coastal and Beach Restoration* (Hammer et al. 2005). Computer modeling performed during the study indicates that limiting the depth of excavation can prevent effects to the shoreline adjacent to these borrow sites (Hammer et al. 2005).

1.9. PERMITS, LICENSES, AND ENTITLEMENTS

Refer also to Section 4.35, Compliance with Environmental Requirements.

A FDEP Joint Coastal Permit and Sovereign Submerged Lands Authorization will be acquired before project construction. A Joint Coastal Permit Application was prepared and submitted to FDEP in April 2009. A complete copy of the permit application and requests for additional information (RAI) and responses can be downloaded from the following website: http://bcs.dep.state.fl.us/envprmt/martin/pending/0295380_%20Martin_County_Beach_Restoration/001_JC/Completeness%20Review/

The proposed beach nourishment project is subject to the provisions of the Coastal Zone Management Act, and the State of Florida will evaluate the proposal for consistency with the goals and objectives of the act. Consultation with SHPO is also required before dredge and fill operations will be authorized by state and federal regulatory agencies. The project stipulates discharge of fill material into the waters of the United States, and is therefore subject to Section 404 of the CWA. Issuance of the FDEP permit represents compliance with the federal mandate for CWA compliance.

As a federal agency with jurisdiction to manage resources available on the Outer Continental Shelf (OCS), BOEMRE was invited in April 2007 by USACE to participate as a partner on the Martin County HSDR Project. This partnership was developed to fulfill BOEMRE's mandatory statutory environmental and leasing requirements for the issuance of a negotiated noncompetitive agreement for the use of OCS sand resources. As a cooperating agency, with respect to NEPA, BOEMRE

- Participated in the NEPA process;
- Participated in the scoping process;
- Assumed, at the request of USACE, responsibility for developing information and preparing environmental analyses for which BOEMRE has special expertise; and
- Made available staff support at the lead agency's request to enhance the interdisciplinary capability of USACE.

BOEMRE also agreed to participate in the required Endangered Species Act of 1973 (ESA) Section 7 consultation; the Magnuson-Stevens Fishery and Conservation Management Act Essential Fish Habitat consultation (Section 305); the National Historic Preservation Act (NHPA) Section 106 process; and the Coastal Zone Management Act Section 307 consistency determination. As the lead federal agency for ESA Section 7 and the Essential Fish Habitat consultations, USACE notified USFWS and NMFS of its lead role and BOEMRE's cooperating status. BOEMRE and USACE jointly submitted the ESA Section 7 and Essential Fish Habitat assessments to USFWS and NMFS. USACE also acted as the lead federal agency for Section 106 compliance in accordance with 36 CFR Part 800.2(2), while BOEMRE acted as a cooperating agency for Section 106 compliance, offering input and consultation as needed.

2. ALTERNATIVES

Chapter 2 describes in detail the No Action Alternative, the preferred alternative, and other reasonable alternatives that were studied in detail. This SEIS tiers directly from the 1986 *Feasibility Report with Final EIS* and the 1994 *GDM with EA* which previously considered a full suite of structural and non-structural measures. Since the beach nourishment alternative was selected as the preferred alternative and the project was constructed in 1995, this SEIS does not re-consider the full suite of alternatives evaluated during the initial planning process. The alternatives evaluated and compared in this SEIS include various sources of beach-quality sand with the purpose of identifying a new borrow area in support of the authorized beach nourishment project since the previously approved borrow area (Gilbert Shoal) has been depleted.

To provide background information on the initial planning process, Section 2.1 summarizes alternatives previously considered in the 1986 *Feasibility Report with Final EIS* and 1994 *GDM with EA* and the rationale for selection of the preferred alternative. Section 2.2 describes the alternatives evaluated for the current proposed action which is identification of a new borrow area, compares costs associated with mining sand from these sources and, summarizes impacts on the environment and coastal processes from removal of this sand. Section 2.3 provides information on the mitigation and monitoring program.

2.1. ALTERNATIVES PREVIOUSLY CONSIDERED

A broad range of nonstructural and structural measures were considered during the original planning and evaluation process to reduce beach, land, and property losses resulting from erosion, storms, and hurricanes along the project reach. These alternatives were presented in the 1986 *Feasibility Report with SEIS* and the 1994 *GDM with EA*. The alternatives considered include the No Action Alternative, seven nonstructural alternatives, and eight structural alternatives (**Table 2.1-1**). The nonstructural measures sought to preclude any significant form of physical development or construction and emphasized management measures rather than structural measures. The structural measures included use of revetments, seawalls, groins, and beach nourishment. Each alternative was given serious consideration during the planning process.

Section 2.1.1 describes the alternatives. Section 2.1.2 describes the issues and basis of choice for preferred alternative selection. Section 2.1.3 identifies alternatives that were eliminated from further consideration and discusses the rationale for elimination based on project planning objectives. Section 2.1.4 identifies alternatives not within the jurisdiction of the lead agency. Section 2.1.5 discusses the selection of the preferred alternative.

Table 2.1-1. 1994 GDM Evaluation of Potential Nonstructural (NS) and Structural (S) Measures to Address Beach Erosion along Hutchinson Island, Martin County, Florida

POSSIBLE MEASURES		Local Planning Objectives				Principles and Guidelines				
		Provision for Recreation Beach	Protection from Flooding and Wave Damage	Beach Erosion Control	Protection of Tourist-based Economy	National Economic Development	Environmental Quality	Other Social Effects	Regional Economic Development	
NONSTRUCTURAL MEASURES										Eliminated or Carried Forward
NS-1	No-Action	O	O	O	O	O	O	O	O	Carried forward for comparison purposes
NS-2	Coastal Construction Control Line	O	P	O	P	O	P	P	P	Eliminated; erosion would continue unabated
NS-3	Moratorium on Construction	O	P	O	O	O	O	O	O	Eliminated; erosion would continue unabated
NS-4	Establish a No-Growth Program	O	O	O	O	O	O	O	O	Eliminated; erosion would continue unabated
NS-5	Relocation of Structures	O	P	O	O	O	O	P	O	Eliminated; erosion would continue unabated
NS-6	Flood-Proofing of Structures	O	P	O	O	O	O	P	O	Eliminated; erosion would continue unabated
NS-7	Condemnation of Structures and Land Acquisition	O	P	O	O	O	O	P	O	Eliminated; erosion would continue unabated
STRUCTURAL MEASURES										Eliminated or Carried Forward
S-1	Seawalls	O	P	P	P	P	O	P	O	Eliminated, does not meet project objectives
S-2	Revetments	O	P	P	O	O	O	P	O	Eliminated, does not meet project objectives
S-3	Beach Nourishment	F	P	F	F	F	F	F	F	Carried forward, meets project objectives
S-4	Groins	P	P	O	O	P	O	O	O	Eliminated, does not meet project objectives
S-5	Submerged Artificial Reefs	F	P	P	P	P	O	O	P	Eliminated, does not meet project objectives
S-6	Nearshore Placement	P	P	P	P	P	O	O	P	Eliminated, does not meet project objectives
S-7	Breakwaters	P	P	P	O	P	O	O	O	Eliminated, does not meet project objectives
S-8	Dunes and Vegetation	O	P	P	O	O	P	O	O	Eliminated, does not meet project objectives

F – Fully meets project objectives
P – Partially meets project objectives
O – Does not meet project objectives

2.1.1. ALTERNATIVES DESCRIPTION

No Action Alternative (NS-1). The No Action Alternative would have perpetuated the receding and eroding beach conditions and provided no solution to existing problems. However, it also would have avoided any undesirable effect that may be associated with structural and nonstructural plans for beach erosion control. This option, although not favored by the local sponsor, was maintained throughout the study process to provide a basis for comparison of the effects of other alternatives. This plan provided no corrective measures and would have allowed tidal and shoreline processes to continue current trends. Development trends and local planning goals indicated that development and a steady influx of residents into the study area would have continued regardless of beach improvements. Even with reduced beach capacity, recreational use was expected to continue to increase. With the reduced beach width, the shoreline erosion would have continued to endanger the primary dunes and the structures landward of the beach and dune system.

Coastal Construction Control Line (NS-2). The state Coastal Construction Control Line (CCCL) was developed to control and regulate development in the sensitive dune and beach areas of many coastal counties, while assuring reasonable use of private property. Recognizing the value of the state's beaches, the Florida legislature initiated the CCCL Program to protect the coastal system from improperly sited and designed structures, which can destabilize or destroy the beach and dune system. Adoption of a CCCL establishes an area of jurisdiction in which special siting and design criteria are applied to construction and related activities. These standards are typically more stringent than those already applied in the rest of the coastal building zone because of the greater weather-related forces expected to occur in the more seaward zone of the beach during a storm event. Martin County's CCCL received state approval on May 23, 1972.

This NS alternative considered potential changes to the CCCL or building regulations that could have been implemented by the State of Florida. Such changes could have included moving the CCCL landward, increasing the setback for construction, or increasing the standards for construction to reduce storm damages. Beach rezoning and modification of building codes would likely have occurred with changes to the CCCL, which would have impacted land use planning. Erosion of the shoreline would have continued unabated by this measure.

Moratorium on Construction (NS-3). This management measure would not have permitted new construction in areas vulnerable to storm damages. As properties were damaged, reconstruction would not have been permitted. Erosion of the shoreline would have continued unabated by this measure. Although not in the federal interest, this measure could have been implemented by state or local governments. A moratorium on construction was rejected by local interests since the desired growth of the area was oriented towards tourism and recreation, attracting retirees, and promoting a stable construction industry.

Establish a No-Growth Program (NS-4). This management measure would have limited reconstruction following storm damage, but would not have allowed for new structures within areas adjacent to the study area that were vulnerable to storm damage. Erosion of the shoreline would have continued unabated by this measure. Although not in the federal interest, this measure could have been implemented by state or local governments. The establishment of a no-growth program was rejected by local interests. Growth in the area, particularly in connection with beach activities, was needed to provide economic depth to the communities.

Relocation of Structures (NS-5). With this management alternative, structures within the study area that were most vulnerable to storm damage would have been identified. Where feasible, those vulnerable structures would have been moved farther landward on their parcels to escape the storm-damage-prone areas.

Flood-Proofing of Structures (NS-6). Flood-proofing existing structures and more stringently regulating floodplain and shorefront development are management measures that state and local governments could have been implemented. This measure would have required changes to the building codes to prevent flood damages associated with coastal storms. New construction and substantial reconstruction would have been improved by regulation of new building codes, and existing structures could have been improved through incentives and aid programs.

Condemnation of Structures and Land Acquisition (NS-7). This measure would have allowed the shoreline to erode in the study area with a loss of land until the shoreline reached equilibrium. Those structures vulnerable to storm damage would have been acquired, demolished, and the natural areas restored. Such parcels would have become public property and would have reduced the number of structures vulnerable to storm damage. This alternative was rejected by local residents because it did not fulfill one of the primary project goals of protection of existing resources.

Seawalls (S-1). Concrete seawalls would have been constructed in front of vulnerable structures and improvements/maintenance would have been allowed for existing seawalls and stone revetment. These structural improvements would have provided a significant degree of protection to the existing structures.

Revetments (S-2). Revetments are a type of beach armor that involves installing rocks, bags, mats, or tubes along the slope of the beach to protect the beach from erosion. Revetments differ from seawalls as seawalls are vertical structures and revetments are sloped structures. Hardening of the shoreline by revetment would have protected upland structures, while reducing the impact of wave reflection to the nearshore profile, as seen in seawalls. A revetment for this project would have used large rocks that are designed to protect against the 40-year storm event. Revetments would have been placed on severely eroded beaches to provide limited and site-specific protection against erosion.

Beach Nourishment (S-3). Beach nourishment addressed federal and local planning objectives and anticipated beach erosion losses while considering the needs of the study area. Beach nourishment dimensions were designed to protect against the 40-year storm event; however, future beach renourishment would be undertaken periodically to maintain the recreational and erosion control features within design dimensions. Dimensions of the beach fill were based on the degree of protection desired, economics, a specified beach width for storm damage protection, and environmental impacts to nearshore hardbottom.

Groins (S-4). Groins would have been constructed of large, interlocked rocks, placed perpendicular to the shoreline. The groins would have extended from above the mean high water (mhw) line out into shallow water. The length, orientation, and head of the structure (T-head or not) would have been designed based on wave conditions, storms, and sediment transport. A series of groins would have helped anchor a beach in front of existing development and prevented further beach erosion. However, the beaches adjacent to the groins would have to be supplemented with nourishment so the adjacent beaches would not be starved of sand. Groins have been successfully used in “hot-spots” that exhibit accelerated erosion. Because the entire project area was experiencing significant erosion, the groin field would have extended the entire 4 miles. Therefore, groins were considered a method to help hold the fill in place and to reduce periodic renourishment requirements. The beach fill material would have come from either an offshore borrow area or an upland sand source.

Submerged Artificial Reefs (S-5). This management measure would have used the perched beach concept to limit the amount of underwater fill and retain the dry beach for a longer period. This would have been accomplished by placing a submerged artificial reef in shallow water with beach fill material “perched” landward of the reef structure. This measure may have reduced initial fill quantities, reduced renourishment requirements, and offered mitigation for the environmental impacts of nearshore rock outcropping burial. The submerged artificial reef would have been constructed out of large rocks with a foundation material to avoid subsidence. The beach fill material would have come from either an offshore borrow area or an upland sand source.

Nearshore Placement (S-6). Dredged material would have been placed in the nearshore in water depths of 15 feet and deeper to provide a combination of wave attenuation benefits and nourishment of the active beach profile. This method would have avoided placing dredged material directly over nearshore rock and assumed that a portion of the sand placed in shallow water would migrate towards the beach under normal wave conditions, attached to the beach, and shaped the beach into a normal equilibrium profile. Dredged material would have come from either an offshore borrow area or an upland sand source.

Breakwaters (S-7). Breakwaters offshore along the Martin County study area would have been constructed to stabilize the beach and reduce the wave energy reaching the shoreline in their lee. As a result, the rate of annual erosion would have decreased. The breakwaters would have been constructed of large rocks with foundation materials

sufficient to prevent subsidence. The breakwaters would have been trapezoidal in profile and placed parallel to the shoreline in shallow water. The breakwater would have been constructed in segments, separated from each other to prevent infilling between the beach and the breakwater. The elevation and length of each breakwater segment and the distance between segments would have been designed using wave and sediment transport characteristics.

Dunes and Vegetation (S-8). Dunes stabilize a beach and accommodate the damages wrought by storms and extreme conditions of wind, wave, and an elevated sea surface. Dunes maintain a sand repository during storms and provide sacrificial sand before structures would be damaged. In so doing, the dune system provides a measure of public safety and property protection. Vegetated dunes provide greater resistance to sand erosion by binding the sand to the extensive and deep-penetrating root system. Dune vegetation also promotes dune growth by trapping the sand that is transported by significant wind action. This measure would have entailed placement of beach-compatible material from either upland or offshore sources into dune features adjacent to the existing bluff. The top elevation of the dunes would have tied into the bluff. The front slope of the dune would have been a function of the material grain size and construction equipment. Vegetation would have been planted on the constructed dunes and the non-federal sponsor would have been responsible for watering the plants until the plants became established.

2.1.2. ISSUES AND BASIS OF CHOICE

The alternatives were evaluated for the potential to contribute to the project objectives and consistency with project constraints. Several alternatives were not evaluated further than the initial screening due to a combination of economic viability, effectiveness, and/or political or social acceptance. The screening process eliminated from further consideration and detailed evaluation those alternatives that did not respond to the needs of the problem area or the overall planning objectives. The federal planning objectives are to address beach erosion by identifying and selecting the best course of action. The local planning objectives were incorporated in the overall screening process based upon the expressed desires of the local sponsor. Only those alternatives that warranted consideration based upon the overall planning objectives were brought forward for further evaluation.

Alternatives were eliminated from further consideration if they did not fully meet local and federal planning objectives, maximize benefits as required by National Economic Development (NED) Benefit Evaluation Procedures, or adhere to the Water Resource Council's "Principles and Guidelines." The "Principles and Guidelines" require the systematic preparation and evaluation of alternative ways of addressing identified problems, needs, concerns, and opportunities under the objective of NED consistent with protecting the nation's environment. The process also requires that the impacts of a proposed action be measured and the results displayed or accounted for in terms of contributions to the four accounts of: NED, Environmental Quality (EQ), Regional Economic Development (RED), and Other Social Effects (OSE).

Analyses of the economic feasibility of the various shore protection alternatives in Florida most often indicate that beach nourishment represents the optimum solution to the erosion problems within the framework of federal guidelines. Beach fill alternative designs are formulated to provide various levels of protection to development, prevent loss of land, and provide recreation benefits. Since the beach nourishment alternative (S-3) offers the better course of action and opportunities to address the NED objective, it is carried forward for more detailed evaluation.

2.1.3. ALTERNATIVES ELIMINATED FROM DETAILED EVALUATION

With the exception of the No Action Alternative, all nonstructural alternatives were eliminated from detailed evaluation because they did not meet the stated goals of the project as defined in Section 1.4. All of the structural measures except beach nourishment (S-3) were also eliminated. **Table 2.1-1** summarizes which structural and nonstructural measures did not meet, only partially met, or fully met project objectives and principles and guidelines.

In general, all of the nonstructural measures (NS-2 through NS-7) were eliminated because erosion along the project reach would have continued unabated. Continual erosion of the shoreline would not have protected structures, dunes, or sea turtle nests, and would have adversely affected recreation, tourism, and the economic health of the community.

With the exception of beach nourishment (S-3), the proposed structural measures only partially met some of the project objectives and principles and guidelines. Various structural methods of hardened shore protection, such as revetments and seawalls, were eliminated from further consideration because those measures would not function well in the study area, would not solve the beach erosion problem, and/or would not provide enhanced recreational and sea turtle nesting benefits. Details on the rationale for eliminating structural measures are provided below.

Seawalls (S-1). Construction of new concrete seawalls or improvement/maintenance of existing bulkheads/seawalls would provide a significant degree of protection to existing structures. The shoreline was expected to erode in front of the seawall but stabilize at the location of the seawall, counteracting any further storm-induced recession of the shoreline. Without renourishments at regular intervals, little dry beach would likely have remained in front of the seawall, resulting in substantial economic and environmental loss. Reflecting wave energy off existing seawalls and revetments would have steepened offshore profiles and caused hazardous bathing conditions due to increased undertow and runouts. Additionally, seawalls can interrupt the longshore flow of sand, exacerbating erosion problems in some areas and creating new erosion problems further downshore. Environmental concerns with this measure included loss of a healthy beach ecological community, including sea turtle nesting habitat, and potential loss of nearshore rock habitat as the nearshore beach profile adjusted to the new wave energy environment in front of the seawall. For these reasons, this alternative was eliminated from further consideration.

Revetments (S-2). Hardening of the shoreline by revetment would have protected upland structures, while reducing the impact of wave reflection to the nearshore profile as seen in seawalls. A revetment would have provided localized and site-specific protection to beach erosion, however hardening of the beach in one area would have likely transferred the problems of erosion further down the beach resulting in the loss of beach for recreation and sea turtle nesting. While initial construction of this measure would have avoided impacts to the nearshore rock outcropping habitat, adjustment of the nearshore profile may have caused increased scour around the rocks or increased the water depth. Changes to the nearshore beach profile may also have affected surfing and snorkeling. Construction of revetments did not meet several goals of the project, including maintenance of a sandy beach for nesting sea turtles and the provision of recreational areas and maintenance of the commerce associated with it; therefore, this alternative was eliminated from further consideration.

Groins (S-4). A groin field would have helped anchor a beach in front of existing development and reduced further beach erosion. Groins have been successfully used in “hot-spots” that exhibited accelerated erosion. As the entire project area has been experiencing significant erosion, the groin field may have extended the entire 4 miles. Beaches adjacent to the constructed groins would have needed to be supplemented with nourishment so that adjacent beaches would not be starved of sand. For this reason, groins are considered a method to help anchor beach sand and reduce periodic renourishment requirements. The recreational beach would have been stabilized, thus benefiting the tourism industry. However, large rock structures within the surf zone would have been a safety hazard and impacted surfing, snorkeling, and swimming. Impacts to sea turtle nesting activities were not entirely known. Groins did not fully address the project objectives; therefore, this alternative was eliminated from further consideration.

Submerged Artificial Reefs (S-5). This measure may have reduced initial fill quantities, reduced renourishment requirements, and offered mitigation for the environmental impacts of nearshore rock outcropping burial. However, the nearshore rocks in the study area are located in shallow water and would have likely been covered by the artificial reef and beach fill. The recreational beach would have been stabilized, thus benefiting the tourism industry. Impacts to the nearshore rock and profile would have impacted the fishing community and surfing community. As this measure could have impacted the entire natural rock outcropping and would not have provided improved benefits over other measures; therefore, this alternative was eliminated from further consideration.

Nearshore Placement (S-6). Dredged material placed in the nearshore in water depths of 15 feet and deeper would have provided a combination of wave attenuation benefits and nourishment of the active beach profile. This measure may be more cost-effective than onshore disposal by hopper dredge and would have eliminated the need for pump-out facilities. However, this measure by itself would not have added the same level of beach nourishment or storm damage protection as direct beach nourishment (S-3). By placement in the nearshore, some material may have migrated to the beach

and some material may be lost offshore. This would have necessitated dredging a greater volume of sand compared to the beach nourishment measure. The recreational beach would likely have been stabilized or widened, thus benefiting the tourism industry. However, impacts to the nearshore rock would have impacted the fishing community and the surfing community. This measure provided less storm damage protection and greater environmental impacts, but potentially some cost savings over the beach nourishment measure. Given this comparison, this alternative was eliminated from further consideration.

Breakwaters (S-7). Construction of breakwaters would have stabilized the beach and reduced the wave energy reaching the shoreline in their lee and decreased erosion. Breakwaters constructed seaward of the existing nearshore rock would have avoided direct impacts during construction. Shoreline accretion of sand would have occurred if the breakwaters were of sufficient size, but also caused burial of the nearshore rock. The breakwaters would also have changed the nearshore profile and may have affected longshore sediment transport and adjacent shores. A smaller sized breakwater to stabilize the shoreline but avoid accretion and sediment transport blockage would have had limited effects on storm damage prevention. Combining breakwaters with beach nourishment would have provided added beach elevations and beach width for storm damage reduction, but would have substantially increased project costs. Even without beach nourishment, breakwaters may have affected the nearshore profile such that some areas of rock would be buried and other areas would experience increased scour. The recreational beach would have been stabilized or widened, thus benefiting the tourism industry. However, impacts to the nearshore rock could have affected the fishing community and surfing community. Impacts to sea turtle nesting activities are not entirely known.

In 1993, an experimental breakwater shore protection project was constructed in Palm Beach, Florida. The Palm Beach breakwater prefabricated erosion prevention reef consisted of 330 interlocking concrete units (1.8 m H x 3.7 m L x 4.6 m W) placed along 1,260 meters of shoreline, and approximately 76 meters offshore. Post-construction monitoring of the submerged breakwater revealed an increase in longshore currents via ponding of water trapped behind the breakwater, which was then diverted alongshore. The annual volumetric erosion rate measured 2 years after breakwater construction was 2.3 times higher than the pre-project rate (Browder et al. 1996). Due to this acceleration of shoreline erosion, the breakwater reef was removed.

Potential increased erosion associated with offshore breakwater installation did not meet the project goals of maintaining beaches for nesting sea turtles and recreation. As this measure does not fully meet project objective; therefore, this alternative was eliminated from further consideration.

Dunes and Vegetation (S-8). The dune measure would have offered some storm damage protection and stabilized the beach at existing conditions. The vegetation would have increased sand erosion resistance and promoted dune growth through sand trapping. This measure provided environmental restoration of a vegetated dune system

in areas where the historical dunes have been eroded away. Stabilizing the beach may also have provided some incidental benefits to recreation, tourism, and sea turtle nesting habitat. This measure would have had little, if any, impact on the nearshore rock and could have been implemented in combination with other plans. This measure is mutually exclusive with the seawall and revetment measures, as they occur in the same footprint. This measure did not fully meet the objectives because it did not provide the authorized level of beach protection and recreational; therefore, this alternative was eliminated from further consideration.

2.1.4. ALTERNATIVES NOT WITHIN THE JURISDICTION OF LEAD AGENCY

Alternatives Coastal Construction Control Line (NS-2), Moratorium on Construction (NS-3), Establish a No-Growth Program (NS-4), Flood Proofing of Structures (NS-6), and Condemnation of Structures and Land Acquisition (NS-7) were not within the jurisdiction of the lead agency and would have been exercised by the state or local sponsor if deemed feasible. The adoption of effective regulatory measures to prohibit development of homes, subdivisions, and commercial centers in hazardous flood areas is a local responsibility. Some of the components of these alternatives are included in the coastal zone management measures undertaken by Martin County. Those five alternatives, which are not within the jurisdiction of the lead agency, would have not prevented, control, or mitigate the erosion problem experienced along the study area. Therefore, those alternatives did not meet the needs of the study area or the study objectives and were not carried forward.

2.1.5. PREFERRED ALTERNATIVE – BEACH NOURISHMENT

The preferred alternative, Beach Nourishment (S-3) was the only practical solution that addressed the erosion problem within the project area and fulfilled Martin County's goals and objectives. The authorized beach nourishment plan maximized net NED benefits; met the federal objectives of restoring a protective beach with subsequent periodic nourishment to provide 40-year storm protection; considered the recreational and environmental needs of the study area; and minimized erosion losses over the life of the project. Therefore, this measure was carried forward as the preferred alternative during the initial planning process.

This measure authorized the initial beach nourishment (completed in 1996) that created the appropriate beach dimensions to serve as a buffer against wave attack and future renourishments at regular intervals. The authorized project area covered 4 miles of shoreline from the St. Lucie County line southward to near the southern limit of Stuart Public Beach Park. Plan S-3 included restoration of the primary dune as needed to an elevation of 12.5 feet above msl and a top width of 20 feet. A 35-foot-wide protective berm would be provided at elevation 8.0 feet above msl, with a 1V:8.5H foreshore slope to mlw, then a 1V:20H slope to the existing bottom (**Figure 1.2-2**). Beach nourishment along the project reach created a wider beach with a greater berm height, provided greater storm protection, provided enhanced recreational opportunities for tourists and the community, and created additional sea turtle habitat.

2.2. SUPPLEMENTAL EIS ALTERNATIVES

The additional alternatives presented in this section are a subset of the preferred alternative, Beach Nourishment (S-3), that was selected and authorized based on the initial planning and screening process (as described in the previous section). Sufficient quantities of beach-quality sand were available from the previously approved nearshore borrow area (Gilbert Shoal) for the 1996, 2001, 2002, and 2005 beach nourishment projects. However, that borrow area has been fully utilized; therefore, alternate sand sources are being evaluated in this SEIS to meet future nourishment requirements for the remaining life of the federal cost-sharing portion of this project which expires in 2046. The alternatives considered in the SEIS include:

- No Action Alternative
- S-3A: Beach Nourishment Using an Offshore Sand Source
- S-3B: Beach Nourishment Using an Upland Sand Source

Section 2.2.1 describes the alternatives considered in this SEIS. Section 2.1.2 describes the issues and basis of choice for preferred alternative selection. Section 2.1.3 identifies alternatives that were eliminated from further consideration and discusses the rationale for elimination based on project planning objectives. Section 2.1.4 discusses the selection of the preferred alternative and activities associated with the proposed action.

2.2.1. DESCRIPTION OF ALTERNATIVES

2.2.1.1. No Action Alternative

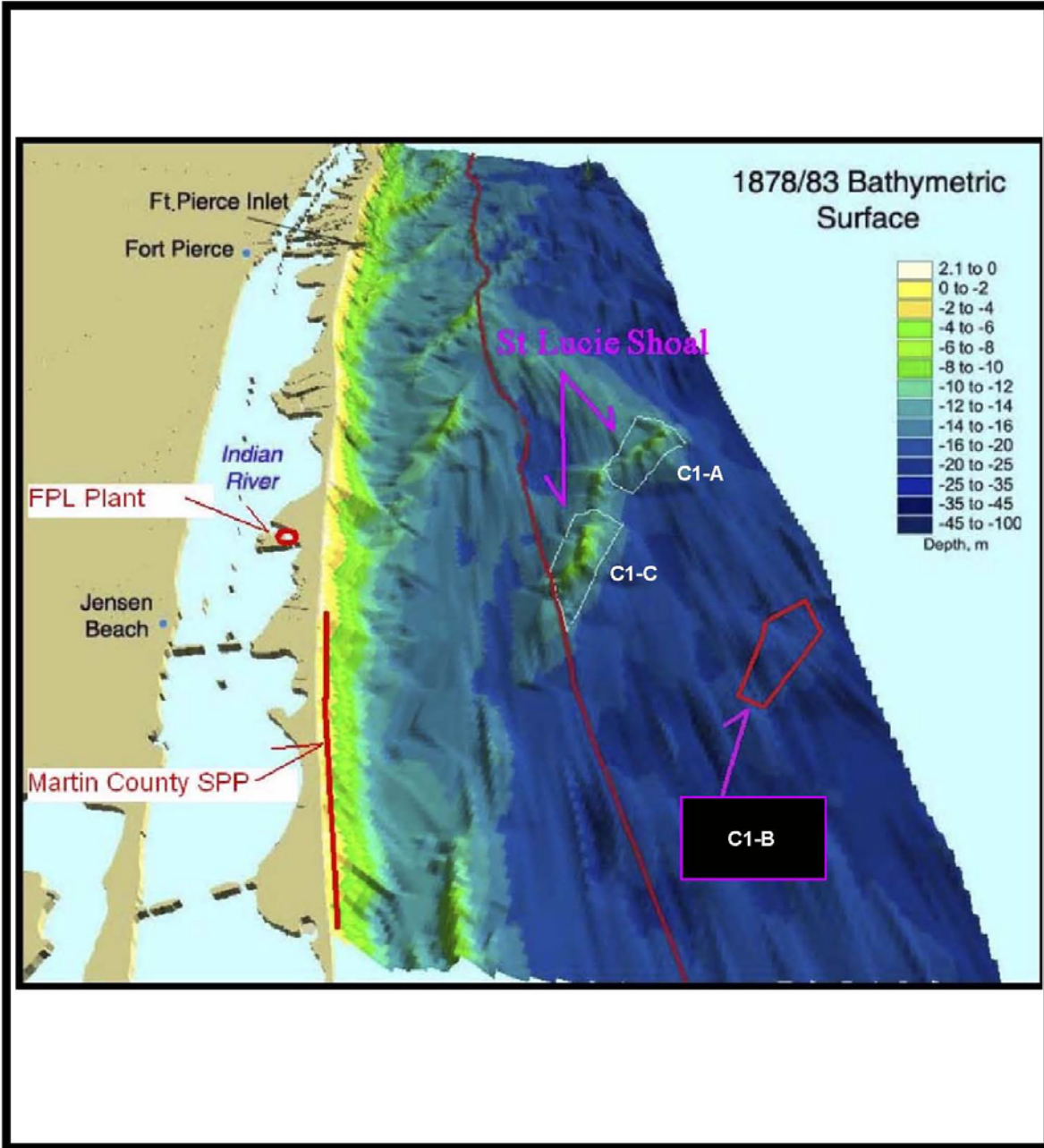
The No Action Alternative involves no beach construction or fill placement, borrow area excavation, or other actions associated with stabilizing and protecting the beach and the structures landward of the beach. The No Action Alternative means that no alternative sand source would be identified and approved to provide beach-compatible sand for the remaining authorized period of federal cost-sharing participation. This option, although not favored by the local sponsor, is maintained throughout the study process to provide a basis for comparison of the effects of other alternatives. The No Action Alternative provides no corrective measures and would allow tidal and shoreline processes to continue current trends resulting in unabated erosion along the project reach. With the reduced beach width, the shoreline erosion could endanger the primary dunes and the structures landward of the beach and dune system and potentially affect recreational opportunities, sea turtle habitat, tourism, and the local economy. However, it also would avoid any impacts that may be associated with periodic placement of beach fill along the project reach and mining sand from a new borrow area.

Note that under the USACE's No Action Alternative, authorization from BOEMRE would not be required; therefore, BOEMRE would not be undertaking a connected action.

2.2.1.2. Beach Nourishment Using an Offshore Sand Source (S-3A)

Lying along the inner shelf of the Atlantic coast are numerous sand shoals and low-relief areas containing millions of cubic meters of potential borrow material. Some sand shoals can be kilometers long, up to 10 meters thick, and hundreds of meters wide

(Hammer et al. 2005). Offshore bottom sediments are typically comprised of sorted sand with some fraction of silt and can potentially provide an economical source of beach nourishment material if the sand is determined to be compatible with the native beach sediment. Three borrow areas that lie primarily in federal waters and fall under the jurisdiction of the BOEMRE were initially considered as potential sand sources for this project: C1-A, C1-B, and C1-C (**Figure 1.2-1**). C1-A and C1-C are located within the St. Lucie Shoal complex, which is an elongated area of relatively high relief that runs northward from the Martin/St. Lucie county line 3 to 7 miles offshore in the Inner Shelf Plain zone (**Figure 2.2-1**). C1-B is located about 3 miles south-southeast of the St. Lucie Shoal in an area with relatively less vertical relief than C1-A and C1-C. A more detailed description of each proposed borrow area is provided below.



**FIGURE 2.2-1.
3-D VIEW OF ST. LUCIE SHOAL AND
BORROW AREA "B"
MARTIN COUNTY HURRICANE AND
STORM DAMAGE REDUCTION PROJECT
HUTCHINSON ISLAND, FLORIDA**

This map and/or digital data is for planning purposes only and should not be used to determine the precise location of any feature. Data provided as-is. Q:\GIS\PROJECTS\SEIS_MARTIN_CO\SEIS\Figure updates\030211\Figure2_2-1_3-D St. Lucie Shoal.mxd Data sources: MMS 2004

Borrow Areas C1-A and C1-C

BOEMRE (formerly MMS) conducted a regional reconnaissance investigation of the federal waters along Florida’s central-east coast to identify sources of beach-quality sand in federal waters offshore of Martin and St. Lucie Counties. This investigation titled: *Environmental Surveys of Potential Borrow Areas on the Central East Florida Shelf and the Environmental Implications of Sand Removal for Coastal and Beach Restoration* (Hammer et al. 2005) included a seismic survey, grab samples, vibracores, wave analysis, and sediment transport studies of the proposed borrow areas C1-A and C1-C located within the St. Lucie Shoal complex. The St. Lucie Shoal is complex is described as a shallow (5-12 m), well-defined, shore-oblique shoal (Hammer et al. 2005). These two sites are located within a larger area identified as Resource Area C1 in Hammer et al (2005).

Grab samples were collected to provide information on surface sediment characteristics and sand volume estimates were determined using vibracore data collected by the Florida Geological Survey (FGS) and BOEMRE. **Table 2.2-1** summarizes sand resource characteristics within areas C1-A and C1-C. Data indicate that the sediments are coarser at higher profile elevations and become finer with depth. Two vibracores collected from C1-C measured 6 to 7 meters of suitable sediment, and the sediments at approximately 3- to 5-meter depth were characterized as yellowish gray to light olive gray, moderately to poorly sorted, fine- to medium-grained sand (mean grain size of 0.54 mm), with approximately 86% carbonate content (Hammer et al. 2005). The surface area of the northern borrow site in Area C1 (C1-A) is $5.16 \times 10^6 \text{ m}^2$. The maximum excavation depth was 12 meters, resulting in 5.8 million cubic meters (mcm) (7.6 mcy) of sand. The southern borrow site in Area C1 (C1-C) covers approximately $4.71 \times 10^6 \text{ m}^2$ of seafloor. For an excavation depth of 12 meters, the resulting sand volume is 8.8 mcm (11.5 mcy).

Table 2.2-1. Sand Resource Characteristics at Offshore Borrow Areas C1-A and C1-B

Borrow Site	Borrow Site Surface Area (x 10 ⁶ m ²)	Maximum Excavation Depth (m)	Borrow Site Sand Volume (mcy)	D10 (mm)	D50 (mm)	D90 (mm)
C1 north (C1-A)	5.16	12	7.6	1.96	0.61	0.26
C1 south (C1-C)	4.71	12	11.5	0.62	0.29	0.18

D10 = grain diameter above which 10% of the distribution is retained
 D50 = median grain diameter
 D90 = grain diameter above which 90% of the distribution is retained

Source: Hammer et al. (2005)

In 2004, a study funded by the Minerals Management Service (now BOEMRE), compared hypothetical pre-dredge and post-dredge scenarios on St. Lucie Shoal within borrow areas C1-C and C1-A. The post-dredge scenario assumed a maximum excavation depth of -7 meters, dredging the -5-meter shoal’s crest down to adjacent

water depths of approximately -12 meters. This cut depth over the affected footprint equates to dredging approximately 14.6 million cubic meters from areas C1-A and C1-C. The cumulative scenario assumed dredging resulted in near flat bed conditions. In this scenario, modeling showed the potential for unacceptable changes in longshore sediment transport potential, including the potential development of an erosional hotspot along a stretch of shoreline southeast of the C1-C borrow area. The study recommended that the maximum cut depth be reduced. The potential adverse effects of modifying offshore bathymetry generally increase with increasing footprint and depth of cut, as well as proximity to shoreline. The potential change in wave height and angle at the shoreline is foremost related to changes in shoal crest height and orientation relative to incident waves. The hypothetical cut depth of -7 meters across C1-A and C1-C was somewhat unrealistic since best-available geotechnical data suggests suitable sediment thicknesses within C1-A and C1-C of only -3 to -7 meters (Hammer et al. 2005). The study did not consider the consequences of relatively shallower depth cuts, which could have provided sufficient volume for several construction cycles and potentially had a negligible impact on longshore sediment transport.

In 2007 to 2008, a Historic Assessment and Submerged Cultural Resources Survey was conducted to assess the presence or absence of submerged cultural resources within four proposed borrow areas located off Martin and St. Lucie Counties, including sites C1-A and C1-C (SEARCH 2008). Results of the remote sensing survey identified no potentially significant submerged cultural resources within C1-A, and this area was cleared from an archaeological perspective. Within borrow area C1-C, one cluster of magnetic targets with an associated sidescan sonar image was identified. The magnetic signature suggests this target may represent a potentially significant submerged cultural resource and is therefore recommended for avoidance. If avoidance of these anomalies is not possible additional investigation in the form of diver investigations to positively identify the targets is recommended by a qualified underwater archaeologist to determine its significance and eligibility for listing on the National Register of Historic Places (NRHP).

In addition, sidescan sonar data collected during the archaeological survey was analyzed in more detail to determine the presence or absence of hardbottom within borrow areas C1-A and C1-C (ANAMAR 2009) (Appendix L). Analysis of sidescan sonar data identified seven targets within C1-A which revealed high backscatter that could indicate the presence of hardbottom (Figures 4 through 11 in Appendix L). No targets were identified within C1-C. It was recommended that further ground-truthing investigations of these features be conducted to verify the presence of hardbottoms, composition and structure of resources, and utilization by fish assemblages.

Borrow Area C1-B

C1-B is as a relatively deep (14-17 m), poorly-defined, low-relief shoal complex. It is 1.6 square miles (approximately 1000 acres) in size and consists of a large sandy mound which rises to a crest elevation of about -40 feet mlw in surrounding water depths of 60 feet or more (USACE 2009). Dredging depths of cut range from 6 to 12 feet over most of the extent of the borrow area.

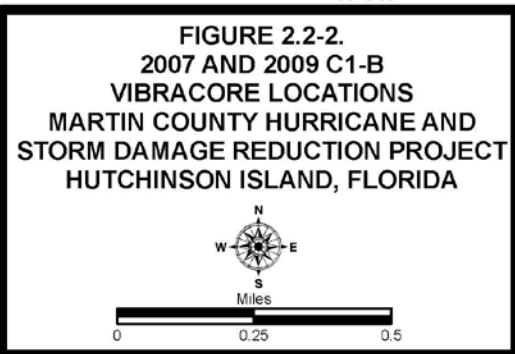
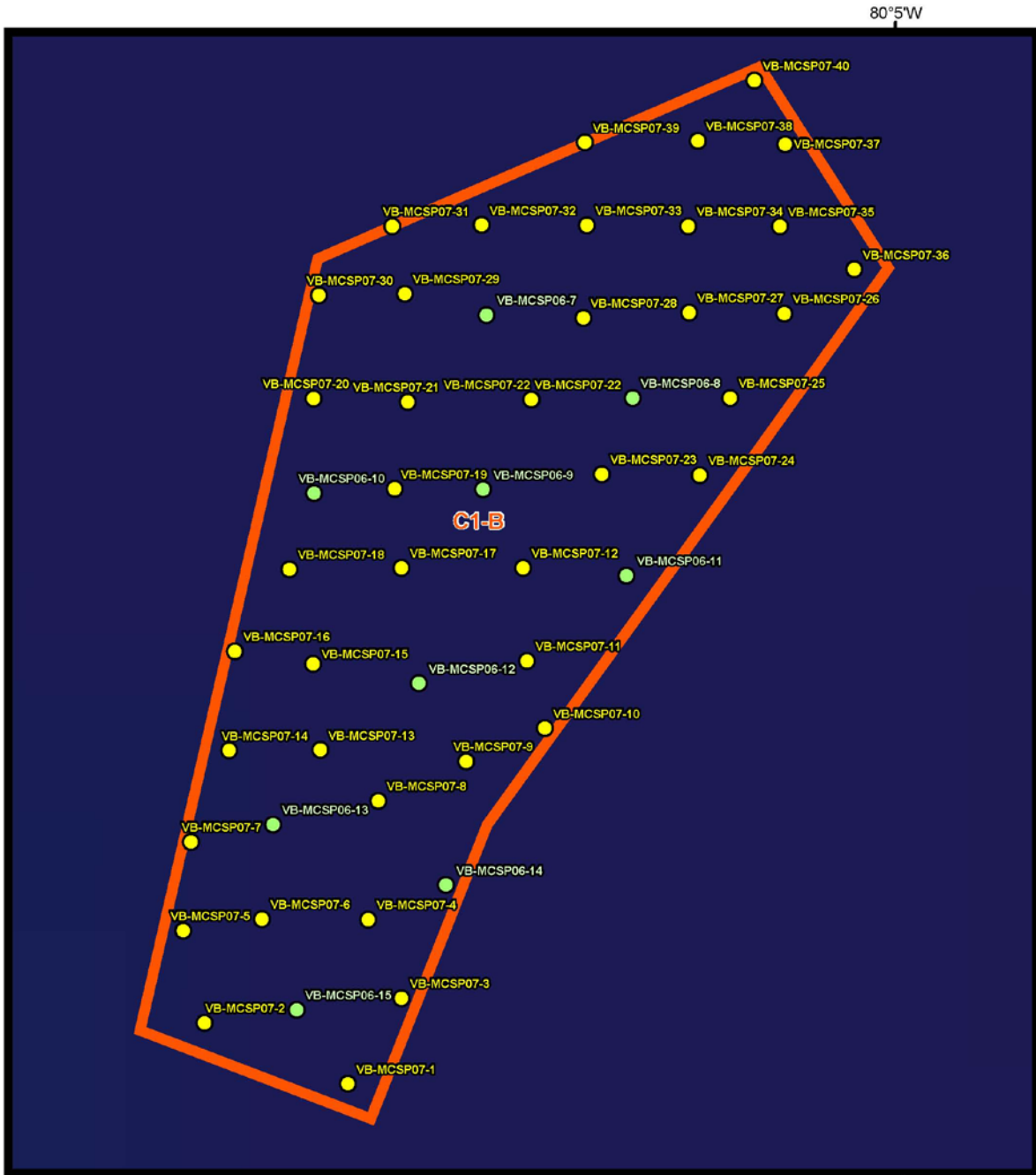
In August 2007, USACE collected vibracores to characterize the sediment within borrow area C1-B (**Figure 2.2-2**). The vibracore borings revealed sands, silty sands, and shelly material throughout the C1-B borrow area, with clays and silts near the termination depths (Challenge Engineering and Testing 2007). The sand is primarily calcareous with a mixture of shell and contains a small (less than 5%) amount of silt. The sediment in C1-B has a mean grain size of 1.37 phi (0.39 mm), a sorting of 1.14 phi, contains 2.47% silt, and 100% of the sand in the borrow area has a moist Munsell value of 5 or higher (Taylor Engineering, Inc. 2009a). The colors of the materials were noted to change significantly from dark to lighter as the split core tubes were left open to air-dry. Carbonate content analyses suggest that the borrow area composite should not exceed the maximum acceptable carbonate content of 93% (Taylor Engineering, Inc. 2009a). Based on these results, the material was determined to be good beach-quality sand that would comply with the Florida state sand rule. A more detailed discussion of the results of the geotechnical studies is provided in Section 3.1.9.1 and the full report is provided in Appendix F.

Sand volume estimates within the C1-B borrow area based on vibracore data indicated 4 to 15 feet of suitable sediment in addition to the 2-foot required buffer. The excavation depth varies from -56 to -65 feet mlw, resulting in approximately 11.5 mcy of sand.

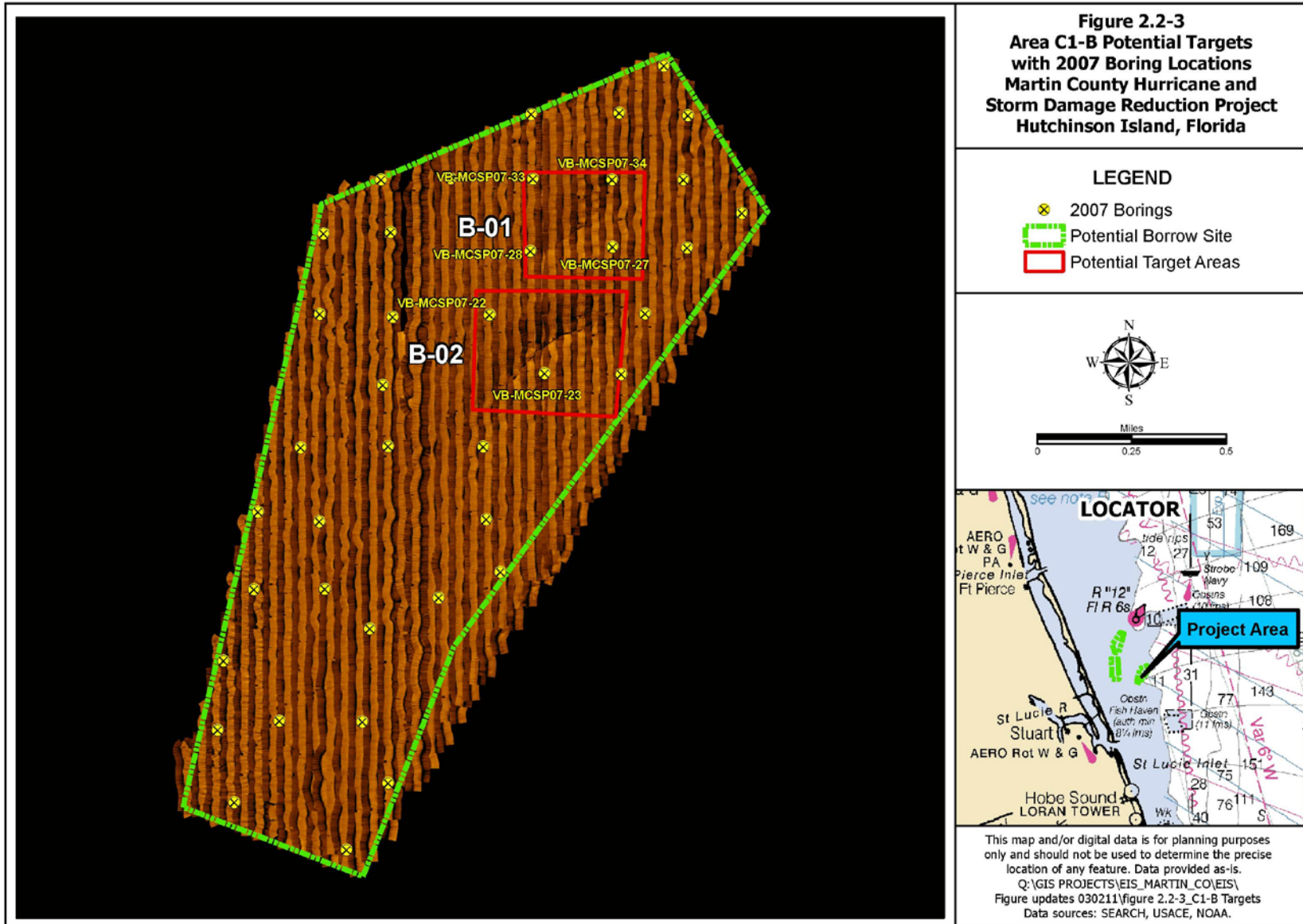
As with C1-A and C1-C, a study was conducted using the Steady State Spectral WAVE (STWAVE) model in borrow area C1-B to determine if excavating portions of this feature could potentially influence wave refraction patterns across the region, possibly resulting in wave energy focusing and increased erosion along the adjacent shoreline (USACE 2009). Different dredging configurations were analyzed to help develop a borrow area dredging plan that minimizes adverse impacts on the adjacent shoreline. Conclusions from this study indicate that no significant changes to the nearshore wave environment are expected as a result of dredging borrow area C1-B to the maximum limits of excavation. A complete copy of this report is provided in Appendix K.

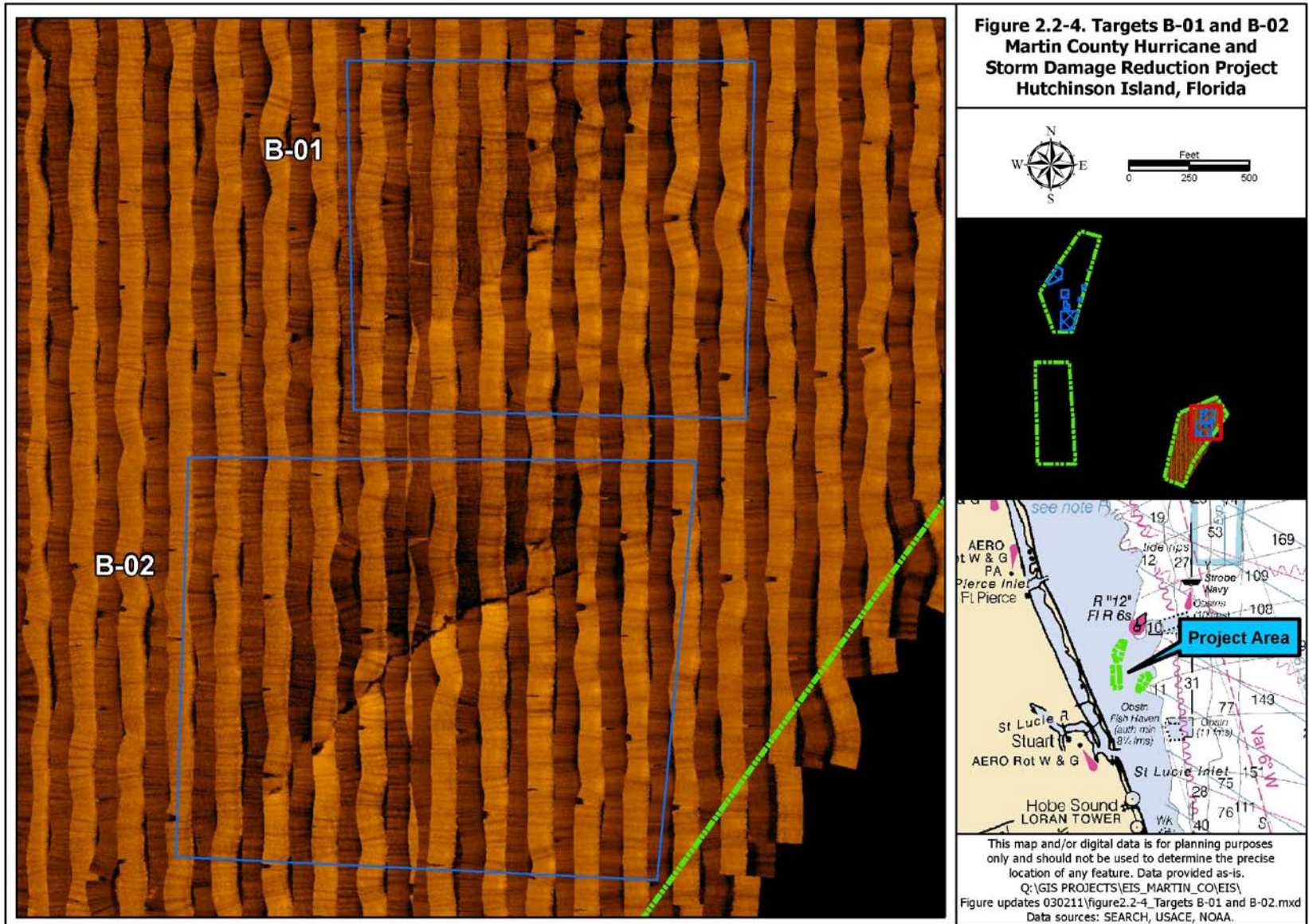
In 2007 to 2008, a Historic Assessment and Submerged Cultural Resources Survey was conducted to assess the presence or absence of submerged cultural resources within four proposed borrow areas located off Martin and St. Lucie Counties, including site C1-B (SEARCH 2008). Results of the remote sensing survey identified no potentially significant submerged cultural resources within C1-B, and this area was cleared from an archaeological perspective.

In addition, sidescan sonar data collected during the archaeological survey was analyzed in more detail to determine the presence or absence of hardbottom within borrow area C1-B (ANAMAR 2008) (Appendix L). Analysis of sidescan sonar data identified two targets within C1-B which revealed high backscatter that could indicate the presence of hardbottom (**Figures 2.2-3 and 2.2-4**; Appendix L). It was recommended that further ground-truthing investigations of these features be conducted to verify the presence of hardbottoms, composition and structure of resources, and utilization by fish assemblages.



This map and/or digital data is for planning purposes only and should not be used to determine the precise location of any feature. Data provided as-is. Q:\GIS\PROJECTS\SEIS_MARTIN_CO\SEIS\Figure updates\030211\Figure2.2-2_boring_locations.mxd Data sources: LAB/INS, USACE, FDEP, ANAMAR.





During the geotechnical survey performed in August 2007, vibracores were collected near Targets B-01 and B-02 and results indicate mostly sand and shell but no consolidated rock (see core logs in Appendix F). As recommended, further groundtruthing was also conducted by the sponsor in July 2009 to characterize these two targets. The dive survey was designed to investigate the proposed borrow area substrate and the overlying water column for significant resources including hardbottom or reef habitats, aggregations of fishes, protected species such as sea turtles, or other biologically relevant conditions (Hesperides Group, LLC 2009). Teams of two divers collected flora and fauna lists, sediment descriptions, water temperature, depth, and visibility data.

The survey confirmed that the proposed borrow area is located on a relatively deep sand shoal with contains no hardbottom resources and observed few species that are normally associated with natural or artificial reefs (Hesperides Group, LLC 2009). Additionally, an investigation of the two small anomalies identified in the sidescan sonar survey revealed no significant benthic features, only small, current-induced sand ridges. A complete copy of this report is provided in Appendix O.

2.2.1.3. Beach Nourishment Using an Upland Sand Source (S-3B)

A considerable accumulation of sand exists along the upland portion of Florida. Generally, these accumulations are found in the form of relict sand dunes or in the landward portion of prograding shoreline areas (NOAA 2008b). Mining sand deposits from upland areas can reduce project costs if an adequate source of sand exists near the project area. However, upland areas with sufficient sand material are often not close enough to the beach nourishment site to provide for economical transportation. Also, the grain size of upland sand sources is often not large enough to provide resistance to wave action, and would therefore erode too quickly from the nourished site. However, assessment of the impacts of mining upland sand sources is typically much simpler than assessing offshore mining impacts (NRC 1995).

Upland commercial sand sources have been used at least five times in previous federal beach nourishment projects in Dade County. These projects constructed along Miami Beach and Sunny Isles were relatively small in scope, varying from 9,000 to 50,000 cy per project with a total placement of 150,000 cy for all five projects. Upland sources have yet to provide large quantities of sand for full-scale beach nourishment projects due primarily to the expense of transportation and logistical difficulties of construction. These difficulties are expected to be similar for the proposed Martin County HSDR Project, which is a large project requiring approximately 787,800 cy for the next renourishment phase in 2012.

Several sand mines with a potential source of nourishment material are located in Glades, Lake, Martin, Palm Beach, Polk, and St. Lucie counties (**Table 2.2-2**). The distance from the sand mine to the project area ranges from 12 to 148 miles. Sand could be transported by barge or rail and dump trucks, hauled to the beach, and dumped at designated access sites for redistribution along the beach. **Tables 2.2-3 and 2.2-4** summarize the sand grain size characteristics, costs, and available quantity of sand material from the multiple sand mines using 2007 estimates.

Grain size is critical to the feasibility of selecting a borrow site. Grain size from the sand mines varies from 0.26 to 0.68 millimeters (mm) and fines are less than 2 percent (**Table 2.2-3**). Vibracores taken offshore along the St. Lucie Shoal indicate there is a general coarsening upwards trend, with yellowish gray to light olive gray, moderately to poorly sorted fine- to medium-grained sand with a mean grain size of 0.54 mm (Hammer et al. 2005). The grain size of the native beach sand is 0.35 mm.

The price per cubic yard for many of the suppliers of upland sand exceeds the 2012 estimated total unit cost of \$9.48/cy for sand from the offshore borrow areas (**Table 2.2-4**). The 2007 total unit cost of upland sand material delivered to the project area ranges from \$9.00/cy (note: this price does not include delivery) to \$32.00/cy. Therefore, the cost of 787,800 cy yards of sand from an upland source ranges from \$7,090,200 to \$25,209,800. It is important to consider that this estimate does not include equipment needed to move the sand to the desired grade and template design. These unit prices are likely to increase by 2012. In addition, only Palm City Sand Mine and Indiantown Sand Mine could meet the estimated quantities of 787,800 cy needed for the next renourishment phase.

The logistics involved with transportation of the sand from the inland borrow site to the project area is also expected to be an issue of concern among local residents since the project area, which is located on Hutchinson Island, is not easily accessible by highway and can be reached only by driving through the city of Stuart. Nourishing the beach by a trucking operation can have substantial secondary impacts associated with traffic congestion, road damage, spilled sand along roadways, noise, air pollution, and numerous safety and aesthetic concerns at the beach fill site where dump trucks must drive along the beach (NRC 1995). A typical street-legal dump truck carries about 9 to 16 cy of material; therefore, approximately 49,238 to 87,533 truck-loads must be hauled to the site to meet the renourishment requirement of 787,800 cy. Since USFWS requires that nourishment activities not be conducted during the peak sea turtle nesting season (May 1 through October 31), this leaves only 6 months, or 180 days, to construct the project. Even if this was a 7-days/week project, 274 to 486 dump trucks per day would have to arrive at the site to meet project requirements. Because of these potential drawbacks and the large number of truckloads involved, upland sand sources may be rejected as logistically and economically unpractical as a borrow source for large-scale nourishment projects such as this.

Table 2.2-2. Sand Mine Locations

Mine	City	County	Distance from Project Area (miles)
Dickerson's Indrio Pit	Ft. Pierce	St. Lucie	37
Stewart Mine (Indrio Pit)	Ft. Pierce	St. Lucie	37
Witherspoon Sand Plant	Moore Haven	Glades	91
E.R. Jahna Mine (Ortona Sand Mine)	Moore Haven	Glades	92
Star Pit	South Bay	Palm Beach	68
Palm Beach Aggregates	Loxahatchee	Palm Beach	62
Palmdale Sand Mine	Palmdale	Glades	93
Lake Wales Sand Mine	Lake Wales	Polk	109
Gator Sand Mine	Davenport	Polk	146
474 Sand Mine	Clermont	Lake	148
Indiantown Sand Mine	Indiantown	Martin	32
Palm City Sand	Palm City	Martin	12

Information compiled by Taylor Engineering, Inc. (2007)

Table 2.2-3. Description of Sand at Multiple Sand Mines

Mine	Mean Grain Size (mm)	Mean Grain Size (phi)	Fines (%)	Unified Soils Classification	Visual Description
Dickerson's Indrio Pit	0.68	0.55	1.6	Med sand	Light gray, fine sand and shell fragments
	0.32	1.63	1.8	Fine sand	Fine sand, little shell fragments
	0.36	1.49	0.9	Fine sand	Light brownish gray fine sand
	0.33	1.62	1.0	Fine sand	Light gray fine sand
Stewart Mine (Indrio Pit)	0.41	1.29	1.0	Fine to med sand	Light brownish gray
	0.32-0.36	1.47-1.64	<1.0	Fine sand	Quartz aggregate/silicate
E.R. Jahna Mine (Ortona Sand Mine)	0.53	0.92	No data provided	Med sand	Fine sand
Star Pit	0.60	0.73	No data provided	No data provided	No data provided
Palmdale Sand Mine	0.53	0.92	0.1	SP	Very light tan slightly silty fine sand
Lake Wales Sand Mine	0.52	0.96	0.0	SP	Very light tan slightly silty fine sand
Gator Sand Mine	0.46	1.11	0.1	SP	Very light tan slightly silty fine sand
474 Sand Mine	0.49	1.02	0.0	SP	Very light tan slightly silty fine sand
Indiantown Sand Mine	0.40	1.34	1.4	No data provided	Pale brown fine sand, little shell fragment
Palm City Sand	0.26	1.96	No data provided	No data provided	Light brown fine sand

Information compiled by Taylor Engineering, Inc. (2007)

Table 2.2-4. Sand Mine Supply and Cost Information (2007 Costs) (Page 1 of 2)

Mine	Supplier	Type	Material Delivered (\$/cy)	Estimated Quantity Available	Processing Rate	Transport Rate
Dickerson's Indrio Pit	Dickerson Aggregates, Inc.	Indrio Dredge (Stab.)	\$13.06/cy	--	--	--
	Wild Bros.	Light sand	\$15.73/cy	22,500-30,000 cy	2,000 cy/day	--
		Tan sand	\$17.06/cy	3,000-3,750 cy	1,000-1,500 cy/day	--
	Siboney Contracting Co.	Light Brownish Gray Sand	\$9.33/cy + delivery	150,000 cy	--	--
Stewart Mine (Indrio Pit)	Stewart Mining Industries	Light Brownish Gray Sand	\$9.33/cy + delivery	150,000 cy	--	--
	Siboney Contracting Co.	Light Brownish Gray Sand	\$17.67/cy	150,000 cy	--	2,420-2,740 cy/day (150-170 trucks/day)
	Austin Tupler Trucking	Light Brownish Gray Sand	\$20.67/cy + FL sales tax	150,000 cy	--	562-750 cy/day
	Eastman Aggregate Enterprises, LLC	Light Brownish Gray Sand	\$18.67/cy	225,000 cy	1875 cy/day	4,500-6,000 cy/day
	Indian River Contracting	Light Brownish Gray Sand	\$9.00/cy + delivery	150,000 cy	--	1,393 cy/day 10,000 cy/wk
	CKA and Associates, Inc.	Gray Fine Sand	18.32/cy	150,000 cy	--	2250-3750 cy/day/crew depending on conditions
	Sunshine Land Design	Stewart's Material	\$18.00/cy	150,000 cy	--	Have over 100 trucks
Witherspoon Sand Plant	Florida Rock Industries	--	\$10.67/cy + delivery	--	7,500 cy/day with notice	--
	Googe Transport, Inc.	--	\$18.50/cy	--	--	645-806 cy/day (40-50 loads/day)
E.R. Jahna Mine (Ortona Sand Mine)	Austin Tupler Trucking	Light Gray Sand	\$32.00/cy + FL sales tax	75,000 cy	--	562-750 cy/day

Table 2.2-4. Sand Mine Supply and Cost Information (2007 Costs) (Page 2 of 2)

Mine	Supplier	Type	Material Delivered (\$/cy)	Estimated Quantity Available	Processing Rate	Transport Rate
Star Pit	Bergeron Sand and Rock Mining	Gray Sand w/ Trace Limestone Fragments	\$16.00/cy	22,500-30,000 cy	--	--
Palmdale Sand Mine	Mulo Incorporated	Gray Sand w/ Trace Limestone Fragments	17.33/cy	--	--	403-806 cy/day (25-50 trucks)
	Rinker Florida Aggregate Sales, Inc.	--	\$20.00/cy	--	--	2,000 cy/day
Lake Wales Sand Mine	Blue Goose Growers, Inc.	--	\$22.53/cy	--	--	3,500 cy/day minimum
Gator Sand Mine		--	Prices depend on fuel costs	--	--	
474 Sand Mine		--	Prices depend on fuel costs	--	--	
Indiantown Sand Mine		Pale brown fine sand, little shell fragments	\$16.00-\$18.00/cy	700,000 cy	700,000 cy	
Palm City Sand	Poma & Sons, Inc.	Light brown fine sand	\$10.97/cy (\$2/mile, 24 miles round trip, 16 cy/truck)	1,000,000 cy	1,200-1,500 cy/day	Suggests about 10 trucks/day.

Information compiled by Taylor Engineering, Inc. (2007)

2.2.2. ISSUES AND BASIS OF CHOICE

Table 2.2-5 lists the alternatives considered and summarizes the direct and indirect impacts of these alternatives. The alternatives were evaluated for the potential to contribute to the project objectives and consistency with project constraints. Some alternatives were not evaluated further than the initial screening due to a combination of economic viability, unacceptable environmental impacts, and logistics. The screening process eliminated from further consideration and detailed evaluation those alternatives that did not respond to the needs of the problem area or the overall planning objectives. The federal planning objectives are to address beach erosion by identifying and selecting the best course of action. The local planning objectives were incorporated in the overall screening process based upon the expressed desires of the local sponsor. Only those alternatives that warranted consideration based upon the overall planning objectives were brought forward for further evaluation.

Alternative S-3B, Beach Nourishment Using an Upland Sand Source is not selected as the preferred alternative because it is not economically or logistically feasible to truck in the amount of sand needed for a project of this size.

Alternative S-3A, Beach Nourishment Using an Offshore Sand Source is selected as the most economically and logistically feasible alternative that meets the project objectives. Using offshore deposits provides the important benefit of adding sand to the beach/nearshore system rather than simply moving sand from the nearshore to the beach (Hammer et al. 2005). Furthermore, sand resources extracted from federal waters are less likely to change the bathymetry and modify existing physical oceanographic conditions than sand resources extracted from nearshore sites, thus causing less environmental and physical impacts. In relatively shallow nearshore waters, alterations to local currents and waves can dramatically affect nearshore and shoreline erosion and accretion. From a biological standpoint, excavation of sand further from the shoreline may also have less adverse impacts on essential fish habitats than sites closer to shore (Jordan 1999).

2.2.3. ALTERNATIVES ELIMINATED FROM FURTHER EVALUATION

Under the S-3A alternative, proposed offshore borrow areas C1-A and C1-C located within the St. Lucie Shoal complex were eliminated from further evaluation based the findings of the 2004 BOEMRE study, the 2008 archaeological survey, and the analysis of sidescan sonar data (as described in Section 2.2.1.2).

Based on information from these studies, proposed borrow areas C1-A and C1-C were eliminated from further evaluation due to:

1. The potential for unacceptable impacts to the wave climate and shoreline sediment transport from maximum deflation of these two borrow areas.
2. The identification of a magnetic signature within C1-C that suggests the target may represent a potentially significant submerged cultural resource that is recommended for avoidance or further investigation.

3. The potential for hardbottom within C1-A based on analysis of sidescan sonar which would require further ground-truthing investigations to verify features

It is important to note the hypothetical cut depth of -7 meters across C1-A and C1-C was somewhat unrealistic since best-available geotechnical data suggest suitable sediment thicknesses within C1-A and C1-C of only -3 to -7 meters (Hammer et al. 2005). The study did not consider the consequences of relatively shallower depth cuts, which could have provided sufficient volume for several construction cycles and potentially had a negligible impact on longshore sediment transport. If additional modeling is conducted using different dredging depths and dredging scenarios, the impacts to wave climate and shoreline sediment transport may become insignificant, and these sites could potentially be re-considered viable options for other beach nourishment projects in the area.

Table 2.2-5. Summary of Direct and Indirect Impacts of the Alternative Project Plans (Page 1 of 7)

ALTERNATIVE: ENVIRONMENTAL FACTOR:	Plan S-3A Beach Nourishment Using an Offshore Sand Source C1-B Borrow Area	Plan S-3B Beach Nourishment Using an Upland Sand Source	No-Action Status Quo
PROTECTED SPECIES – Sea Turtles	<p>Direct adverse impacts –</p> <ul style="list-style-type: none"> • Alteration of the beach face resulting in potential adverse impact to nesting and hatching success (including effects from grade changes, sediment material, over-compaction, escarpment formation, artificial lighting during construction) resulting in potential “incidental” take of sea turtles • Potential taking of sea turtles with hopper dredge <p>Direct positive impacts –</p> <ul style="list-style-type: none"> • Nesting area along project reach would increase with nourishment activities <p>Indirect adverse impacts –</p> <ul style="list-style-type: none"> • Burial of approximately 1.3 acres nearshore hardbottom habitat that serves as foraging habitat for juvenile sea turtles 	<p>Direct adverse impacts –</p> <ul style="list-style-type: none"> • Alteration of the beach face resulting in potential adverse impact to nesting and hatching success (including effects from grade changes, sediment material, over-compaction, escarpment formation, artificial lighting during construction) resulting in potential “incidental” take of sea turtles <p>Direct positive impacts –</p> <ul style="list-style-type: none"> • Nesting area along project reach would increase with nourishment activities <p>Indirect adverse impacts –</p> <ul style="list-style-type: none"> • Burial of approximately 1.3 acres nearshore hardbottom habitat that serves as foraging habitat for juvenile sea turtles 	<p>Nesting will continue in the area without direct or cumulative effects on either nesting or hardbottom feeding and refuge by juvenile sea turtles.</p> <p>Sea turtle nesting would be negatively impacted as beaches erode.</p>
PROTECTED SPECIES – Birds	<p>Direct adverse impacts –</p> <ul style="list-style-type: none"> • Potential destruction of nests • Potential disturbance to nesting adults and hatchlings <p>Indirect adverse impacts –</p> <ul style="list-style-type: none"> • Alteration of intertidal feeding habitat by burial 	Same as S-3A	Local habitat use (feeding, resting, nesting) by listed birds is expected to continue

Table 2.2-5. Summary of Direct and Indirect Impacts of the Alternative Project Plans (Page 2 of 7)

ALTERNATIVE: ENVIRONMENTAL FACTOR:	Plan S-3A Beach Nourishment Using an Offshore Sand Source C1-B Borrow Area	Plan S-3B Beach Nourishment Using an Upland Sand Source	No-Action Status Quo
PROTECTED SPECIES – Manatees	Direct adverse impacts – • Possible encounters with manatees by dredge and support vessels during dredge and disposal operations.	No effects anticipated.	Local habitat use by manatees is expected to continue.
PROTECTED SPECIES – Whales	Direct adverse impacts – • Possible encounters with whales by dredge and support vessels during dredge and disposal operations, esp. at borrow area.	No effects anticipated.	Local habitat use by whales is expected to continue.
HARD GROUND	Direct adverse impacts – • Burial of nearshore hardgrounds • Potential for mechanical damage to hardgrounds along pipeline corridors Indirect adverse impacts - • Potential for secondary impacts to nearshore hardbottom adjacent to the ETOF resulting from sedimentation and/or turbidity • Loss of ecological functions important to local flora and fauna including substrate for attachment, nesting sites, spawning sites, and feeding sites.	Direct adverse impacts – • Burial of nearshore hardgrounds Indirect adverse impacts - • Potential for secondary impacts to nearshore hardbottom adjacent to the ETOF resulting from sedimentation and/or turbidity Loss of ecological functions important to local flora and fauna including substrate for attachment, nesting sites, spawning sites, and feeding sites.	Natural hardground exposure will fluctuate, and might increase with continued beach erosion.
SHORELINE EROSION	Would improve storm protection and minimize erosion losses over the life of the project, maintain or improve sand dune and beach, would improve recreation and nesting habitat. Dredging scenarios will be designed to prevent shoreline erosion from altered wave climate and sediment transport.	Would improve storm protection and minimize erosion losses over the life of the project, maintain or improve sand dune and beach, would improve recreation and nesting habitat.	Shoreline would continue to erode at its present rate.

Table 2.2-5. Summary of Direct and Indirect Impacts of the Alternative Project Plans (Page 3 of 7)

ALTERNATIVE: ENVIRONMENTAL FACTOR:	Plan S-3A Beach Nourishment Using an Offshore Sand Source C1-B Borrow Area	Plan S-3B Beach Nourishment Using an Upland Sand Source	No-Action Status Quo
FISH AND WILDLIFE RESOURCES	<p>Direct adverse impacts –</p> <ul style="list-style-type: none"> • Burial of nearshore hardbottom habitat which includes attached invertebrates and plants as well as less mobile fishes and crustaceans • Burial of softbottom areas along the surf zones and disturbance of softbottom areas in the borrow area will temporarily eliminate infaunal assemblages • Suspended sediment (turbidity) will negatively affect filter feeding organisms. Suspended sediment can abrade gill tissues on fishes and invertebrates. <p>Indirect adverse impacts -</p> <ul style="list-style-type: none"> • Feeding by visually oriented predators will be temporarily impacted during project construction • Temporary relocation of motile faunal population • Burial of hardbottom habitat will reduce amount of foraging habitat • Temporary infaunal diversity changes in the nearshore and offshore softbottom areas 	<p>Direct adverse impacts –</p> <ul style="list-style-type: none"> • Burial of nearshore hardbottom habitat which includes attached invertebrates and plants as well as less mobile fishes and crustaceans • Burial of softbottom areas along the surf zones will temporarily eliminate infaunal assemblages • Suspended sediment (turbidity) will negatively affect filter feeding organisms. Suspended sediment can abrade gill tissues on fishes and invertebrates. • Mining of the upland borrow area may impact species utilizing habitat in or near the borrow site. <p>Indirect adverse impacts -</p> <ul style="list-style-type: none"> • Feeding by visually oriented predators will be temporarily impacted during project construction • Temporary relocation of motile faunal population • Burial of hardbottom habitat will reduce amount of foraging habitat 	<p>Local habitat use by fishes and invertebrates will continue in relation to natural variability of the physical environment.</p> <p>Continual erosion of the beach and dune areas would potentially decrease habitat for nesting turtles and birds and dune species.</p>

Table 2.2-5. Summary of Direct and Indirect Impacts of the Alternative Project Plans (Page 4 of 7)

ALTERNATIVE: ENVIRONMENTAL FACTOR:	Plan S-3A Beach Nourishment Using an Offshore Sand Source C1-B Borrow Area	Plan S-3B Beach Nourishment Using an Upland Sand Source	No-Action Status Quo
FISH AND WILDLIFE RESOURCES	<ul style="list-style-type: none"> Migratory birds and shorebirds may be temporarily discouraged from using areas during constructions activities 	<ul style="list-style-type: none"> Temporary infaunal diversity changes in the nearshore and offshore softbottom areas Migratory birds and shorebirds may be temporarily discouraged from using areas during constructions activities 	
MARINE MAMMALS	Possible encounters with marine mammals by dredge and support vessels during dredge and disposal operations, esp. at borrow area.	No anticipated effects.	No anticipated effects.
MIGRATORY BIRDS	Bird species that reside or winter in the project area may be temporarily displaced by disturbance from ongoing activities. Sand placement or grading activities may crush eggs or hatchlings. Potential indirect impacts as a result of dredging operations may include ship-following behavior, temporary reductions in prey items nearshore and offshore, and increased foraging in pump-out area.	Bird species that reside or winter in the project area may be temporarily or permanently displaced by disturbance from ongoing activities. Sand placement or grading activities may crush eggs or hatchlings.	Continued erosion of the project area may impact nesting or foraging habitat.
DUNE VEGETATION	Direct adverse impacts – <ul style="list-style-type: none"> Potential for damage to existing dune vegetation during construction Direct positive impacts – <ul style="list-style-type: none"> Density of existing dune plant species would increase in areas where planting has occurred. Increased shoreline width would better protect dune communities during storm activities. 	Same as S-3A	Existing dune vegetation could be impacted and possibly lost due to erosion.

Table 2.2-5. Summary of Direct and Indirect Impacts of the Alternative Project Plans (Page 5 of 7)

ALTERNATIVE: ENVIRONMENTAL FACTOR:	Plan S-3A Beach Nourishment Using an Offshore Sand Source C1-B Borrow Area	Plan S-3B Beach Nourishment Using an Upland Sand Source	No-Action Status Quo
WATER QUALITY	Direct adverse impacts – <ul style="list-style-type: none"> • Temporary increases in turbidity adjacent to the borrow site and beach fill area. Turbidity would be monitored during project construction and work would cease if turbidity is not in compliance with Florida water quality standards.	Same as S-3A	No anticipated effects.
CULTURAL RESOURCES	Direct adverse impacts – <ul style="list-style-type: none"> • No cultural resources have been documented during surveys. No anticipated effects. 	Direct adverse impacts – <ul style="list-style-type: none"> • Potential impacts to undocumented archeological resources at the mine site. 	No anticipated effects.
RECREATION	Direct adverse impacts – <ul style="list-style-type: none"> • Temporary disruption and/or localized suspension of recreation at beach and at offshore dredging location during construction activities. • Temporary increases in turbidity may degrade snorkeling and diving experiences around borrow and nourishment areas Direct positive impacts - <ul style="list-style-type: none"> • Provides increased recreational space for public use. 	Direct adverse impacts – <ul style="list-style-type: none"> • Presence of dump trucks will impact beach activities during project construction (approx. 49,238 to 87,533 truck-loads of sand would be needed to meet the renourishment requirement of 787,800 cy). • Temporary increases in turbidity may degrade snorkeling and diving experiences around beach fill areas Direct positive impacts - <ul style="list-style-type: none"> • Provides increased recreational space for public use. 	Beaches would continue to erode, resulting in decrease use of beach area; potential increase in nearshore hardground diving areas.

Table 2.2-5. Summary of Direct and Indirect Impacts of the Alternative Project Plans (Page 6 of 7)

ALTERNATIVE: ENVIRONMENTAL FACTOR:	Plan S-3A Beach Nourishment Using an Offshore Sand Source C1-B Borrow Area	Plan S-3B Beach Nourishment Using an Upland Sand Source	No-Action Status Quo
AESTHETICS	Direct adverse impacts – <ul style="list-style-type: none"> • Temporary aesthetic impacts associated with construction activities Direct positive impacts – <ul style="list-style-type: none"> • Provides a wider, more attractive beach for public use. 	Same as S-3A	Aesthetic impacts associated with unabated beach erosion; landward advancement of surf zone.
NAVIGATION	Direct adverse impacts - <ul style="list-style-type: none"> • Temporary and localized increase in vessel traffic associated with transit of dredge and support vessels between fill area and offshore borrow area during dredge activities. 	No anticipated effects.	No anticipated effects.
ECONOMICS	The 2012 cost of placing 787,800 cy of material from the proposed offshore borrow area is estimated at \$10,104,476 or \$9.48 per cubic yard. Short-term economic impacts to beach-associated tourism revenues during project construction. No permanent impacts on commercial or recreational fishing are expected.	The 2007 total unit cost of upland sand material delivered to project area ranges from \$9.00/cy (note: this price does not include delivery) to \$32.00/cy. Therefore, the cost of 787,800 cy yards of sand from an upland source ranges from \$7,090,200 to \$25,209,600. Short-term economic impacts to beach-associated tourism revenues during project construction. No permanent impacts on commercial or recreational fishing are expected.	Continued erosion of existing beach would result in increased potential of storm damage, increased energy requirements associated with post-storm clean-up activities, and a likely reduction in beach-associated tourism revenues, property tax, and jobs.
ENERGY REQUIREMENTS AND CONSERVATION	Insignificant energy requirements for beach construction project.	Insignificant energy requirements for beach construction project.	Energy requirements associated with clean-up after storm events would continue to increase concurrent with damages.

Table 2.2-5. Summary of Direct and Indirect Impacts of the Alternative Project Plans (Page 7 of 7)

ALTERNATIVE: ENVIRONMENTAL FACTOR:	Plan S-3A Beach Nourishment Using an Offshore Sand Source C1-B Borrow Area	Plan S-3B Beach Nourishment Using an Upland Sand Source	No-Action Status Quo
AIR QUALITY	Direct adverse impacts – <ul style="list-style-type: none"> • Small, localized, temporary increases in concentrations of nitrogen dioxide (NO₂), SO₂, CO, VOCs, and PM mostly associated with the dredge plant. 	Direct adverse impacts – <ul style="list-style-type: none"> • Small, localized, temporary increases in concentrations of nitrogen dioxide (NO₂), SO₂, CO, VOCs, and PM mostly associated with dump trucks used to transport sand. 	No anticipated impacts.
ESSENTIAL FISH HABITAT	Direct adverse impacts – <ul style="list-style-type: none"> • Temporary increases in turbidity will affect feeding and respiration of federally managed species, particularly in early life stages • Direct burial or removal of infaunal assemblages • Direct burial of hardbottom habitat potentially causing relocation of motile faunal populations, reductions in feeding success and recruitment of juvenile fish, and mortality of demersal fish species. 	Direct adverse impacts – <ul style="list-style-type: none"> • Temporary increases in turbidity will affect feeding and respiration of federally managed species, particularly in early life stages • Direct burial of infaunal assemblages • Direct burial of hardbottom habitat potentially causing relocation of motile faunal populations, reductions in feeding success and recruitment of juvenile fish, and mortality of demersal fish species. 	No anticipated impacts.
ESSENTIAL FISH HABITAT	<ul style="list-style-type: none"> • Dredging offshore borrow may impact coastal migratory species, snapper-grouper complex, red drum, and sailfish. • Impacts associated with mining the borrow area may include turbidity, sedimentation, disruption of feeding activities and migratory routes, and entrainment 		

2.2.4. PREFERRED ALTERNATIVE – BEACH NOURISHMENT USING OFFSHORE BORROW AREA C1-B

Beach Nourishment Using Offshore Borrow Area C1-B is selected as the Preferred Alternative because it addresses the erosion problem within the project area and fulfills Martin County's goals and objectives. Beach restoration using dredged material from the proposed offshore borrow area C1-B would provide a sufficient amount of beach-compatible sand at a more economical cost and with less transportation complications than beach sand from an upland borrow source. This site is located further away from shore than proposed borrow sites C1-A and C1-C, and wave analysis modeling results indicate that dredging this site for fill material would not result in unacceptable impacts to the wave climate and shoreline sediment transport from dredging this area. In addition, based on survey results, no submerged cultural resources or hardbottom resources have been identified within C1-B.

The construction activities associated with the authorized Martin County HSDR are related periodic beach nourishment which involves placement of beach fill along the 4-mile project reach and shaping/contouring of the fill to meet template requirements. To avoid sea turtle nesting season, all construction must occur between November 1 and May 1, and no construction equipment may be stored on the beach outside of this window.

A hopper dredge would be used to excavate sand from the offshore borrow sites. A hopper dredge works by dredging sand from the borrow site into a hopper (storage area) and then transporting the material to a pump-out location just offshore of the nourishment area. Once the hopper dredge arrives at the pump-out location, the dredge connects to the discharge pipeline. The dredge then mixes the dredged material with seawater to form a slurry and pumps the slurry from the hopper, through the discharge pipeline which runs along the ocean floor, and up onto the beach nourishment area. If possible, previously established pipeline corridors will be used to transfer material from the dredge to the beach fill areas (**Figure 2.2-5 a,b**). However, the exact location of the pipelines will be determined prior to construction to make sure no hardbottom resources are present. The 3-foot-diameter pipelines may be collared to minimize contact with the ocean bottom. Anchors or spuds will be located entirely in sand bottom. Daily monitoring of all pipelines to shore will be performed to check for sand movement and leaks. Continuous leak monitoring will be required of the dredging contractor through fluctuation in pressure through the pipelines.

The initial discharge of material would be formed into a shore-parallel dike that would advance alongshore ahead of the construction template backfill. The dike would help to contain the discharge effluent, allowing time for sediments to drop from the flow. Construction would generally commence at the south end of the project and work toward the north. The material will be graded and shaped by earthmoving equipment in order to achieve the desired beach profile. The contractor will use earthmoving equipment and surveying techniques to achieve the desired beach profile. The traditional fill template will consist of a +8 foot National Geodetic Vertical Datum (NGVD) berm elevation, 90-foot berm width, a 1 vertical: 10 horizontal foreshore construction slope, and a

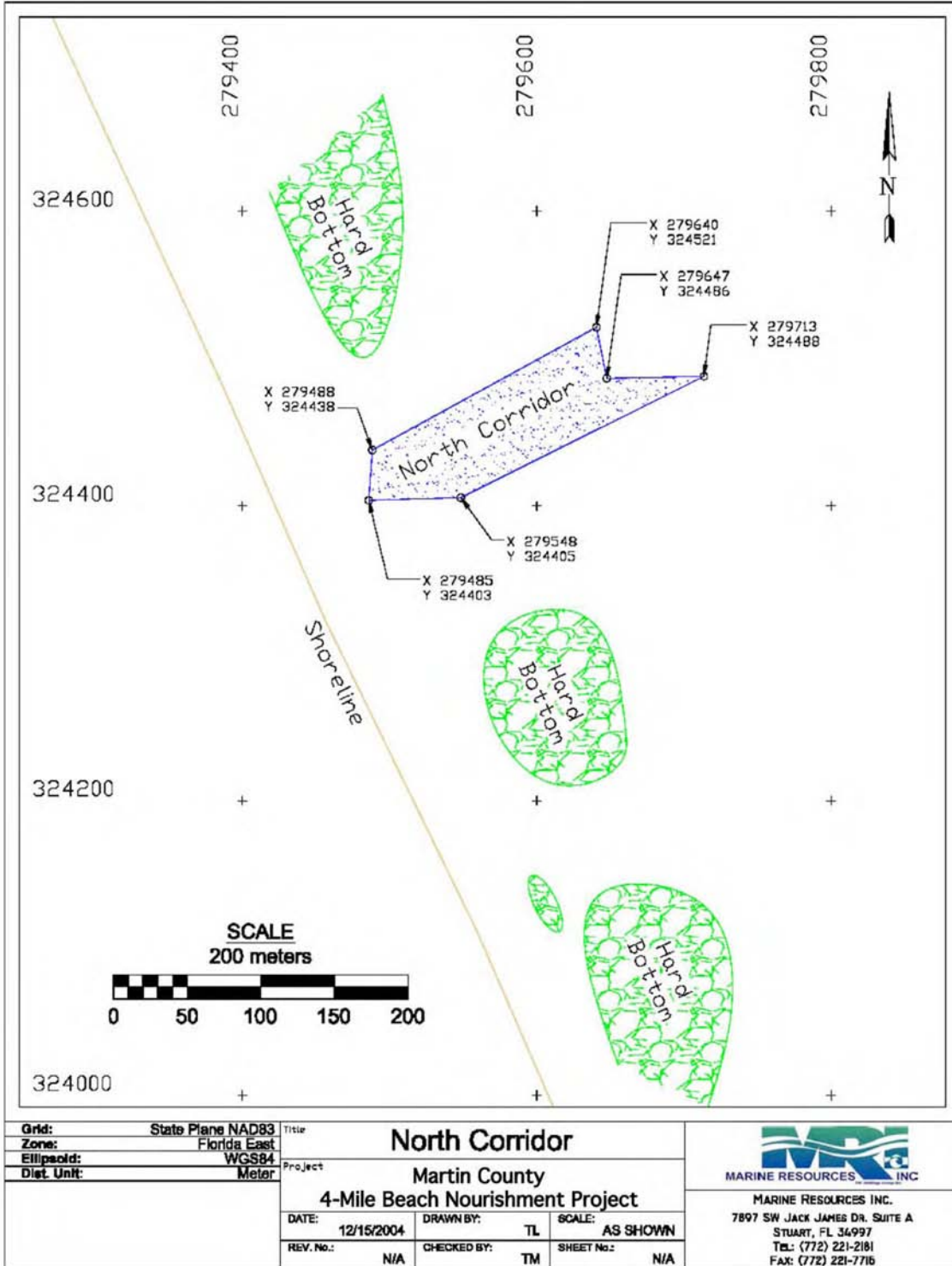
20-foot-wide dune crest with an elevation + 12.5 feet NGVD (**Figure 1.2-2**). The experimental fill (“turtle-friendly”) template will consist of a construction berm commencing landward at an elevation of +8 foot NGVD with a 1 vertical:50 horizontal slope grading to a 1 vertical:20 horizontal slope to the mean low water line with a berm width of 50 feet (**Figure 2.2-6**). Each alternating experimental and traditional beach segment will be 2,000 feet in length with a 700-foot transition zone between each treatment. If the alternating fill template is not constructed, the entire project fill template will be constructed to either the traditional or experimental profile as outlined above.

All staging and beach access corridors are to be determined by the contractor and upland vegetation will be avoided to the maximum extent possible. USACE has proposed to plant sea oats (*Uniola paniculata*) as needed to replace lost vegetation.

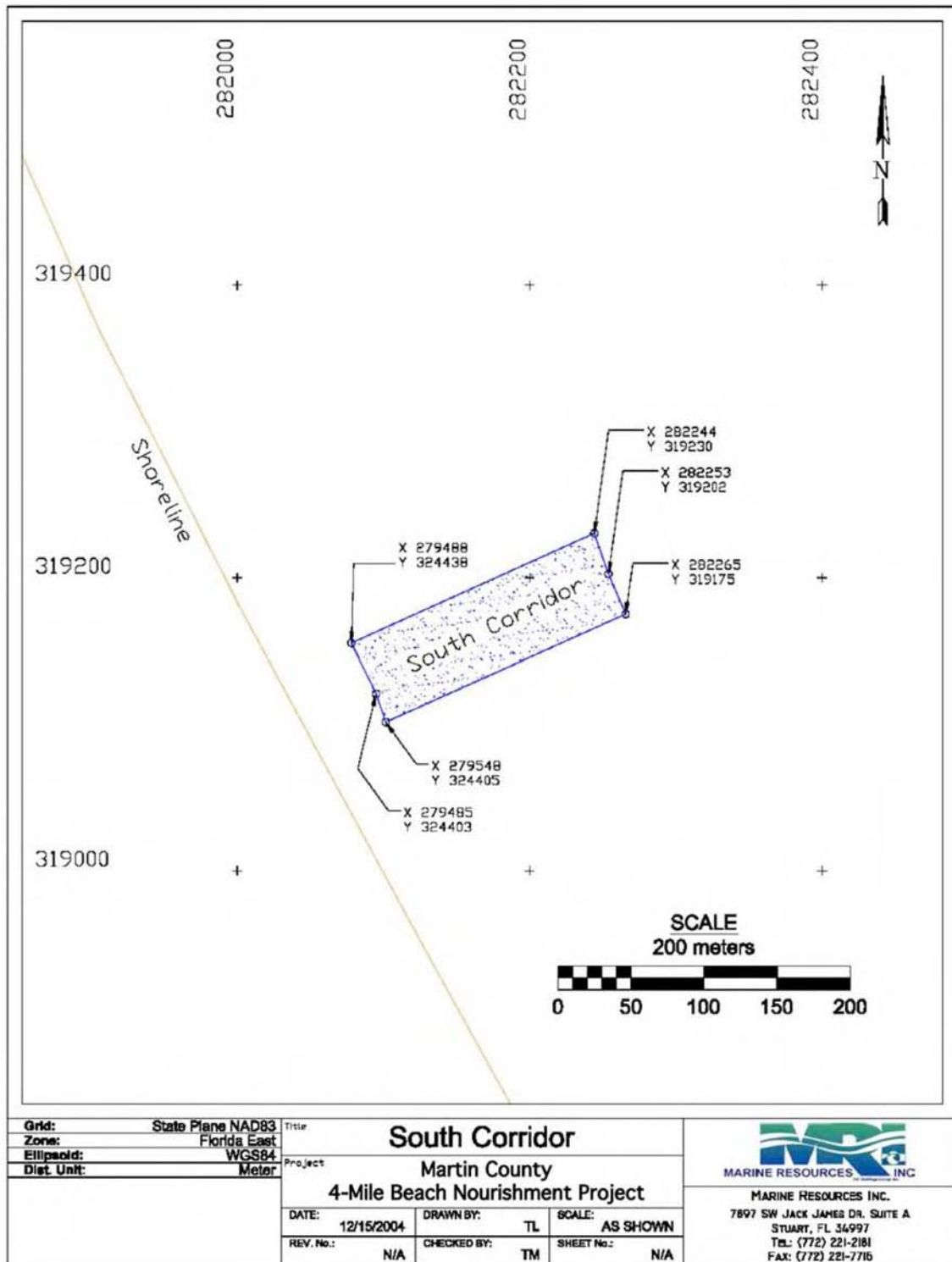
Assuming the use of one medium-sized hopper dredge with pump-out capability, the anticipated 2012 construction event is estimated to have a total construction time of 3.85 months (116 days). Mobilization of the dredge, pipeline, and land-based equipment is expected to take 20 days. The dredging and beach fill work is expected to take 86 days. This entails the hopper dredge dredging sand from the borrow area, transporting the sand to the pump-out pipe line, and pumping sand onto the beach where it is graded to the construction template using dozers. Once the beach fill is complete it is expected to take 10 days to demobilize all equipment. Note, that this construction time assumes 787,800 cubic yards will be needed. So, if less sand is needed it will take less time to construct. Also, these estimates don’t include unforeseen delays that may occur from bad weather conditions or equipment problems.

Borrow area C1-B covers approximately 1000 acres and is estimated to contain sufficient material (between 2.4 to 4 mcy) for the remaining period of Federal participation which expires in 2046. A typical renourishment event would require the excavation of approximately 787,800 cy of material. The next nourishment event scheduled for 2012. Each nourishment event is expected to impact approximately 125 acres within the borrow area. Anticipated maximum excavation depths would be approximately 10 feet which is anticipated to deflate higher areas within the borrow area down to the existing adjacent bottom elevations. The nourishment interval for this project is estimated at 13 years which is based on current erosion rates and economic data; however, more frequent nourishments may be required if storm activity erodes the beach faster than anticipated.

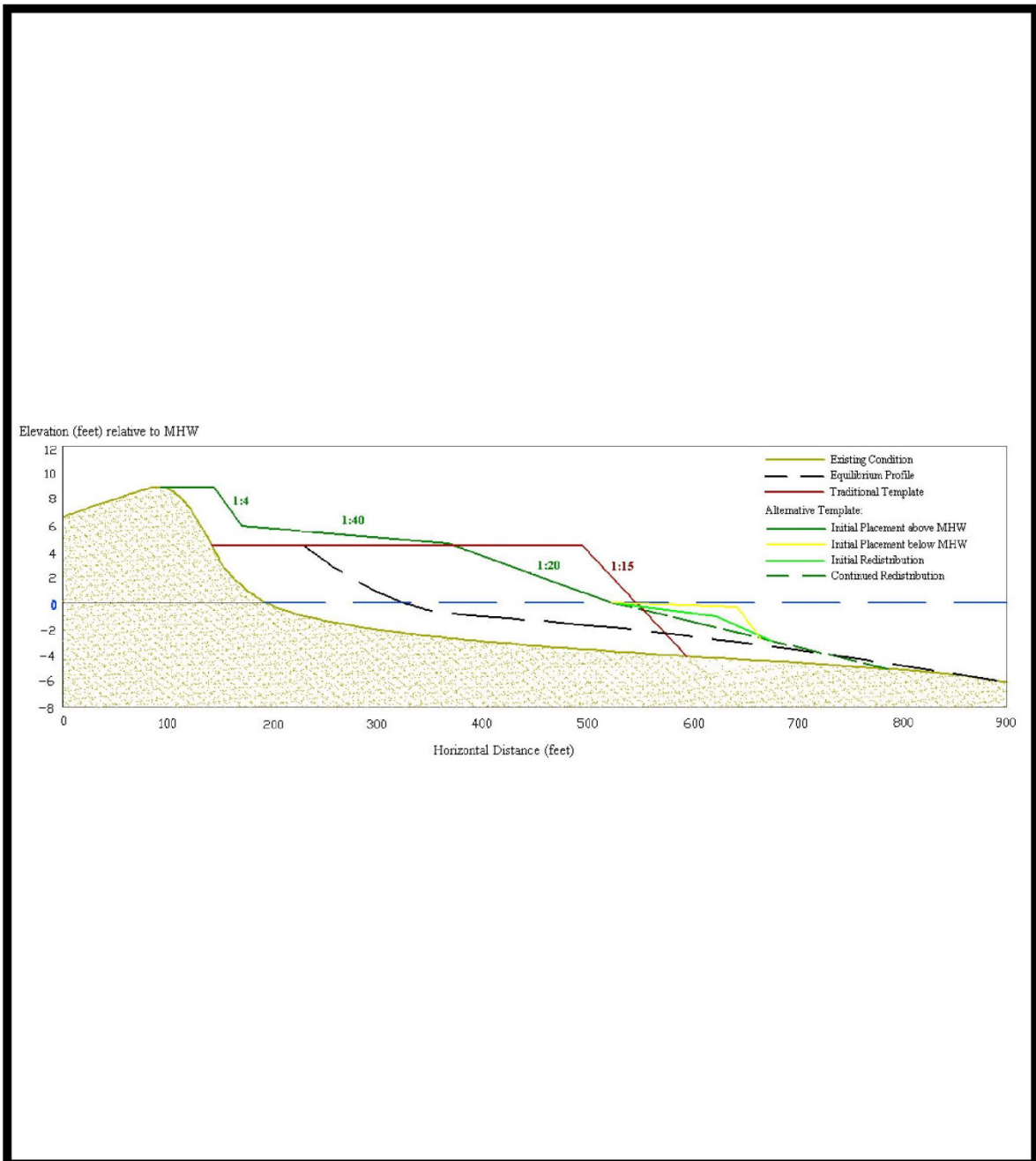
The 2012 cost of placing 787,800 cy of material from the proposed offshore borrow area is estimated at \$10,104,476 or \$9.48 per cubic yard. This cost estimate includes mobilization/demobilization, dredging and beach fill, tilling, construction/vibration controls and monitoring, endangered species observers, sea turtle trawling, and sea turtle relocation trawling. Pre- and post-construction monitoring would be paid for by the local sponsor as part of its cost share for the project and is not factored into this cost estimate.



**FIGURE 2.2-5a
 NORTH PIPELINE CORRIDOR LOCATION
 MARTIN COUNTY HURRICANE AND STORM DAMAGE REDUCTION PROJECT
 HUTCHINSON ISLAND, FLORIDA**



**FIGURE 2.2-5b
 SOUTH PIPELINE CORRIDOR LOCATION
 MARTIN COUNTY HURRICANE AND STORM DAMAGE REDUCTION PROJECT
 HUTCHINSON ISLAND, FLORIDA**



**FIGURE 2.2-6.
CONCEPTUAL ALTERNATIVE TEMPLATE DESIGN
(ACTUAL SLOPE DEPENDENT ON
SITE-SPECIFIC CONSIDERATIONS)
MARTIN COUNTY HURRICANE AND
STORM DAMAGE REDUCTION PROJECT
HUTCHINSON ISLAND, FLORIDA**

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Note that under Alternative S-3A, the BOEMRE's connected action is the issuance of a negotiated agreement that authorizes use of the offshore borrow area so that the USACE and local sponsor can obtain the necessary sand resources for beach nourishment. The BOEMRE action is needed since the USACE and local sponsor requested non-competitive access to the borrow area.

As described above, for the 2012 event, USACE is proposing alternate berm templates designed to allow the beach to equilibrate more rapidly to further minimize sea turtle nesting impacts. In a recent report prepared for FDEP, assessments of alternative construction templates for beach nourishment projects were evaluated to better identify aspects of traditional beach nourishment projects that negatively or positively impact sea turtles and provided recommendations for alternative design criteria that may improve the quality of nesting habitat (PBS&J and EAI 2007). The goal of the experiment is to design an alternative construction template that more closely mimics a natural beach profile, improves the quality of the built beach as sea turtle nesting habitat, and provides an acceptable level of shoreline protection. A conceptual alternative design template is provided in **Figure 2.2-6**.

2.3. MITIGATION AND MONITORING

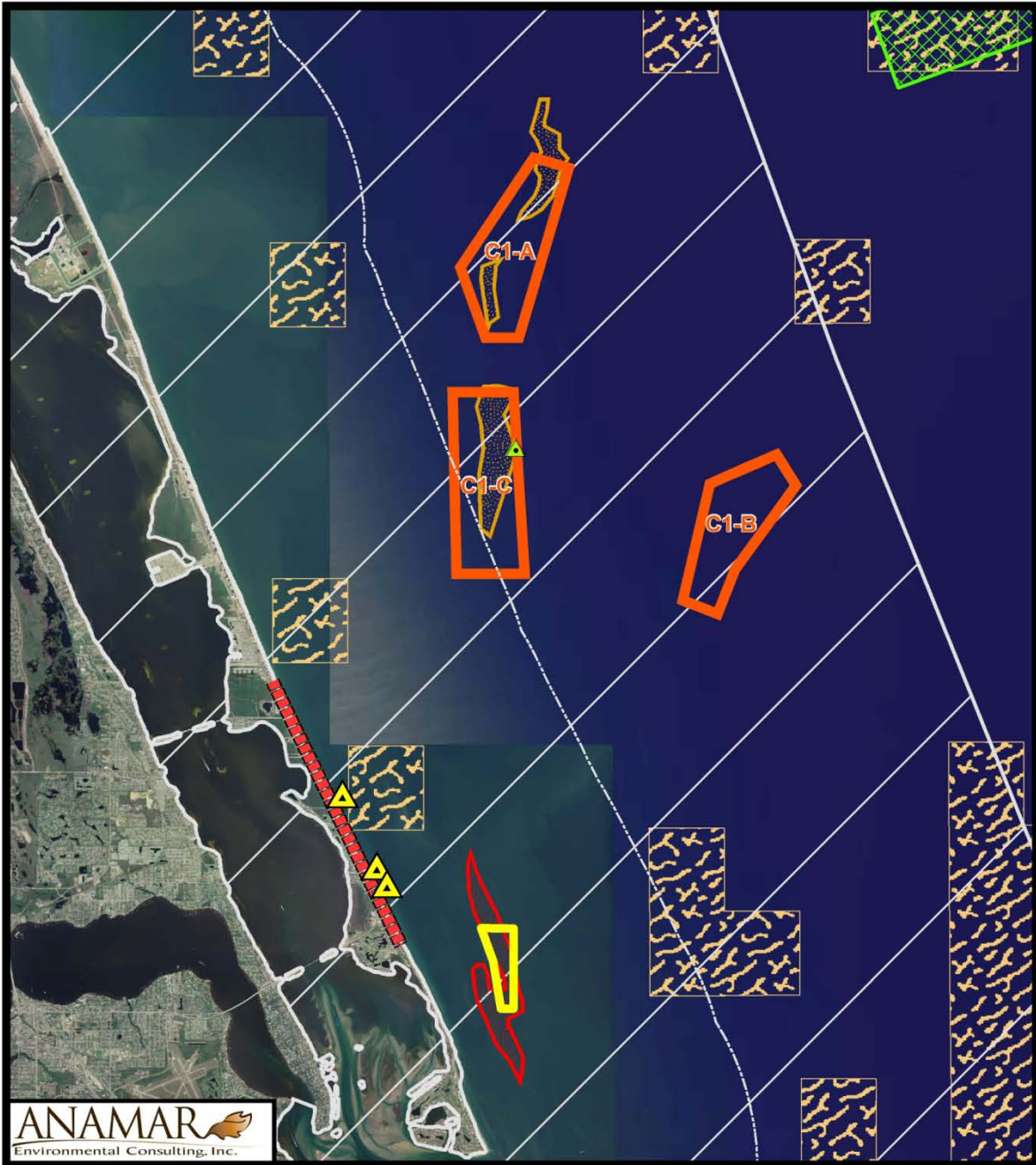
This section describes the mitigation and monitoring plans for the Martin County HSDR project. Additional information on protective measures and contract specifications is provided in Section 4.35, Environmental Commitments.

2.3.1. MITIGATION

Compensatory mitigation has already been implemented for the authorized beach nourishment project to offset impacts to nearshore hardbottom habitat located within the project ETOF between monuments R-1 through R-25. Since the same template will be used for future nourishments, no additional impacts to nearshore hardbottoms are anticipated; therefore, no additional mitigation for these resources is proposed within the ETOF. However, a contingency mitigation plan has been developed by Martin County and details how unanticipated impacts outside of the ETOF would be compensated (Appendix I).

Nearshore artificial reef was created within three sites (A, B, and C) totaling 6 acres and located approximately 900 feet offshore monuments R-12, R-18, and R-20 (**Figure 2.3-1**). These reefs were constructed during the summer of 2000 using steel and concrete material from the dismantled Evans Crary Bridge. Reef monitoring has been conducted by the late Dr. Lee Harris, Florida Institute of Technology, Associate Professor of Ocean Engineering. Annual monitoring data were collected in 2002, 2003, 2004, and 2006. Monitoring was not completed in 2005 due to low visibility conditions. Mitigation monitoring reports are included in Appendix G. The reports include results of fish and benthic species identification and abundance. The most recent monitoring reports from 2006 suggest that the 2004 and 2005 hurricanes caused some burial of the reef structures. This was most notable in mitigation reef C where the clusters of reef material were less abundant and spaced further apart. Harris (2006) found more shallow water depths to the sand bottom as compared to previous monitoring events, so

burial of a significant amount of artificial reef was suspected. There was some settlement (and/or burial) and scour around the bridge pieces that were located in 2006. The scour provides habitat similar to that provided by similar scour around nearshore natural reefs in the area. Many of the components that are stacked on top of each other appear to be stable, and are continuing to provide many overhangs and crevices, which are an excellent habitat for a variety of marine organisms to thrive (Harris 2006).



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LEGEND

St. Lucie Shoal USCG Buoy	St. Lucie Shoal
Mitigation Reefs	Potential Borrow Sites
Previous Borrow Area	Coral Essential Habitat (FWRI) EFH/HAPC*
Federal/State Jurisdictional Boundary	SEAMAP Offshore Hard Bottom
Extent of Nourishment	Potential Phragmatopoma (worm reefs)
Gilbert Shoal	EFH/HAPC*
	Special Management Zones

*EFH/HAPC - Essential Fish Habitat/Habitat Areas of Particular Concern

FIGURE 2.3-1.
EXTENT OF PROPOSED NOURISHMENT,
BORROW AREAS, AND COASTAL AND
MARINE RESOURCES
MARTIN COUNTY HURRICANE AND
STORM DAMAGE REDUCTION PROJECT
HUTCHINSON ISLAND, FLORIDA

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2.3.2. MONITORING

FDEP-approved biological and physical monitoring plans are required as part of the Joint Coastal Permit Application (Appendix I). Project monitoring represents a cooperative effort between USACE Jacksonville District, FDEP Bureau of Beaches and Coastal Systems, USFWS, and Martin County.

Monitoring of the renourished beach will be required through acquisition of project-specific data to include, at a minimum, pre-construction and periodic post-construction topographic and bathymetric surveys of the beach, offshore, and borrow site areas; aerial photography; and engineering analysis. A pre-construction and "as-built" beach profile survey will be produced that depicts the changes and improvements in the beach profile after renourishment has occurred. Subsequent elevation surveys of the renourished beach will be performed to assess changes in the beach profile annually for the first 3 years after renourishment and semi-annually for the next 8 years (**Table 2.3-1**). The as-built survey will allow verification of design elevations, design profiles, and project dimensions, while the post-construction surveys will allow assessment of post-construction performance of the completed project. The post-construction beach surveys will also be used to plan, design, and optimize subsequent nourishment projects.

Extensive environmental and biological monitoring is proposed for the renourished beach, mitigation reef, adjacent beach, and control beach. This monitoring plan is summarized in **Table 2.3-2**. The monitoring plan will include onshore monitoring, nearshore monitoring, and turbidity monitoring. Onshore monitoring performed within the nourished beach footprint and adjacent areas will document marine turtle nesting activity, scarp formation, and sediment compaction. Nearshore monitoring, performed in both the beach construction area and control area, will document the extent, condition, and biota of the nearshore hardbottom reefs including marine turtle foraging habitat. Nearshore monitoring will also be conducted at the three mitigation reef sites and will assess the development of a hardbottom community, identify biota using the mitigation reefs, and document amount of scouring that is occurring at the base of the rock used to construct the reefs.

A control area will be monitored and will provide hardbottom data and marine turtle foraging habitat data for comparison with the beach construction area and mitigation area. This monitoring plan will first be implemented prior to construction activities (a pre-construction baseline event) and then repeated at specified time intervals as noted in **Table 2.3-2**.

Turbidity will be monitored at the renourished beach site and the borrow site to ensure construction activities are not causing an unacceptable increase in turbidity. Turbidity monitoring will be implemented at background and compliance locations at both construction sites and will be measured every 6 hours while construction activities are in progress.

Prior to construction, an FDEP Water Quality Certificate (WQC) will be issued. This permit will include general and specific conditions and requirements to be accomplished during project construction and post-project monitoring.

Table 2.3-1. Project Physical Monitoring Requirements

Requirement Type	Frequency of Requirement													
	Pre-Const	Pre-Const	Const.	1	2	3	4	5	6	7	8	9	10	11
	FY-2009	FY-2010	FY-2011	FY-2012	FY-2013	FY-2014	FY-2015	FY-2016	FY-2017	FY-2018	FY-2019	FY-2020	FY-2021	FY-2022
Topographic and Bathymetric Surveys of the Beach and Offshore		X*	X**	X	X	X		X		X		X		X
Aerial Survey			X	X	X	X		X		X		X		X
Bathymetry at Borrow Site		X*	X**		X		X							

* No more than 90 days before construction commences.

** No more than 60 days after construction completed.

Table 2.3-2. Project Biological and Environmental Monitoring Requirements

Activity	Frequency	Duration	Survey Season	Variables Measured	Reporting
Sediment Compaction Monitoring	Annually (Post-Construction)	Initial and 2 Years Post-Construction	Pre-Turtle Nesting Season (March 1)	Compaction (PSI)	Annual
Scarp Monitoring	Annually (Post-Construction)	Initial and 2 Years Post-Construction	Pre-Turtle Nesting Season (March 1)	Scarp Height	Annual
Marine Turtle Nest Monitoring	Annually, Daily March 1 – October 31	Initial and 3 Years Post-Construction	March 1 – October 31	Emergences, Nests, Reproductive Success	Annual
Shorebird Monitoring (Breeding and Non-Breeding)	<u>Breeding Birds</u> April 1 or 10 Days before Construction	Initial	April 1 (or 10 Days before Construction) – August 1	Breeding Activity	Within 24 Hours of Breeding Confirmation
	<u>Non- Breeding Birds</u> 2 Weeks before Construction	Initial through First Year Post-Construction	2 Weeks before Construction – August 31	Presence	One Month after Collection
Beach Lighting Survey	First Nesting Season (Post-Construction)	Pre-Construction and 1 Year Post-Construction	Before March 1	Beach Lights	March 15 (Pre-Nesting Report) December 1 (Year End Report)
Project Site Hardbottom Monitoring	Annually (Pre- and Post-Construction)	Pre-Construction, Construction, and 3 Years Post-Construction	May 1 – September 30	Qualitative: Substrate Type, Benthic Assemblage Quantitative: Species Richness, Percent Cover	60 Days after Survey or December 1
Turbidity Monitoring	During Construction (Every 6 Hours)	During Construction	N/A	Turbidity (NTUs)	Within 1 Week of Collection

2.3.2.1. ONSHORE MONITORING

During the 3 years following fill placement and prior to the beginning of the marine turtle nesting season (March 1), sand compaction in the beach renourishment area will be measured to assess compaction and to determine if tilling is required to loosen the sand. Visual surveys for escarpments along the beach fill area will occur immediately following beach nourishment and for three subsequent years. All scarps that exceed 18 inches in height will be leveled or the beach profile reconfigured to minimize scarp formation.

Daily marine turtle nest monitoring will be conducted from March 1 through October 31 during the year construction occurs and for 2 years following construction. If construction occurs during the early sea turtle nesting season (March 1 to April 30), nighttime sea turtle nest surveys will occur. If construction occurs during the late sea turtle nesting season (November 1 to November 30), daily early morning sea turtle nest surveys will be conducted 65 days prior to project initiation and continue through September 30. Following construction, marine turtle nest surveys will continue daily during the nesting season and for the next two nesting seasons. Monitoring of nesting activity in the two seasons following construction shall include daily surveys and any additional measures required by FFWCC. A survey will be conducted of all lighting visible from the beach placement area immediately after construction and by March 15 each year for 2 years post-construction.

One-time comprehensive monitoring, in addition to that described above, is required for the alternating turtle friendly berm experiment in order to determine if statistically significant improvements in nest densities and hatchling production can be achieved through modifications to the traditional construction template. This would be as follows:

TASK	SUB-TASK
Daily Monitoring	Count of all crawls by type (nest or false crawl) and survey area
	GPS data collection for randomly selected crawls
	Documentation of abandoned digs along randomly selected crawls
Nest Marking & Monitoring	Marking of nests along randomly selected crawls
	Daily monitoring of marked nests
	Assessment of hatchling orientation for all marked nests
	Excavation of marked nests after hatching and evaluation of nest contents
Sediment Compaction Analyses	Measure compaction along randomly selected crawls
Scarp Monitoring	Measure scarps each week
Grain-size Analyses	Collect and analyze sediments at 32 locations twice a year
Characterization of Weather and Wave Conditions	Obtain and summarize weather and wave data from official websites
LiDAR Data Collection	Collect LiDAR data once each year
Engineering Profiles	Determine beach profiles (across dune and berm to approximately – 4 feet NGVD) at approximately 500-foot intervals six times a year

(PBS&J, 2007, modified)

Marine turtle monitoring will occur in the nearshore to assess differences in marine turtle foraging activities in three distinct locations: the project area (including downdrift area), a control hardbottom site, and the three constructed reef mitigation areas. Marine turtle monitoring will occur quarterly for 1 year prior to construction (pre-construction), monthly during construction, and quarterly for 2 years post-construction. Monitoring will consist of documenting species and abundance of marine turtles at each monitoring location.

Monitoring of breeding shorebirds within the project boundaries shall begin on April 1 or 10 days before construction-related activities begin. Nesting surveys shall occur daily throughout the construction period or through August if no shorebird nesting activity is observed. Non-breeding shorebird monitoring within the project boundaries shall begin 2 weeks before construction-related activities begin and occur every 2 weeks for at least 1 year post-construction.

2.3.2.2. NEARSHORE MONITORING

A new baseline hardbottom survey was conducted in August 2010. Hardbottom monitoring, performed before construction, immediately after construction, and 2 years post construction, will document the sessile plant communities and animal communities that inhabit the nearshore reefs and sediment accumulation within the communities. Monitoring will occur annually in three distinct locations: project area (including downdrift area), a control hardbottom site, and the three constructed reef mitigation areas. Monitoring in the control area will provide data from a natural hardbottom site for comparison with hardbottom data from the beach construction and mitigation areas.

The nearshore hardbottom edge shall be mapped during the pre-construction monitoring event and all subsequent nourishment events. This information will be used to document conditions along the previously mapped nearshore hardbottom edge for comparison to the pre-construction survey. Transects will be established in the three hardbottom monitoring areas (project site, control site, and mitigation areas) and monitoring will occur in quadrats along each transect so changes in the benthic landscape including physical relief, sand cover, and species dominance/abundance can be recorded.

2.3.2.3. TURBIDITY MONITORING

Turbidity will be monitored at the renourished beach site and the borrow site to ensure that construction activities are not causing an unacceptable increase in turbidity. Turbidity monitoring will be implemented at background and compliance locations at both construction sites and will be measured every 6 hours while construction activities are in progress.

3. AFFECTED ENVIRONMENT

The Affected Environment section succinctly describes the existing environmental resources and how they may be affected if any of the alternatives are implemented. This section does not describe the entire suite of environmental resources, only those relevant to the project that would potentially be affected during or after construction activities. This section, in conjunction with the description of the No Action Alternative, forms the baseline conditions for determining the environmental impacts of the proposed action and reasonable alternatives.

3.1. GENERAL ENVIRONMENTAL SETTING

3.1.1. PROJECT LOCATION

The project area is located on Hutchinson Island in Martin County, Florida (**Figure 1.1-1**). The Martin County shoreline is composed of mainly developed coastal barrier islands separated from the mainland by tidal lands, lakes, and bays that are interconnected by a system of tidal waterways maintained as part of the Intracoastal Waterway. The barrier islands are low, varying in width from 200 feet to nearly a mile, and low in elevation, ranging from 5 to 25 feet above msl. St. Lucie Inlet at the north end of Jupiter Island connects the Atlantic Ocean with the Indian River, a lagoon that extends about 100 miles northward. St. Lucie Inlet is an artificial inlet opened into the Atlantic Ocean through the barrier island. Jupiter Inlet, a natural opening at the south end of Jupiter Island, connects the ocean with the Loxahatchee River. These inlets provide exchange of sediment and water between estuaries and the continental shelf, primarily as a function of tide.

The general project area is composed primarily of multifamily homes, small condominium complexes, and large hotels facing either west towards the Indian River Lagoon or east towards the Atlantic Ocean. Beaches line the eastern side of Hutchinson Island and are composed of shell fragments and fine sand. Coquina rock outcroppings occur periodically along the shore of the barrier island (**Figure 3.1-1**). Martin County beaches are used by multiple wildlife species including nesting sites for threatened and endangered sea turtles. The dune system along the landward side of the beach affords some protection to the shorefront development, but is subject to overwash and erosion during severe storms. Because of this, erosion of the protective beach along Hutchinson Island is a severe seasonal problem.

The project area also includes the diverse inner shelf habitat offshore of St. Lucie and Martin County, including the physically dominated surf zone, nearshore hard bottom habitat, and offshore sand borrow areas. The nearshore beach environment consists of primarily medium- to coarse grained sand mixed with carbonate. Anastasia Formation underlies the entire project area and is exposed in places along with more recent Holocene beach rock. The offshore borrow area is located approximately 7 miles offshore in the Inner Shelf Plain zone. Morphology of the continental margin offshore consists of reef features of Tertiary origin, littoral deposition from the Pleistocene era, and current-induced features. Repeated sea level changes resulted in a series of deposition events between glacial periods forming a complex stratigraphic sequence.

Figure 3.1-1. Example of Exposed Coquina Rock Outcroppings Located Approximately 2 Miles South of the Project Area (Bathtub Reef Park)



The underlying Anastasia Formation is present throughout the project area, which is confined to the Inner Shelf Plain Zone of the Florida Continental Shelf. The Inner Shelf Plain Zone lies between the Inner Smooth Zone to landward and the Deep Ridge Zone to seaward. Approximate depths are between 16 and 40 meters. The predominant sediment material is relict terrigenous sands and shell debris. **Figure 2.3-1** depicts marine resources in the area, including existing mitigation reefs, nearshore and offshore hardbottom areas, and special management areas (HAPC) in the vicinity.

Multiple factors control the coastal processes along the shoreline of Martin County including winds, tides, currents, waves, storm events, and geology and geomorphology. Sections 3.1.2 through 3.1.9 describe the role of each of these factors and their effect on beach erosion in the project area.

3.1.2. STORM EVENTS

The coastline of Martin County is low-lying and vulnerable to storm surge and other storm event damages. Tropical cyclones (tropical storms and hurricanes), typically occur between June and November, and generally originate in the tropical and subtropical latitudes in the Atlantic Ocean north of the equator. During the winter months (December-March), frontal weather patterns driven by cold arctic air masses reach Central Florida with greater frequency. These fronts typically generate southwest winds that shift to the northwest before frontal passage, and then to the northeast behind the front. If the northeaster occurs when the moon is in perigee, the winds are accompanied by abnormally high tides.

The surges and waves caused by cyclonic disturbances and northeaster storms present a major threat to the stability of the shoreline in Martin County. A total of 50 hurricanes passed within a radius of 150 miles of Martin County between 1830 and 1985 (USACE 1986). Of that total, 19 hurricanes passed within a 50-mile radius. In recent years, major storms that have affected Martin County include Hurricane Floyd (1999), Hurricane Irene (1999), Hurricane Jeanne (2004), Hurricane Frances (2004), Hurricane Dennis (2005), Hurricane Katrina (2005), Hurricane Ophelia (2005), and Hurricane Wilma (2005). Storm paths from the 2004 and 2005 hurricane seasons are depicted in **Figure 3.1-2**.

In the fall, winter, and spring months, the Martin County shoreline is vulnerable to northeasters, which may form with little or no advance warning and persist up to a week to 10 days. The average duration of a northeaster, however, is only about 2 to 3 days. Particularly severe northeasters that have affected the project area occurred in 1956, 1957, 1962, 1963, 1964, 1979, 1981, 1984 (Thanksgiving Day Storm), 1990, and 2004.

In 2004, Hurricanes Frances and Jeanne caused significant damage to the Martin County shore protection project area, causing substantial shoreline recession. Storm damages resulted in a loss of approximately 269,500 cy of material from the project reach, equal to 45% of the periodic renourishment volume of 590,000 cy (USACE 2005). Between early July and late October 2005, the Martin County shore protection project was severely impacted by three hurricanes (Katrina, Ophelia, and Wilma), all of

which reached category 3 strength or higher. The individual storms had significant intensity and durations of impact; however, their cumulative destruction to the project area was extraordinary. This is in large part due to their nearly continuous occurrence which allowed no recovery time for material to migrate back onshore and provide protection against subsequent storm activity. The shoreline recession for the project area averaged 20.7 feet and resulted in a loss of 149,500 cy of material over the 4-mile project reach (USACE 2006).

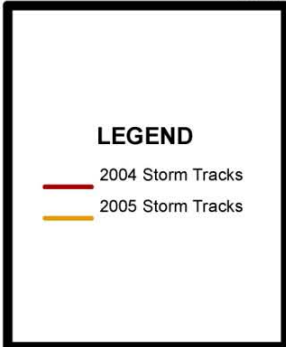
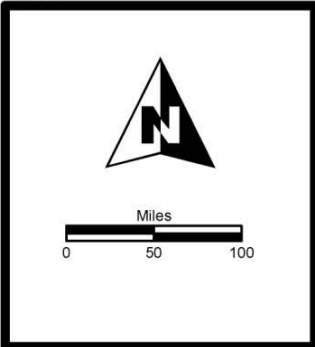
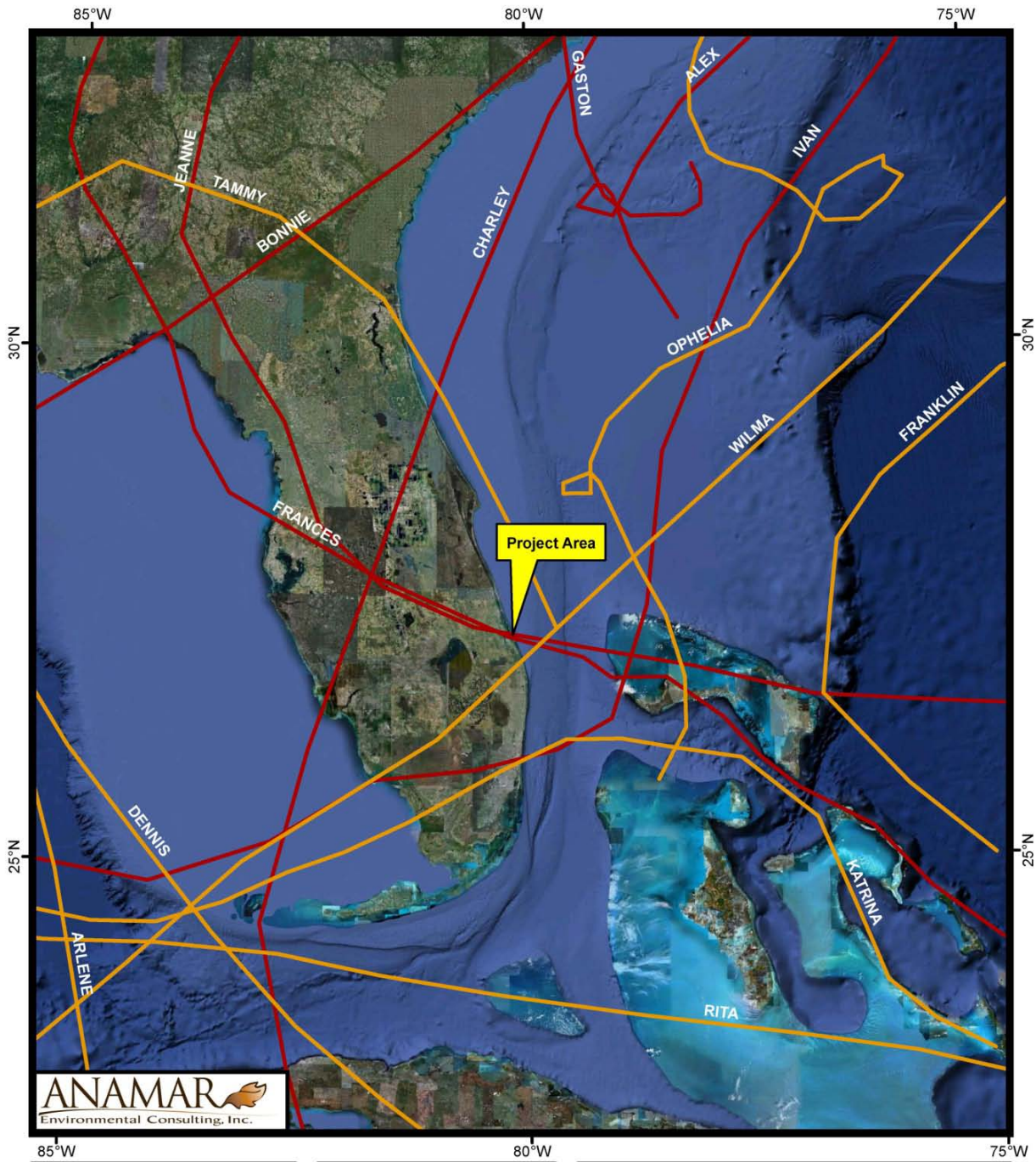


FIGURE 3.1-2.
2004-2005 ATLANTIC BASIN
HURRICANE TRACKS
MARTIN COUNTY HURRICANE AND
STORM DAMAGE REDUCTION PROJECT
HUTCHINSON ISLAND, FLORIDA

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3.1.3. WINDS

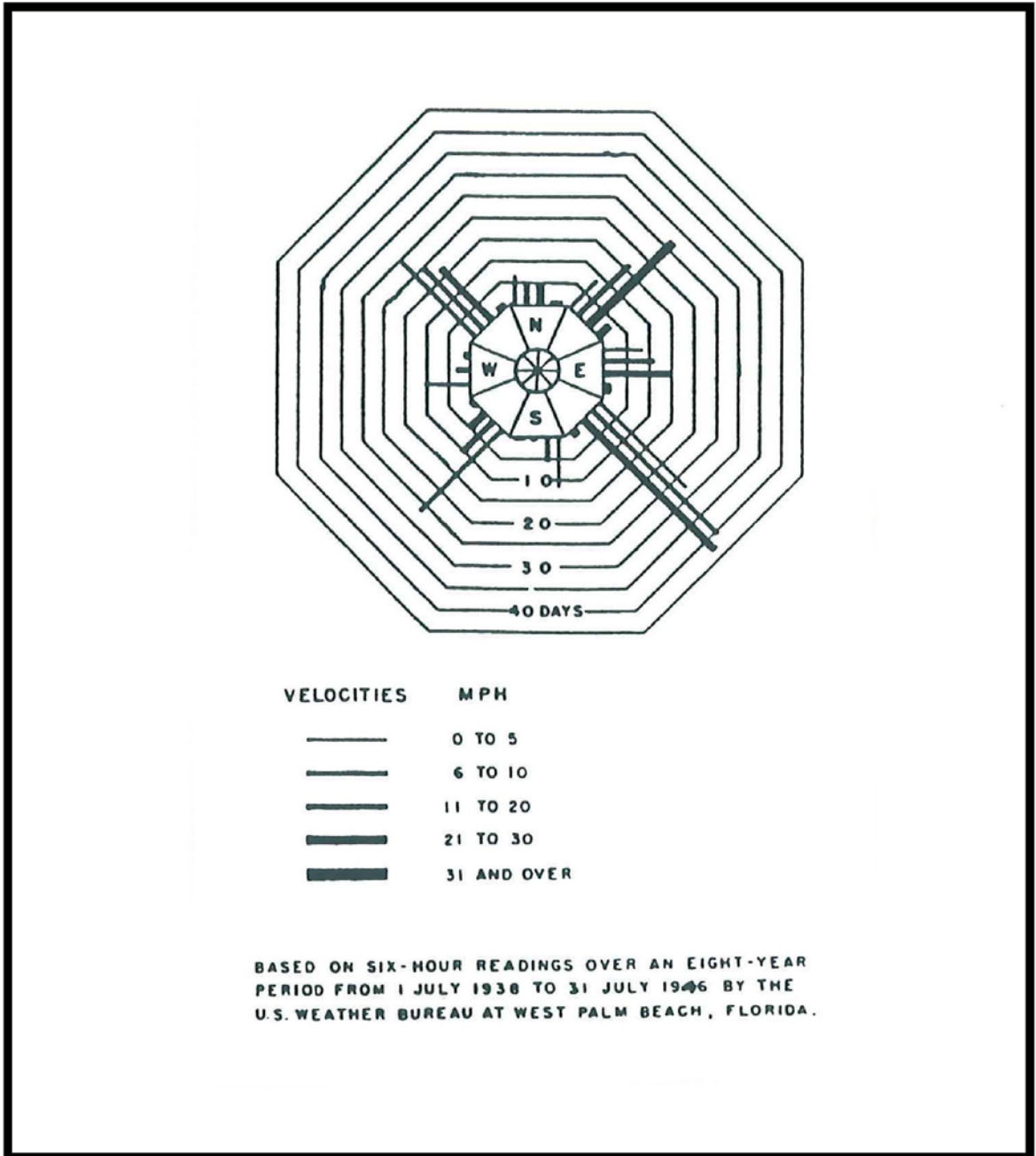
Local winds generate most of the short-period waves experienced in the project area, and vary notably by season. The wind rose in **Figure 3.1-3** is based on data taken at the U.S. Weather Bureau Station in West Palm Beach, Florida, during an 8-year period from July 1938 to July 1946. The wind rose in **Figure 3.1-4** is based on data taken at the West Palm Beach International Airport during a 10-year period from 1998 to 2007. These wind roses indicate that the prevailing winds are from the northeast, east, and southeast, with easterly and southeasterly winds occurring most often.

During winter months (December through March), winds are often from the northwest, north, and northeast. Cold fronts, associated with areas of low pressure, generally traverse the continental U.S. from west to east. Severe northeasters can cause extensive beach erosion and shorefront damage. The summer months (June through September) are characterized by tropical weather systems traveling east to west in the lower latitudes. These tropical systems have the potential to develop into tropical storms and hurricanes, which can generate devastating winds. Southeast tradewinds make up the typical summer wind climate.

3.1.4. WAVES

Wave height, period, direction of approach, magnitude, and phasing of storm surge are important dynamic factors influencing beach change in central east Florida (Hammer et al. 2005). The most familiar ocean waves are wind-generated waves, which are formed by the transfer of energy from winds blowing over the water surface. Wind-generated waves can vary in size from ripples to as large as 10 feet or more in height. Their size and frequency of occurrence are important factors in shaping the shoreline on Florida's sandy coasts. Storm waves generated by the wind are the primary cause of beach sand erosion and shoreline damage in the study area. Wind waves that occur in the study area consist of "sea" and "swell" waves. Sea waves are generated by local winds and are observed traveling with the wind. Swell waves are generated from distant storms that enter the study area independent of local wind conditions. The broad continental shelf has the greatest influence on regional-scale wave transformation, and the large sand ridges shown in **Figure 2.2-1** appear to have the greatest influence on smaller-scale wave refraction patterns in the Martin County study area (USACE 2009).

In most cases, buoy data provide the most informative source of wave information because they represent actual measurements rather than hindcast information derived from large-scale models. However, very few sites along the U.S. east coast have wave records from buoy measurements of sufficient length to justify their use as a source of long-term information (Hammer et al. 2005). Sources of measured directional wave data from offshore central east Florida include the Florida Coastal Data Network (CDN) (Wang et al. 1990) and various short-term deployments of individual gauges [e.g., the 1991 University of Florida deployment of a wave gauge offshore Jupiter Island (Harris 1991)]. However, the most comprehensive analysis of nearshore wave climate for central east Florida is by the USACE Coastal and Hydraulics Laboratory through wave hindcast studies (Hubertz et al. 1993).



**FIGURE 3.1-3.
AVERAGE DIRECTION, DURATION AND VELOCITY
OF WINDS FOR 8-YEAR PERIOD
AT WEST PALM BEACH, FLORIDA
MARTIN COUNTY HURRICANE AND
STORM DAMAGE REDUCTION PROJECT
HUTCHINSON ISLAND, FLORIDA**

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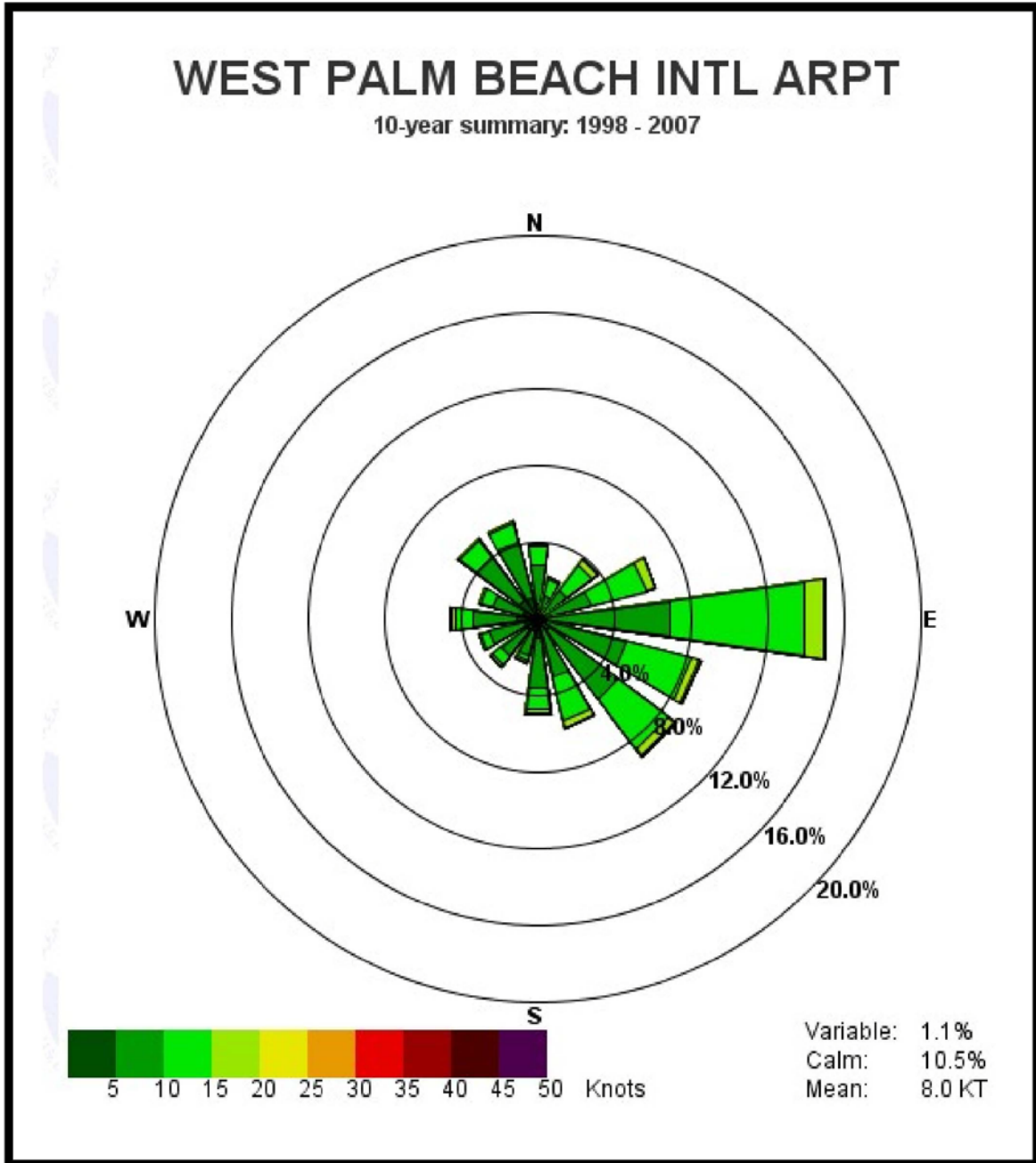


FIGURE 3.1-4
AVERAGE DIRECTION, DURATION AND VELOCITY
OF WINDS FOR 1998-2007 AT WEST PALM BEACH, FLORIDA
MARTIN COUNTY HURRICANE AND
STORM DAMAGE REDUCTION PROJECT
HUTCHINSON ISLAND, FLORIDA

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The wave hindcast data used in this report were obtained from station 14 located at a water depth of 180 feet offshore of Hutchinson Island, where the shoreline angle is 24° west of due north. Wave plots for station 14 are shown in **Figure 3.1-5**. Most waves (76%) occur within the 30° and 90° compass sector. Dominant wave direction is between 30° and 60°, from which 39% of waves in the record propagate. Mean height for all waves is 1.2 meters, with a standard deviation of 0.7 meter. Mean height for waves from the dominant direction is 1.3 meters, and the standard deviation is 0.7 meter. A significant number of wave events (40%) have peak periods greater than 9 seconds, and the mean peak period for the entire record is 9.1 seconds (Hammer et al. 2005). A summary of averaged monthly wave heights derived from the 20-year Wave Information Study (WIS) record are provided in **Table 3.1-1**.

Table 3.1-1. Averaged Monthly Wave Conditions from 1980 to 1999

Month	Wave Height (m)	Peak Period (s)	Wave Direction (Deg*)
January	1.31	6.0	28
February	1.32	6.2	25
March	1.29	5.7	23
April	1.11	5.4	22
May	0.96	5.2	16
June	0.72	4.4	11
July	0.56	4.1	3
August	0.68	4.2	4
September	1.07	4.9	17
October	1.45	5.5	22
November	1.49	5.7	27
December	1.35	6.1	31

* Wave directions measured in degrees from shore-normal, counterclockwise

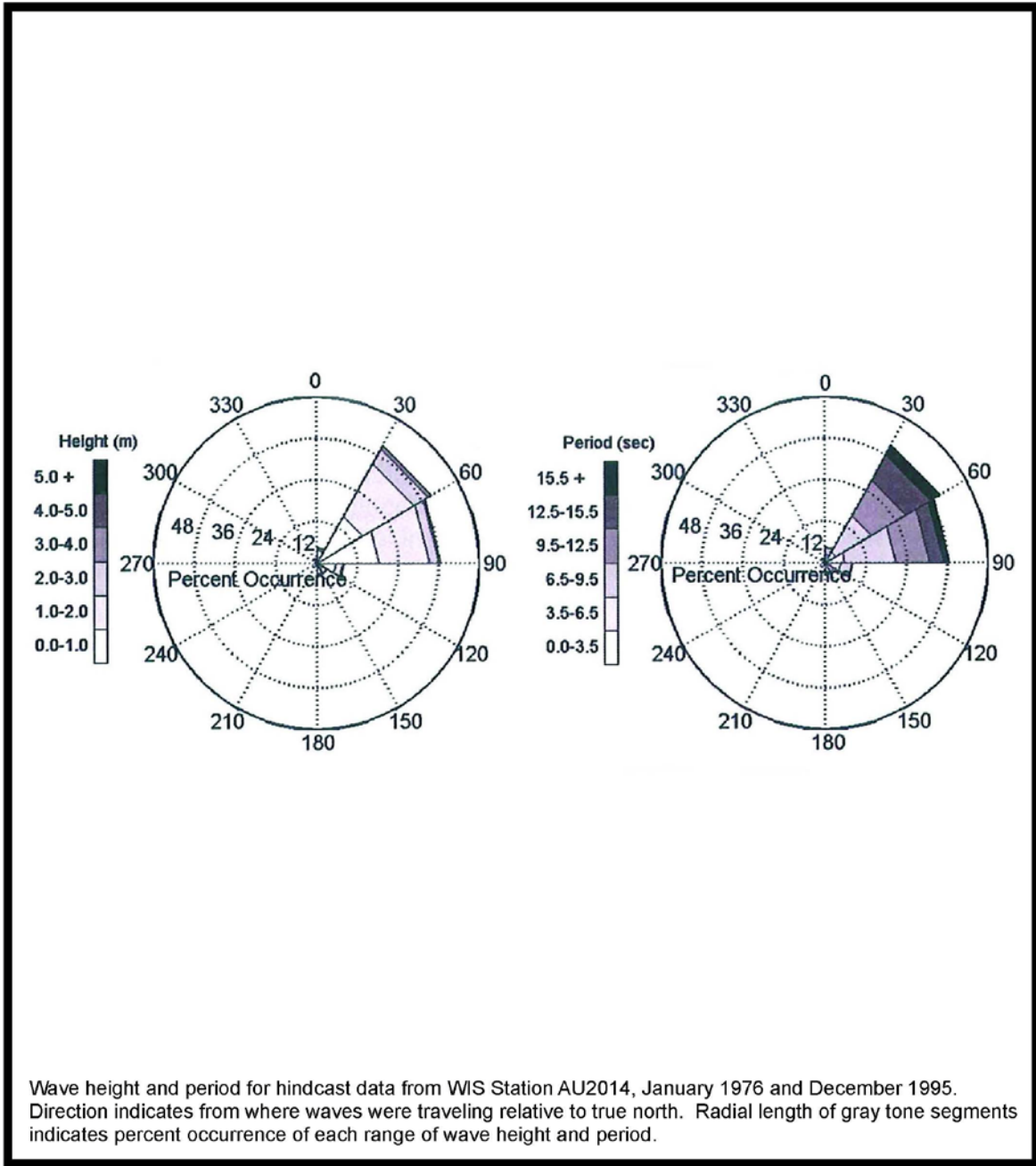
Source: USACE (2009)

3.1.5. TIDES

Tides in the project area are a mixture of semi-diurnal and diurnal types. The mean annual range of tide in the Atlantic Ocean at Hutchinson Island is 2.6 feet, and the higher spring range is 3.1 feet (NOAA 1993). All elevations, depths, and water levels in this report refer to mlw, which is 1.1 feet below the 1929 NGVD 2.9 feet below mhw.

Storms and hurricane winds blowing in from the sea can create abnormally high tides in the coastal area. Tropical storms in this vicinity can occasionally increase the tide range to about 7 feet. The lowest tide to be expected is 2 feet below mlw.

Wind set-up is a local phenomenon that can occur during tropical depressions and severe storm events. It is the tendency for water levels to increase at the downwind shore and decrease at the upwind shore. Wind set-up occurs most dramatically in shallow water and has significantly more effect on seasonal and long-term erosion than astronomical tides. During severe onshore winds, wind set-up of 3 to 4 feet is not uncommon. As developed by the National Oceanic and Atmospheric Administration (NOAA), the storm surge levels with a frequency of occurrence of once in 10 years, 50 years, and 100 years would be 3.7, 5.2, and 6.1 feet above msl, respectively.



Wave height and period for hindcast data from WIS Station AU2014, January 1976 and December 1995. Direction indicates from where waves were traveling relative to true north. Radial length of gray tone segments indicates percent occurrence of each range of wave height and period.



**FIGURE 3.1-5.
WAVE HEIGHT AND PERIOD DATA FOR
JANUARY 1976 AND DECEMBER 1995 AT WIS 14m
MARTIN COUNTY HURRICANE AND
STORM DAMAGE REDUCTION PROJECT
HUTCHINSON ISLAND, FLORIDA**

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3.1.6. CURRENTS

The Florida Gulf Stream is the most significant ocean current off the east coast of Florida. With the exception of intermittent local reversals, its predominate flow is northward. The average annual current velocity is 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. The axis of the Florida Gulf Stream is about 30 nautical miles from Hutchinson Island.

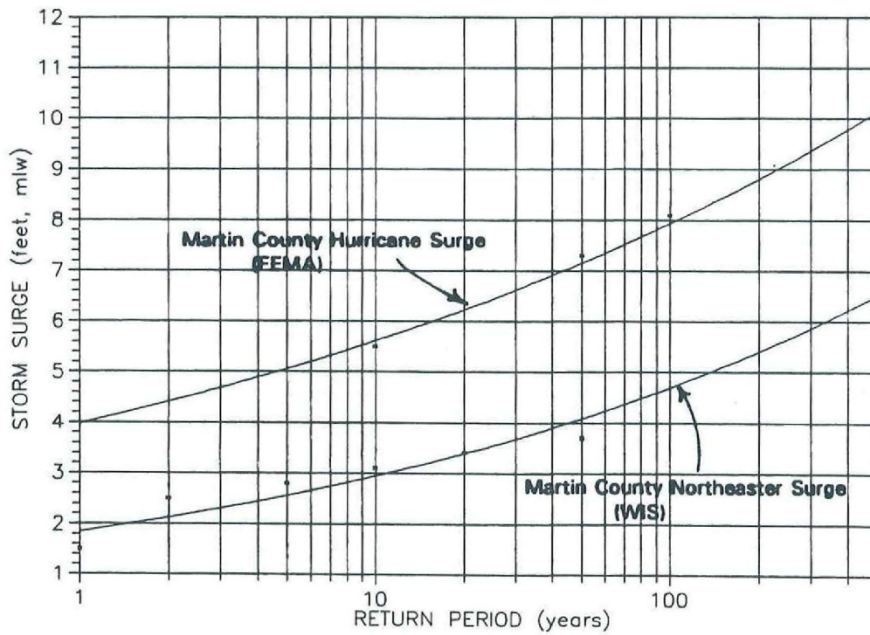
The Florida Current is the local manifestation of the Gulf Stream, the intense western boundary current of the North Atlantic that transports heat north from the equator. The system narrows and intensifies between the southeast Florida shore and the Bahamas; this portion of the Gulf Stream is commonly known as the Florida Current. The axis of the Florida Current runs northward, east of the study area. Flow speeds can exceed 2.5 m/sec (Lee et al. 1985). The Florida Current dominates circulation along the central east Florida continental shelf. However, wind-driven currents also play an important role. Unlike other shelf regions where tidal forces contribute substantially to circulation processes, the controlling parameter in the Florida Current area seems to be the lateral position of the frontal zone relative to the shelf—the closer the front, the greater the influence on local circulation.

Circulation processes within the study area include spin-off eddies and meanders of the Florida Current, wind-driven currents, upwelling/downwelling dynamics, and tides. Other contributions may stem from shelf waves, inertial oscillations, and coastal inlet exchange. Shelf currents are aligned principally along isobaths; cross-shelf components are typically much weaker. Despite the presence of multiple forcing mechanisms, most current energy on the shelf can be related to subtidal variability (Lee and Mayer 1977). The position of the Florida Current front is the principal control of subtidal shelf circulation from Miami, Florida, to Cape Hatteras, North Carolina (Zantopp et al. 1987).

3.1.7. STORM SURGE

Storm surge elevation is defined as the rise of the ocean surface above its normal high tide level during a storm. The increased elevation can be attributed to a variety of factors including waves, wind shear stress, and atmospheric pressure. An estimate of storm surge is essential for design of the beach fill crest elevation, as a higher storm surge will allow larger storm waves to attack the shore.

The major threats to the shoreline of Hutchinson Island are storm surge and waves caused by northeasters, subtropical and tropical storms, and hurricanes. Storm surge and wave elevations can be classified and predicted for various storms using historical information and theoretical models. **Figure 3.1-6** shows the storm surge elevations for hurricane surge levels and northeaster surge levels at selected recurrence intervals for the Martin County Atlantic coast. The hurricane surge frequency data were derived from Federal Emergency Management Agency (FEMA) (FEMA 1983) and the northeaster surge frequency data were derived from WIS (Ebersole 1982). The surge curves are based on data points for the 10-, 50-, 100-, and 500-year recurrence intervals.



**FIGURE 3.1-6.
STORM SURGE FREQUENCY CURVE
MARTIN COUNTY HURRICANE AND
STORM DAMAGE REDUCTION PROJECT
HUTCHINSON ISLAND, FLORIDA**

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Higher frequency of storm occurrence and storm surge elevations were obtained from WIS Report 7 for other meteorological-induced water-level anomalies (i.e., northeaster-type storms) (Ebersole 1982). Hindcasting of northeaster storm surges was performed using historical wind and pressure fields. Water levels given in the WIS Report 7 are referenced to the stillwater level. Data for northeaster events for Martin County are based on interpolation between the storm surge data for Mayport and Miami Beach, Florida (**Figure 3.1-6**).

3.1.8. SEA LEVEL RISE

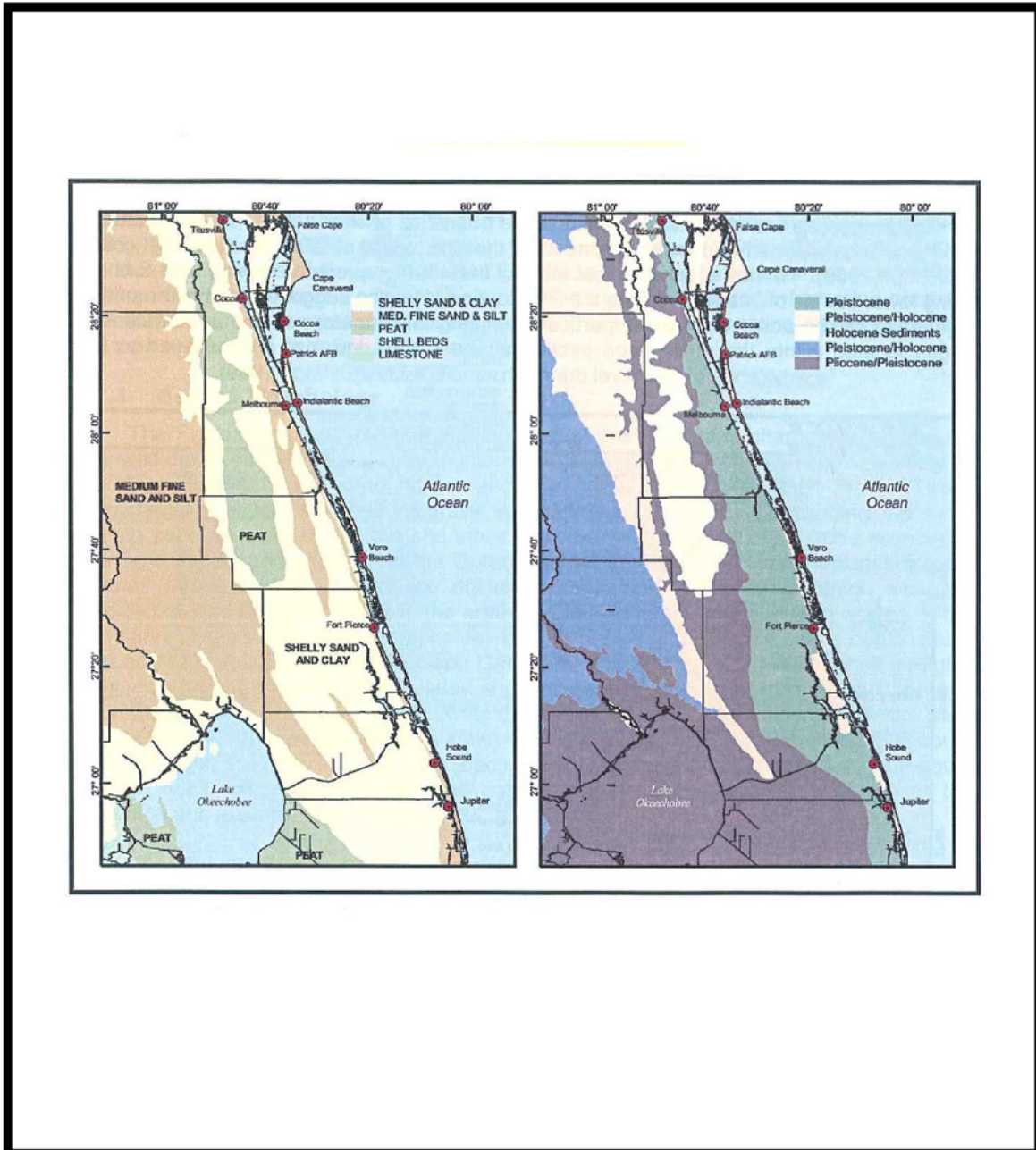
Average sea level is an important factor affecting erosion along the Florida east coast. Sea level along the Atlantic coast is estimated to be rising at a rate of 0.006 feet per year. Changes in sea level have large ramifications in flat coastal regions. A slight increase in the level of the ocean along the flat beaches of the Florida east coast, though very small vertically, would shift the shoreline landward a noticeable distance.

3.1.9. GEOLOGY AND GEOMORPHOLOGY OF STUDY AREA

Beach sediments along the project area are composed primarily of medium- to coarse-grained sand with large quantities of carbonate mixed throughout (Meisburger and Duane 1971). Inundated sediments in the project area generally are classified in the Anastasia Formation, which is regarded as Pleistocene in age, but includes some recently cemented Holocene beach rock (Hammer et al. 2005). The Anastasia underlies all modern beach sediments within the study area (Freedenberg et al. 1995). State geological maps illustrate the general stratigraphy and surficial sediment classification for subaerial deposits within the project area (**Figure 3.1-7**).

Morphology of the continental margin offshore of southeastern Florida reflects the influence of four shaping processes, including, reef building during the Tertiary period, deposition on the shelf in the littoral zones of the Pleistocene era, erosion by the Florida Current, and deposition and shaping by bottom currents (Uchupi 1969). Meisburger and Duane (1971) documented the Eocene and post-Eocene history within the study area as one of repeated invasions and retreats of the sea. Erosional unconformities and hiatuses in the Eocene column point to tectonic instability throughout that period. Analysis of seismic reflection profiles indicated an abrupt steepening of dip of some deep reflections, an apparent effect of a near-coast fault between Cape Canaveral and Fort Pierce (Meisburger and Duane 1971). During the Pleistocene, central east Florida was alternately flooded and exposed to subaerial erosion, leaving a variable and sometimes complex series of sediment and erosional surfaces (Meisburger and Duane 1971). During Pleistocene interglacial periods, marine sands were deposited in submerged areas and transgressive stratigraphic sequences were formed (Stauble and McNeill 1985). The last major event was the advance of the Holocene sea across the upper continental slope and shelf, starting about 12,000 years ago and ending about 4,000 years ago (Curry 1965; Milliman and Emery 1968). Reworking of some marine sands deposited within interglacial periods continued during the Holocene (Stauble and McNeill 1985). Presently, a thick sedimentary section underlies the area, with Pleistocene sediments of the Anastasia Formation comprise much of the offshore subsurface sedimentary environment. The offshore portion of the study area is limited

to the Florida Continental Shelf, which is the southern-most part of the East Coast Shelf. It is composed of strata lying at low angles and dipping generally easterly and southeasterly (Field and Duane 1974). The continental shelf narrows dramatically from a maximum width of about 48 km near Cape Canaveral to a minimum of about 16 km in the southern extent of the study area where it merges with the Florida-Hatteras slope (**Figure 3.1-7**). This reduction in width is accompanied by a distinct increase in shelf steepness from north to south (Field and Duane 1974). The Florida Continental Shelf has been classified into several morphologic zones, including an inner smooth zone extending from the shoreline out to a depth of about 16 meters, a ridge zone (known as the Inner Shelf Plain) extending from 40- to 60-meter water depth, and another deep ridge zone between 60 and 80 meters (Uchupi 1969) (**Figure 3.1-8**). The inner ridge zone between 16- and 40-meter water depth occurs in an area blanketed by relict terrigenous sands containing appreciable quantities of shell debris. The proposed borrow area C1-B identified for this project is located within the inner ridge portion of the continental shelf.



**FIGURE 3.1-7.
SURFICIAL SEDIMENTS AND STRATIGRAPHY
OF CENTRAL EAST FLORIDA
MARTIN COUNTY HURRICANE AND
STORM DAMAGE REDUCTION PROJECT
HUTCHINSON ISLAND, FLORIDA**

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**FIGURE 3.1-8.
PHYSIOGRAPHIC PROVINCES OF THE CONTINENTAL
MARGIN OFFSHORE CENTRAL EAST FLORIDA
MARTIN COUNTY HURRICANE AND
STORM DAMAGE REDUCTION PROJECT
HUTCHINSON ISLAND, FLORIDA**

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3.1.9.1. C1-B Borrow Area Sediment Characteristics

In August 2007, USACE collected 40 vibracore soil test borings to termination depths of approximately 20 feet below the seafloor to characterize the sediment within the preferred C1-B borrow area (**Figure 2.2-2**). Sieve analysis and carbonate content tests were conducted on all 40 samples. The vibracore borings revealed sands, silty sands, and shelly material throughout the C1-B borrow area, with clays and silts near the termination depths (Challenge Engineering and Testing 2007). The sand is primarily calcareous with a mixture of shell and contains a small (less than 5%) amount of silt. The sediment in C1-B has a mean grain size of 1.37 phi (0.39 mm), a sorting of 1.14 phi, contains 2.47% silt, and 100% of the sand in the borrow area has a moist Munsell value of 5 or higher (Taylor Engineering, Inc. 2009a). The colors of the materials were noted to change significantly from dark to lighter as the split core tubes were left open to air-dry. The complete geotechnical report is provided in Appendix F.

Challenge Engineering and Testing, Inc. (2007) used acid digestion testing to ascertain the carbonate content of 49 representative vibracore samples. The carbonate content ranged from 30% to 90%. Notably, the analysis excluded the estimated percentage of carbonate based on visual shell. These results suggest that the borrow area composite should not exceed the maximum acceptable carbonate content of 93% (Taylor Engineering, Inc. 2009a).

Sand volume estimates within the C1-B borrow area were determined using vibracore data collected by the USACE in 2006 and 2007 and allowable dredging limits (**Figure 3.1-9**). The vibracores collected from the C1-B borrow area measured 4 to 15 feet of suitable sediment in addition to the 2-foot required buffer. The total project requirement for the remainder of the 50-year life of the Martin County HSDR Project is between 2.4 and 4.0 mcy. The surface area of C1-B is approximately 1000 acres. The excavation depth varies from -56 to -65 feet mlw, resulting in approximately 11.5 mcy of sand.

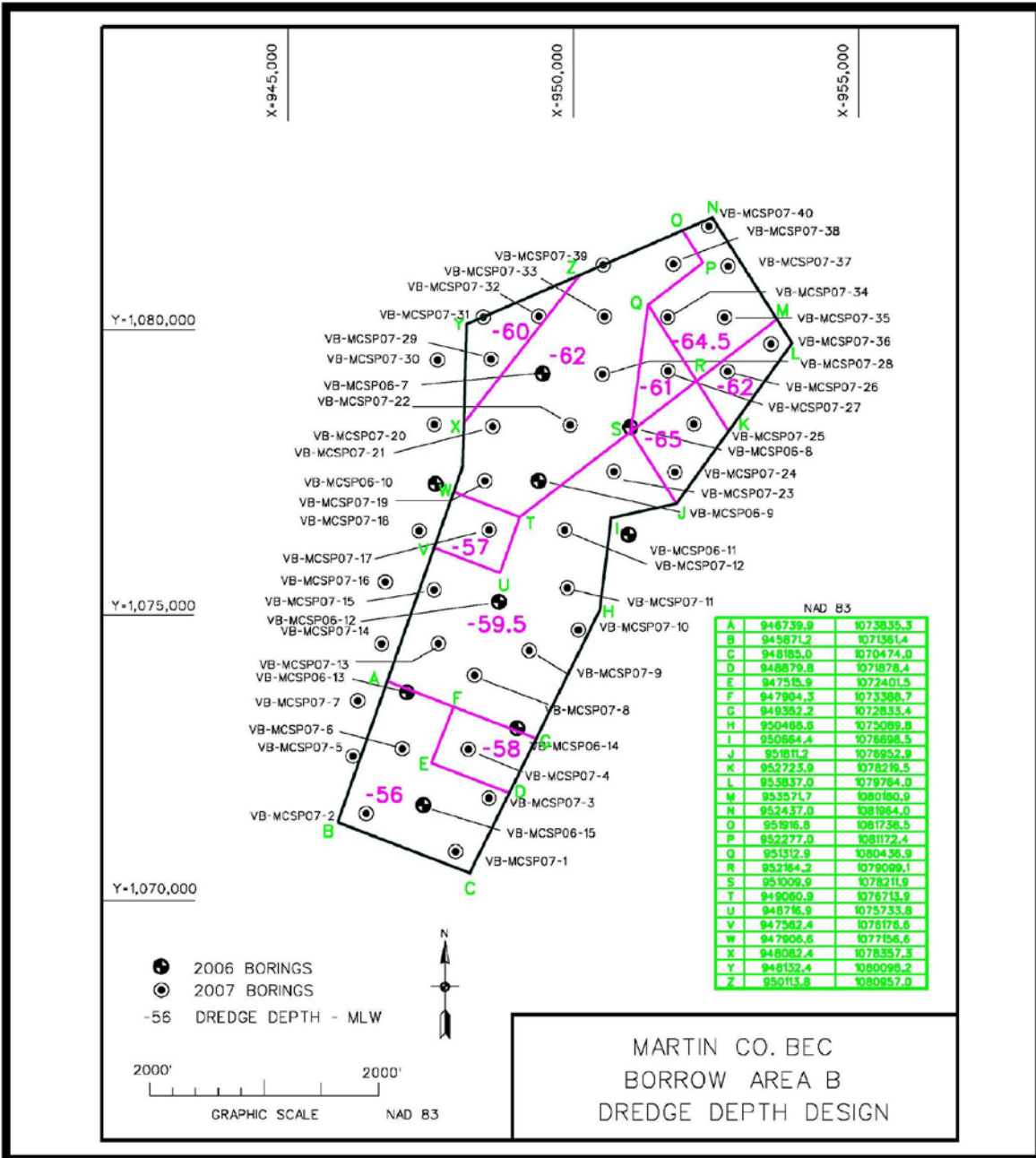


FIGURE 3.1-9.
BORROW AREA C1-B - DREDGE DEPTH AND DESIGN
MARTIN COUNTY HURRICANE AND
STORM DAMAGE REDUCTION PROJECT
HUTCHINSON ISLAND, FLORIDA

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3.1.9.2. Native Beach Sediment Characteristics

In November 2008, Taylor Engineering collected 64 sand samples from the beach in Martin County to determine the color of the native sediment. **Table 3.1-2** contains results of the color analysis of the samples collected. The moist sand colors, based on the Munsell classification system, are predominantly 5Y and 2.5Y 5/1 or higher (Taylor Engineering, Inc. 2009a).

Table 3.1-2 Native Sediment Moist Munsell Color

Station	Moist Munsell Color			
	Toe of Dune	Berm Crest	MHW	MLW
SL R-110	2.5Y 6/2	2.5Y 6/2	2.5Y 6/2	2.5Y 6/2
SL R-112	2.5Y 6/2	2.5Y 6/2	2.5Y 6/2	2.5Y 5/2
SL R-114	5Y 6/2	5Y 6/2	5Y 6/3	5Y 5/2
R-1	5Y 6/2	2.5Y 6/2	2.5Y 7/2	5Y 6/2
R-4	2.5Y 6/2	2.5Y 6/2	5Y 7/2	2.5Y 6/2
R-7	2.5Y 7/2	2.5Y 7/2	2.5Y 7/2	2.5Y 6/2
R-10	5Y 6/1	2.5Y 6/1	2.5Y 6/1	5Y 5/1
R-13	5Y 5/1	5Y 6/1	5Y 6/1	5Y 5/1
R-16	5Y 5/1	5Y 6/1	5Y 6/2	5Y 5/1
R-19	5Y 5/1	5Y 5/1	5Y 5/1	5Y 5/1
R-22	5Y 5/1	5Y 6/1	5Y 5/1	5Y 5/1
R-25	5Y 6/1	5Y 5/1	5Y 5/1	5Y 5/1
R-26	5Y 5/2	5Y 6/2	5Y 6/2	5Y 5/2
R-28	2.5Y 5/2	5Y 6/2	5Y 6/2	n/a
R-31	2.5Y 5/2	2.5Y 6/2	2.5Y 6/2	2.5Y 5/2
R-34	2.5Y 5/3	2.5Y 5/2	2.5Y 6/2	2.5Y 5/2

Source: Taylor Engineering, Inc. (2009a)

Because sediments within a borrow area can vary, the commonly used summary statistics (mean grain size and sorting coefficient) for assessing grain size distributions may not adequately characterize the sediments that ultimately end up on the beach. The extensive handling and mixing of sediments throughout the dredging process often result in substantial changes in grain size distributions compared to those in sediment samples taken from the borrow area.

Data compiled from past sediment surveys established a mean grain size range and material sorting. A beach sampling analysis (Harris 2005, 2007, and 2008) included the collection of sand samples at six cross-shore (at elevations 10, 5, 0, -5, -10, and -15 feet NGVD) and five alongshore locations [at FDEP reference monuments R-112 (in St. Lucie County), R-4, R-15, R-24, and R-30] of the 2005, 2006, and 2007 beach. Beach sampling analysis before 2005 included the collection of sand samples between four and six cross-shore (at elevations 10, 5, 0, -5, -10, and -15 feet NGVD) and eight alongshore locations (at FDEP reference monuments R-1, R-4, R-7, R-11, R-15, R-18, R-20, and R-25). **Table 3.1-3** lists native beach sediment characteristics from six sampling events. The data from these efforts indicate a composite mean grain size of roughly 0.26 to 0.39 mm throughout the project area and a sorting coefficient (standard deviation) of roughly 0.31 to 1.47 phi (Taylor Engineering, Inc. 2009a).

Table 3.1-3. Native Sediment Characteristics

Date	Monuments	Locations	Mean Grain Size*		Silt Content*	Carbonate Content	Sorting	Data Source
		(ft-NGVD)	(phi)	(mm)	(%)	(%)	(phi)	
1990	R-1, R-4, R-7, R-11, R-15, R-18, R-20, R-24	+10, +5, 0, -5, -10, -15	1.772	0.293	0.71		0.31	ATM 1998
1996	R-1, R-4, R-7, R-11, R-15, R-18, R-20, R-25	+10, 0, -10, -15	1.721	0.303	1.36		1.36	Taylor Engineering 2000
1997	R-1, R-4, R-7, R-11, R-15, R-18, R-20, R-26	+10, 0, -10, -15	1.927	0.263	1.60		1.47	Taylor Engineering 2000
2005	R-4, R-15, R-24, R-30, R-112	+10, +5, 0, -5, -10, -15	1.342	0.394	0.39	21 - 93	1.37	Harris 2005
2006	R-4, R-15, R-24, R-30, R-113	+10, +5, 0, -5, -10, -15	1.709	0.306	0.29	8 - 42	1.28	Harris 2007
2007	R-4, R-15, R-24, R-30, R-113	+10, +5, 0, -5, -10, -15	1.571	0.337	0.60	19 - 91	1.29	Harris 2008

*Composite, Moments Method

Source: Taylor Engineering (2009a)

3.1.9.3. Borrow Area Compatibility with Native Sand

Table 3.1-4 summarizes the composite sediment characteristics of both the native beach and borrow area C1-B. The acceptable limits match those found in the Sediment QA/QC Plan which is included as an attachment in the FDEP permit application. Table 3.1-5 indicates that the composite properties of the borrow area closely resemble those of the native beach. Therefore, sediment used as beach fill in Martin County from this borrow area is compatible with the native sand and will preserve the integrity of the beach (Taylor Engineering, Inc. 2009a).

Table 3.1-4. Comparison of Borrow Area and Native Beach Sediment Characteristics

Characteristic	Native Beach Composite	Borrow Area Composite	Beach Fill Acceptable Limits
Mean Grain Size (mm)	0.26 – 0.39	0.39	0.18 – 0.75*
Mean Grain Size (phi)	1.34 – 1.93	1.37	-
Sorting (phi)	0.31 – 1.47	1.14	-
Silt Content (%)	0.6 – 1.60	2.47	0 - 2.5
Carbonate Content (%)	26 – 66	83.45	<93**
Moist Munsell Color	Hues of 2.5Y, 5Y Value 5 or lighter Chroma lighter than 3	Hues of 10YR Value 5 or lighter Chroma lighter than 3	Hues of 2.5Y, 5Y, 10YR Value 5 or lighter Chroma lighter than 3

*Range of the July 2007 data, carbonate removed.

**Based on range of native beach carbonate data.

Source: Taylor Engineering (2009a)

3.2. VEGETATION

Much of the project area is undergoing development, and consequently, the land has been cleared of native vegetation to make room for hotels, condominiums, and private residences. The proximity of this development, as well as foot traffic to the beach, affects the ability of the dune system to experience the natural cycle of erosion and accretion. Native vegetation around these developments has largely been replaced with ornamentals that are of little use to native wildlife.

In June 1994, prior to the initial beach nourishment, an assessment of beach and dune vegetation was conducted (ATM 1994). The entire project reach was surveyed and included the area from mhw landward, through the pioneer zone, over the primary dune, and for a distance of 25 feet into the back dune community. The vegetative community of the dune system varied from areas with well established naturally functioning ecosystems to areas where no natural vegetation existed.

An example of a well-established and high quality beach and dune system is located between survey monuments R-8 and R-12, also known as Bob Graham Beach (**Figure 3.2-1**). This area is characterized by a wide, gently sloping non-vegetated beach; an area of pioneer plants (whose roots stabilize the dune) including seashore saltgrass (*Distichlis spicata*), railroad vine (*Ipomoea pes-caprae*), beach morning glory (*Ipomoea imperati*), seashore panicum (*Panicum virgatum*), and sea oats (*Uniola paniculata*); and a densely vegetated back dune including sea purslane (*Sesuvium portulacastrum*), beach elder (*Iva imbricata*), palmetto (*Serenoa repens*), and sea grape (*Coccoloba uvifera*).

Several areas along the project reach were planted with sea oats and have supported the recruitment of pioneer dune species. In these areas, the dune system is in various stages of recruitment and succession (**Figure 3.2-2**). These areas are characterized by

a narrow zone of colonizing plants and a back dune vegetated primarily with herbaceous groundcover species with less than 100% areal cover (ATM 1994). During the 1994 survey, five plant species protected by state and/or federal laws were observed in the study area. They include beach creeper (*Ernodea littoralis*), inkberry (*Scaevola plumier*), burrowing four o'clock (*Okenia hypogaea*), sea lavender [*Tornefortia (Mallotonia) gnaphalodes*], and coastal vervain (*Verbena glandularia maritima*). ATM (1994) includes a complete plant list and details regarding specific locations of the threatened and endangered plants.

The existing upland vegetation in the general project area includes shrubs and trees such as sand pine (*Pinus clausa*), Australian pine (*Casuarina equisetifolia*), sea grape, and wax myrtle (*Myrica cerifera*). The nearby major water courses are the Indian River and St. Lucie River, and these rivers are bordered primarily with red mangroves (*Rhizophora mangle*). Other flora along these rivers include cordgrass (*Spartina* sp.), glasswort-salt grass (*Salicornia* sp.), and rush (*Juncus roemerianus*) marshes. The vegetation closer to the ocean and on the dunes, is primarily pioneer species such as saltgrass (*Salicornia* sp.), sand spur (*Cenchrus* sp.), wild bean (*Macroptilium lathyroides*), seaside spurge (*Euphorbia polygonifolia*), and sea oats.

3.3. THREATENED AND ENDANGERED SPECIES

Table 3.3-1 lists the endangered and threatened species that potentially occur within the project area and that are under the jurisdiction of USFWS, NMFS, and FWC. According to the 2003 USFWS Standard Local Operating Procedures for Endangered Species (SLOPES) for the federally threatened southeastern beach mouse (*Peromyscus polionotus niveiventris*): “the beach mouse has been extirpated from Fort Pierce Inlet, St. Lucie County south through Broward County.” Therefore, the threatened and endangered species of concern within the project area include the loggerhead, green, hawksbill, Kemp’s ridley, and leatherback sea turtles; the West Indian manatee; the humpback whale, the North Atlantic right whale, the finback whale, the sei whale, and the sperm whale; the smalltooth sawfish; and the piping plover. There are no designated or proposed critical habitats vital to the continued existence of any endangered or threatened species in the study area. The Biological Assessment (Appendix J) discusses life history traits of threatened and endangered species in detail, identifies potential project impacts on the species, and provides protection and conservation recommendations.

Figure 3.2-1. Example of a Typical Well-Established Dune System along the Project Reach, Hutchinson Island, Martin County, Florida



Figure 3.2-2. Typical Planted Sea Oats and Early Recruitment Areas along the Project Reach, Hutchinson Island, Martin County, Florida

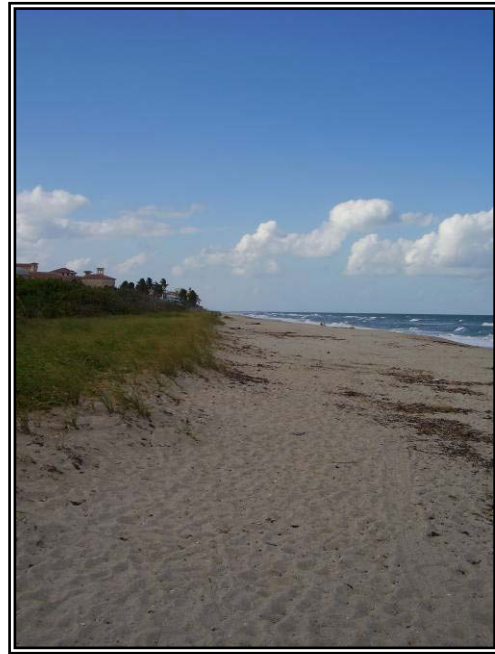
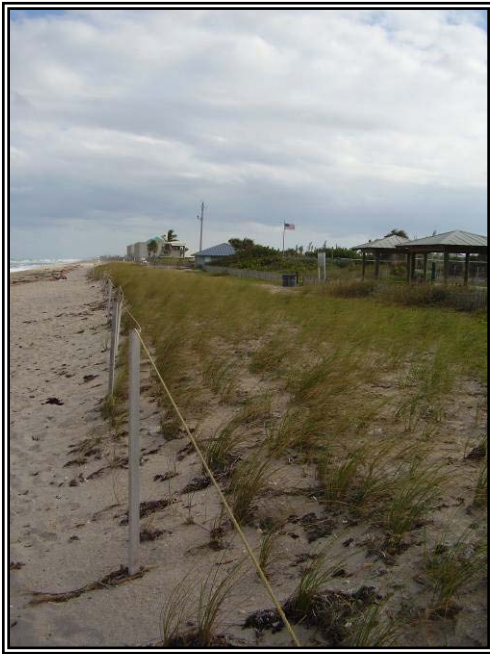


Table 3.3-1. Federally and State Listed and Candidate Species in Martin County, Florida

Common Name	Scientific Name	Listing Status		
		USFWS	NMFS	FFWCC
FISH				
Smalltooth sawfish	<i>Pristis pectinata</i>	-	Endangered	-
REPTILES				
American alligator	<i>Alligator mississippiensis</i>	Threatened/SA	-	-
Eastern indigo snake	<i>Drymarchon corais couperi</i>	Threatened	-	-
Green sea turtle	<i>Chelonia mydas</i>	Endangered*	Endangered*	-
Hawksbill sea turtle	<i>Eretmochelys imbricata</i>	Endangered	Endangered	-
Kemp's ridley sea turtle	<i>Lepidochelys kempii</i>	Endangered	Endangered	-
Leatherback sea turtle	<i>Dermochelys coriacea</i>	Endangered	Endangered	-
Loggerhead sea turtle	<i>Caretta caretta</i>	Threatened	Threatened	-
BIRDS				
Piping plover	<i>Charadrius melodus</i>	Threatened	-	-
American Oystercatcher	<i>Haematopus palliatus</i>	SSC	-	-
Brown Pelican	<i>Pelicanus occidentalis</i>	SSC	-	-
Black Skimmer	<i>Rynchops niger</i>	SSC	-	-
Least Tern	<i>Sterna antillarum</i>	Endangered	-	Threatened
Roseate Tern	<i>Sterna dougalii dougalii</i>	Threatened	-	-
MAMMALS				
Finback whale	<i>Balaenoptera physalus</i>	-	Endangered	-
Humpback whale	<i>Megaptera novaeangliae</i>	-	Endangered	-
North Atlantic right whale	<i>Eubalaena glacialis</i>	-	Endangered	-
Sei whale	<i>Balaenoptera borealis</i>	-	Endangered	-
Sperm whale	<i>Physeter catodon</i> [= <i>macrocephalus</i>]	-	Endangered	-
West Indian manatee	<i>Trichechus manatus</i>	Endangered	-	-

SA = Similarity of Appearance

SSC = Species of Special Concern

* Breeding colonies in Florida are listed as endangered; elsewhere threatened

3.3.1. SEA TURTLES

Martin County is within normal nesting areas of three species of sea turtles: loggerhead sea turtle (*Caretta caretta*), green sea turtle (*Chelonia mydas*), and leatherback sea turtle (*Dermochelys coriacea*). The loggerhead is listed as a threatened species, while all other sea turtles are listed as endangered under the U.S. Endangered Species Act of 1973. In Martin County, FWC defines March 1 through October 31 as the official nesting season for all species of sea turtles.

In order to eliminate or reduce the risk of impacting nesting sea turtles, project construction will not be conducted during peak sea turtle nesting season. It is estimated that beach construction activities will commence after the sea turtle nesting season ends (November 1) and will be completed prior to the beginning of the main nesting season (April 15). Between 1985 and 1990 (6 years), a cumulative total of only 2 nests were successfully dug in March in Martin County (an average of 0.33 nests/year) and 35 nests in April (an average of 5.8 nests/year) in Martin County. These data indicate that minimal nesting activity occurs in March and April, and that impacts to nesting sea turtles can be minimized if construction is completed before April 15.

3.3.1.1. Nesting Habitat

The east coast of Florida (including Martin County) supports one of the highest nesting densities of loggerhead, green, and leatherback sea turtles within the southeastern United States. Ninety percent of loggerhead nesting in the U.S. occurs in south Florida (Shoop et al. 1985). Hutchinson Island supports the greatest concentration of sea turtle nesting activity in Florida and one of the highest loggerhead sea turtle nesting aggregations in the western Atlantic (Harris et al. 1984; Hopkins and Richardson 1984; Williams-Walls et al. 1983; NMFS and USFWS 1991a).

Historical Nesting Activity (Pre- and Post-Project Construction)

Sea turtle nesting surveys have been conducted annually on Hutchinson Island since 1981. During the 1985 nesting season, 1,071 loggerhead clutches were deposited on the project beach (ABI 1979). In addition, more than 3,000 (27 nests) green sea turtle eggs and 675 (9 nests) leatherback sea turtle eggs were deposited in the project beach during the summer of 1985. Between 1985 and 1990, the project area produced a total of 7,638 loggerhead, 189 green, and 55 leatherback sea turtle nests (ABI 1994).

Beach nourishment first occurred on the Martin County portion of Hutchinson Island during the winter of 1995/1996. During the 1995, 1996, and 1997 sea turtle nesting seasons, a comprehensive study was conducted on the effects of beach nourishment. This study included physical and biological components and addressed all aspects of sea turtle reproduction from the emergence of adult females onto the beach through the emergence of hatchlings from their nests, and it provided a complete year (1995) of pre-construction survey data and 2 years (1996 and 1997) of post-construction data. The results of this comprehensive study have been presented in three reports (EAI 1997a and 1997b; Ernest and Martin 1999). Sea turtle nesting and nest reproductive success were monitored during the subsequent 3 years (1998-2000), and results summarized in three reports (EAI 1998, 2000a, and 2000b).

In the spring of 2001, a 1.4-km-long section of beach along the southern portion of the original 1995/1996 nourishment area was renourished (R-16 to R-22.3). In accordance with permit conditions for this project, a sea turtle nest relocation program was instituted prior to and during construction, and sea turtle nest monitoring was required following project construction. In the spring of 2002, another 0.8-km-long section of beach immediately north of the 2001 project area was renourished (R-13.5 to R-16). Again, a turtle nest relocation/protection program was implemented prior to and during construction, while a program to monitor nesting and nest reproductive success continued after construction was completed. Results of the 2001 and 2002 nest relocation programs, as well as subsequent monitoring of nesting and reproductive success from 2001 through 2004, were reported (EAI 2002, 2003, 2004a, 2004b).

The northernmost 6.8 km of Martin County’s coastline underwent beach renourishment (6.6 km) and dune restoration (0.2 km) during the spring of 2005 (R-1 to R-25). These projects restored the county beach after the passage of Hurricanes Frances and Jeanne in September 2004. In conformance with permit conditions for the 2005 beach and dune projects, a construction-phase sea turtle nest relocation program and a post-construction-phase sea turtle nesting and reproductive success monitoring program were implemented (EAI 2005).

Recent Nesting Activity (2004-2009)

During the 2009 nesting season, Martin County accounted for approximately 14.9 percent of the overall nesting along Florida’s Atlantic coast. From 2004 to 2009, there was an average of 5,949 loggerhead, 760 green, and 335 leatherback sea turtle nests laid within the county (**Table 3.3-2**).

Table 3.3-2. Summary of Sea Turtle Nesting along 21.9 miles of Coastline in Martin County, Florida, from 2004 to 2009

Year	Loggerhead		Green Turtle		Leatherback	
	Nests	False Crawls	Nests	False Crawls	Nests	False Crawls
2004	5,130	8,430	300	929	144	75
2005	5,822	9,969	584	3,824	230	308
2006	5,532	7,313	579	1,585	205	110
2007	5,210	7,491	1,307	4,129	494	212
2008	7,356	8,463	1,111	2,935	274	120
2009	6,643	7,322	679	1,069	663	177
Mean	5,949	8,165	760	2,412	335	167

Source: USFWS (2010)

Loggerhead Sea Turtle

Of the counties along the east coast of Florida, Martin County supported the third highest nesting of loggerhead sea turtles with 6,643 nests or 303 nests per mile in 2009

(FWC 2009b; **Table 3.3-2**). In 2009, loggerhead sea turtles laid 660 nests along 4 miles of shoreline in the project area (**Table 3.3-3**). In 2009, loggerhead sea turtles made 7,322 false crawls in Martin County (Table 3.3-2). Along 4 miles of shoreline in the project area, loggerhead turtles made 561 false crawls in 2009 (Table 3.3-3).

Green Sea Turtle

Of the counties along the east coast of Florida, Martin County supported the third highest nesting of green sea turtles with 679 nests or 31 nests per mile in 2009 (FWC 2009b; Table 3.3-2). In 2009, 40 green sea turtles nests were laid along 4 miles of shoreline in the project area (Table 3.3-3). In 2009, green sea turtles made 1,069 false crawls in Martin County (Table 3.3-2). Along 4 miles of shoreline in the project area, green sea turtles made 31 false crawls in 2009 (Table 3.3-3).

Leatherback Sea Turtle

Of the counties along the east coast of Florida, Martin County supported the highest nesting of leatherback sea turtles with 663 nests or 30 nests per mile in 2009 (FWC 2009b; Table 3.3-2). In 2009, 224 leatherback sea turtles nests were laid along 4 miles of shoreline in the project area (Table 3.3-3). In 2009, leatherback sea turtles made 177 false crawls in Martin County (Table 3.3-2). Along 4 miles of shoreline in the project area, leatherback sea turtles made 23 false crawls in 2009 (Table 3.3-3).

Hawksbill and Kemp’s Ridley Sea Turtle

No occurrences of hawksbill or Kemp’s ridley nesting have been documented in the action area or Martin County (USFWS 2010). The majority of nesting surveys conducted in Florida occur during the morning hours and are based on interpretation of the tracks left by the turtles as they ascend and descend the beach; the turtles themselves are rarely observed. Because hawksbill and Kemp’s ridley turtle tracks are difficult to discern from loggerhead tracks, it is likely that nesting by both species is underreported (Meylan et al. 1995).

Table 3.3-3. Summary of Sea Turtle Nesting along Approximately 4 Miles (FDEP Reference Monuments R-1 to R-25) of Shoreline in Martin County, Florida, from 2004 to 2009

Year	Loggerhead		Green Turtle		Leatherback	
	Nests	False Crawls	Nests	False Crawls	Nests	False Crawls
2004	505	613	23	22	38	3
2005	996	2143	25	150	76	56
2006	688	950	29	81	59	15
2007	764	707	86	173	162	21
2008	928	665	37	51	82	11
2009	660	561	40	31	224	23
Mean	757	940	40	85	107	22

Source: USFWS (2010)

3.3.1.2. Inner Shelf Habitat

Five sea turtle species occur on the eastern Florida inner shelf (shoreline to the 20-meter isobath). In order of abundance, based on results of sea turtle monitoring, they are the loggerhead, green, hawksbill, Kemp's ridley, and leatherback sea turtles (**Table 3.3-4**) (Hammer et al. 2005). The table orders the species from highest to lowest abundance. The east coast of Florida is an important year-round habitat for juvenile, subadult, and adult loggerhead and green sea turtles on both the inner shelf and mid-shelf (20- to 40-meter isobath). Hawksbill, Kemp's ridley, and leatherback sea turtles also are found year-round, although they primarily use the mid-shelf and (in the case of leatherbacks) the outer shelf and continental slope (Teas 1993).

Table 3.3-4. Sea Turtle Species Potentially Occurring Offshore of East Florida

Common and Scientific Names	Status ^a	Life Stages Present	Seasonal Presence	Nesting Season
Loggerhead sea turtle (<i>Caretta caretta</i>)	T	Adults, subadults, juveniles, and hatchlings	Year-round (most abundant during spring and fall migrations)	April-September
Green sea turtle (<i>Chelonia mydas</i>)	T/E ^b	Adults, subadults, juveniles, and hatchlings	Year-round	May-November
Hawksbill sea turtle (<i>Eretmochelys imbricata</i>)	E	Adults, subadults, juveniles, and hatchlings	Year-round	June-September
Kemp's ridley sea turtle (<i>Lepidochelys kempii</i>)	E	Juveniles and subadults	Year-round (most abundant during spring and fall migrations)	(no nesting in area)
Leatherback sea turtle (<i>Dermochelys coriacea</i>)	E	Adults, subadults, juveniles, hatchlings	March-October	March-July

^a Status: E = endangered, T = threatened under the Endangered Species Act of 1973

^b Green sea turtles are listed as threatened except for Florida, where breeding populations are listed as endangered. Due to inability to distinguish between the two populations away from the nesting beach, green sea turtles are considered endangered wherever they occur in U.S. waters.

Source: Hammer et al. (2005) and USFWS (1999)

The ESA protects all sea turtles in U.S. territorial waters. Currently, USFWS lists leatherbacks as endangered and loggerheads as threatened. Except for the Florida breeding population, listed as endangered, USFWS also lists green turtles as threatened. Due to the inability to distinguish between the breeding and non-breeding populations away from the nesting beach, green sea turtles are considered endangered wherever they occur in U.S. waters (NMFS and USFWS 1991a,b).

Loggerhead Sea Turtle

Loggerhead turtles are present year-round in Florida waters, with peak abundance during spring and fall migrations. Data suggest that nesting adult females are short-term residents that migrate into east Florida waters at 2 to 3-year intervals and reside elsewhere during non-nesting years (Henwood 1987; Schroeder and Thompson 1987). Adult males do not seem to migrate with adult females but may reside in the

vicinity of nesting beaches throughout the year. Following nesting activities, many adult loggerheads disperse to the seas around islands in the Caribbean Sea, waters off southern Florida, and the Gulf of Mexico (Meylan and Bjorndal 1983; Nelson 1988). Subadult loggerheads forage opportunistically along the Atlantic seaboard, although evidence suggests that a resident population of subadults overwinter in the Canaveral area each year (Henwood 1987).

Juvenile loggerheads, which researchers believe overwinter along the eastern Florida inner shelf, depart in the spring (March – April) and are replaced by adult males that migrate into the area to mate (Ryder et al. 1994). The adult loggerhead population (males and females) in Florida waters increases during the nesting season (Magnuson et al. 1990). In general, the eastern coast of Florida appears to be an important year-round habitat for loggerhead sea turtles along both the inner shelf (0 to 20 meters) and middle shelf (20 to 40 meters) depths. It appears the nearshore rock resources in these areas represent a travel corridor (to nesting sites) and not a main foraging or developmental habitat (Ryder et al. 1994). Juvenile loggerhead turtles generally feed on insects and invertebrates from within *Sargassum* mats, while subadult and adult loggerheads primarily feed upon bottom dwelling invertebrates (crabs, mollusks, shrimp), and macroalgae (Ryder et al. 1994).

On the project beach, hatchling turtles normally emerge between July and September during the night and swim offshore to begin a pelagic existence within *Sargassum* rafts, drifting in current gyres and convergence zones for several years [Carr 1987; Turtle Expert Working Group (TEWG) 1996a; Witherington 2002]. Post-hatchlings from the Florida coast eventually enter currents of the North Atlantic Gyre. At a carapace length of approximately 40 to 60 centimeters (cm), they leave the pelagic environment and move into nearshore habitats (Carr 1987; Bowen et al. 1993).

Green Sea Turtle

The USFWS considers the green as common within the inner shelf waters off the project area. All life stages of green turtles can be found during different times of the year in and around the project area. Juvenile green turtles (approximately 2 to 5 years of age) also may move into shallow coastal and estuarine waters along the entire east coast of Florida (CSA 2009a, Schmid 1995; Hirth 1997).

Florida comprises the major feeding grounds for green turtles in U.S. waters, where the turtles forage mainly on algae and the seagrass *Thalassia testudinum* (Burke et al. 1992). The nearshore waters of the project area include no seagrass (CSA International, Inc. 2010a).

Subadult green turtle habitats on the east coast of Florida include shallow estuarine environments such as the Indian River Lagoon (Ehrhart et al. 1996; Provanca et al. 1998; Bresette et al. 2000), deeper coral and limestone reefs in South Florida (Wershoven and Wershoven 1992; Makowski et al. 2002; Makowski 2004), and shallow nearshore habitats in Brevard, Indian River, Martin, and St. Lucie Counties (Bresette et al. 1998; Ehrhart et al. 2001; Holloway-Adkins et al. 2002). Subadults also inhabit

manmade environments such as shipping channels and turning basins (Henwood 1987, Redfoot 1997).

Several researchers have found juvenile green turtles over nearshore hardbottom habitats in the project area foraging on species of red algae (Ehrhart et al. 1996; Holloway-Adkins 2001; Holloway Adkins 2005). The most frequently-consumed species were *Gelidium* spp., *Bryothamnion seaforthii*, *Hypnea* spp., *Gracilaria* spp., *Laurencia* spp., and *Bryocladia cuspidata*. The same reports also described juvenile green turtle consumption of a variety of small invertebrates and occasional portions of jellyfish. However, the overall results indicate juvenile green turtles in nearshore hardbottom habitats are feeding as herbivores (Holloway-Adkins 2001; Gilbert 2005; Holloway-Adkins and Provanca 2005). Sand, pieces of rock, and shell debris found in foraging samples indicate green turtles forage close to the substrate and for unknown reasons either incidentally or selectively ingest these non-nutritional items. Stranding events and foraging studies indicate that sea turtles at all life stages are susceptible to ingesting anthropogenic debris (Balazs 1985; Carr 1987; Witherington 2002).

Leatherback Turtle

Adult leatherback reportedly occur in east Florida waters primarily during summer; aerial surveys also have sighted leatherback turtles off northeast Florida from October through April (Schroeder and Thompson 1987; Knowlton and Weigle 1989; CSA 2002). During these surveys, leatherbacks occurred on the mid-shelf and inner shelf, but not usually near shore (CSA 2002). However, historical data suggest that leatherbacks also may use inner shelf waters during periods of local thermal fronts that concentrate food resources (Thompson and Huang 1993). The cryptic behavior of hatchling and/or juvenile leatherback turtles has resulted in little knowledge of their pelagic distribution. Leatherback turtles occur only very rarely in the nearshore waters of the project area.

Hawksbill Turtle

Hawksbill turtles occur in tropical and subtropical seas of the Atlantic, Pacific, and Indian Oceans. In the western Atlantic, hawksbill turtles generally inhabit clear tropical waters near coral reefs, including the southeast Florida coast, Florida Keys, The Bahamas, Caribbean Sea, and southwestern Gulf of Mexico (NMFS and USFWS 1993).

Hatchling hawksbills are pelagic, drifting with *Sargassum* rafts. Available data suggest they are herbivorous during this period but become more omnivorous as they age (Ernst et al. 1994). Juveniles shift to a benthic foraging existence in shallow waters, progressively moving to deep waters as they grow and become capable of deeper dives for sponges (Meylan 1988; Ernst et al. 1994). Adult hawksbills typically associate with coral reefs and similar hardbottom areas where they forage on invertebrates, primarily sponges.

Kemp's Ridley Turtle

The Kemp's ridley is the smallest and most endangered of the sea turtles. Its distribution includes the Gulf of Mexico and southeast U.S. coast, although some individuals have ventured as far north along the eastern seaboard as Nova Scotia and

Newfoundland (TEWG 1996b). Adult Kemp’s ridley turtles occur almost exclusively in the Gulf of Mexico, primarily on the inner shelf (Byles 1988). Kemp’s ridley hatchlings inhabit offshore *Sargassum* mats and drift lines associated with convergences, eddies, and rings. Gulf and Atlantic surface currents widely disperse the hatchlings. After reaching a size of about 20 to 60 cm carapace length, juveniles enter shallow coastal waters (TEWG 2000).

Post-pelagic (juvenile, subadult, and adult) Kemp’s ridley turtles feed primarily on portunid crabs, but also occasionally eat mollusks, shrimps, dead fishes, and vegetation (Mortimer 1982; Lutcavage and Musick 1985; Shaver 1991; NMFS and USFWS 1992b; Burke et al. 1993; Werner and Landry 1994). The Kemp’s ridley is considered very rare in nearshore waters of the project area.

3.3.2. MARINE MAMMALS

Three federally-listed species of marine mammals occur on the inner shelf (shoreline to the 20-meter isobath) of the project area (**Table 3.3-5**). The table orders the several species by relative abundance (highest to lowest).

Table 3.3-5. Endangered Marine Mammal Species Potentially Occurring on the Eastern Florida Inner Shelf

Common and Scientific Names	Status ¹	Life Stages Present	Abundance within the Project Area	Seasonal Presence
Florida manatee (<i>Trichechus manatus latirostris</i>)	E	Adults, subadults, and juveniles	Common	Year-round (most abundant during winter)
Humpback whale (<i>Megaptera novaeangliae</i>)	E	Adults, subadults, and juveniles	Rare	December to March
North Atlantic right whale (<i>Eubalaena glacialis</i>)	E	Adults, subadults, and juveniles	Rare	December to March

¹ Status: E = endangered.

Source: Wiley et al. 1995; USFWS 2001; <http://www.neaq.org>

3.3.2.1. Florida Manatee

The West Indian manatee is one of the most endangered marine mammals in coastal waters of the U.S. In the southeastern U.S., manatees are limited primarily to Florida and Georgia. This group constitutes a separate subspecies called the Florida manatee (*Trichechus manatus latirostris*) that is divided into four recognized populations, or management stocks (Atlantic Coast, Southwest, Upper St. John’s River, and Northwest), based on regional manatee wintering sites (<http://www.nefsc.noaa.gov/nefsc/publications/tm/tm213/F2009App6.pdf>; USFWS 2001a). Adult Florida manatees average about 3 meters (9.8 feet) in length and 1,000 kg (2,200 lbs.) in weight. Their maximum lifespan is approximately 59 years. Age of first pregnancy is 3 to 4 years, and their gestation period for a single calf is 11 to 14 months, with an average interbirth interval of 2.5 years (USFWS 2001a).

Manatees are seen mostly as solitary individuals or in groups of up to six individuals. Florida manatees found along the Atlantic U.S. coast are of the Atlantic Region subpopulation (USFWS 2001a), and observers on the Atlantic coast counted 2,148 individuals (FMRI 2009). Most manatees in the southeastern U.S. migrate between a summer range and a winter range, determined by water temperature changes. During winter months, the Florida manatee population confines itself to coastal waters of the southern half of peninsular Florida and to springs and warm water outfalls as far north as southeastern Georgia (USFWS 2001a). As water temperatures rise in spring, individuals disperse from these winter aggregation areas, some migrating as far north as coastal Virginia (USFWS 2001a). Manatees inhabit both salt and fresh water of sufficient depth (1.5 meters to usually less than 6 meters) throughout their range. They are usually found in canals, rivers, estuarine habitats, and saltwater bays, but on occasion have swum as far as 3.7 miles off the Florida coast (USFWS 2001a). Individual and small groups of manatees are regularly sighted within shallow nearshore waters off St. Lucie and Martin Counties, including the Fort Pierce inlet (pers. comm., Lois Edwards [Coastal Tech, Inc.] and Keith Spring [CSA International, Inc.], August 2010).

In 1976, USFWS designated critical habitat for this species. All of the critical habitat areas are located in peninsular Florida, predominantly along the inland waters of the southwest and southeast coasts (USFWS 2001a). However, the project area is not designated as critical habitat.

3.3.2.2. Humpback Whale

The humpback whale (*Megaptera novaeangliae*) is federally listed as endangered. It 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, there are at least five geographically distinct feeding aggregations 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 and abundance. Calving and breeding occurs in the Caribbean from January to March (Tove 2000). The coastal region of Florida is not designated as an area of concentrated occurrence for humpback whales. The habitat in the vicinity of the borrow area is not ideal for foraging or breeding humpback whales, but could potentially serve as a migration corridor to feeding and breeding grounds.

3.3.2.3. North Atlantic Right Whale

The North Atlantic right whale (*Eubalaena glacialis*) is one of the most endangered whales in the world. The New England Aquarium's (NEAQ) Atlantic right whale research and conservation initiative estimates a total world population of about only 400 (NEAQ 2010). North Atlantic right whales range from Iceland to eastern Florida, primarily in coastal waters. This species uses the waters around Cape Cod and Great South Channel for feeding, nursery, and mating during summer (Kraus et al. 1988; Schaeff et al. 1993). From June to September, most animals are feeding north of Cape Cod. Southward migration occurs offshore from mid-October to early January (Kraus et al. 1993). Coastal waters of the southeastern U.S. (off Georgia and northeastern Florida) are important wintering and calving grounds for North Atlantic right whales. Migration northward along the North Carolina coast may begin as early as January but primarily occurs during March and April (Lee and Socci 1989; Krause et al. 1990).

Designated critical habitat for the North Atlantic right whale includes portions of Cape Cod Bay and Stellwagen Bank and the Great South Channel (off Massachusetts) and a strip of near coastal waters extending from southern Georgia to Sebastian Inlet, Florida; therefore, there is no right whale critical habitat located in the project area. The southern critical habitat area widens near the Georgia-Florida State boundary where the highest concentrations of individual whales are concentrated during their winter calving season (typically December through March, with peak calving in December and January) (**Figure 3.3-1**). During this time, the population consists primarily of mothers and newborn calves, some juveniles, and occasionally some adult males and noncalving adult females (<http://www.neaq.org>).

3.3.2.4. Other Whales

During summer, sei whales (*Balaenoptera borealis*) and finback whales (*Balaenoptera physalus*) are found at their higher-latitude breeding areas. During fall, winter, and spring, these species are expected to occur primarily east of the 2,000-meter isobaths. Sperm whales (*Physeter macrocephalus*) are found along the shelf break (approximately 200-m isobaths) and eastward. These species typically occur much farther east and in deeper water than the offshore borrow area. Therefore, none of these species are expected to occur within the action area.

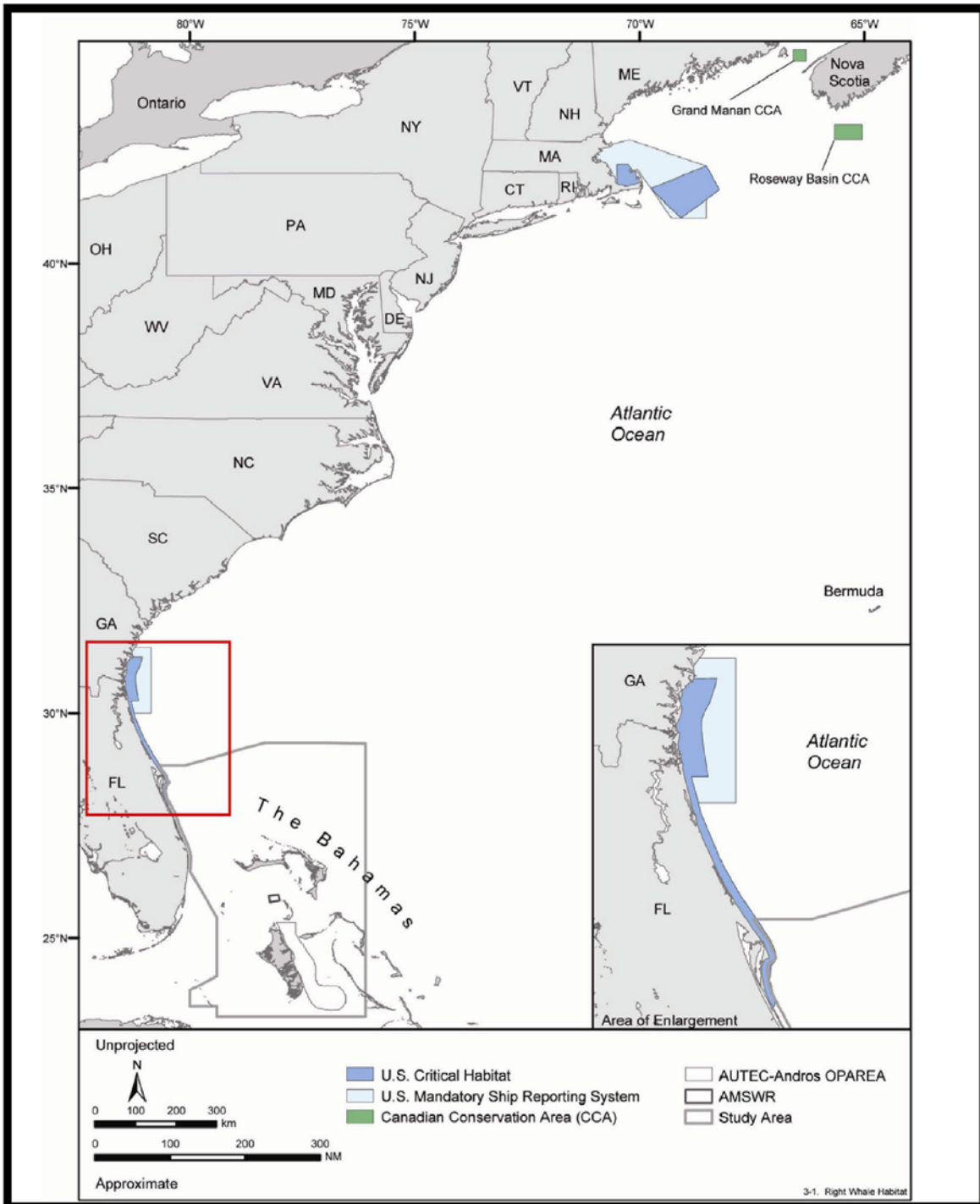


FIGURE 3.3-1.
DESIGNATED CRITICAL HABITATS, CONSERVATION AREAS,
AND MANDATORY SHIP REPORTING ZONES FOR NORTH ATLANTIC RIGHT WHALES
MARTIN COUNTY HURRICANE AND STORM DAMAGE REDUCTION PROJECT
HUTCHINSON ISLAND, FLORIDA

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3.3.3. SMALLTOOTH SAWFISH

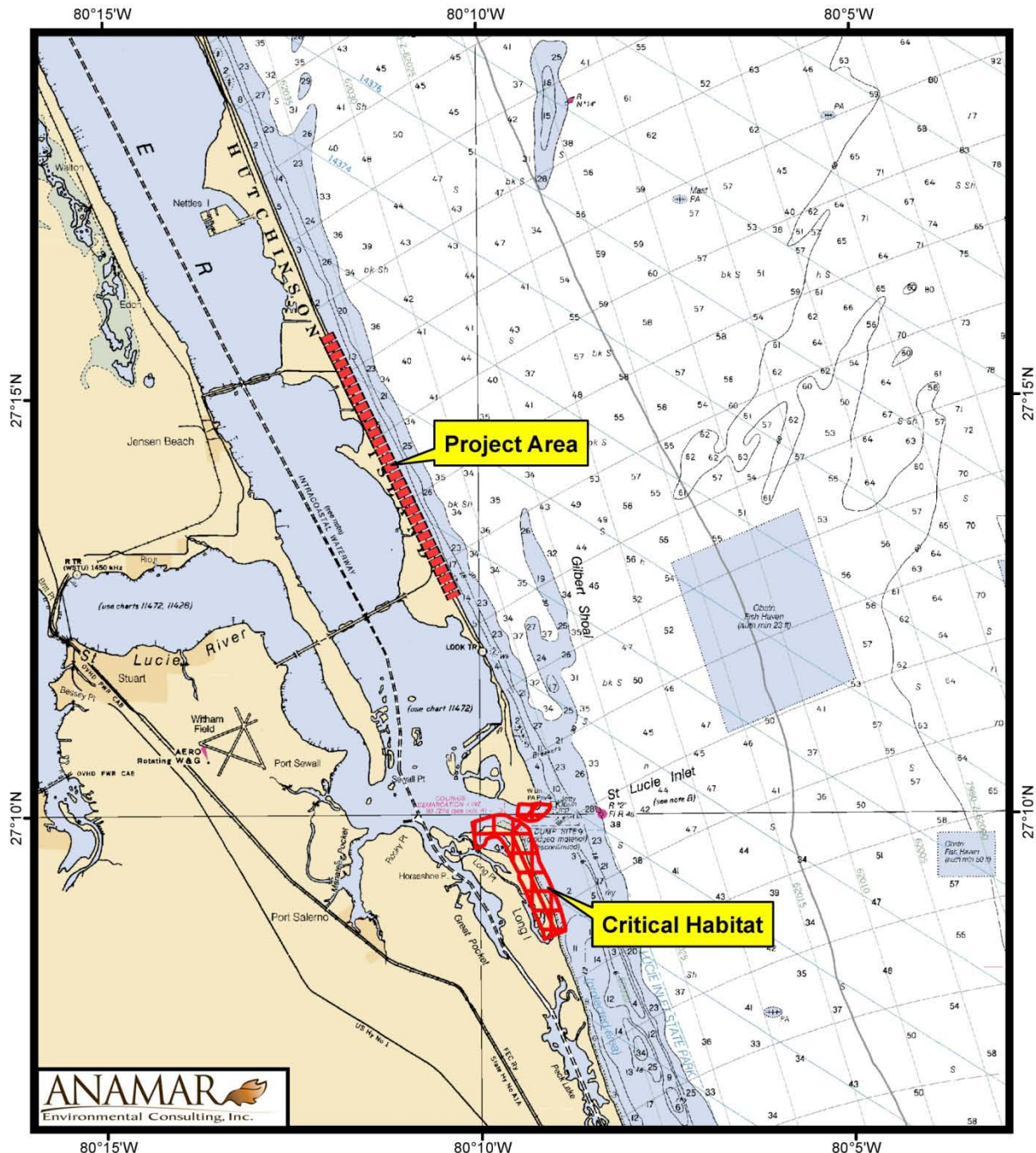
The smalltooth sawfish (*Pristis pectinata*) is currently listed as endangered by NMFS and rarely occurs within the project area. This species has become rare along the southeastern Atlantic and northern Gulf of Mexico coasts of the U.S. during the past 30 years, and its known primary range is now reduced 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.

The smalltooth sawfish is distributed in tropical and subtropical waters worldwide. It normally inhabits shallow waters (10 meters or less), often near river mouths or in estuarine lagoons over sandy or muddy substrates, but may also occur in deeper waters (20 meters) of the continental shelf. Shallow water less than 1 meter deep appears to be an important nursery area for young smalltooth sawfish. Maintenance and protection of habitat is an important component of the 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 2006). Their diet consists of macroinvertebrates and fishes such as herrings and mullets. The saw is reportedly used to rake surficial sediments in search of crustaceans and benthic fishes or to slash through schools of herrings and mullets (NMFS 2006).

3.3.4. PIPING PLOVER

The piping plover (*Charadrius melodus*) is a rare to uncommon winter resident that can be found 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 be found inland but prefers sandy beaches and tidal mudflats where it forages along the waterline or high up the beach along the wrackline. 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 previous winter census stated that approximately 20 to 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]. A piping plover survey was conducted in the vicinity of the project area (St. Lucie Inlet) from January to May 2009 by EAI in support of permitting planned dune restoration project at Bathtub Beach Park on Hutchinson Island. According to Robert Ernest, there was one documented sighting of a piping plover in or near the project area, but their occurrence there is very rare, given the high amount of human use and associated disturbances (Robert Ernest, personal communication, August 7, 2009). Only one solitary bird has been observed on the Atlantic beaches (of Hutchinson Island) considerably distant to the inlet (EAI 2009). Designated critical habitat for wintering piping plovers in the vicinity of the project area is found to the south of the project area on Juniper Island, Martin County, Florida (Florida Unit 33) (**Figure 3.3.2**). No critical habitat is designated within the project area.



LEGEND

Project Area
 Critical Habitat

FIGURE 3.3-2. GENERAL LOCATIONS OF THE DESIGNATED CRITICAL HABITAT FOR THE WINTERING PIPING PLOVER MARTIN COUNTY HURRICANE AND STORM DAMAGE REDUCTION PROJECT HUTCHINSON ISLAND, FLORIDA


 Miles


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3.4. NEARSHORE HARDGROUNDS AND ARTIFICIAL REEFS

Section 3.4.1 describes nearshore hardground resources within and adjacent to the site and results of hardbottom surveys that have been conducted in the project area. Section 3.4.2 provides results of monitoring surveys conducted at the mitigation reefs constructed within the project area.

3.4.1. NEARSHORE HARDGROUNDS

Nearshore hardbottom features along the project area comprise marine components of the Anastasia formation, including lithified shell fragments (especially coquina clam), quartz sand, and calcium carbonate (Cooke and Mossom 1929; Cooke 1945). These features parallel the shoreline, extending through the intertidal and subtidal zones, and range from relatively wide expanses of pavement-like platforms with ledges to isolated patches of rocks. The ledges typically have exposed vertical faces and overhangs along the shoreward edges. Nearshore hardbottom in this area is ephemeral in nature due to high wave energy and a dynamic sedimentary environment. Generally, these reefs have a low profile, but in some areas along Martin County they rise several feet above the bottom. At some locations, the reefs are frequently covered by a thin layer of sand, leaving only scattered patches of exposed rock.

The sabellariid tubeworm *Phragmatopoma lapidosa* (also known as *P. caudata*) colonizes nearshore hardbottom in portions of the project area. This colonial species settles in intertidal and subtidal hardbottom areas and utilizes sand particles in concert with a mucoproteinaceous cement to construct dwelling tubes resulting in construction of reef-like structures (Gore et al. 1978; Nelson and Demetriades 1992; Kirtley 1994; Drake et al. 2007). This “wormrock” is somewhat ephemeral, as storm waves and burial by sediments may destroy the structures (CSA International 2009) 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 *P. lapidosa* 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).

These worm reefs provide two very important functions. First, as hardened structures, the reefs tend to help dissipate destructive wave energy. Second, the reefs provide attachment area for livebottom plants and structural habitat for a wide variety of invertebrates and fishes. Although these worm reefs are found from Cape Canaveral to Key Biscayne, they are best developed between St. Lucie and Martin Counties off the Hutchinson Island coast. Off the east coast of Florida, 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; Inc. [CPE] 2006; CSA 2010a) and is 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 1989; Holloway-Adkins 2001; CSA 2009).

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, and 1974; Multer and Milliman 1967; Kirtley and Tanner 1968; Mehta 1973).

1994 Baseline Survey

Prior to initial project construction in 1995, a nearshore reef and rock survey was conducted by CSA to characterize the reefs and hardbottom communities off northeast Martin County for assessing impacts from, and planning for, beach renourishment (Coastal Science Associates 1994). These investigations revealed hardbottom reef tracts consisting of ephemeral limestone outcrops with the marine bristle worm, *Phragmatopoma lapidosa*. It was estimated that between the St. Lucie/Martin County line and the St. Lucie Inlet there were approximately 150 acres of hardbottom communities, approximately 80% of which were of the sabellariid worm reef type (ATM 1991). Some of these reef tracts were scattered along the project beach between monuments R-1 and R-25, with the western edge beginning approximately 500 feet seaward of the 1992 shoreline (**Figure 2.3-1**). During initial construction, it was estimated that approximately 1.3 acres of hardbottom habitat were located within the project construction template. To offset impacts to nearshore hardbottom habitat, nearshore artificial reef was created three sites totaling approximately 6 acres located approximately 900 feet offshore monuments R-12, R-18, and R-20 (**Figure 2.3-1**). These reefs were constructed during the summer of 2000 using steel and concrete material from the dismantled Evans Crary Bridge within the ETOF.

Two additional nearshore hardbottom surveys were conducted in 2007 and 2010 along the project reach to establish pre-construction baseline conditions. The surveys included a combination of sidescan sonar with ground-truthing, aerial photography, and underwater diver-verified reef characterization studies. Results of the surveys are provided below.

2007 Baseline Survey

As part of the current permitting process, Martin County was required to provide more recent baseline information on hardbottom resources that occur within and downdrift of the proposed project area. Wormrock reefs (hardbottom) in the project area provide an important habitat resource, particularly as a developmental habitat for immature green turtles. Other primary benthic habitats within the area of evaluation include exposed lime rock, sand, and unconsolidated substrate. A long-term study was conducted to evaluate hardbottom exposure in the project area (R-1 to R-25) and

downdrift of the project site (R-25 to R-30) (Stites et al. 2007; Taylor Engineering, Inc 2009a). The report is provided in Appendix H.

To meet project goals, the following tasks were performed:

- Mapping of historical hardbottom distribution using available aerial photography;
- Measurement of hardbottom exposure in the project area; and
- Quantification of historic hardbottom distributions and, where possible, linked the results to beach nourishment and storm events.

Aerial photographs from 1996 through 2008 were reviewed to evaluate the distribution of nearshore hardbottom within the Martin County HSDR Project area and to assess their extent in relation to the 1996 predicted equilibrium toe of fill (ETOF) approved under FDEP Permit No. 0169205-001-008. Only the aerial photographs from 1997, 2001, 2004, and 2008 were of sufficient clarity to map exposed hardbottom.

Two zones were established seaward of the FDEP reference monuments so the hardbottom within the project footprint could be differentiated from the hardbottom seaward or downdrift of the project area (beyond the ETOF). These two zones are defined as

- Zone A - the nearshore bottom within the beach design template (R-monument to the predicted 1996 ETOF).
- Zone B - the nearshore bottom from the predicted ETOF seaward an additional 500 feet. FDEP typically requires post-construction transect data within this zone to assess secondary impacts associated with beach nourishment activities.

Preliminary drawings of delineated visible hardbottoms overlaid on aerial photographs from 1997, 2001, 2004, and 2008 are provided in **Figure 3.4-1** (Taylor Engineering, Inc. 2009a). Hardbottom distribution and community composition were characterized along transects within the project area to develop a baseline of biological information. The goal of that evaluation was to identify any trends in the available data with respect to exposure of hardbottom resources.

Table 3.4-1 summarizes the results of total exposed hardbottom acres within project and downdrift areas. Total exposed hardbottom varied in the four evaluation years with the least amount of hardbottom visible within Zone A during 2001 and the greatest amount of visible hardbottom within Zone B during 2004 (Taylor Engineering, Inc. 2009a). The least amount of hardbottom habitat occurred in 2001 in project area Zone A, only a few months after a partial nourishment between R-16 and R-22.

In all 4 evaluation years, the greatest area of exposed hardbottom occurred within the project area Zone B in 2004 (**Table 3.4-1**). Within Zone B, the 2004 aerials (taken roughly 1 year after the last beach nourishment) show 54.7 acres of exposed hardbottom, which is 68% more exposed hardbottom than in 1997, 70% more than in 2001, and 66% more than in 2008. Analysis of the downdrift areas found similar

consistency in exposed hardbottom acreage (**Table 3.4-1**), with exposed hardbottom acreage and distribution differing little between 2001, 2004, and 2008. No 1997 aerials exist for the downdrift area, thus no comparative evaluation occurred.

Zone A comprises the nearshore waters, mhw seaward to the ETOF, within both the project and downdrift areas. Within the project area, Zone A exhibited the maximum hardbottom area in 1997 (14.0 acres) and the least (1.2 acres) in 2001 (**Table 3.4-1**). Analysis of the 2004 aerial showed 7.3 acres of hardbottom, 48% less than in 1997 (Stites et al. 2007, Taylor Engineering, Inc. 2009a). In 2008, 11.7 acres of hardbottom became visible, only 17% less than that observed in 1997.

Table 3.4-1. Hardbottom Acres within Project and Downdrift Areas, Martin County, Florida

Location	Hardbottom Acres			
	1997	2001	2004	2008
Project Area, Zone A	14.0	1.2	7.3	11.7
Project Area, Zone B	17.5	16.8	54.7	18.5
Downdrift Area, Zone A	No Aerial	7.1	2.3	11.5
Downdrift Area, Zone B	No Aerial	0.2	0.0	0.0
Total Area	31.5	25.3	64.3	41.7

Source: Taylor Engineering, Inc (2009a)

In all 4 evaluation years, the greatest area of exposed hardbottom occurred within the project area Zone B in 2004 (**Table 3.4-1**). Within Zone B, the 2004 aerials (taken roughly 1 year after the last beach nourishment) show 54.7 acres of exposed hardbottom, which is 68% more exposed hardbottom than in 1997, 70% more than in 2001, and 66% more than in 2008. Analysis of the downdrift areas found similar consistency in exposed hardbottom acreage (**Table 3.4-1**), with exposed hardbottom acreage and distribution differing little between 2001, 2004, and 2008. No 1997 aerials exist for the downdrift area, thus no comparative evaluation occurred.

Zone A comprises the nearshore waters, mhw seaward to the ETOF, within both the project and downdrift areas. Within the project area, Zone A exhibited the maximum hardbottom area in 1997 (14.0 acres) and the least (1.2 acres) in 2001 (**Table 3.4-1**). Analysis of the 2004 aerial showed 7.3 acres of hardbottom, 48% less than in 1997 (Stites et al. 2007, Taylor Engineering, Inc. 2009a). In 2008, 11.7 acres of hardbottom became visible, only 17% less than that observed in 1997.

2010 Baseline Survey

In August 2010, CSA conducted a pre-construction hardbottom baseline survey along the project reach extending from range monument R-1 south to R-29 (**Figure 3.4-2**) (CSA International 2010).

The baseline survey objectives were as follows:

- Establish and survey 12 permanent cross-shore transects—10 within the project area and two downdrift of project area (Figure 1 of CSA report);
- Map the nearshore hardbottom edge within the project area;
- Conduct quantitative video transect surveys along two 20-m segments of hardbottom along each transect; and
- Collect qualitative video along the entire length of each transect.

A total of 52 taxa were recorded during the baseline survey, including 36 macroalgal taxa, 15 faunal taxa, and biotic turf. Distribution of hardbottom habitat in the project area was patchy and likely ephemeral in nature. Natural hardbottom occurred from the nearshore hardbottom edge eastward approximately 40 meters (from 30 to 70 meters) along the project area transects, while artificial reefs (comprising concrete pilings) were encountered on the easternmost portions of these transects (approximately from 70 to 150 meters).

Hardbottom in the downdrift area consisted of a relatively continuous stretch of rock from the intertidal zone eastward approximately 30 meters composed of naturally occurring exposed coquina limestone (Anastasia formation) and sabellariid wormrock (*P. lapidosa*). Wormrock abundance was greater in the downdrift area than in the project area, likely due to a more favorable location for wormrock formation in the shallow, intertidal zone.

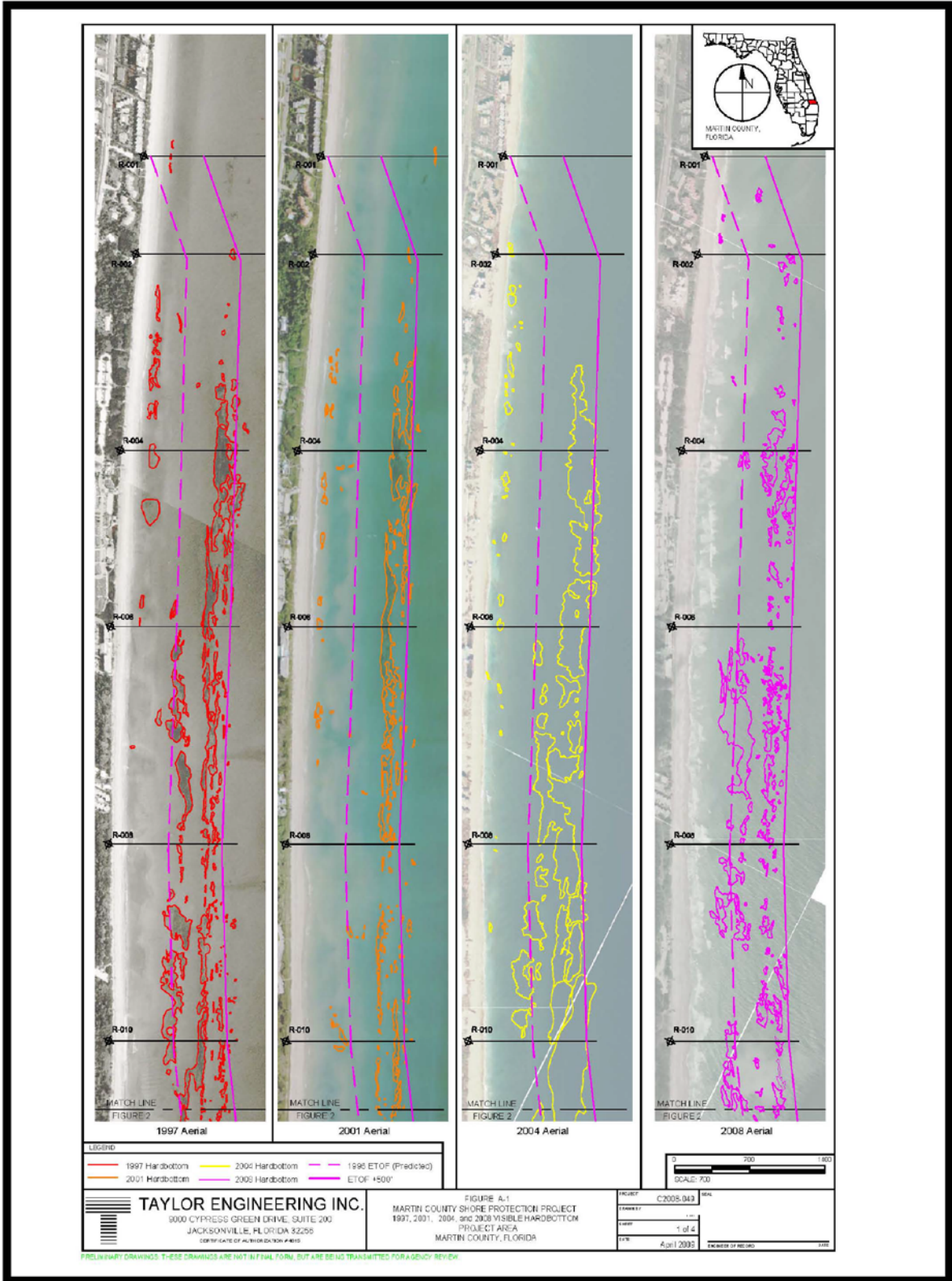
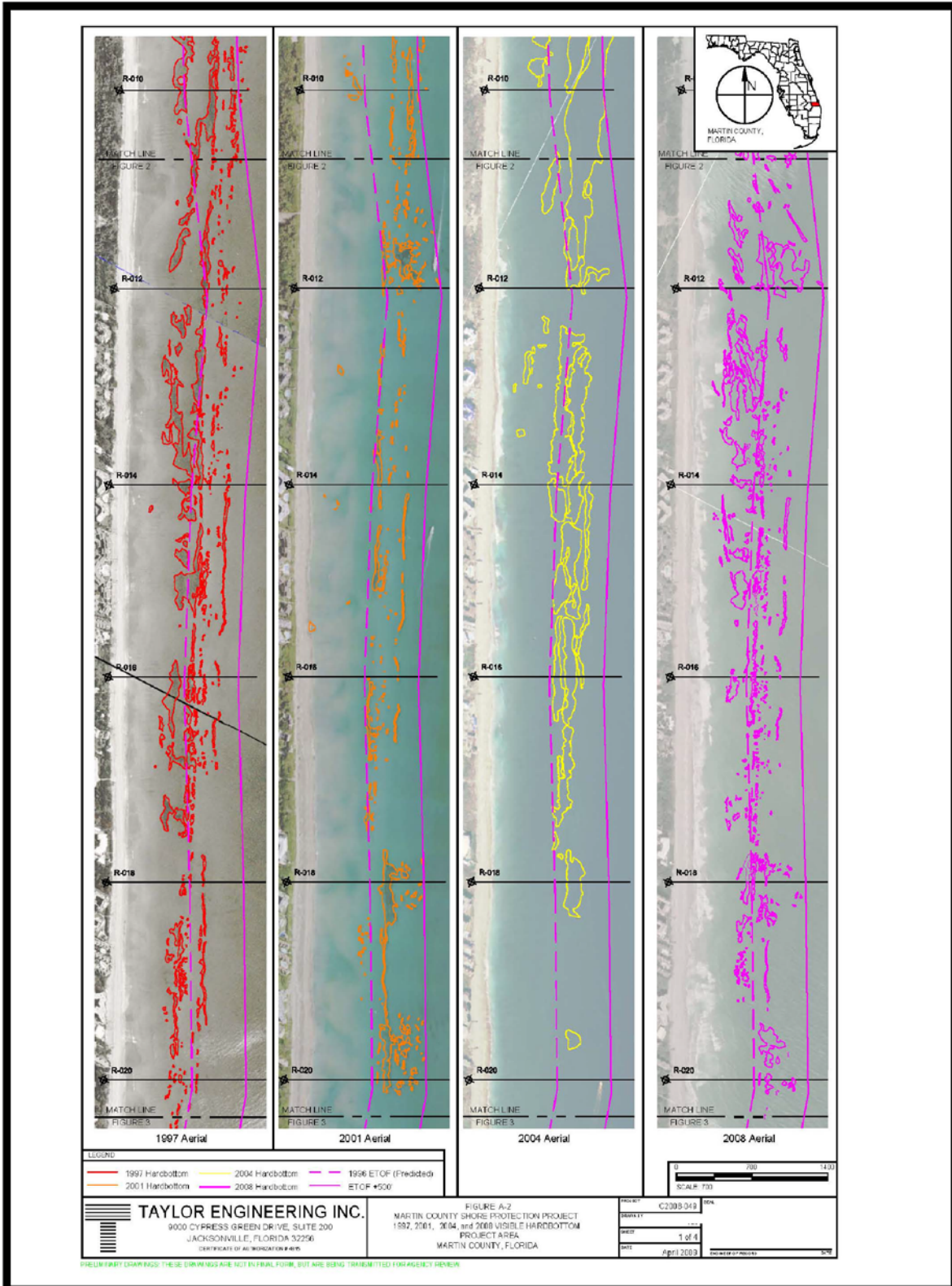


FIGURE 3.4-1a. 1997, 2001, 2004, AND 2008 VISIBLE HARDBOTTOM, MARTIN COUNTY HURRICANE AND STORM DAMAGE REDUCTION PROJECT, HUTCHINSON ISLAND, FLORIDA

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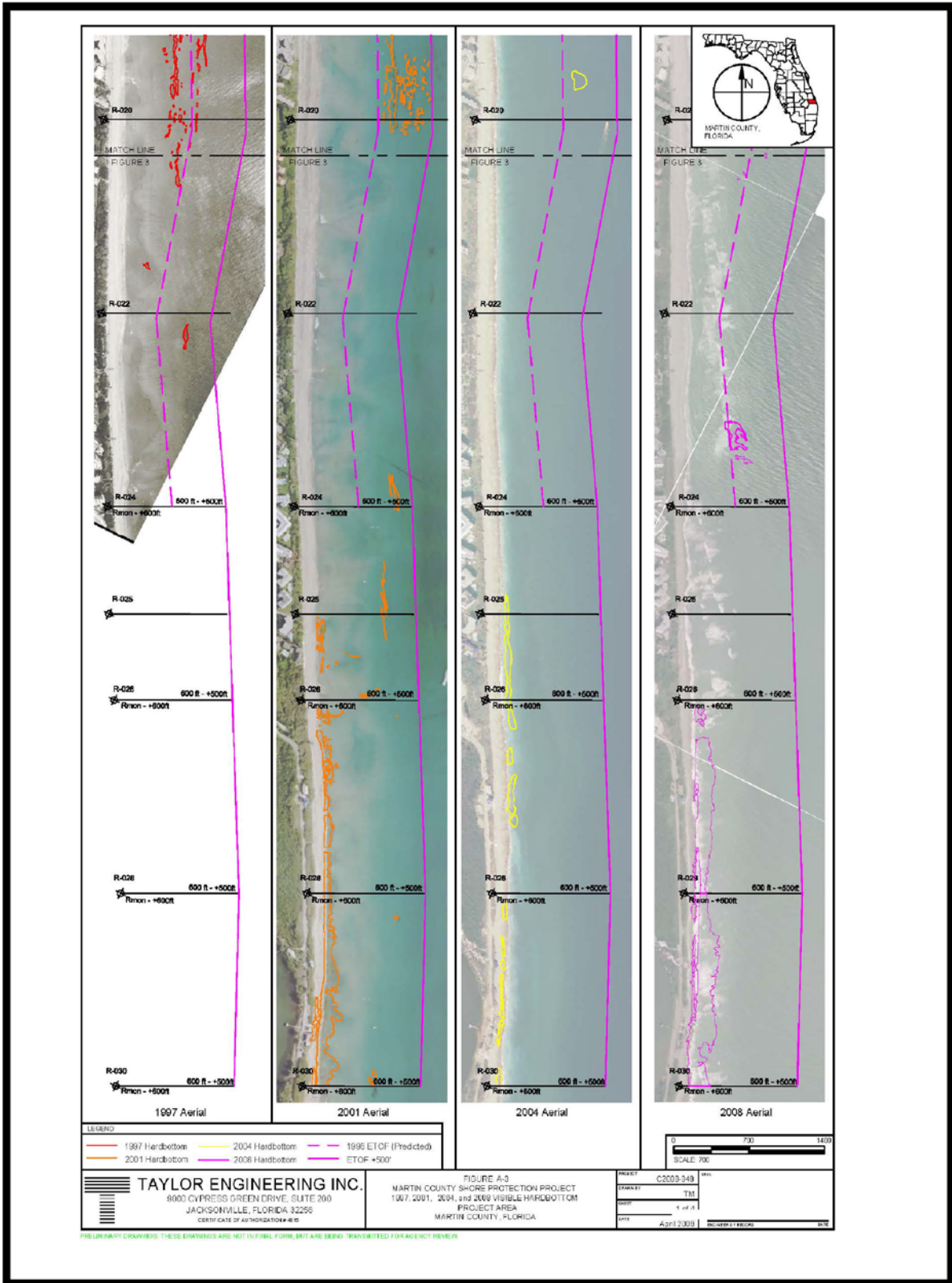


FIGURE 3.4-1c. 1997, 2001, 2004, AND 2008 VISIBLE HARDBOTTOM, MARTIN COUNTY HURRICANE AND STORM DAMAGE REDUCTION PROJECT, HUTCHINSON ISLAND, FLORIDA

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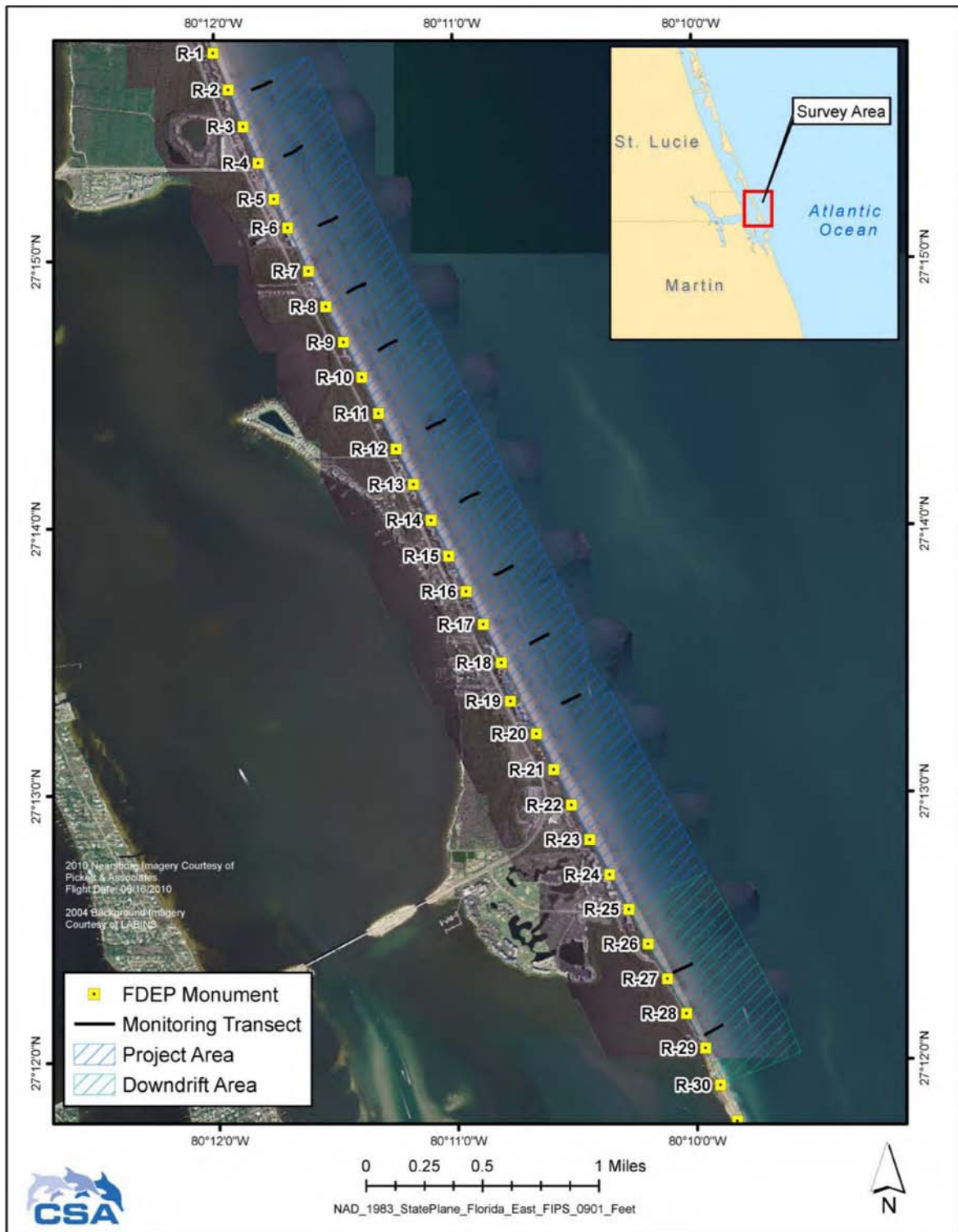


FIGURE 3.4-2
SURVEY AREA OVERVIEW SHOWING PERMANENT CROSS-SHORE
TRANSECTS ESTABLISHED AND SURVEYED DURING THE
HUTCHINSON ISLAND SHORE PROTECTION PROJECT 2010 HARD
BOTTOM BASELINE SURVEY; MARTIN COUNTY HURRICANE AND
STORM DAMAGE REDUCTION PROJECT, HUTCHINSON ISLAND,
FLORIDA

3.4.2. ARTIFICIAL REEFS

The loss of nearshore hardbottom habitat between monuments R-22 and R-23 was mitigated by creating three areas of nearshore artificial reefs totaling 6 acres. Results of annual monitoring of fish and benthic species identified at nearshore mitigation reefs A, B, and C are summarized in **Figure 3.4-3** and **Tables 3.4-2 and 3.4-3**. At Site A, a total of 21 fish species were identified in 2006, as compared to 23 in 2004. In 2006, the number of sport fishes identified at Site A was 8, the highest number of species recorded during 6 years of monitoring. Several spiny lobsters were also observed at Site A in 2006. During all spring and summer monitoring events, there appeared to be several well-established colonies of sabellariid wormrock reef at Site A; however, in December 2006, it was noted that wormrock was absent (Harris 2006). At Site B, a total of 17 fish species were identified in 2006, as compared to 20 in 2004. The total benthic coverage increased between 2004 and 2006. The invasive exotic green algae species *Caulerpa brachypus* was observed drifting and attached to the substrates in 2004, but was not observed in 2006. At Site C, a total of 15 fish species were identified in 2006, as compared to 20 in 2004. Spiny lobster was also observed. The most notable observation in 2006 was the continued increase in attached benthic organism's thickness and coverage on the steel and concrete surfaces. The absence of the invasive species *Caulerpa brachypus* was also noted. Since monitoring was initiated in 2002, two federally protected species, the Goliath Grouper and Striped Croaker, have been observed at all three mitigation sites. They are considered species of special concern because of their limited habitat range in Florida. The only known breeding population of Striped Croaker in North America is located in Brevard, Indian River, and St. Lucie Counties (Gilmore 1992). This species is dependent on nearshore rock algae reefs for most of its lifespan (Harris 2006). Overall, the results indicate that these artificial reefs have become an active living artificial reef community utilized by both fish and benthic organisms (Harris 2006). Representative photographs of the current conditions of Sites A, B, and C are provided in **Figures 3.4-4, 3.4-5, and 3.4-6**, respectively.

The monitoring reports also indicate that some burial of the reef structures occurred during the 2004 and 2005 hurricanes. This was most notable in mitigation reef C where a decline in the clusters of reef material was noted. Water depths to the sand bottom were significantly shallower than during the previous monitoring events, so burial of a significant amount of the material was suspected. Some settlement (and/or burial) and scour around the bridge pieces that were located in 2006 was also noted. The scour provides habitat similar to that provided by scour around nearshore natural reefs in the area. Many of the stacked components within the artificial reef appear to be stable, and are continuing to provide many overhangs and crevices, which are an excellent habitat for a variety of marine organisms (Harris 2006).

Characteristics indicative of sand movement after beach nourishments were detected based on a review of aerial photographs taken in 1997, 2001, and 2003, and an evaluation of current biological conditions. Zone A (includes the nearshore bottom within the beach design template hardbottom) fluctuates widely in response to various factors (storms, nourishment, and intertidal sand transport), but the influence of

nourishment events may diminish within a year of an event. Zone B (includes the nearshore bottom from the predicted ETOF seaward an additional 500 feet) hardbottom acreage fluctuates but remains relatively stable despite the various factors, suggesting relatively low nourishment-related impacts. Although containing relatively little hardbottom, the downdrift area remains relatively stable despite a variety of factors (Stites et al. 2007).

Figure 3.4-3. Number of Fish Species Identified (not Including Unidentified Fry) at Mitigation Reef Sites A, B, and C from 2002-2006, Martin County, Florida

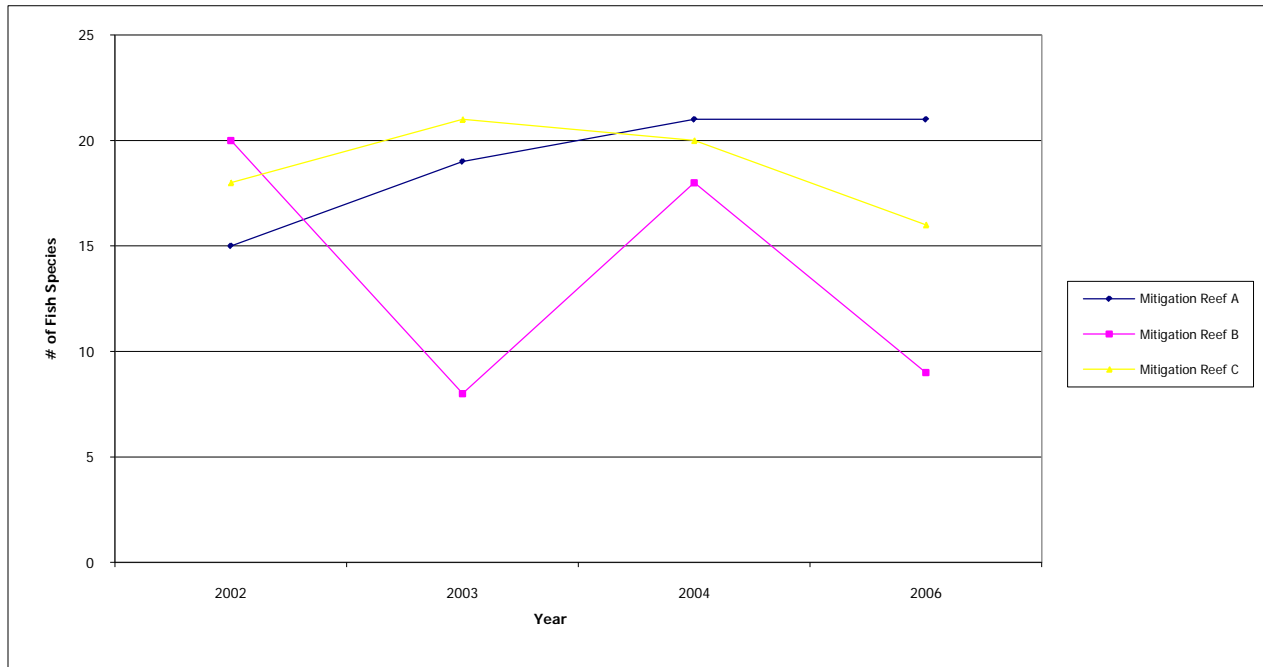


Table 3.4.-2. Fish Species Census from 2002-2006 for Nearshore Mitigation Reefs A, B, and C, Martin County, Florida (page 1 of 3)

Species	Mitigation Reef A				Mitigation Reef B				Mitigation Reef C			
	2002	2003	2004	2006	2002	2003	2004	2006	2002	2003	2004	2006
Atlantic Bumper											10's	1
Atlantic Spadefish	>20	10's	10's	10's	>10	>10	2	10's	>20	>10	2	
Barracuda			1	10's	1		1	1	1	1	1	
Beaugregory	4	4	2	1	4				5	1	2	10's
Bermuda Chub		1							1			
Black Margate			10's	10's		4	5			>10	10's	10's
Blue Angelfish			1	2								
Blue Runner	>20	10's	100's				100's	3		100's	10's	
Cardinalfish			4									
Common Snook	3	10's	8	3	2	1	10's		1	8	2	1
Cubaru				2								10's
Doctorfish	1	7	1		4		10's		2			
Dwarf Goatfish			1									
French Angelfish			2		1							
Fry (unidentified species)			100's	10's			100's	100's		10's	100's	
Gag Grouper			2	1						1	1	
Goliath Grouper		2		1			1		1			2
Gray Triggerfish		1					7	1	1	1	1	
Grey Angelfish		1	1							1		
Grey Snapper	>10	>10	10's	7	>10	3	10's		>10	7	10's	2
Green Moray Eel										1		
Hairy Blenny				2	4				1			4
Highhat	8		1	4	4				7	2	1	3
Hogfish		1										
King Mackerel				1								

Table 3.4.-2. Fish Species Census from 2002-2006 for Nearshore Mitigation Reefs A, B, and C, Martin County, Florida (page 2 of 3)

Species	Mitigation Reef A				Mitigation Reef B				Mitigation Reef C			
	2002	2003	2004	2006	2002	2003	2004	2006	2002	2003	2004	2006
Lane Snapper	8	4	1		3		2	2		10's	1	
Mackeral Scad										10's		
Mutton Snapper										1		
Nurse Shark											2	
Porcupinefish							1				1	
Porkfish	>10	>60	10's	10's	>20	>60	10's	10's	>20	100's	100's	>20
Red Porgy		3	3							4	4	
Reef Croaker											10's	
Round Scad (Cigar Minnow)												100's+
Sergeant Major		1			1				4			
Sailors Choice			>10				10's		>50			
Scamp											1	
Schoolmaster									1			
Scorpionfish				2								
Sheepshead	3	>10		3	4	>10	4	5	3	6	7	
Slippery Dick		5				5						
Southern Flounder				2			1					
Spanish Grunt								2				
Spiny Lobster	1			8	1				1			2
Spotted Goatfish					2							
Spotted Moray Eel			1		1		1					
Spottail Pinfish	1	8	10's	10's	>10	>14	10's			10	1	3
Spotted Scorpionfish										1		
Stonecrab	1											
Stripped Croaker				5			10's					100's

Table 3.4.-2. Fish Species Census from 2002-2006 for Nearshore Mitigation Reefs A, B, and C, Martin County, Florida (page 3 of 3)

Species	Mitigation Reef A				Mitigation Reef B				Mitigation Reef C			
	2002	2003	2004	2006	2002	2003	2004	2006	2002	2003	2004	2006
Tomtate	100's			10's	100's				>30			10's
Townsend Angelfish												1
Two Spot Cardinalfish					3							
White Margate	>20	10's			1					3		
White Spotted Soapfish								1				

Data compiled by ANAMAR Environmental Consulting, Inc. from several reports (Harris 2002, Harris 2003, and Harris 2006). Copies of reports are provided in Appendix G. No data were collected in 2005 due to lack of visibility. Information on number of adults and juveniles is not included in this table, but can be found in the reports.

Table 3.4-3. 2006 Benthic Species Census and Abundance for Nearshore Mitigation Reefs A, B, and C, Martin County, Florida

Benthic Species Identified	Common Name	Mitigation Reef A	Mitigation Reef B	Mitigation Reef C
Green Algae				
<i>Bryopsis pennata</i>	No common name	Abundant		Abundant
<i>Caulerpa mexicana</i>	Mexican seaweed	Abundant	Abundant	
<i>Codium</i> spp.		Single		
Red Algae				
<i>Botryocladia occidentalis</i>	No common name	Few		
<i>Bryothamnion triquetrum</i>	Red marine alga	Few	Few	Few
<i>Gelidium americanum</i>	No common name	Abundant	Abundant	Abundant
<i>Gracilaria mammillaris</i>	No common name	Many	Many	Many
Brown Algae				
<i>Dictyota</i> spp.	Y-branched alga	Few		
<i>Padina</i> spp.	Scroll alga	Few		
Sponges				
<i>Pseudaxinella lunaecharta</i>	Orange sticky sponge	Abundant	Abundant	Abundant
Encrusting sponges		Abundant	Abundant	Abundant
Unidentified orange sponge		Abundant		
Yellow encrusting sponge		Many	Few	Few
Cnidarians				
<i>Aglaophenia latecarinata</i>	Feather plume hydroid		Abundant	Abundant
<i>Carijoa riisei</i>	White telesto	Many	Many	Many
<i>Leptogorgia hebes</i>	Regal sea fan	Abundant	Abundant	Abundant
<i>Leptogorgia virgulata</i>	Yellow sea whip	Few	Abundant	Abundant
Mat anenome			Single	Single
<i>Oculina difusa</i>	Ivory bush coral	Many		
<i>Phyllangia americana</i>	Hidden cup coral	Few	Few	Few
Solitary anenome			Few	Few
Worms				
<i>Phragmatopoma</i> spp.	Sabellariid wormrock	Many		
Tubeworms		Few	Few	Few
Tunicates				
<i>Ascidia niger</i>	Black solitary tunicate	Many	Many	Many
<i>Eudistoma obscuratum</i>	Black condominium tunicate	Many	Many	Many
Globular tunicates (<i>Styela</i> spp. – like)	Solitary tunicates	Abundant	Abundant	Abundant
White colonial tunicate		Many	Many	Many
Sea Urchins				
<i>Arbacia punctulata</i>	Purple urchin	Few		
<i>Echinometra lucunter</i>	Rock-boring urchin	Few		
Gastropods				
<i>Terebra salleana</i>	Eastern augers		Many	Many
Bryozoans				
<i>Bugula turrita</i>	Fan bryozoan		Single	Single

Data compiled by ANAMAR Environmental Consulting, Inc. from Harris (2006). Complete report is provided in Appendix G.

Figure 3.4-4. Photographs of Artificial Mitigation Reef A



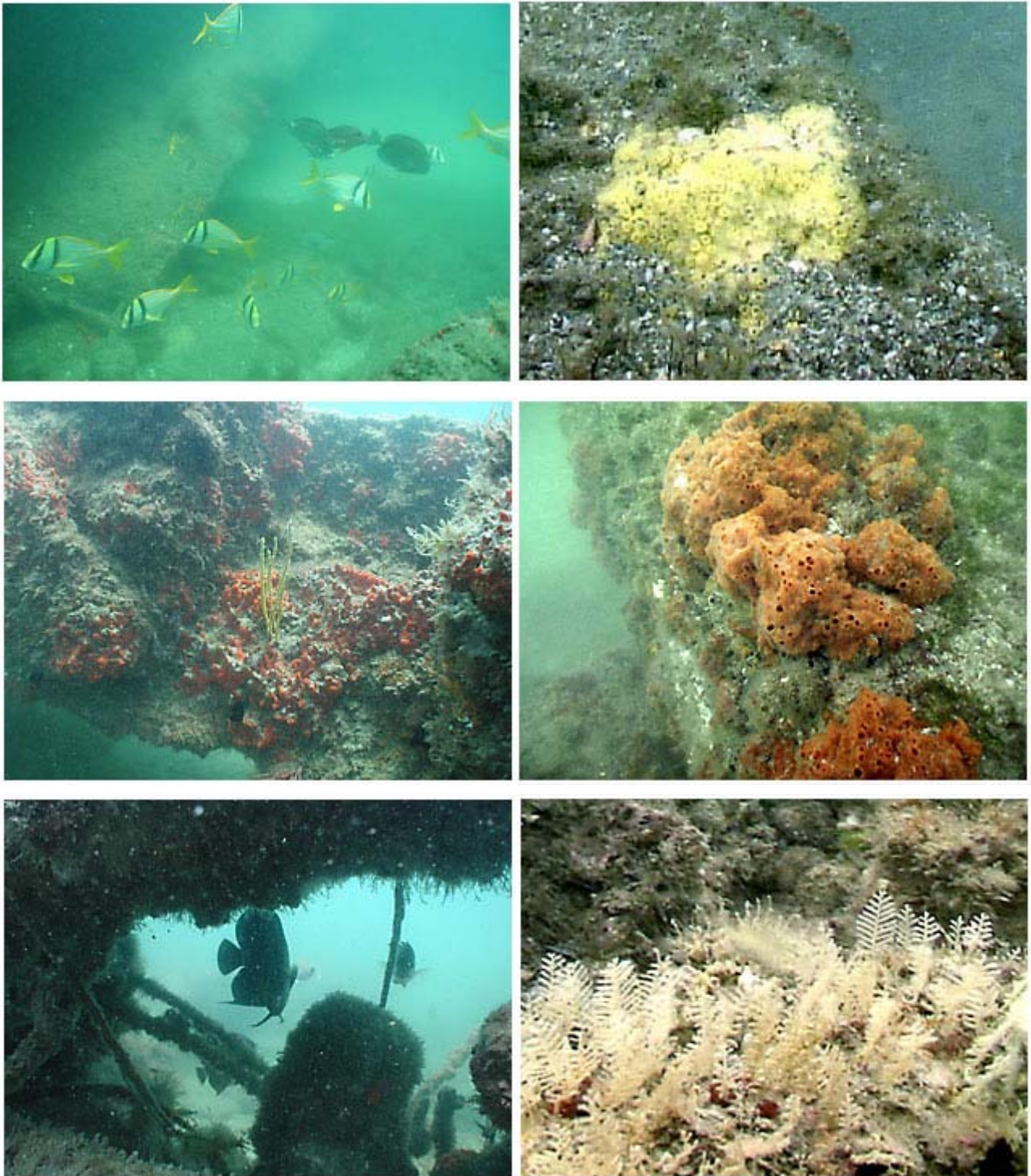
Photos Courtesy of Lee Harris and Kerry Dillon, Martin County Artificial Reef Program
(www.martinreefs.com)

Figure 3.4-5. Photographs of Artificial Mitigation Reef B



Photos Courtesy of Lee Harris and Kerry Dillon, Martin County Artificial Reef Program
(www.martinreefs.com)

Figure 3.4-6. Photographs of Artificial Mitigation Reef C



Photos Courtesy of Lee Harris and Kerry Dillon, Martin County Artificial Reef Program|
(www.martinreefs.com)

3.5. OFFSHORE HARDBOTTOM

Hardbottom habitats on the continental shelf off eastern Florida consist of rock outcrops colonized by various algae, sponges, hard corals, soft corals, fire corals, tunicates, and other sessile invertebrates that comprise the epibiota (Hammer et al. 2005). Solitary corals found in this area include *Astrangia* and *Phylangia* and colonial corals include members of the following genera: *Diploria*, *Isophyllia*, *Mycetophyllia*, *Montastrea*, and *Solenastrea* (Hammer et al. 2005). Offshore hardbottom areas generally support more dense and more diverse epibiotical assemblages than those found on nearshore hardbottom (Goldberg 1973). Much of the rock substrate underlying these epibiotical assemblages is composed of relict Pleistocene beach ridges that generally parallel the present-day shoreline (Meisburger and Duane 1971). These ridges are generally positioned along a north-south axis and tend to protrude at variable heights above the sedimentary layer in a discontinuous fashion. Exposed rock will vary in relief from a level pavement to ledges as high as 4 meters. In areas where rock substrate is exposed for adequate periods of time, epibiota will assemble through larval settlement from the water column. Such assemblages are thought to take decades to develop into mature communities composed of long-lived organisms (Dayton 1984).

Within the region encompassed by the sand resource areas, hardbottom tracts exist in offshore (shelf) and nearshore (0- to 4-meter depths) waters. Offshore hardbottom features are associated with the shallow shelf, intermediate shelf, and outer shelf (Miller and Richards 1979; Perkins et al. 1997). A single hardbottom trend occurs in nearshore waters of the project area (SAFMC 1998b; Lindeman and Snyder 1999).

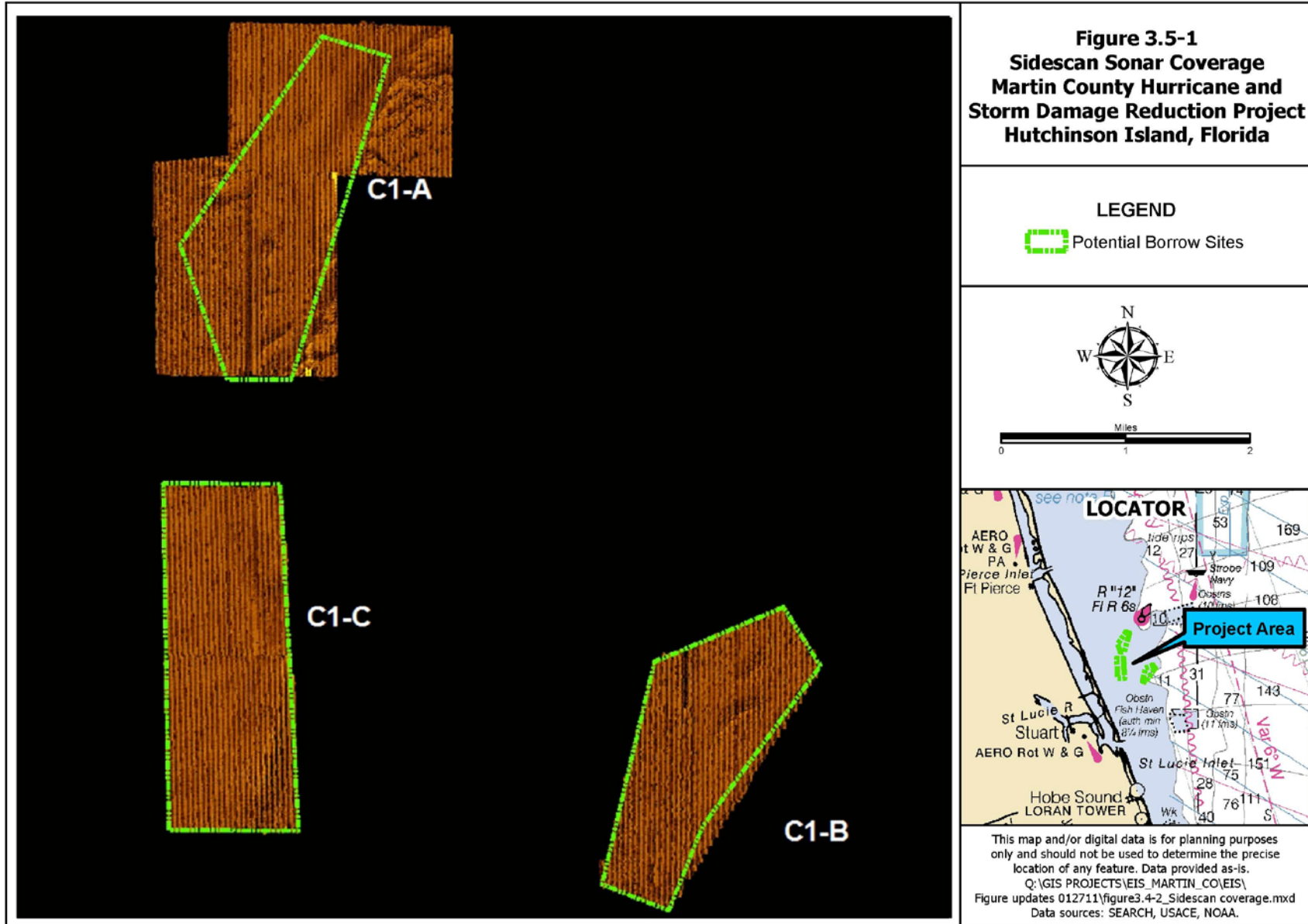
Coquina rock outcroppings are not uncommon offshore of Martin County in water depths of 30 to 90 feet. These outcroppings are similar to nearshore reefs, but are more stable and have a greater diversity of attached organisms and associated fish and invertebrate species. Many of these coquina rock outcropping reefs are popular fishing and diving areas.

During the period December 2007 to June 2008, sidescan sonar surveys of offshore borrow areas C1-B were conducted by Southeastern Archaeological Research, Inc. (SEARCH) as a component of the submerged cultural resource study for this project (**Figure 3.5-1** old **Figures 3.4-2**). To determine the presence of hardbottom and assess potential dredging impacts to hardbottom resources within the potential borrow areas, a more detailed analysis of existing sidescan sonar data was performed by ANAMAR Environmental Consulting, Inc (Appendix L). The sidescan mosaics revealed areas of high backscatter in Borrow Area C1-B. Two target areas, B-01 and B-02, were identified within C1-B (**Figures 2.2-3 and 2.2-4**). A geotechnical survey was performed in August 2007 in area C1-B (**Figure 2.2-3**). Cores were collected near Targets B-01 and B-02, indicating mostly sand and shell but no consolidated rock (see core logs in Appendix F).

Further groundtruthing was conducted by the sponsor in July 2009 to characterize these features. The dive survey was designed to investigate the proposed borrow area substrate and the overlying water column for significant resources including hardbottom

or reef habitats, aggregations of fishes, protected species such as sea turtles, or other biologically relevant conditions (Hesperides Group, LLC 2009). Teams of two divers collected flora and fauna lists, sediment descriptions, water temperature, depth, and visibility data.

The survey confirmed that the proposed borrow area is located on a relatively deep sand shoal with contains no hardbottom resources and observed few species that are normally associated with natural or artificial reefs (Hesperides Group, LLC 2009). Additionally, an investigation of the two small anomalies identified in the sidescan sonar survey (**Figure 2.2-4**) revealed no significant benthic features, only small, current-induced sand ridges. Green benthic algae was abundant over the entire area surveyed and the water column planktonic biomass was visibly heavy. The most numerous fishes observed were small, schooling members of the herring and jack families. The substrate consisted of sand and shell hash of fine to medium grain size with minimal amounts of silt/clay (fines). Bathymetric contours of the shoal were small and not visibly discernible to the divers during the survey. A complete copy of this report is provided in Appendix O.



3.6. FISH AND WILDLIFE RESOURCES

The beaches of Martin County are typical of south-central Atlantic coastal areas that are subject to dynamic and often stressful conditions. The biological communities found in the general project area are well adapted to the particular physiochemical and hydrodynamic conditions associated with the supralittoral beach zone, intertidal swash zone, nearshore reefs, offshore reefs and softbottom areas. The most diverse continental shelf fish assemblage within the United States occurs south of Cape Canaveral to Jupiter Inlet. More than 800 fish species have been recorded within a 10-mile radius of the St. Lucie Inlet (Gilmore 2008).

3.6.1. BIRDS

Birds are abundant on the beaches and in estuarine habitats in Martin County, with shore and wading birds comprising the majority of the avifauna. The motility of these species allows these organisms to seek protective refuge and forage for food in the dunes and tree stands that comprise a portion of the project area. Birds that may nest, forage, court, stage, roost, or otherwise use the beach, nearshore, or offshore habitat in the project area include both protected and species that, while are not listed, fall under the consideration of the policies of cooperating State and Federal agencies. These policies and agreements are discussed in this section, along with recent monitoring efforts, resources, and species known to occur in the vicinity of the project area.

3.6.1.1. Migratory Bird Policies

USACE Jacksonville District Migratory Bird Protection Policy

Florida's coastal areas provide habitat to numerous unique species of migratory birds, a large majority of which are shorebirds and colonial nesting birds. These species are protected by state and federal laws. Habitat for these birds can be affected and, in some cases, created during construction and/or dredging along the waterways. The Jacksonville District in conjunction with FWC, the Audubon Society, and USFWS has developed a district-wide policy concerning its activities and migratory bird nesting.

The Migratory Bird Treaty Act of 1918, as amended (16 USC 703) protects most migratory bird species as listed by USFWS. The Florida Endangered and Threatened Species Act of 1977, Title XXVIII, Chapter 372.072, provides for the protection of species listed by the State. The purpose of USACE's Migratory Bird Protection Policy is to provide protection to nesting migratory bird species that commonly use the dredged material disposal sites within Jacksonville District while facilitating disposal of dredged material to meet the Federal standard for navigation channel and harbor maintenance as authorized by Congress. Section 4.35, Environmental Commitments includes information regarding USACE protection specifications for contracts as related to migratory bird protection and a link to the policy.

Memorandum of Understanding – USFWS and BOEMRE

In June 2009, a Memorandum of Understanding (MOU) was entered between BOEMRE and USFWS to meet the requirements under Section 3 of Executive Order 13186 (66 FR 3853, January 17, 2001) concerning the responsibilities of Federal agencies to

protect migratory birds. The Executive Order directs executive departments and agencies to take certain actions to further implement the Migratory Bird Treaty Act (MBTA). The purpose of this MOU is to strengthen migratory bird conservation through enhanced collaboration between the BOEMRE and USFWS. This MOU does not waive legal requirements under the MBTA or any other statutes and does not authorize the take of migratory birds. This MOU identifies specific areas in which cooperation between the Parties will substantially contribute to the conservation and management of migratory birds and their habitats.

Birds of Conservation Concern

The 1988 amendment to the Fish and Wildlife Conservation Act mandates USFWS to “identify species, subspecies, and populations of all migratory nongame birds that, without additional conservation actions, are likely to become candidates for listing under the Endangered Species Act (ESA) of 1973.” *Birds of Conservation Concern 2008* (USFWS 2008) is the most recent effort to carry out this mandate. The overall goal of this report is to accurately identify the migratory and non-migratory bird species (beyond those already designated as federally threatened or endangered) that represent our highest conservation priorities. The project area is located in Bird Conservation Region 31 (BCR). **Table 3.6-1** identifies birds of conservation concern from BCR 31 (Peninsular Florida) (USFWS 2008). Note that not of all the species on this list occur in the project area.

3.6.1.2. Habitat and Monitoring Results

No critical habitat is designated within the project area. Designated critical habitat for wintering piping plovers in the vicinity of the project area is found to the south of the project area on Jupiter Island, Martin County, Florida (Florida Unit 33) (**Figure 3.3-2**).

In April 2005, daily migratory bird observations were conducted along the project during the 2005 renourishment event. These observations are summarized in **Table 3.6-2**. Ring-billed gulls and sanderlings were the most commonly observed species. Black-bellied plovers, ruddy turnstones, willets, laughing gulls, and royal terns were also frequently observed during the monitoring period. Occasional observations of crows, mottled ducks, brown pelicans, spotted sandpiper, Wilson’s plovers, herring gulls, common loon, and killdeer were also recorded.

FWC maintains a database of observations made by individuals, agencies, and conservation organizations that monitor beach-nesting birds in Florida (<http://myfwc.com/shorebirds/bnb/data-summary-results.asp>, accessed February 25, 2011). Data recorded include bird counts, nesting productivity, courtship behavior, predation, number of chicks and eggs, and life stages. Data from the 2010 monitoring efforts along the beaches in Martin County include least terns, oystercatchers, and black skimmers observed in various courting and nesting stages. Most of the observations were recorded south of the project area in Sailfish Point. However, this data helps characterize local nesting habits of birds in the vicinity of the project area.

Table 3.6-1. BCR 31 (Peninsular Florida) 2008 Birds of Conservation Concern List

Common Name	Species Name
Black-capped Petrel (nb)	<i>Pterodroma hasitata</i>
Audubon's Shearwater (nb)	<i>Puffinus lherminieri</i>
Brown Booby (nb)	<i>Sula leucogaster</i>
Magnificent Frigatebird	<i>Fregata magnificens</i>
American Bittern (nb)	<i>Botaurus lentiginosus</i>
Least Bittern	<i>Ixobrychus exilis</i>
Reddish Egret	<i>Egretta rufescens</i>
Roseate Spoonbill	<i>Ajaja ajaja</i>
Swallow-tailed Kite	<i>Elanoides forficatus</i>
Bald Eagle (b)	<i>Haliaeetus leucocephalus</i>
Short-tailed Hawk	<i>Buteo brachyurus</i>
American Kestrel (paulus ssp.)	<i>Falco sparverius</i>
Peregrine Falcon (b)	<i>Falco peregrinus</i>
Yellow Rail (nb)	<i>Coturnicops noveboracensis</i>
Black Rail	<i>Laterallus jamaicensis</i>
Limpkin	<i>Aramus guarauna</i>
Snowy Plover (c)	<i>Charadrius alexandrinus</i>
Wilson's Plover	<i>Charadrius wilsonia</i>
American Oystercatcher	<i>Haematopus palliatus</i>
Solitary Sandpiper (nb)	<i>Tringa solitaria</i>
Lesser Yellowlegs (nb)	<i>Tringa flavipes</i>
Whimbrel (nb)	<i>Numenius phaeopus</i>
Long-billed Curlew (nb)	<i>Numenius americanus</i>
Marbled Godwit (nb)	<i>Limosa fedoa</i>
Red Knot (rufa ssp.) (a) (nb)	<i>Calidris canutus</i>
Semipalmated Sandpiper (Eastern) (nb)	<i>Calidris pusilla</i>
Buff-breasted Sandpiper (nb)	<i>Tryngites subruficollis</i>
Short-billed Dowitcher (nb)	<i>Limnodromus griseus</i>
Least Tern (c)	<i>Sternula antillarum</i>
Black Skimmer	<i>Rynchops niger</i>
White-crowned Pigeon	<i>Patagioenas leucocephala</i>
Common Ground Dove	<i>Columbina passerina</i>
Mangrove Cuckoo	<i>Coccyzus minor</i>
Smooth-billed Ani	<i>Crotophaga ani</i>
Chuck-will's-widow	<i>Caprimulgus carolinensis</i>
Red-headed Woodpecker	<i>Melanerpes erythrocephalus</i>
Loggerhead Shrike	<i>Lanius ludovicianus</i>
Black-whiskered Vireo	<i>Vireo altiloquus</i>
Brown-headed Nuthatch	<i>Sitta pusilla</i>
Yellow Warbler (gundlachi ssp.)	<i>Dendroica petechia</i>
Prairie Warbler	<i>Dendroica discolor</i>
Prothonotary Warbler	<i>Protonotaria citrea</i>
Bachman's Sparrow	<i>Peucaea aestivalis</i>
Grasshopper Sparrow	<i>Ammodramus savannarum</i>
Henslow's Sparrow (nb)	<i>Ammodramus henslowii</i>
Nelson's Sharp-tailed Sparrow (nb)	<i>Ammodramus nelsoni</i>
Saltmarsh Sharp-tailed Sparrow (nb)	<i>Ammodramus caudacutus</i>
Seaside Sparrow (c)	<i>Ammodramus maritimus</i>
Painted Bunting (nb)	<i>Passerina ciris</i>

Source: USFWS 2008

Table 3.6-2. Migratory Birds Observed Daily on the Beach during the 2005 Renourishment Event

Date: April 2005	Black-bellied Plover	Crows	Ring-billed Gull	Ruddy Turnstone	Sanderling	Willet	Laughing Gull	Royal Tern	Mottled Duck	Brown Pelican	Spotted Sandpiper	Wilson's Plover	Herring Gull	Common Loon	Killdeer
1	1	2	2	1	18	1									
2			20-30		30-40	2	1	1							
3			15-25		35-45	1	4								
4			6	2	15-20		7	15							
5	2		15	4	32	1									
6	1		6		38		6								
7			3	1	22										
8				4	24	2	1								
9	1		3		23	3	4	1							
10	1		1				7	4	2	3					
11	1		15		49	1									
12			10		22										
13			1		23	3									
14	2		3		29										
15			4		40	1									
16	1		5		19	10									
17			1	2	19						1	1			
18		1	12	5	6	4							2		
19	1	3	5	8	30	2								1	
20	2		4	10	10	5	1	1	2	1					
21	1		4	16	15	4		1							
22	1		6	5	26	1	2	2							
23	4			2	25	1		2							
24	1				28				2						
25	4		5	5	32				2						
26			1		31										
27	1			2	16			1				1			
28			4		20			1				7			
29			1		20			2							
30			1	4	10										1

3.6.2. NEARSHORE FISH AND BENTHIC FAUNA

Inhabitants in the intertidal swash zone must cope with diurnal tides which leave many organisms aerially exposed for up to 6 hours at a time, and subjected to the high energy of the ocean waves. Typically, these habitats have low species diversity because of the harsh environmental conditions. However, animals that are able to adapt to these dynamic conditions are faced with very little competition from other organisms. Hence, the populations that are able to survive in this dynamic zone usually consist of a large number of individuals representing few species.

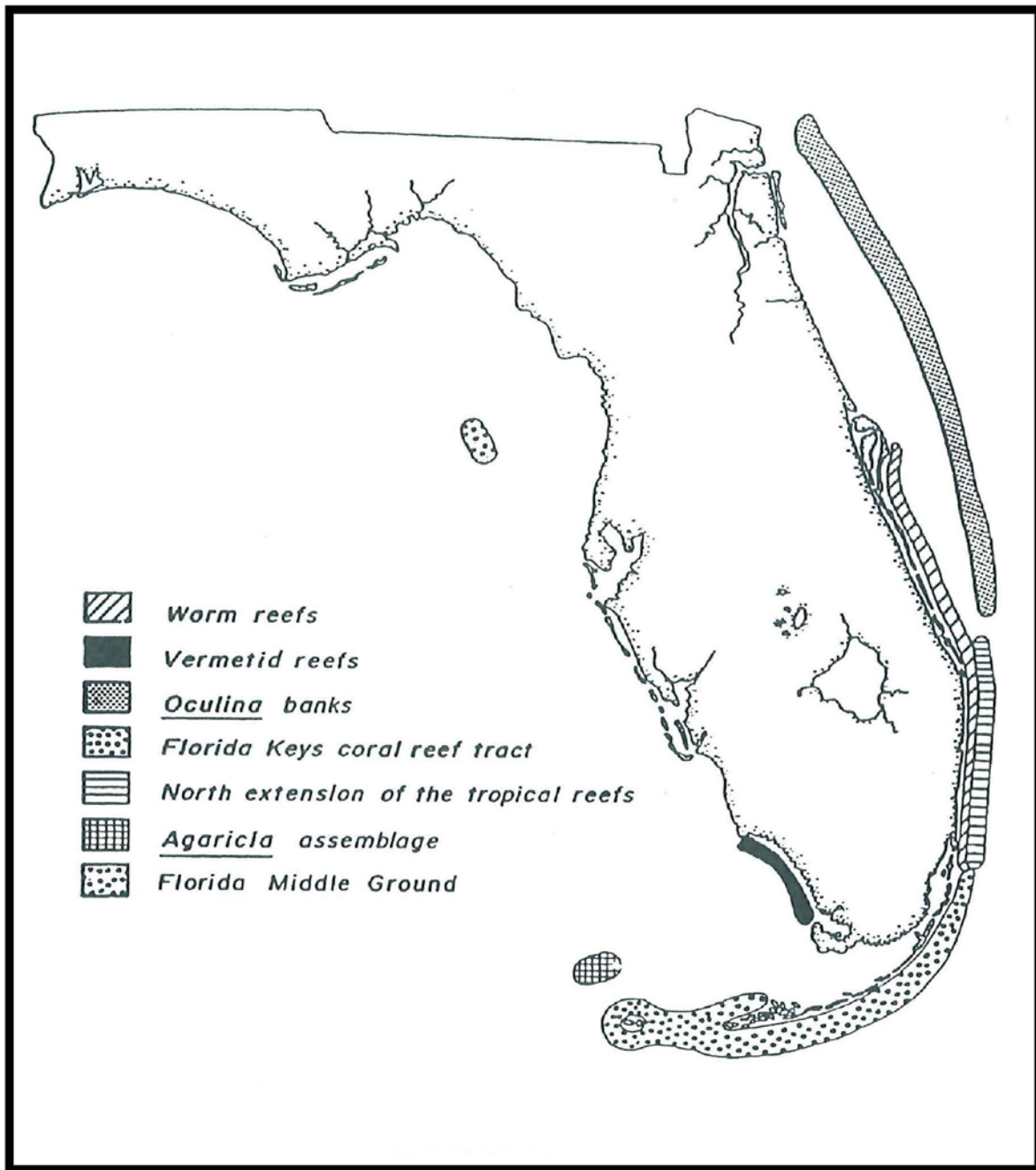
The Atlantic coquina clam (*Donax variabilis*) is a common small mollusk that is well suited to living in areas of dynamic conditions where re-suspension of material caused by wave action continually buries their burrows. With the passage of each wave, the clams rapidly dig a new burrow with their muscular foot appendage. Smaller crustaceans, such as haustoriid amphipods, must continually burrow into the sand as each passing wave tends to wash away their burrows. Receding waves tend to wash amphipods and isopods out of their burrows and suspend these organisms into the nearshore water column where they serve as an important food source for many shorebirds and nearshore fish, such as the Florida pompano (*Trachinotus carolinus*) and permit (*Trachinotus falcatus*). A variety of polychaete worms are also highly specialized for life in this dynamic environment and successfully adapt to more turbid conditions. These intertidal organisms provide an important food source for foraging shore and wading birds. Highly visible decapod crustaceans of the supralittoral zone include the ghost crab (*Ocypode quadrata*), mole crab (*Emerita talpoida*), and Atlantic fiddler crab (*Uca pugilator*). These organisms are highly motile and burrow into the moist sand for refuge and to retard water evaporation from their bodies during aerial exposure (Barnes 1974).

Both nearshore and offshore reefs are found along the entire Atlantic coast of Florida (**Figure 3.6-1**) and contribute significantly to the high biodiversity found in these areas. Limestone depositions, which form ridges and rocky outcrops and contribute to livebottom communities, are found along the entire length of the project area. Livebottom biota are among the most widely distributed benthic communities in Florida waters. Many of the rocky outcrops are carved and shaped by sand scouring and through bioerosion caused by rock-boring organisms such as clionid sponges and clams. From these erosional forces, the overall surface area of the rock structures is increased (an increase in rugosity) and forms important attachment sites for sessile organisms. The first inhabitants of these rocks usually are the attached algae. Herbivory by nearby crustaceans is well documented (Barnes and Hughes 1988) and the attached algae provide the primary food source for a wide variety of invertebrates. 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*). The limestone outcrops that form three-dimensional structures provide the only vertical habitat found along vast expanses of sandy substrate. Large carnivores such as great barracuda (*Sphyræna barracuda*), lane snapper (*Lutjanus synagris*), yellowtail snapper (*Ocyurus chrysurus*), grouper (*Epinephelus* sp.), and sea bass (*Centropristis* sp.) are frequently found around

these rocky structures. Smaller reef fish, such as sheepshead (*Archosargus probatocephalus*), porkfish (*Anisotremus virginicus*), hairy blenny (*Labrisoma nuchipinnis*), slippery dick (*Halichoeres bivittata*), and doctorfish (*Acanthurus chirurgus*), are also commonly seen foraging around the hardbottom habitat. In 1993, prior to project construction, a quantitative fish census was performed by USFWS. The results are summarized in the Coordination Act Report (CAR) (Appendix C of 1994 GDM).

The most recent (2007) nearshore species inventory, showed that relatively more complex and well-developed epibiotal and fish communities were observed in association with substrate that had exposed rock cover than where sand substrate predominated (CSA 2007). Greater numbers of benthic species were observed in areas of higher vertical relief and near distinct ledges (CSA 2007). The epibiotal communities were dominated by various species of algae. In addition to algae, exposed rock areas were colonized by hydroids, small numbers of sponges and tunicates, and rarely by hard and soft corals. The hard corals *Oculina* sp., *Phyllangia americana*, *Siderastrea sidereal*, and *Siderastrea radians* were observed in exposed rock cover areas. Overall, very low numbers of sponges and corals were observed during the survey. Sabellariid worm rock was present in the study area and appeared to be healthy and in an accretionary or growth stage. Motile invertebrates were observed in very low numbers and were associated with the rock outcrops. A total of 41 epibiota were identified during the *in situ* species inventory (**Table 3.6-3**).

Eight fish species were observed during the CSA 2007 monitoring survey. The most common adult and juvenile fishes observed were porkfish (*Anisotremus virginicus*), sheepshead (*Archosargus probatocephalus*), and black margate (*Anisotremus surinamensis*). Individual fish of the following species were also observed: schoolmaster (*Lutjanus apodus*), cocoa damselfish (*Pomacentrus variabilis*), silver porgy (*Diplodus argenteus*), spadefish (*Chaetodipterus faber*), and hairy blenny (*Labrisomus nuchipinnis*). Like the epibiota, fish abundance was greater in areas of high vertical relief and near distinct ledges.



**FIGURE 3.6-1.
DISTRIBUTION OF POTENTIAL REEF HABITAT
MARTIN COUNTY HURRICANE AND STORM DAMAGE REDUCTION PROJECT
HUTCHINSON ISLAND, FLORIDA**

This map and/or digital data is for planning purposes only and should not be used to determine the precise location of any feature. Data provided as-is.
Q:\GIS PROJECTS\SEIS_MARTIN_CO\EIS\Figure updates 030211\Figure3.6-1_reefs.mxd Source: Jaap, W.C. and P. Hallock 1990

Table 3.6-3. List of Taxa Identified *In Situ* by Divers along the Entire Length and within 1 Mile to Each Side of the Quantitative Survey Lines on Nearshore Habitat North of the Inlet in Martin County, Florida (page 1 of 2)

Identified Taxa	Survey Lines															
	R-2	R-6	R-8	R-10	R-12	R-14	R-16	R-18	R-20	R-22	R-24	R-26	R-28	R-30	R-35	R-40
Stony Corals																
<i>Siderastrea radians</i>							X									X
<i>Siderastrea sidereal</i>															X	X
<i>Occulina</i> sp.																X
<i>Phyllangia Americana</i>				X												
Octocorals																
<i>Leptogorgia virgulata</i>	X			X												
<i>Leptogorgia</i> sp.				X												
Macroalgae																
<i>Botryocladia</i> sp.			X			X	X									
<i>Bryothamnion</i> sp.			X	X											X	X
<i>Heterosiphonia gibbesii</i>			X													
<i>Liagora</i> sp.		X		X												X
Unidentified red algae		X	X	X			X	X							X	X
<i>Avrainvillea</i> sp.																X
<i>Halimeda</i> sp.		X		X											X	X
<i>Caulerpa mexicana</i>		X	X	X											X	
<i>Caulerpa racemosa</i>																X
<i>Caulerpa prolifera</i>				X		X									X	
<i>Caulerpa sertularioides</i>															X	
<i>Codium</i> sp.		X														X
<i>Penicillus</i> sp.															X	
Unidentified green algae			X	X												
<i>Dictyota</i> sp.	X		X	X	X		X									X
<i>Padina</i> sp.				X											X	X
Unidentified brown algae			X	X												X

Table 3.6-3. List of Taxa Identified *in situ* by Divers along the Entire Length and within 1 Mile to Each Side of the Quantitative Survey Lines on Nearshore Habitat North of the Inlet in Martin County, Florida (page 2 of 2)

Identified Taxa	Survey Lines															
	R-2	R-6	R-8	R-10	R-12	R-14	R-16	R-18	R-20	R-22	R-24	R-26	R-28	R-30	R-35	R-40
Turf algal complex	X	X	X	X	X	X	X	X	X	X					X	X
Mat cyanobacteria					X	X										X
Unidentified drift algae				X	X											
Unidentified macroalgae		X	X	X	X		X	X							X	X
Fauna																
Unidentified bryozoan																X
Hydroids			X	X	X	X									X	X
<i>Phragmatopoma lapidosa</i>				X			X								X	
Colonial tunicates	X			X												X
Solitary tunicate	X			X		X									X	
Holothuroid																X
<i>Encope</i> sp.	X															
Actiniidae	X			X												
Cirripedia										X						
Gastropoda										X						
<i>Arbacia</i> sp.			X													
Sponges																
Unidentified sponge		X	X												X	
Encrusting sponge			X													
<i>Cliona</i> sp.					X											X

Source: CSA (2007)

3.6.3. OFFSHORE FISH AND BENTHIC FAUNA

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).

During the 2009 dive survey, various invertebrate and vertebrate organisms were observed. Results indicate the benthic community of the C1-B borrow area is composed of taxa typical of soft bottom habitats such as bivalves, gastropods, echinoderms, and crustaceans (Hesperides Group, LLC 2009). Several species of invertebrates found strictly in soft bottom habitats were very common, including razor clams (*Ensis directus*), arrowhead sand dollar, and a portunid crab. Other notable fauna included various small bivalves and gastropods, beaded sea stars (*Astropecten articulatus*), sea hare (*Aplysia* sp.), brittle stars (*Ophiarachna* sp.), and box crabs (*Calappa flammea*). Numerous sand dollars were observed on several of the dives along with egg cases of *Neverita duplicata*, and a moon snail in the family *Naticidae*. These taxa are generally characterized by locally dense populations, high fecundity, and short life spans.

Distribution of interstitial bryozoans has recently been studied at shoals located offshore St. Lucie County, including the St. Lucie Shoal. A study for the USACE conducted by Brostoff (2002) identified an average of 19 different species located within the samples from the St. Lucie Shoal, with the exceedingly dominant species collected being *Cupuladria doma*. Previous studies of Capron Shoal (north of St. Lucie Shoal) by Winston and Håkansson (1986) described the interstitial bryozoan population as adapting to interstitial conditions, characterized by small size, simplified, colony structure, and very early reproduction. The distribution of encrusting bryozoans extends along sandy continental shelves, providing a food source for crustaceans, echinoderms, and mollusks (Winston and Håkansson 1986).

Although there is no hardbottom habitat located within the boundaries of the offshore borrow area, it does occur in the vicinity of the project area; therefore, the resources associated with hardbottom habitats are described. Offshore hardbottom areas support a suite of species similar to that found on nearshore hardbottom, but diversity is generally higher (Hammer et al. 2005). Most of these species are reef fishes of tropical origin, and several examples of the transitional nature of the region are found. Mutton

snapper (*Lutjanus analis*), yellowtail snapper, sailors choice (*Haemulon parra*), schoolmaster (*Lutjanus apodus*), and dog snapper (*Lutjanus jocu*) reach northern limits within the area encompassed by the sand resource areas (Gilmore and Hastings 1983). Some cross-shelf segregation of fish species has been noted offshore of the Hutchinson Island area, but this is more evident in the northern portion of the study area where inshore temperature ranges are more variable and tropical elements of the assemblage are displaced offshore. Nevertheless, the most obvious cross-shelf faunal break occurs at the outer shelf. Species common on deeper reefs but not generally found shallower than 30 meters are wrasse bass (*Liopropoma eukrines*), bank butterflyfish (*Chaetodon aya*), tattler (*Serranus phoebe*), and yellowtail reef fish (*Chromis enchrysurus*). Species that typify intermediate reefs are blue angelfish (*Holacanthus bermudensis*), spotfin butterflyfish (*Chaetodon ocellatus*), reef butterflyfish (*Chaetodon sedentarius*), jackknife-fish (*Equetus lanceolatus*), and hogfish (*Lachnolaimus maximus*).

3.6.4. MARINE MAMMALS

The Marine Mammal Protection Act of 1972 protects all marine mammals from harvesting within the borders of the U.S., regardless of status. Therefore, all marine mammals encountered in the offshore region of Hutchinson Island must be given due consideration. This section considers marine mammals not listed under the ESA.

The inner shelf plain and estuaries surrounding the project area support seasonal and permanent populations of marine mammals. Bottlenose dolphins are year-round residents, while the North Atlantic Right Whale and Humpback Whale may pass through the study area during migration. Key biological aspects of selected marine mammal species that could possibly occur in the proposed action areas are summarized in **Table 3.6-4** and sections below.

Table 3.6-4. Marine Mammals Occurring in Project Area

Common Name	Scientific Name	Frequency off Florida
WHALES		
Bryde's whale	<i>Balaenoptera brydei</i>	Rare
Minke whale	<i>Balaenoptera acutorostrata</i>	Regular
Pygmy sperm whale	<i>Kogia breviceps</i>	Regular
Dwarf sperm whale	<i>Kogia sima</i>	Regular
Gervais' beaked whale	<i>Mesoplodon europaeus</i>	Regular
Cuvier's beaked whale	<i>Ziphius cavirostris</i>	Regular
Blainville's beaked whale	<i>Mesoplodon densirostrus</i>	Regular
Sowerby's beaked whale	<i>Mesoplodon bidens</i>	Rare
True's beaked whale	<i>Mesoplodon mirus</i>	Extralimital
DOLPHINS		
Bottlenose dolphin	<i>Tursiops truncates</i>	Regular
Atlantic spotted dolphin	<i>Stenella frontalis</i>	Regular
Pantropical spotted dolphin	<i>Stenella attenuate</i>	Regular
Spinner dolphin	<i>Stenella longirostris</i>	Regular
Striped dolphin	<i>Stenella coeruleoalba</i>	Regular
Risso's dolphin	<i>Grampus griseus</i>	Regular
Pygmy killer whale	<i>Feresa attenuate</i>	Regular
False killer whale	<i>Pseudorca crassidens</i>	Regular
Short-finned pilot whale	<i>Globicephala macrorynchus</i>	Regular
Orca	<i>Orcinus orca</i>	Regular
Rough-toothed dolphin	<i>Steno bredanensis</i>	Regular
Clymene dolphin	<i>Stenella clymene</i>	Regular
Common dolphin	<i>Delphinus delphis</i>	Rare
Fraser's dolphin	<i>Lagenodelphis hosei</i>	Regular
Melon-headed whale	<i>Peponocephala electra</i>	Regular
Harbor porpoise	<i>Phocoena phocoena</i>	Extralimital

3.6.4.1. Whales

Bryde's whales (*Balaenoptera brydei*) are found both offshore and near the coast in tropical and subtropical waters, in both deep and shallow waters. They are found in subtropical and tropical waters and generally do not range north of 40° in the northern hemisphere or south of 40° in the southern hemisphere (Jefferson et al. 1993). These whales opportunistically feed on plankton (e.g., krill and copepods), and crustaceans (e.g. pelagic red crabs, shrimp) as well as schooling fish (e.g., anchovies, herring, mackerel, pilchards, and sardines). Bryde's whales use different methods to feed, including skimming the surface, lunging, and creating bubble nets

(<http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/brydeswhale.htm>, accessed December 22, 2010).

Strandings of Gulf Stream (or Gervais') beaked whale (*Mesoplodon europaeus*), Cuvier's beaked whale (*Ziphius cavirostris*), pygmy sperm whale (*Kogia* sp.), and minke whale (*Balaenoptera acutorostrata*) are known to occur in Florida. Beaked whales are believed to primarily inhabit deep water, but could potentially be found in the borrow area vicinity.

3.6.4.2. Dolphins

Bottlenose Dolphin

Bottlenose dolphins (*Tursiops truncatus*) are very sociable and are typically found in groups of two to 15 individuals, although groups of 100 have been reported. They are opportunistic feeders, taking a wide variety of fishes, cephalopods, and shrimp. There are two morphologically and genetically distinct forms of bottlenose dolphins: a nearshore (coastal) and an offshore form (Duffield et al 1983, Duffield 1986). The offshore form is distributed primarily along the outer continental shelf and continental slope in the Northwest Atlantic Ocean; however, the offshore morphotype has been documented to occur relatively close to shore over the continental shelf south of Cape Hatteras, NC

Atlantic Spotted Dolphin

Atlantic spotted dolphins (*Stenella frontalis*) prefer the tropical to warm temperate waters along the continental shelf of the Atlantic Ocean. This species generally occurs in coastal or continental shelf waters 65 to 820 feet (20 to 250 meters) deep, but can be found occasionally in deeper oceanic waters. The population in the western North Atlantic is estimated at 36,000 to 51,000 animals (http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/spotteddolphin_atlantic.htm, accessed December 22, 2010). Group size for the Atlantic spotted dolphin may range from just a few dolphins to several thousand. They prey on epipelagic (surface dwelling) fish, squid, and crustaceans. Atlantic spotted dolphins are expected to be uncommon within the vicinity of the project area.

Pantropical Spotted Dolphin

Pantropical spotted dolphins (*Stenella attenuata*) often occur in groups of several hundred to 1,000 animals. They are considered quite gregarious, often schooling with other dolphin species, such as spinner dolphins. Although specific migratory patterns haven't been clearly described, they seem to move inshore in the fall and winter months and offshore in the spring. They feed primarily on mesopelagic cephalopods and fishes (http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/spotteddolphin_pantropical.htm, accessed December 22, 2010). Pantropical spotted dolphins spend the majority of their day in shallower water typically from 300 to 1,000 feet (90 to 300 meters) deep, with nocturnal feeding occurring in deeper waters. Pantropical spotted dolphins are expected to be uncommon within the vicinity of the project area.

Spinner Dolphin

Spinner dolphins (*Stenella longirostris*) are distributed in oceanic and coastal tropical waters (Leatherwood *et al.* 1976). This is presumably an offshore, deep-water species (Schmidly 1981; Perrin and Gilpatrick 1994), and its distribution in the Atlantic is very poorly known. In the western North Atlantic, these dolphins occur in deep water along most of the U.S. coast south to the West Indies and Venezuela, including the Gulf of Mexico. Spinner dolphin sightings have occurred exclusively in deeper (>2,000 m) oceanic waters (CETAP 1982; Waring *et al.* 1992) off the northeast U.S. coast. Spinner dolphins often occur in groups of several hundred to several thousand animals. They are considered quite gregarious, often schooling in large groups and with other dolphin species, such as spotted dolphins. Spinner dolphins feed primarily at night on mid-water fishes and deep-water squid, while resting for most of the daylight hours. In most places, spinner dolphins are found in the deep ocean where they likely track prey.

Striped Dolphin

Striped dolphins (*Stenella coeruleoalba*) are some of the most abundant and widespread dolphins in the world. This species occurs in the U.S. off the west coast, in the northwestern Atlantic and in the Gulf of Mexico. In general, striped dolphins appear to prefer continental slope waters offshore to the Gulf Stream (Leatherwood *et al.* 1976; Perrin *et al.* 1994; Schmidly 1981). Striped dolphins are usually found in tight, cohesive groups averaging between 25 and 100 individuals, but have been occasionally seen in larger groups of up to several hundred and even thousands of animals. Striped dolphins feed on a diverse diet consisting of various species of relatively small, closely-packed, midwater, "benthopelagic" and/or "pelagic" shoaling/schooling fish (e.g., "myctophids" and cod) and cephalopods (e.g., squid and octopus) throughout the water column. Recent abundance estimates for the Western Atlantic population is between 68,500 and 94,500 (<http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/stripeddolphin.htm>, accessed December 22, 2010).

Risso's Dolphin

Risso's dolphins (*Grampus griseus*) are distributed worldwide in tropical and temperate seas, and in the Northwest Atlantic occur from Florida to eastern Newfoundland (Leatherwood *et al.* 1976; Baird and Stacey 1990). Off the northeast U.S. coast, Risso's dolphins are distributed along the continental shelf edge from Cape Hatteras northward to Georges Bank during spring, summer, and autumn (CETAP 1982; Payne *et al.* 1984). In winter, the range is in the mid-Atlantic Bight and extends outward into oceanic waters (Payne *et al.* 1984). In general, the population occupies the mid-Atlantic continental shelf edge year round, and is rarely seen in the Gulf of Maine (Payne *et al.* 1984). Risso's dolphins are found in groups of 5 to 50 animals, but groups typically average between 10 and 30 animals. They have been reported as solitary individuals, pairs, or in loose aggregations in the hundreds and thousands. Occasionally this species associates with other dolphins and whales. The Western North Atlantic stock is estimated to be 13,000 to 20,500 animals (<http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/rissosdolphin.htm>, accessed December 21, 2010).

Pygmy Killer Whale

Pygmy killer whales (*Feresa attenuate*) are small members of the dolphin group and are found primarily in deep waters throughout tropical and subtropical areas of the world. Pygmy killer whales usually occur in groups of 50 or less. They are generally less active than other oceanic dolphins; frequently they are seen "logging"--resting in groups at the surface with all animals oriented the same way. They prefer deeper areas of warmer tropical and subtropical waters where their prey is concentrated. The numbers of pygmy killer whales off the U.S. or Canadian Atlantic coast are unknown, and seasonal abundance estimates are not available for this stock, since it was rarely seen in any surveys. A group of six pygmy killer whales was sighted during a 1992 vessel survey of the western North Atlantic off of Cape Hatteras, North Carolina, in waters >1500 meters deep (Hansen et al. 1994), but this species was not sighted during subsequent surveys (NMFS 1999a; NMFS 2002; Mullin and Fulling 2003). Pygmy killer whales are expected to be uncommon within the vicinity of the nearshore area and proposed borrow area.

False Killer Whale

False killer whales (*Pseudorca crassidens*) are large members of the dolphin family. These whales are gregarious and form strong social bonds. They are usually found in groups of 10 to 20 that belong to much larger groups of up to 40 individuals in Hawaii and 100 individuals elsewhere. False killer whales are also found with other cetaceans, most notably bottlenose dolphins. They feed during the day and at night on fishes and cephalopods. False killer whales occur in the U.S. in Hawaii, along the entire West Coast, and from the Mid-Atlantic coastal states south. They prefer tropical to temperate waters that are deeper than 3,300 feet (1000 meters) (<http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/falsekillerwhale.htm>, accessed December 22, 2010). Since false killer whales prefer deeper water, they are expected to be uncommon within the vicinity of the project area.

Short-finned Pilot Whale

Short-finned pilot whales (*Globicephala macrorhynchus*) are found in warm temperate and tropical waters and occur primarily along the Atlantic coast south of Cape Hatteras. Strandings along the east coast of Florida have occurred during fall, winter, and spring. As they occur predominantly in the offshore waters of Florida beyond the continental shelf, pilot whales are not expected to occur nearshore or in the vicinity of the project area.

Orca

Orcas (*Orcinus orca*) normally occur in small groups and feed on bony fishes, sharks, rays, skates, cephalopods, seabirds, sea turtles, and other marine mammals. Orca sightings off the coast of northern Florida have been close to shore. However, just to the north off of North Carolina, there are sightings in deep waters seaward of the continental shelf break. Orcas are expected to be rare throughout the year between the shoreline and the proposed borrow area.

3.7. ESSENTIAL FISH HABITAT

The Magnuson-Stevens Fishery Conservation and Management Act requires identification of habitats needed to create sustainable fisheries and comprehensive fishery management plans (FMPs) with habitat inclusions. The act also requires preparation of an EFH assessment (Appendix E) and coordination with NMFS when EFH impacts occur.

EFH is defined as “those waters and substrates necessary to fish for spawning, breeding, feeding or growth to maturity” [16 U.S.C. § 1801(10)]. Waters are defined as aquatic areas and their associated physical, chemical, and biological properties that are used by fish during each stage of their cycle. Substrate includes “sediment, hardbottom, structures underlying the waters, and associated biological communities”. Necessary is defined as “the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem.” Fish includes finfishes, mollusks, crustaceans, and all other forms of marine animal and plant life other than marine mammals and birds, whereas “spawning, breeding, feeding, or growth to maturity” covers the complete life cycle of species of interest.

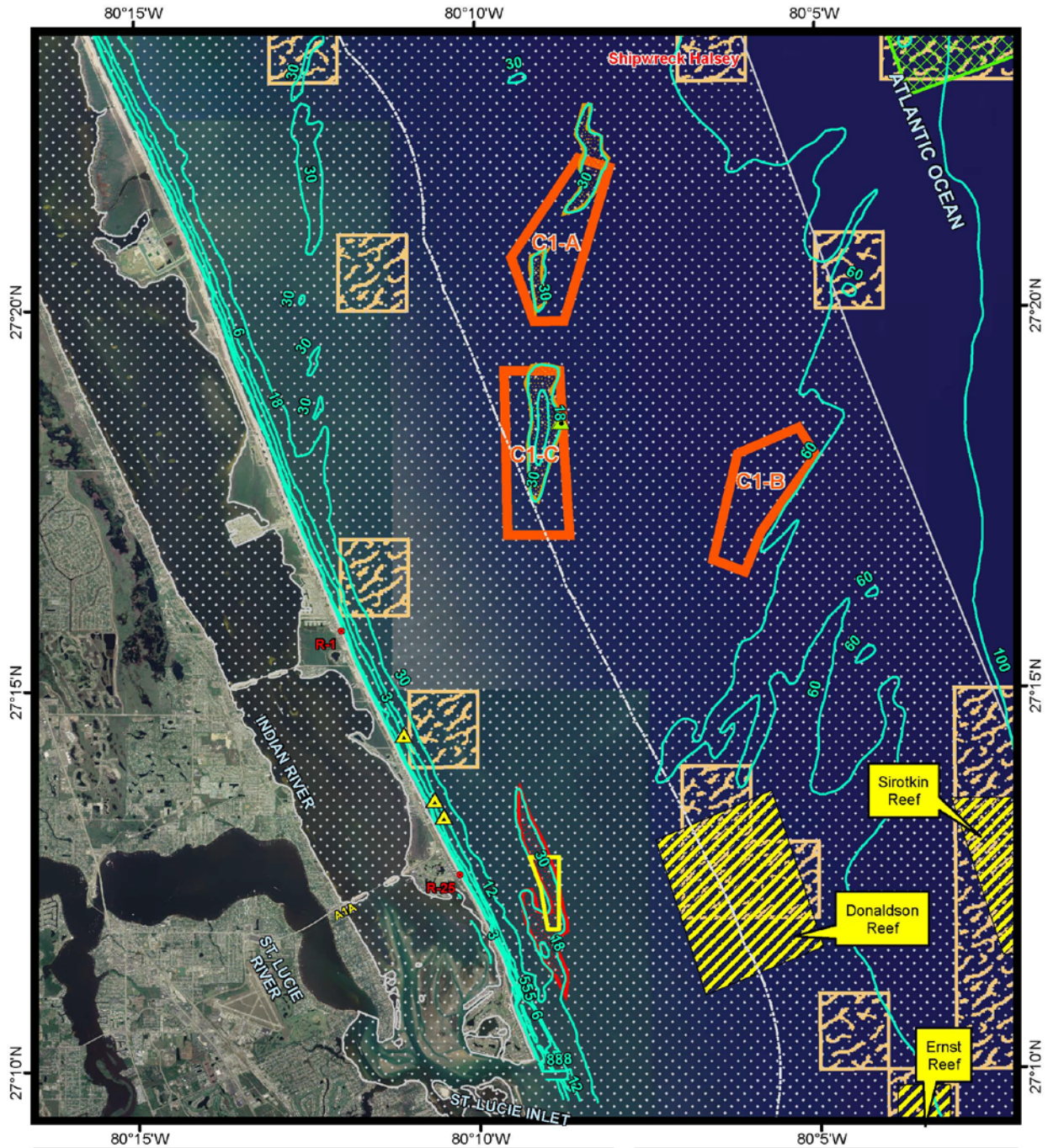
The project area falls under the jurisdiction of the South Atlantic Fisheries Management Council (SAFMC), which is responsible for the conservation and management of fish stocks within the federal 200-mile limit of the Atlantic Ocean off the coasts of North Carolina, South Carolina, Georgia, and east Florida to Key West. The SAFMC has produced several Fisheries Management Plans (FMPs) for single and mixed groups of species. All of these FMPs, including those for penaeid shrimps, spiny lobster, red drum, snapper-grouper (reef fishes) and coastal migratory pelagics were amended in a single document (SAFMC 1998b) to address EFH within the South Atlantic region. In addition to the FMPs prepared by the SAFMC, highly migratory species (e.g., tunas, billfishes, sharks, and swordfish) are managed by the Highly Migratory Species Management Unit, Office of Sustainable Fisheries, NMFS. This office prepared an FMP for highly migratory species that includes descriptions of EFH for sharks, swordfish, and tunas (NMFS 1999b). The SAFMC recently prepared a Fishery Ecosystem Plan (SAFMC 2009) that expands many of the EFH descriptions provided in the Habitat Plan (SAFMC 1998b). Note that some of the species managed by SAFMC and NMFS also are under the jurisdiction of the Atlantic States Marine Fisheries Commission (ASMFC) in order to further coordinate the conservation and management of the states' shared fishery resources.

Table 3.7-1 summarizes species or species groups managed by the SAFMC and NMFS that may be found within or in the vicinity of the project area. **Figure 3.7-1** depicts EFH in the project area and **Figures 3.4-1a,b,c** depict nearshore hardbottom resources along the project reach. Members of these groups occur in the project area for at least a portion of their life history. The following subsections briefly describe the EFH for these species and their respective life stages.

Table 3.7-1. EFH Designations, Associated Species Complexes, and Locations

EFH Designation	Fishery	Position within the Project Area
<i>Sargassum</i>	Dolphin-Wahoo, Snapper/Grouper, Highly Migratory Species	Borrow Area
Sandy Shoals	Coastal Migratory Pelagics, Sailfish	Borrow Area
Hardbottom	Snapper/Grouper, Spiny Lobster	Fill Area
Artificial Reefs	Red Drum, Snapper/Grouper	Fill Area
Offshore Marine Habitats Used for Spawning and Growth to Maturity	Penaeid Shrimp	Borrow Area
Ocean High-Salinity Surf Zones	Red Drum, Coastal Migratory Pelagics	Fill Area
Nearshore Shelf/Oceanic Waters	Spiny Lobster	Fill Area
Shallow Subtidal Bottom	Spiny Lobster	Fill Area

The continental shelf off South Hutchinson Island is unique in that its climate and oceanographic and topographical setting within tropical and warm temperate aquatic environments has produced an exceptionally complex and uniquely rich fish fauna and EHF setting in a relatively small area (Gilmore 2008). Gilmore (2008) compiled information from the published literature, unpublished literature, unpublished fish survey data, and interviews with local fishermen to provide quantitative information on regional fish distribution, life history, ecology, and EFH in coastal waters adjacent to South Hutchinson Island and the Florida central east coast. This study was conducted to help make informed decisions and predictions of fish and fishery impacts relevant to beach restoration activities, including ocean shoal sand.



LEGEND

● Range Monuments	▨ Artificial Reef Areas
▲ Mitigation Reefs	▭ Potential Borrow Sites
▲ St. Lucie Shoal USCG Buoy	▭ Potential Worm Reefs
▭ Previous Borrow Area	▭ SEAMAP Offshore Hard Bottom
— Bathymetric Contours	
— Federal/State Boundary	
▭ Gilbert Shoal (Previous Borrow Site)	
▭ Snapper/Grouper Special Mgt. Zones	
▭ St. Lucie Shoal	

FIGURE 3.7-1.
ESSENTIAL FISH HABITAT
MARTIN COUNTY HURRICANE AND
STORM DAMAGE REDUCTION PROJECT
HUTCHINSON ISLAND, FLORIDA

This map and/or digital data is for planning purposes only and should not be used to determine the precise location of any feature. Data provided as-is. Q:\GIS PROJECTS\SEIS_MARTIN_CO\SEIS\Figure updates 030211\Figure3.7-1_EFH_070810. Data sources: LABINS, FGDL, FDEP, ANAMAR.

3.7.1. ESSENTIAL FISH HABITAT TYPES

3.7.1.1. *Sargassum*

Sargassum, a genus of macroalga that permanently drifts at the surface in warm waters of the Atlantic Ocean (SAFMC 2002), normally occurs in scattered individual clumps ranging from 10 to 50 cm (4 to 20 inches) in diameter. Accumulation of *Sargassum* and other flotsam in lines often indicates a convergence zone between water masses. Convergence zones are sites of considerable biological activity; many species (including juvenile sea turtles and pelagic fishes) will gather along these zones regardless of whether *Sargassum* or other flotsam is present (Carr 1986).

Floating *Sargassum* provides habitat for as many as 100 fish species at some point in their life cycle, but only two spend their entire lives there: the Sargassumfish and the Sargassum pipefish (Adams 1960, Dooley 1972, Bortone et al. 1977, SAFMC 2002). Most fishes associated with *Sargassum* are temporary residents (e.g., juveniles of jacks, triggerfishes, flyingfishes, and filefishes). Adults of these species reside in shelf or coastal waters (McKenney et al. 1958, Dooley 1972, Bortone et al. 1977, Moser et al. 1998, Comyns et al. 2002). In addition, several larger species of recreational or commercial importance, including dolphin, yellowfin tuna, blackfin tuna, skipjack tuna, little tunny, and wahoo, feed on the small fishes and invertebrates attracted to *Sargassum* (Morgan et al. 1985).

The SAFMC has designated *Sargassum* as EFH for species in the snapper-grouper complex and the dolphin-wahoo fishery. Species within the snapper-grouper complex use *Sargassum* for spawning (SAFMC 2002). *Sargassum* is considered a Habitat of Particular Concern (HAPC) for dolphin and wahoo (SAFMC 2003a). In addition to SAFMC-managed species, billfish and swordfish utilize *Sargassum* for various life stages.

3.7.1.2. Sandy Shoals

Coastal migratory pelagic fish use sandy shoals for all lifestages, though spawning most frequently takes place inshore (Collette and Nauen 1983). It is likely that sailfish, though a member of the highly migratory species complex, also use the shoals for spawning. This species tends to frequent nearshore waters more often than other highly migratory species. Interviews conducted with local fishermen indicated that shoals concentrate planktivorous fish, herrings, sardines, and menhaden. The large schools of herrings, sardines, and menhaden attract pelagic carnivores such as barracuda, mackerel, little tunny, and various jacks and sharks to waters adjacent to the shoals (Gilmore 2008).

Gilmore (2008) stated the sand/shoal fish assemblage studies of Walsh et al. (2006) and Vasslides and Able (2008) were of direct value. The Walsh and Vasslides-Able studies provide insight into the value of shoals to both benthic and pelagic species and have relevance in Florida even though they were both based on work done on the continental shelf in other states. Vasslides and Able (2008) found that sand ridges (sand shoals) off New Jersey were “strategic ecological features” increasing the

abundance of certain species and providing EFH for economically important species, commercial, and recreational fisheries.

3.7.1.3. Nearshore Hardbottom

Nearshore hardbottom provides EFH for the snapper-grouper species complex and the spiny lobster. This habitat is derived from large accretionary ridges of coquina mollusks, sand, and shell marl, which lithified parallel to ancient shorelines during Pleistocene interglacial periods (Duane and Meisburger 1969). The habitat complexity of nearshore hardbottom is expanded by colonies of tube-building polychaete worms (Kirtley and Tanner 1968) and other invertebrates and macroalgae (Goldberg 1973, Nelson and Demetriades 1992). Generally, nearshore hardbottom is utilized by adult and juvenile fishes, and for spawning by the large and diverse snapper-grouper complex. Juvenile spiny lobsters use nearshore hardbottom before moving to offshore reefs as they mature (FWRI Web article http://research.myfwc.com/features/view_article.asp?id=4128).

Nearshore hardbottom habitat occurring in the project area was described in Section 3.4. On a broad scale, nearshore hardbottom is distributed in patches along the east coast of Florida, providing important ecological functions for plants, invertebrates, marine turtles, and fishes of the region (CSA International, Inc. 2009a) and is considered EFH for coastal pelagic and reef fish management units (SAFMC 1998a, 2009). More detailed information on specific fish assemblages can be found in Section 2.1.2 of Appendix E. Structural complexity of nearshore hardbottom is augmented by the reef-building polychaete *Phragmatopoma lapidosa*.

The only HAPC for coral, coral reefs, and live/hardbottom within the project area is the *P. lapidosa* worm reefs found on nearshore hardbottom in water depths of 0 to 4 meters.

3.7.1.4. Artificial Reefs

Artificial reefs are designated EFH for the snapper-grouper complex and red drum fishery. Mitigation reefs A, B, and C are situated approximately 900 feet offshore of the project area (Appendix G). Man-made reefs are deployed to change habitats from a soft to a hard substrate system or to add vertical profile to low-profile (<1 meter) hard substrate systems. These reefs are generally deployed to provide fisheries habitat in a specific desired location that provides some measurable benefit to humans. Man-made reefs provide new primary hard substrate similar in function to newly exposed hardbottom (Goren 1979). Aside from the often obvious differences in the physical characteristics and materials involved in creating a man-made reef, the development and ecological succession of the epibenthic assemblages occur in a similar fashion on natural hard substrates and man-placed hard substrates (Wendt et al. 1989). Demersal reef-dwelling finfish, pelagic planktivores, and pelagic predators use natural and man-made hard substrates in very similar ways and often interchangeably (Sedberry and Van Dolah 1984). The changes in species composition and local abundance of important species in a specific area are often seen as the primary benefits of reef deployment activities.

3.7.1.5. Offshore Marine Habitats Used for Spawning and Growth to Maturity

Penaeid shrimp utilize offshore habitats for multiple life stages. Shelf waters encompassing the three potential borrow areas provide suitable water depth and substrate for spawning shrimp, which migrate offshore as adults. EFH for penaeid shrimp includes inshore estuarine nursery areas, offshore marine habitats for spawning and growth to maturity, and all interconnecting water bodies (SAFMC 1998a, 1998b). Offshore waters also serve as habitat for larval and post-larval shrimp. These shrimp are planktonic and feed on zooplankton in the water column.

3.7.1.6. Nearshore Shelf/Oceanic Waters and Shallow Subtidal Bottom

Nearshore shelf/oceanic waters and shallow subtidal bottom waters are designated as EFH for spiny lobster and are present in the study area. Post-larvae and juveniles utilize these habitats. Larvae and pueruli are dispersed from the Florida Current to the Gulf Stream, advecting into coastal gyres and countercurrents to ultimately inhabit shelf waters and rocky substrate in the study area.

3.7.1.7. Ocean High-Salinity Surf Zone

This zone is designated EFH for coastal migratory pelagics and red drum. Coastal migratory pelagics may utilize this zone during all life stages. Adult red drums utilize this zone during spring and fall migration.

3.7.1.8. Water Column

The water column is considered EFH for the highly migratory species complex. Sailfish, in particular, are known to spawn nearer to shore than the other billfish in this category; therefore, they are included in this assessment.

3.7.2. MANAGED SPECIES

3.7.2.1. Coastal Pelagic Fishes

The major coastal pelagic families occurring in nearshore waters of the project area are ladyfish (*Elops saurus*), anchovies (*Anchoa* spp.), herrings (*Harengula* spp, *Opisthonema oglinum*, and *Sardinella aurita*), mackerels (*Scomberomorus* spp.), jacks (*Caranx* spp., *Trachinotus* spp), mullets (*Mugil* spp.), bluefish (*Pomatomus saltatrix*), and cobia (*Rachycentron canadum*). Coastal pelagic species migrate over the region's shelf waters throughout the year. Some species form large schools (e.g., Spanish mackerel [*Scomberomorus maculatus*]), while others travel alone or in smaller groups (e.g., cobia). Many coastal pelagic species inhabit the nearshore environment along beaches and barrier islands of eastern Florida (Gilmore et al. 1981, Peters and Nelson 1987). Commonly occurring species in the project area include anchovies, menhaden (*Brevoortia* spp.), scaled sardine (*Harengula jaguana*), striped mullet (*Mugil cephalus*), hardhead catfish (*Ariopsis felis*), and Florida pompano (*Trachinotus carolinus*). Larger concentrations of anchovies, herrings, and mullets that aggregate in nearshore soft or hardbottom areas may attract larger predatory species (particularly bluefish, blue runner (*Caranx crysos*), jack crevalle (*Caranx hippos*), requiem sharks (*Carcharhinus* spp., *Negaprion brevirostris*, and *Galeocerdo cuvier*) and Spanish and king mackerel

(*Scomberomorus cavalla*). The distribution of most species depends on water temperature and quality, which vary spatially and seasonally.

Five coastal migratory pelagic fish species are managed by SAFMC: cero mackerel (*Scomberomorus regalis*), cobia (*Rachycentron canadum*), king mackerel (*Scomberomorus cavalla*), Spanish mackerel (*Scomberomorus maculatus*), and little tunny (*Euthynnus alletteratus*) (SAFMC 1998a). The habitat of adults in the coastal pelagic management unit, excluding dolphin (*Coryphaena hippurus*), is the coastal waters outward to the edge of the continental shelf in the Atlantic Ocean. The larval habitat of all species in the coastal pelagic management unit is the water column. Within the spawning area, eggs and larvae are concentrated in the surface waters (SAFMC 1998a).

Spawning of king and Spanish mackerel takes place from May through September, with peaks in July and August. The cero is thought to spawn year round with peaks in April through October, whereas little tunny spawn from April to November. The diet of these scombrids consists primarily of fishes and, to a lesser extent, penaeid shrimp and cephalopods (Collette and Nauen 1983).

Cobia spawn offshore where external fertilization takes place in large spawning aggregations; however, the pelagic eggs have been collected at both inshore and offshore stations. Based on past collections of gravid females, spawning in South Carolina takes place from mid May through August (Shaffer and Nakamura 1989), and likely earlier off the southeast coast of Florida. Cobia are adaptable to their environment and can utilize a variety of habitats and prey. They are voracious predators that forage primarily near the bottom, but on occasion capture prey near the surface. Their favorite benthic prey are crabs, and to a much lesser extent other benthic invertebrates and fishes (Ditty and Shaw 1992).

EFH for coastal pelagic species includes *Phragmatopoma* reefs (worm reefs) off the central coast of Florida; ocean high-salinity surf zone; and nearshore hardbottom is south of Cape Canaveral. This EFH also includes sandy shoals of capes and offshore bars and high-profile rocky bottom and barrier island ocean-side waters from the surf zone to the shelf break zone from the Gulf Stream shoreward (including *Sargassum*). In addition, all coastal inlets and state-designated nursery habitats are included as EFH for coastal migratory pelagic species (SAFMC 1998a).

3.7.2.2. Penaeid Shrimp

Penaeid shrimps managed by the SAFMC and found in the project area are brown shrimp (*Farfantepenaeus aztecus*), pink shrimp (*F. duorarum*), and white shrimp (*Litopenaeus setiferus*). Penaeid shrimp divide their life cycle between offshore and inshore areas. The high-salinity oceanic waters serve as habitat and spawning areas for large mature shrimp, whereas inshore areas are used as nursery areas (SAFMC 1981). Peak spawning occurs in spring, summer, and fall (Florida Fish and Wildlife Conservation Commission's Fish and Wildlife Research Institute [FWRI] http://research.myfwc.com/features/view_article.asp?id=5352).

EFH for penaeid shrimps encompasses the series of habitats used during their life history, which has two basic phases: the adult/juvenile benthic phase and the planktonic larval/post-larval phase (SAFMC 1998a). Benthic adults aggregate to spawn in shelf waters over coarse, calcareous sediments. Eggs attached to the females' abdomen hatch into planktonic larvae. These larvae and subsequent post-larval shrimps feed on zooplankton in the water column and make their way into inshore waters. For the inshore phase of the life history, post-larval shrimps settle to the bottom and resume a benthic existence in estuaries that provide rich food sources as well as shelter from predation. Young penaeid shrimps prefer shallow water habitats with nearby sources of organic detritus such as estuarine emergent wetlands or mangrove fringe.

As shrimp grow, they begin migrating toward high-salinity oceanic waters. Parker (1970) observed that the size of brown shrimp at the time of emigration is apparently related to density of individuals, but smaller individuals tended to concentrate in shallow peripheral zones. St. Amant et al. (1966) observed that as juveniles increased in size, they migrated into deeper, larger bays, through the lower bays and to offshore waters. Lindner and Anderson (1956) stated that shrimp size increased from inshore to offshore waters. The largest shrimp were in the outside waters where salinity values were highest (SAFMC 1998b).

The relative abundance of pink, white, and brown shrimp in the Atlantic may be related to offshore bottom sediment composition. Kennedy and Barber (1981) suggest that spawning pink shrimp may be most abundant off Cape Canaveral and Cape Lookout because that species has an affinity for the hard, coarse, and particularly calcareous bottom sediments indicative of those areas.

3.7.2.3. Red Drum

Red drum (*Sciaenops ocellata*), a member of the drum family Sciaenidae, occur in the project area. EFH for red drum includes tidal freshwater, estuarine emergent wetlands (e.g., flooded salt marshes, brackish marsh, and tidal creek systems), mangrove shorelines, seagrasses, oyster reefs and shell banks, unconsolidated bottom (e.g., soft sediments), ocean high-salinity surf zones, and artificial reefs (SAFMC 1998a, 2009). Red drum EFH particular to the project area includes ocean high-salinity and surf zone.

Red drum are found from Virginia to the Florida Keys, however distribution is largely determined by life stage and migration pattern. Red drum use a wide reach of the oceanic system, from the beachfront seaward. Large red drum are thought to migrate along the Atlantic coast and are subjected to man's alterations of the natural system. Nearshore and offshore bar and bank areas, such as Gaskins and Joiner Banks in South Carolina, are areas where large concentrations of red drum can be located. Nearshore artificial reefs are also known to attract red drum when they migrate in the spring and fall. Red drum concentrate around inlets, shoals, and capes, and regularly move between the surf zone and deeper water (SAFMC 1998a).

The distribution of red drum between estuarine habitat and oceanic waters is dependent largely on stage of development, temporal, and environmental factors. Red drum are euryhaline, living in both diluted and concentrated seawater. Eggs and newly hatched larvae require salinities above 25 ppt. Spawning occurs in or near passes of inlets (e.g., “Grillage” at the mouth of Charleston Harbor), where larvae are transported into the upper estuarine areas of low salinity. As larvae develop into juveniles and subadults, they utilize progressively higher salinity estuarine and beachfront surf zones. Red drum move out of estuarine areas as adults and occupy the high-salinity surf zone of nearshore and offshore coastal waters. In North Carolina and Virginia, large adults move into estuaries during summer months.

HAPCs for red drum are coastal inlets, state-designated nursery habitats of particular importance to red drum, documented sites of spawning aggregations, and habitats for submerged aquatic vegetation (SAFMC 1998a). In many areas throughout the geographic range of red drum, mature adults migrate from inshore waters to spawn in coastal and offshore areas. Tagging studies conducted in inshore waters of the area have documented that red drum will migrate to ocean inlets such as St. Lucie or Ft. Pierce, presumably to spawn (Stevens and Sulak 2001, Tremain et al. 2004). Adult and subadult red drum occur in the nearshore waters of the region during late summer and fall months.

Other sciaenids found in the project area include kingfish (*Menticirrhus* spp.), sand drum (*Umbrina coroides*), and striped croaker (*Bairdiella sanctaeluciae*). These species are not managed by the SAFMC, but may serve as prey for other managed species in the project area (e.g., reef fishes and coastal pelagic species). Striped croaker is considered a species of special concern by the State of Florida.

3.7.2.4. Snapper-Grouper Complex (Reef Fishes)

The Reef Fish Management Unit consists of 73 species from 10 families. Although the fisheries and adult habitat of most of these species exist well offshore of the project area, the young stages of several reef fishes use nearshore hardbottom (e.g., Gilmore et al. 1981, SAFMC 1998b, Lindeman and Snyder 1999, Lindeman et al. 2000). SAFMC (1998) identified the following habitats as EFH for early life stages of reef fishes: attached macroalgae, seagrasses, salt marshes, tidal creeks, mangrove fringe, oyster reefs and shell banks, soft sediments, artificial reefs, coral reefs, and hard/live bottom. The project and surrounding areas include soft bottom and hard/live bottom. Nearshore hardbottom has been identified as an important habitat for many of the 73 members of the Reef Fish Management Unit (SAFMC 1998b). Appendix E (EFH Assessment) details reef fish species with EFH in the project area.

These hardbottom features extend from nearshore out to at least 200-meter water depths. Juveniles of many species utilize both hardbottom features and inshore habitats, including artificial structures (i.e., docks and bridge pilings), mangrove roots, oyster reefs, and seagrass meadows. Eggs and larvae of reef fishes are pelagic and reside in the upper water column for the first 20 to 50 days of life. HAPCs described for the snapper-grouper management unit include high-relief offshore areas where

spawning occurs, localities of known spawning aggregations, and nearshore hardbottom areas.

Phylogenetically, the snapper-grouper complex is diverse and includes representatives of two suborders of perciformes (Percoidei and Labroidei), and the order Tetraodontiformes. However, 68 of these species are within eight percoid families. There is considerable variation in specific life history patterns and habitat use among the snapper-grouper species complex. According to NMFS stock assessments and SAFMC SSC analyses, 17 of the 73 species in the FMP are overfished (<30%). The overfished species include ten groupers, two snappers, two porgies, one grunt, one temperate bass, and one tilefish (SAFMC 1998b).

This EFH Assessment summarizes some of the ecological variations among the more commercially-valuable species. Short biological characterizations are also provided for 18 representative species from seven families. These include the serranid groupers (snowy grouper, yellowedge grouper, warsaw grouper, speckled hind, scamp, and jewfish), percichthyid temperate basses (wreckfish), lutjanid snappers (gray snapper, mutton snapper, blackfin snapper, red snapper, silk snapper, and vermilion snapper), haemulid grunts (white grunt), sparid porgies (red pogy), carangid jacks (greater amberjack), and malacanthid tilefishes (golden tilefish and blueline tilefish). Seven of these species are over-fished (SAFMC 1998b). Information on habitat use, biological attributes, and reproduction is provided for many of these and other species in Table 2 of the EFH Assessment (Appendix E).

3.7.2.5. Spiny Lobster

Spiny lobsters begin their existence in the Florida Keys as larvae that arrive on oceanic currents. As planktonic larvae, they pass through 11 life stages in more than 6 months (SAFMC 1998a). They then metamorphose into a transitional swimming stage (puerulus) (Little and Milano 1980; Lyons 1989) that is found along Florida's southeast coast year-long (Hunt et al. 1991). Pueruli travel through channels between the Florida Keys and enter nursery areas in Florida Bay and the Gulf of Mexico, where they preferentially settle into clumps of red alga *Laurencia* (Herrkind and Butler 1986). In 7 to 9 days they metamorphose into juveniles and take a solitary residence in the algal clumps for 2 to 3 months (Marx and Herrkind 1986, Hunt et al. 1991).

When juvenile spiny lobster reach a carapace length of 15 to 16 mm, they leave the algal clumps and reside individually within rocky holes, crevices, coral, and sponges. They remain solitary until carapace length reaches approximately 25 to 35 mm, when they begin congregating in rocky dens. They remain in these nurseries from 15 months to 2 years (Hunt et al. 1991).

Adult lobsters move to deeper waters in the coral reef environment, where they occupy dens or holes during daylight hours. They are nocturnal feeders and predominantly prey upon mollusks and crustacea, including hermit crabs and conch. Adults move to offshore reefs to spawn, and larvae are swept to the shallow coastal areas by the

Florida Current, where many are lost during this relatively long process (9 months) (Marx and Herrnkind 1986, Hunt and Lyons 1985; Hunt et al. 1991).

EFH for spiny lobster (*Panulirus argus*) consists of hardbottom, coral reefs, crevices, cracks, and other structured bottom in shelf waters. Juvenile habitat is in nearshore waters and ranges in type from massive sponges, mangrove roots, and seagrass meadows to soft bottom with macroalgal clumps. Spiny lobster has a complex series of planktonic larvae that are transported by small-scale currents as well as the Gulf Stream (SAFMC 1998a). At least two life stages (adults and planktonic larvae) occur in the project area. Adult spiny lobster frequently occurs in holes, crevices, and under ledges provided by nearshore and offshore hardbottom habitats in the region. On occasion these adults migrate, walking in groups or single file lines along the open seafloor (e.g., Kanciruk and Herrnkind 1978). Various stages of planktonic spiny lobster larvae are expected to occur in the water column of the project area; mostly in the vicinity of the borrow site where the advective effect of offshore currents would be prevalent. In addition, the Gulf Stream is an EFH because it provides a mechanism to disperse spiny lobster larvae. Areas that meet the criteria for essential fish habitat-habitat areas of particular concern (EFH-HAPCs) for spiny lobster include Florida Bay, Biscayne Bay, Card Sound, and coral/hardbottom habitat from Jupiter Inlet south to the Dry Tortugas, Florida (SAFMC 1998a).

3.7.2.6. Sailfish

Sailfish are distributed worldwide in tropical and temperate waters throughout the western Atlantic from the Gulf of Maine south to Brazil, and including the Caribbean Sea and the Gulf of Mexico. Compared with marlins and swordfish, sailfish are a nearshore species. Sailfish are believed to live up to 10 years and reach a weight of 110 pounds. An important spawning area for sailfish is off the lower east coast of Florida, where fish move inshore to spawn from mid-May through September. Anecdotal evidence suggests that sailfish frequent the St. Lucie shoal area (DoN 2007).

3.7.2.7. Dolphin and Wahoo

Dolphin (*Coryphaena hippurus*) and wahoo (*Acanthocybium solandri*) are oceanic species associated with the western edge of the Gulf Stream, traveling near this edge as they migrate through the project area near the offshore borrow site.

Data suggest that dolphin may be involved in northward migrations during the spring and summer, with occasional movements and migrations controlled by drifting objects in open waters. Spawning, which is poorly documented, is thought to take place in oceanic waters where pairing occurs (Ditty et al. 1994). Based on the occurrence of young dolphin in the Florida Current, spawning may be almost year round (November-July) with peak activity from January through March (Palko et al. 1982). Owing to the oceanic distribution of this species, it is not surprising that both egg and larval stages are pelagic. Upon hatching, this species experiences rapid growth, with both sexes reaching sexual maturity within the first year (Palko et al. 1982). As larvae, they feed primarily on crustaceans, with copepods as the primary prey item. Adult dolphin are opportunistic, top-level predators. They feed upon a variety of fishes (e.g., flyingfish)

and crustaceans, especially those species commonly associated with drifting flotsam and *Sargassum* in the Florida Current. As suggested by recreational catches in southern Florida, dolphins are present most frequently from March through August and again from September through February (Palko et al. 1982).

Wahoo occur in tropical and subtropical waters of the Atlantic, Pacific and Indian Oceans including the Caribbean and the Gulf of Mexico. They are short-lived fish and grow rapidly, reaching lengths up to 60.1 inches and weights up to 45 pounds. Both sexes are capable of reproducing during the first year of life, with males maturing at 34 inches and females at 40 inches. Spawning in the United States takes place from June to August. Wahoo are voracious predators that feed primarily on fishes such as frigate mackerel, butterfish, porcupinefish, and round herring.

All life stages (eggs, larvae, juveniles, and adults) of dolphins and wahoo are closely associated with the Gulf Stream and could occur in the project vicinity near the offshore borrow site (Appendix E). Dolphins, tunas, and wahoo feed on small fishes and invertebrates associated with drifting *Sargassum* and other flotsam (Manooch et al. 1983, Manooch and Mason 1984, Morgan et al. 1985). HAPC for dolphins and wahoo is *Sargassum*.

3.7.2.8. Highly Migratory Species

Worm et al. (2003) identified eastern Florida as an area supporting a high diversity of oceanic predators, such as sharks, billfishes (*Istiophoridae*), and tunas (*Thunnus* spp. and *Katsuwonus pelamis*), considered under the Highly Migratory Species Management Unit.

Many species, including tunas, swordfish (*Xiphias gladius*), and billfishes, may occur in the project area near the offshore borrow site because of the proximity to the Gulf Stream current. Swordfish and bluefin tuna (*Thunnus thynnus*) migrate through the Florida Straits and into the eastern Gulf of Mexico to spawn (NMFS 1999, 2009). *Sargassum* is important habitat for various life stages of the swordfish, billfishes, and tunas. Sailfish (*Istiophorus platypterus*), blue marlin (*Makaira nigricans*), and white marlin (*Tetrapturus albidus*) regularly occur offshore east Florida.

Coastal sharks are managed under the highly migratory species group. These species commonly occur during various life stages in inland and nearshore shelf waters of east Florida. In the project area, several managed shark species occur, including nurse (*Ginglymostoma cirratum*), hammerheads (*Sphyrna* spp.), and requiem sharks (Gilmore et al. 1981, Gilmore 2009). Some of these species are very wide-ranging and loosely associated with a variety of habitats (e.g., soft bottom, hardbottom, and the water column). Others, particularly the nurse shark, are associated closely with hardbottom habitats. EFH identified by NMFS (1999, 2009) for coastal shark species is presented in Appendix E.

3.7.2.9. Bluefish

Bluefish are managed by the Mid-Atlantic Fishery Management Council (MAFMC). Due to their wide-ranging nature, bluefish this species is included in this assessment. The following is excerpted from the NMFS website at <http://www.nmfs.noaa.gov/habitat/habitatprotection/profile/midatlantic/bluefishhome.htm>.

In the Mid-Atlantic Bight, bluefish eggs are found in the open ocean at temperatures 18°C to 22°C and salinities >31.0 ppt. Peak spawning occurs in the evening (Norcross et al. 1974). Eggs in the southern part of the Mid-Atlantic Bight may be advected south and offshore (Norcross et al. 1974).

Larvae in the Mid-Atlantic Bight occur in open oceanic waters, near the edge of the continental shelf in the southern Bight and over mid-shelf depths farther north (Norcross et al. 1974; Kendall and Walford 1979). Larvae spawned in the South Atlantic Bight (spring-spawned cohort) are subject to advection north via the Gulf Stream (Hare and Cowen 1996, Kendall and Walford 1979), but some recruit successfully to estuaries in the South Atlantic Bight (Collins and Stender 1987; McBride et al. 1993).

The transport of pelagic-juveniles was outlined by Kendall and Walford (1979) and elaborated by Hare and Cowen (1996). Many are found in the vicinity of Cape Hatteras as early as April. In May, several have been collected on the shelf in the South Atlantic Bight (Fahay 1975; Kendall and Walford 1979). By June they occur in the Mid-Atlantic Bight between the shore and the shelf/slope front, actively crossing the shelf (Hare and Cowen 1996). In both the South Atlantic Bight and Mid-Atlantic Bight, there is a strong negative correlation between fish size and depth indicating an offshore origin and onshore migration with growth.

Juveniles occur in estuaries, bays, and the coastal ocean of the Mid-Atlantic Bight and South Atlantic Bight, where they are less common. They occur in many habitats, but do not use the marsh surface. Juveniles begin to depart Mid-Atlantic Bight estuaries in October and migrate south to spend the winter months south of Cape Hatteras.

Adult bluefish occur in the open ocean, large embayments, and most estuarine systems within their range. Although they occur in a wide range of hydrographic conditions, they prefer warmer temperatures and are not found in the Mid-Atlantic Bight when temperatures decline below 14-16°C.

3.8. COASTAL BARRIER RESOURCES

The Coastal Barrier Resources Act (CBRA) of 1982 (PL 97-348) discourages development on largely undeveloped coastal barriers along the Atlantic, Gulf, and Great Lakes coasts by prohibiting use of federal expenditures. The CBRA was designed to help conserve important coastal habitats, save federal dollars, and protect human lives. Due to the urbanization and highly developed nature of much of Hutchinson Island, the northern (St. Lucie County) half and southern (Martin County) half of Hutchinson Island is not part of the CBRA.

A portion of the Martin County project lies within “otherwise protected area” (OPA) P11AP which has development protections already (Martin County Bob Graham Beach Park). New construction in OPAs cannot receive Federal flood insurance unless it conforms to the purposes for which the area is protected. No restrictions are placed on other Federal expenditures within an OPA and therefore P11AP is included in the federally authorized project.

3.9. WATER QUALITY

The State of Florida classifies surface waters from I (drinking water quality) to V (industrial water discharge quality). The biological composition of Class V waters is minimal due to the high toxicity of the water. The water quality around the St. Lucie Inlet and Atlantic Ocean has a State of Florida classification of II, which are waters that are acceptable for recreational bathing, fishing, and wildlife management. The predominant issue that affects water quality in offshore waters in south Florida is turbidity, which is considered a good measure of water quality. Turbidity is a measure of the loss in transparency of water due to the presence of suspended particulates. The more total suspended solids in the water, the cloudier it appears and the higher the turbidity. Turbidity is measured in nephelometric turbidity units (NTUs) and is measured by the intensity of light scattered passing through the water sample.

3.10. HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE

The area along the project shoreline consists primarily of residences and motels and is void of any heavy industry or repair shops. No hazardous or toxic wastes are believed to be in the project area or are knowingly discharged into the waters of the Indian River Lagoon or Atlantic Ocean. However, it is probable that some amount of petroleum byproduct from recreational boats and jet skis is discharged into the coastal waters adjacent to the project beach.

3.11. AIR QUALITY

Martin County lies within the Southeast Florida Intrastate Air Quality Region, as established by 40 CFR Part 81.49. USEPA (40 CFR Part 81.310) designates Martin County 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. The EPA has not made a designation for lead in southeastern Florida.

Ambient air quality along coastal Martin County is generally good due to prevalent ocean breezes from the northeast to the southeast. The area consists of single family and multi-family homes, condominium complexes, and large hotels. Coastal development and the popularity of the beaches area all contribute to motorized vehicles and vessels being in the project area at any given time. The project area along the island does not support any heavy industry that could be associated with airborne particulates. Because of the sea breezes that are usually present along the Hutchinson Island shore, airborne pollutants are readily dispersed. This project will not require air quality permits.

3.12. NOISE

Ambient sources of noise within the project area are beach and nearshore recreational activities, breaking surf, boat and vehicular traffic, and noise from adjacent residences. Because Martin County has many seasonal residents and tourists, many more residents are present in the homes and condominiums located along the project area during the winter months, which results in more ambient noise along the beach front as well as more boating traffic during the winter tourist season.

During project construction, noise levels in the project area both at the beach fill site and offshore borrow area will temporarily increase. This increase will be associated with construction equipment and vehicles within the beach fill area, pump out equipment in the nearshore area, and hopper dredge operations. Hopper dredge sounds consist of a combination of sounds emitted from two relatively continuous sources: engine and propeller noise similar to that of large commercial vessels, and sounds of dragheads moving in contact with the substrate (Clarke et al. 2003; Thomsen et al. 2009).

3.13. AESTHETIC RESOURCES

Consideration of aesthetic resources within the project study area is required by the National Environmental Policy Act of 1969 (NEPA), as amended and ER 1105-2-100. Aesthetic resources are defined as "those natural and cultural features of the environment that elicit a pleasurable response" in the observer, most notably from the predominantly visual sense. The 4 miles of project area public beaches have been eroded by past high tides and strong winds that have deteriorated the aesthetic character and qualities of the area. The authorized shore protection area is developed commercially and residentially and has been severely eroded. Park seawalls and bulkheads have been exposed due to intense wave action. Residential development appears to be in scale with the existing treeline and blends with it when viewed from a distance. Aesthetic resources of the proposed project area have been degraded annually by shoreline erosion.

3.14. RECREATION RESOURCES

Florida beaches historically have attracted high numbers of visitors and are responsible for a majority of tourism in the state (Pilkey et al. 1984). Martin County beaches are heavily utilized by local residents as well as tourists throughout the year and provide the basis of the tourist industry, which in turn benefits the Martin County economy. To improve public access, Martin County has completed several public access strips with parking along the project area (**Table 3.14-1**) and opened two public beaches, Stuart and Jensen. Recreational activities within the project area include, but are not limited to fishing, snorkeling, scuba diving, surfing, birdwatching, swimming, windsurfing, and boating.

The recreation capacity of the Martin County public beaches have been reduced due to erosion of the barrier island. The eroded beach limits recreational use, especially during high tide when very little dry beach is available for passive and active recreational activities. Public parks have spent a considerable amount of money to enhance and preserve beaches for public use along high energy shorelines.

Martin County’s beaches and ocean environment provide many recreational opportunities for residents and visitors (**Table 3.14-1**). The high diversity of fish species in this area supports sport and recreational fishing opportunities, and Martin County is known as the “Sailfish Capital of the World”. With the Gulf Stream just offshore, Martin County is considered by many to be a boating and fishing paradise. With more than 20 marinas, a dozen fishing and sightseeing charters, and a variety of bait and tackle shops, Martin County offers an abundance of boating and fishing excursions.

Scuba diving is also a popular recreational activity. Local waterways have many beautiful reefs and colorful marine life. Snorkeling and scuba diving bring out many visitors and residents to the beaches, rivers, and offshore spots. Martin County’s Artificial Reef Program now offers over a dozen outstanding sites for fishing and dive exploration, and the number continues to grow.

Table 3.14-1. Public Access Points and Associated Activities along the 4-Mile Project Reach, Hutchinson Island, Martin County, Florida

Public Access	Parking Spaces	Activities/Amenities
Glasscock	40	Fishing, surfing, birdwatching, shelling, dune walkovers
Jensen Beach	316	Fishing, surfing, swimming, birdwatching, shelling, snorkeling, windsurfing, dune walkovers
Bob Graham	70	Diving, fishing, swimming, surfing, snorkeling, birdwatching, shelling, dune walkovers, showers
Alex’s Beach	15+	Fishing, swimming, snorkeling, birdwatching, shelling, dune walkovers
Bryn Mawr	27	Fishing, swimming, birdwatching, shelling
Stokes	10	Fishing, swimming, surfing, snorkeling, birdwatching, shelling, dune walkovers
Virginia Forest	26	Fishing, swimming, birdwatching, shelling, dune walkovers
Tiger Shores	31	Fishing, swimming, surfing, birdwatching, shelling, dune walkovers, showers
Stuart Beach	238	Lifeguard, concession, picnic area, restrooms, fishing, surfing, swimming, birdwatching, shelling, snorkeling, windsurfing, dune walkovers, showers, museum

Source: USACE (2005)

3.15. NAVIGATION

Most of the vessel traffic within the Martin County area is associated with recreational boating, fishing, and SCUBA diving. While most of the concentrated vessel traffic is within the Indian River Lagoon and the St. Lucie Inlet, private and chartered fishing boats are common along the nearshore and offshore reefs and shoals.

The proposed borrow areas are 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.

3.16. CULTURAL RESOURCES

The earliest widely accepted date of occupation by aboriginal inhabitants of Florida dates from around 12,000 years ago. This earliest cultural period, called the Paleo-Indian period, lasted until about 7500 B.C. Sea level was lower and the continental shelves were exposed--an area almost twice the width of the current size of the state. Few Paleo-Indian archeological sites are recorded in Florida, however, two are recorded in the vicinity along the Atlantic coast. These are the Douglass Beach site (8SL17) to the north in St. Lucie County and the Cutler Ridge site in Dade County to the south.

During the Archaic period (ca. 7500 B.C. to ca. 500 B.C.), a wider range of resources was exploited and may have led to a more sedentary existence. Sea level rose to its present position. Few Archaic period archeological sites are recorded in south Florida. Known sites are clustered along the Atlantic and Gulf coasts and inland waterways. Four sites have been recorded in Martin County. Most notable is the Hutchinson Island burial mound (8MT37), a National Register eligible Late Archaic site located to the south of the project area.

The Glades culture sequence (ca. 500 B.C. to A.D. 1513) follows the Archaic in this part of Florida, with the largest number of sites along the coasts. Glades site types recorded by the Florida Master Site File include shell and earth middens and low sand mounds located near the project area.

During the early historic period, beginning with the first Spanish colonial period (1513 to 1763), the Calusa inhabited southern Florida. Other native tribes, the Jaega and the Ais inhabited the Atlantic coast as well. Their population was decimated by European-introduced diseases, warfare, enslavement, and migration out of Florida.

The Miccosukee and the Seminole migrated into Florida in the 18th and 19th centuries from Georgia and Alabama. Throughout the mid 1800s, the U.S. relentlessly pursued a policy of Indian removal in Florida. The Seminole and Miccosukee, resisting removal, eventually established themselves in the Everglades, Big Cypress Swamp, and the Ten Thousand Islands.

American settlement in south Florida began in earnest in the late 19th century and in project area, in the 1880s. The earliest communities in Martin County developed along the west bank of the Indian River where the soils were ideal for pineapple production. In the late nineteenth and early twentieth centuries, the Florida East Coast railway brought new settlers and tourists. Land and agriculture were the economic backbone of South Florida.

In 1926 and 1928, hurricanes demolished the region and recovery from the after effects only began around World War II. By the 1950s, the population of the region had exploded and today Martin County's industry includes cattle, agriculture, commercial and sport fishing and tourism.

The Florida Master Site File at the Division of Historic Resources has recorded three historic properties within the beach renourishment area of the Martin County HSDR project. The Jensen Beach site (8MT2), ineligible for the National Register of Historic Places (NRHP), is a prehistoric shell midden located on the beach. It was initially discovered in the 1950s, was revisited in 1994 (Carr 1995) and was not relocated. It is assumed destroyed and is documented as such in the Florida Master Site Files.

Additionally, two, historic shipwrecks, the *No Name* shipwreck (8MT17) and the *Coszme Calzado* (8MT44), are also recorded along the nearshore of the Martin County HSDR project. They date from the mid-nineteenth and early twentieth centuries, respectively. Both vessels were wooden hulled and remnants, including anchors, ballast, pipes and cables are extant along the nearshore of the project area.

The House of Refuge at Gilberts Bar (8MT27), to the south of the project area, is listed on the National Register of Historic Places (NRHP). This is one of only ten Houses of Refuge built by the U.S. Life Saving Service in 1876 that still exists. Immediately to the south of the House of Refuge, the *Georges Valentine* (8MT21), another twentieth century historic shipwreck, lies just offshore. This shipwreck is also listed on the NRHP.

On February 5, 1980, the State Division of Archives, History, and Records Management and the Heritage Conservation and Recreation Service were notified by letter of the proposed action and their comments requested. Both agencies indicated that the proposed project would not adversely impact any sites listed, or eligible for listing, in the National Register of Historic Places.

For the offshore borrow areas for the Martin County HSDRP, the Division of Historical Resources reviewed the project in accordance with Section 106 of the *National Historic Preservation Act of 1966*, as amended, *36 CFR Part 800: Protection of Historic Properties*, and the *National Environmental Policy Act of 1969*, as amended. In a letter to USACE dated July 20, 2006, it was recommended that the proposed borrow sites, Areas C1-A and C1-B, located offshore of St. Lucie County in the area known as the "St. Lucie Shoal" (DHR No. 2006-3203) be investigated by a professional underwater archeologist to locate known and unidentified shipwreck sites that may be impacted by sand borrowing activities associated with the proposed project. Data from the Florida Master Site Files indicate two documented shipwrecks within close proximity to the proposed borrow areas, the *Halsey* (8SL30) and the *America* (8SL28). The *Halsey*, a shipwreck from 1942, is located approximately 1.5 miles north of area C1-A according to NOAA nautical charts and shipwreck data

Between September 2007 and June 2008, SEARCH conducted an underwater remote sensing survey of four proposed sand borrow areas for shore protection projects in the

region. This survey included the borrow area C1-B which is the preferred borrow area for the Martin County HSDRP project. The remote sensing survey used a magnetometer, sidescan sonar, and sub-bottom profiler, integrated with a Differential Global Positioning System (DGPS), to identify any potentially significant submerged cultural resources within these borrow areas.

Results of the survey in the report titled, *Historic Assessment and Submerged Cultural Resources Remote Sensing Survey of Four Borrow Areas for Martin and St. Lucie Counties Shore Protection Projects, Florida* (SEARCH 2008) identified no potentially significant submerged cultural resources with borrow area C1-B. SEARCH also located two previously recorded historic shipwrecks, the *Amazone* (8SL29) and the *Halsey* (8SL30) outside of the project area. SEARCH did not locate the previously recorded *America Wreck* (8SL28) but determined it does not exist in the project area.

3.17. SOCIOECONOMICS

3.17.1. DEMOGRAPHICS

The 2000 census estimated there were 126,731 people residing in Martin County, and the 2007 population estimate was 139,182 people. From April 1, 2000, to July 1, 2007, the population percent change was estimated at 9.8%. Median household income for 2007 was estimated at \$55,229. In 2007, approximately 8.5% of the population was living below poverty. In 2006, of the population that was 25 years of age or older, 88.6% had graduated from high school and 29.0% had a bachelor's degree or higher.

3.17.2. ECONOMICS

3.17.2.1. Tourism

Martin County's economy is largely based on tourism. The tourist dollars brought into Martin County each year account for a large portion of the County's revenue base. Many businesses, particularly along the coast, are tourist-oriented and rely on revenue generated from tourists (<http://www.martin.fl.us>). Tourist-related taxes collected in Martin County in 2007 were \$615,861 (**Table 3.17-1**) (Leigh Goldstein, Marstel-Day, LLC 2008).

Table 3.17-1. Tourism-Related Tax Revenue

Tax Year	Martin County Bed Tax (2%)
2003	\$511,465
2004	\$629,085
2005	\$692,175
2006	\$668,563
2007	\$615,861

Source: Andreassi (2008)

3.17.2.2. Fishing

East central Florida fisheries are significant in economic (billions of dollars) (Kidlow 2008) and aesthetic value. The commercial fishery landings for St. Lucie and Martin Counties alone were worth \$3 to \$9 million annually between 1990 and 2007 (Gilmore 2008). In addition to commercial fishing, recreational fisheries, tournaments, and artificial reef programs contribute significantly to the local economy.

Central east Florida coastal counties not only possess significant inshore fisheries (snook, red drum, spotted seatrout, tarpon, sheepshead, gray snapper, stone/blue crab, shrimp, clam/oyster), but also major lucrative coastal and offshore fisheries (sailfish, swordfish, dolphin, king and Spanish mackerel, pompano, grouper and snapper, shrimp, scallop, spiny lobster) (Gilmore 2008). Local fishing tournaments bring competitors from throughout the United States.

The USFWS and U.S. Census Bureau's 2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation reported that 2.8 million residents and non-residents age 16 years or older sport-fished in Florida, of which 68 percent were Florida residents. In Florida, anglers 16 years or older spent approximately \$4.3 billion on fishing expenses in 2006. Totals include food, lodging, transportation, equipment rental, bait, and cooking fuel. **Table 3.17-2** summarizes total recreation expenditures for fishing in Florida in 2006.

Table 3.17-2. Sport Fishing Expenditures in Florida for State Residents and Non-Residents 16 Years and Older

Expenditure	Cost
Trip-related	\$2.0 billion
Equipment	\$1.9 billion
Other	\$393 million
Total	\$4.3 billion

Source: USFWS and U.S. Census Bureau 2006

A study was conducted to estimate the net economic value that the natural and artificial reef resources of Martin County provide to the local economy and reef users (Hazen and Sawyer 2004). In 2003, visitors and residents spent 529,000 person-days using artificial and natural reefs in Martin County (person-day = one person participating in an activity for a portion or an entire day). Fishing on the reefs is by far the most prevalent reef-related activity in Martin County, comprising 86% of reef-using person-days. Economic contributions related to the use of artificial and natural reefs in Martin County are summarized in **Table 3.17-3**. In 2003, residents and visitors spent \$20 million in reef-related expenditures in Martin County. These expenditures generated \$13.1 million in sales in Martin County, which resulted in \$5.8 million in income to Martin County residents and provided 182 jobs in the county. Reef expenditures generated indirect business taxes of \$856,000.

Table 3.17-3. Economic Contribution of Reef-Related Expenditures to Martin County, Florida, 2003 Residents and Visitors

Type of Economic Contribution	Artificial Reefs	Natural Reefs	All Reefs
Sales, in 2003 dollars ^(a)	\$7,172,000	\$5,965,000	\$13,137,000
Income, in 2003 dollars ^(b)	\$3,211,000	\$2,630,000	\$5,841,000
Indirect Business Taxes, in 2003 dollars ^(c)	\$460,000	\$396,000	\$856,000
Employment ^(d)	99	84	182

a The sales contribution is defined as the value of the additional output produced in the county due to the reef-related expenditures.

b Total income is the sum of wages, salaries, proprietor's income, profits, rents, royalties, and dividends.

c The indirect business tax contribution is the sum of the additional excise taxes, property taxes, fees, licenses, and sales taxes collected due to the reef-related expenditures. It excludes taxes on profit and income.

d Employment includes the number of full-time and part-time jobs.

Source: Hazen and Sawyer (2004)

To obtain demographic characteristics of the reef users in Martin County, resident and visitor boater surveys were conducted. Results of these surveys are summarized in **Tables 3.17-4 and 3.17-5**. The median age of respondents in Martin County who were resident reef users was 53, and the median age was 53 for visitor reef users. Ninety-six percent of the resident reef users were male and 4% were female. Ninety-two percent of the visitor reef users were male and 8% were female. On average, residents have been boating in south Florida for 22 years, while visitors have been boating only for 5 years. The resident reef user's average boat length is 26 feet. Nearly 20% of the respondents were members of fishing and/or diving clubs. The median household income for resident reef users was \$87,500, and \$45,000 for visitor reef users.

Table 3.17-4. Residents: Demographic Characteristics and Boater Profile of Resident Reef Users in Martin County, Florida, 2003

Characteristics	Reef-Users	Martin County Population ^(a)
Median age	53	48
Sex:		
Male	96%	49%
Female	4%	51%
Median household income	\$87,500	\$43,083
Boater profile:		
Average years of residence in Martin County	14	N/A
Average years of boating in South Florida	22	N/A
Average length of boat used for saltwater activities	26 ft.	N/A
Percentage of respondents who belong to fishing and/or diving clubs	19%	N/A
Sample size	272	--

a From the U.S. Bureau of the Census (1999 and 2000)

Source: Hazen and Sawyer (2004)

Table 3.17-5. Visitors: Demographic Characteristics Visitor Reef Users in Martin County, Florida, 2003

Characteristics	Value	Number of Respondents
Median Age of Respondent	53 years	506
Sex of Respondent:		495
Male	92%	--
Female	8%	--
Median Household Income, 2003 Dollars	\$45,000	406
Average Years of Boating in Southeast Florida	5	511
Percentage of Respondents Who Own Boat	82%	500
Percentage of Respondents Who Belong to Fishing and/or Diving Clubs	10%	500

Source: Hazen and Sawyer (2004)

4. ENVIRONMENTAL EFFECTS

This chapter is the scientific and analytic basis for comparing and contrasting the alternatives. It includes a discussion of the anticipated changes to the existing environment including direct, indirect, and cumulative effects. **Table 2.2-5** in Section 2 summarizes and compares the effects of the three alternatives considered (Beach Nourishment Using the Offshore Borrow Area C1-B, Beach Nourishment Using an Upland Sand Source, and the No Action Alternative).

4.1. GENERAL ENVIRONMENTAL EFFECTS

4.1.1. BEACH FILL AREA

The beneficial effects of sand renourishment along the proposed project area include establishing a larger buffer area to protect against storms and flooding, and creating additional dry beach for turtle nesting and recreational activities. Beach renourishment will likely increase sea turtle nesting habitat provided the sand is compatible with naturally occurring beach sediments and that compaction and escarpment remediation measures are incorporated into the project.

Potential negative effects to sea turtles include possible destruction of nests deposited within the boundaries of the proposed project during construction, harassment in the form of construction-related disturbance to or interference with female turtles attempting to nest within the construction area or on adjacent beaches, artificial lighting-induced disorientation of hatchlings as they emerge from the nest and crawl to the water, and behavior modification of nesting females from escarpment formation within the project area during the nesting season. Escarpments can cause false crawls or selection of marginal or unsuitable nesting areas to deposit eggs. Additionally, the quality and/or color of the donor sand could affect nesting success as related to the ability of female turtles to excavate a nest, the nest incubation environment, and the ability of hatchlings to emerge from the nest. At the dredging site, the dredge may entrain swimming turtles.

Several protective measures can minimize some of these potential negative impacts. Scheduling renourishment projects outside the sea turtle nesting window provides the most important means of avoiding and minimizing impacts. During construction, daily pre-dawn surveys to locate nests and the relocation of all found nests to a safe hatchery will reduce impacts within the construction area. During 24-hour operations, minimum and shielded construction lighting will reduce turtle avoidance of the beach and false crawl behavior. The use of sand that is similar to the “natural” or “existing” beach considering grain size distribution including a level of “fines” (material passing through a #200 sieve) not exceeding 5% will likely provide a sand suitable for natural nesting, incubation, and hatching behaviors. After construction, beach tilling can reduce sand density to appropriate levels. Likewise, post-construction removal of scarps prior to sea turtle nesting season will allow turtles to crawl up the beach to safe nesting elevations. Annual escarpment and compaction monitoring typically occurs on an annual basis just prior to the sea turtle nesting season for 3 years following construction. A more detailed discussion of reasonable and prudent measures to avoid and minimize impacts is provided in Section 4.35, Environmental Commitments.

The proposed project will likely produce more favorable environmental conditions than exists at present, although construction operations will produce some temporary adverse effects as discussed above. In addition, the presence of construction equipment and personnel will temporarily detract from the aesthetics of the beach. Construction will include best management practices to ensure efficient construction and to minimize the time that equipment and personnel remain on the project area habitats.

Immediately after renourishment, the dredged sand may be darker than the sediments on the existing beach, which may detract from the aesthetics of the beach. However, the natural working of the dredged sediments by sunlight, rain, and wind will lighten the color of the sediments in a relatively short time.

After construction, the beach profile typically undergoes a period of reworking by waves and currents. The beach fill reclines to an “equilibrium profile” within about one year of a renourishment event. Direct burial of shoreline bottom (benthic) habitat would occur within this equilibrium profile. During the first year post-construction there would be a high potential for greater-than-normal erosion of the dry beach along with possible loss of sea turtle nests. Turbidity could be elevated in the nearshore waters during renourishment and as the beach profile equilibrates during the first year post-construction.

Construction activities will result in temporary disturbance to sandy benthic habitats along the nearshore zones in the immediate proximity of construction activities. However, since these sandy beaches and subtidal areas are populated by small, short-lived organisms with great reproductive potential, these communities usually recover quickly from most environmental disturbances such as beach restoration projects (ATM 1991, Taylor Engineering 2009a).

Prior to the initial beach nourishment in 1996, numerous investigations (including sidescan sonar with ground-truthing, aerial photography, and underwater diver-verified reef characterization studies) were conducted along the project reach. These investigations revealed the presence of hardbottom reef tracts consisting of ephemeral limestone outcrops and the marine bristle worm, *Phragmatopoma lapidosa*. These reef tracts were found scattered along the project beach between monuments R-1 and R-25, with the western edge beginning approximately 500 feet seaward of the 1992 shoreline. During initial construction, 1.3 acres of hardbottom habitat located seaward of monument R-22 were directly impacted by the nourished sand sloughing seaward as it sought equilibrium with the ocean bottom. In 2000, construction of 6.0 acres of artificial reefs (A, B, and C) was completed to mitigate for direct impacts to nearshore hardbottom habitat during initial project construction. These 6 acres of artificial reefs are sufficient to offset impacts to any hardbottom reef located between R-1 and R-25, as indicated by USFWS in the Coordination Act Report dated January 24, 1994 (USFWS 1994).

If possible, previously established pipeline corridors will be used to transfer material from the dredge to the beach fill areas (**Figure 2.2-5a, b**). However, because of the ephemeral nature of hardbottom resources in the project area, the exact location of the pipelines will be determined prior to construction to avoid and minimize impacts to hardbottom to the extent possible. Since no hardbottom or archeological resources are located within or adjacent to the borrow area, no impacts are anticipated during dredging operations. A compensatory mitigation plan has been developed to address any additional impacts within the project area.

4.1.2. OFFSHORE BORROW AREA

Dredging at offshore shoals and ridges creates several physical factors that will produce impacts on biological resources associated with these features (CSA International, Inc. et al. 2009). As general categories, these physical factors are:

- Sediment removal;
- Turbidity; and
- Sediment deposition.

Removal of sediments from borrow sites can alter seabed topography, creating pits that may either refill rapidly or potentially cause detrimental impacts for extended periods of time. Immediate losses of infaunal biomass occur and these can affect adjacent areas through food web disturbances at poorly known time scales. If borrow pits are deep, current velocity is reduced at the bottom, which can lead to deposition of fine particulate matter, and in turn, a biological assemblage can be established that is much different in composition than the original. Long-term physical and biological impacts could occur if dredging significantly changes the physiography of the borrow area.

Dredging causes suspension of sediments, which increases turbidity over the bottom. Although turbidity plumes associated with dredging often are short lived and may affect relatively small areas, resuspension and redispersion of dredged sediments by subsequent currents and waves can propagate dredge-related turbidity for extended periods after dredging ends. For sand dredging from offshore shoals for beach nourishment, turbidity plumes are typically minimal, and consequently turbidity effects are expected to be less important in unprotected offshore areas because sand settles more rapidly than clay and silt and offshore shoals tend to be coarser than inshore deposits. In addition, the open ocean environment provides more dynamic physical oceanographic conditions, which minimize settling effects.

Offshore organisms are adapted to sediment transport processes, which create scouring, natural turbidity, and sedimentation under normal conditions. Biological responses to turbidity depend on all of these physical factors, coupled with the type of organism, geographic locations, and the time of year. Turbidity from dredging can affect food availability for benthic organisms. Changes in light penetration and wavelengths due to turbidity can affect visibility and may be detrimental or beneficial, depending in part on whether an organism is predator or prey.

Turbidity can interfere with food gathering processes of filter feeders and organisms that feed by sight as a result of inundation with non-nutritive particles. In addition to altered feeding rates, other biological responses to turbidity include reduced hatching success, slowed growth, abnormal development, tissue abrasion, and increased mortality. Suspension and dispersion processes uncover and displace benthic organisms, temporarily providing extra food for bottom-feeding species.

Suspended sediments settle and are deposited nearby dredged offshore sand borrow sites. The extent of deposition and boundaries of biological impact are dependent on the type and amount of suspended sediments and physical oceanographic characteristics of the area. Deposition of sediments can suffocate and bury benthic biota, although some mobile soft bottom organisms are able to migrate vertically to the new surface.

4.2. VEGETATION

4.2.1. PREFERRED ALTERNATIVE, BEACH NOURISHMENT USING OFFSHORE BORROW AREA C1-B

The proposed action may result in minor, short-term impacts to the herbaceous dune vegetation that inhabits the upper beach and foredune. Fill placement will not occur landward of the dune crest. The proposed nourishment project will help stabilize the beach and protect the dune vegetative communities from storm surge and erosion. Adding sand to the system will promote further dune habitat development.

During initial project construction, a vegetation protection plan was developed with specific measures to ensure that unacceptable impacts to the existing vegetation communities would not occur (ATM 1994). These measures should also be followed during subsequent renourishment projects. Specific measures to be undertaken include:

1. No fill will be placed landward of the existing line of woody or scrub vegetation (i.e., sea grapes). The precise landward limit of the fill will depend upon the dune conditions at the time of project construction.
2. A pre-construction consultation with FDEP will be conducted to discuss appropriate measures with respect to protection of the threatened and endangered plants within the beachfill area. Because each plant species is unique, the same approach is not necessarily appropriate for each of the species. Specific measures that may be implemented, upon consultation with FDEP, include field staking of areas containing endangered plants, plant relocation, and buffer zones. In some instances, partial or total burial of certain plants (i.e., burrowing four o'clock) may be the only reasonable construction alternative. On-site consultation with FDEP will determine if such impacts are acceptable.

4.2.2. BEACH NOURISHMENT USING AN UPLAND SAND SOURCE

Effects on vegetation at the beach fill site will be similar to the preferred alternative. Sand from an upland source would be obtained from a commercial quarry. There would likely be some terrestrial vegetation loss at the quarry site in association with the excavation of sand.

4.2.3. NO ACTION ALTERNATIVE (STATUS QUO)

The No Action Alternative would adversely affect vegetation within the project area. Continued erosion of the beach would result in continued loss of vegetated beach and dune habitats. Additionally, continued erosion may cause landowners to implement alternative amoring measures such as seawalls to protect their property. These measures could result in negative impacts to the dune system by altering profile and displacing vegetation.

4.3. THREATENED AND ENDANGERED SPECIES

The mandate of the ESA is to ensure that endangered and threatened species are protected and that government departments and agencies should take all reasonable and prudent precautions to assure that their activities do not jeopardize the continued existence, or destroy or adversely modify the critical habitats, of listed species (Dickerson et al. 2004).

4.3.1. PREFERRED ALTERNATIVE, BEACH NOURISHMENT USING OFFSHORE BORROW AREA C1-B

4.3.1.1. Sea Turtles

4.3.1.1(a). Nesting Habitat

Of the threatened and endangered species found in coastal Martin County, nourishment activities are more likely to impact sea turtles, simply by their ubiquity during nesting season. Martin County lies within the peak nesting range for three species of sea turtles (loggerhead sea turtle, green sea turtle, and leatherback sea turtle) that regularly nest along the beaches of southeast Florida. Hutchinson Island supports one of the highest loggerhead sea turtle nesting aggregations in the western Atlantic (Harris et al. 1984; Hopkins and Richardson 1984; Williams-Walls et al. 1983). 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 2005, 2007). Impacts of a nourishment project on sea turtle nesting habitat are typically short-term because a nourished beach will be reworked by natural processes in subsequent years. Constant wave and current action reworks the beach, reducing sand compaction and the frequency of escarpment formation while the sun bleaches darker sand (USFWS 2005)

Physical Alterations

Physical alterations of the beach due to beach nourishment include changes in sand compaction, density, sheer resistance, color, moisture content, and gas exchange of beach sand (Nelson and Dickerson 1988; Nelson 1991; Ackerman 1991; Ackerman

et al.1992). However, the effects of increased sand compaction and scarp formation can be greatly reduced or eliminated through compaction monitoring, mechanical tilling, and beach grading. Compaction monitoring is a state and federal permit that is required immediately following nourishment activities, prior to nesting season commencement, and for 2 years following project completion. Tilling the recently nourished beach is required by state and federal agencies if compaction (using a penetrometer test) exceeds 500 pounds per square inch at any two adjacent sampling stations or depths. Additionally, escarpments greater than 18 inches in height or 100 feet in length must be leveled prior to nesting season commencement.

Effects on Nesting Success

Potential effects of sand renourishment directly related to nesting include destruction of nests deposited within the boundaries of the proposed project, disturbing or interfering with female turtles attempting to nest within the construction area or on adjacent beaches as a result of construction activities, lighting-induced disorientation of hatchling turtles on beaches adjacent to the construction area as they emerge from the nest and crawl to the water, and behavior modification of nesting females from beach escarpment formation during a nesting season that results in false crawls or selection of marginal or unsuitable nesting areas to deposit eggs. The quality of the placed sand could affect the ability of the female turtles to nest, the suitability of the nest incubation environment, and the ability of hatchlings to emerge from the nest.

In general, research has shown that the principal effect of beach nourishment on sea turtle reproduction is a reduction in nesting success during the first year post-nourishment (USFWS 2005). Nesting success is often hindered during this first year following nourishment as a result of escarpments obstructing beach accessibility, altered beach profiles, and increased compaction (USFWS 2007). Research has also shown that the impacts of a nourishment project on sea turtle nesting habitat are typically short-term because a nourished beach will be reworked by natural processes in subsequent years, and beach compaction and the frequency of escarpment formation will decline (USFWS 2005).

The numbers of nests deposited within the study area had generally increased since 1981 (EAI 2005). However, a slight decline in nesting success occurred in 1997, the first year post-construction of the initial 1996 Martin County HSDR Project (Ernest and Martin 1999). After this period, sea turtle reproductive success rebounded to pre-construction levels (Ernest and Martin 2004). Thus, the restoration project effects were limited only to the nesting season immediately following construction.

Loggerhead turtle nesting activity on the renourished beach (Zones Z-EE) was compared to nesting activity on the control beach (Zones K-N) from 1991 through 2005 (EAI 2005). Annual numbers of loggerhead turtle nests and turtle nesting success from 1991 to 2005 are provided in **Figures 4.3-1 and 4.3-2**. Annual nest numbers for 2005 were relatively low on both beaches when compared to the previous 14 years (**Figure 4.3-1**). This is consistent with the overall trend for Florida. Loggerhead nest

numbers during 2005 were the second lowest on record for the past 17 years based on Index Nesting Beach Survey data (FWC and FWRI 2006).

During the turtle survey period from 1991 through 2005, the annual number of loggerhead turtle nests and nesting success on both the renourished beach (Zones Z-EE) and control beach (Zones K-N) exhibited similar annual fluctuation patterns (**Figures 4.3-1 and 4.3-2**). This similarity in nest fluctuations between the project and control beach was evident during both the baseline years (1991 to 1995) and following the 1996 initial renourishment event (EAI 2005). Both the project beach and control beach experienced a high number of loggerhead turtle nests in 1995 and 2000, with nests at the project beach exceeding nests at the control beach. A slight decline in nest numbers began in 1996 at the project beach and continued until 1999 (**Figure 4.3-1**). This period of decline may have coincided with the initial beach nourishment in 1996; however, the decline may also be unrelated to the nourishment since the control beach also experienced a very pronounced decline in 1997 (EAI 2005). A decline in nest numbers began in 2001 at both the project beach and control beach, suggesting that factors other than the partial renourishment events in 2001 and 2002 likely affected the number of loggerhead turtle nests (EAI 2005).

USFWS has jurisdiction over sea turtles on the beach (nesting adults, incubating eggs, and hatching young). For projects located from Brevard to Broward Counties, USFWS requires that nourishment activities not be conducted during the peak nesting season from May 1 through October 31 to minimize the impact to nesting sea turtles. In addition, USFWS requires that sea turtle nests be monitored and relocated between March 1 and April 30 if nourishment activities are conducted during that period. The 2010 USFWS Biological Opinion contains specific terms and conditions that must be complied with to minimize impacts to sea turtles during project construction (see Section 4.35, Environmental Commitments). These protective measures and the use of beach-compatible sand sources help ensure the continued existence of suitable nesting habitat for sea turtles without jeopardizing the existence of the species.

Beneficial Effects

USFWS biological opinions for similar projects acknowledge 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 2005).

For the 2012 event, USACE is proposing alternate berm templates designed to allow the beach to equilibrate more rapidly to further minimize sea turtle nesting impacts. In a recent report prepared for FDEP, assessments of alternative construction templates for beach nourishment projects were evaluated to better identify aspects of traditional beach nourishment projects that negatively or positively impact sea turtles and provided recommendations for alternative design criteria that may improve the quality of nesting habitat (PBS&J and EAI 2007). The goal of the experiment is to design an alternative construction template that more closely mimics a natural beach profile, improves the quality of the built beach as sea turtle nesting habitat, and provides an acceptable level of shoreline protection. A conceptual alternative design template is provided in **Figure 2.2-6**.

Summary

Since the proposed project would use sand with characteristics very similar to the native beach sand, sand quality will not likely have negative effects on sea turtle nesting or hatchling emergence. However, beach nourishment along the project reach may still have negative effects on nesting sea turtles (from nesting disturbance, sand compaction, potential for scarp formation, artificial lighting) during the first post-construction year. As natural processes rework the nourishment area and the beach equilibrates, the increase in beach area provided by nourishment will likely have a long-term benefit on sea turtle nesting.

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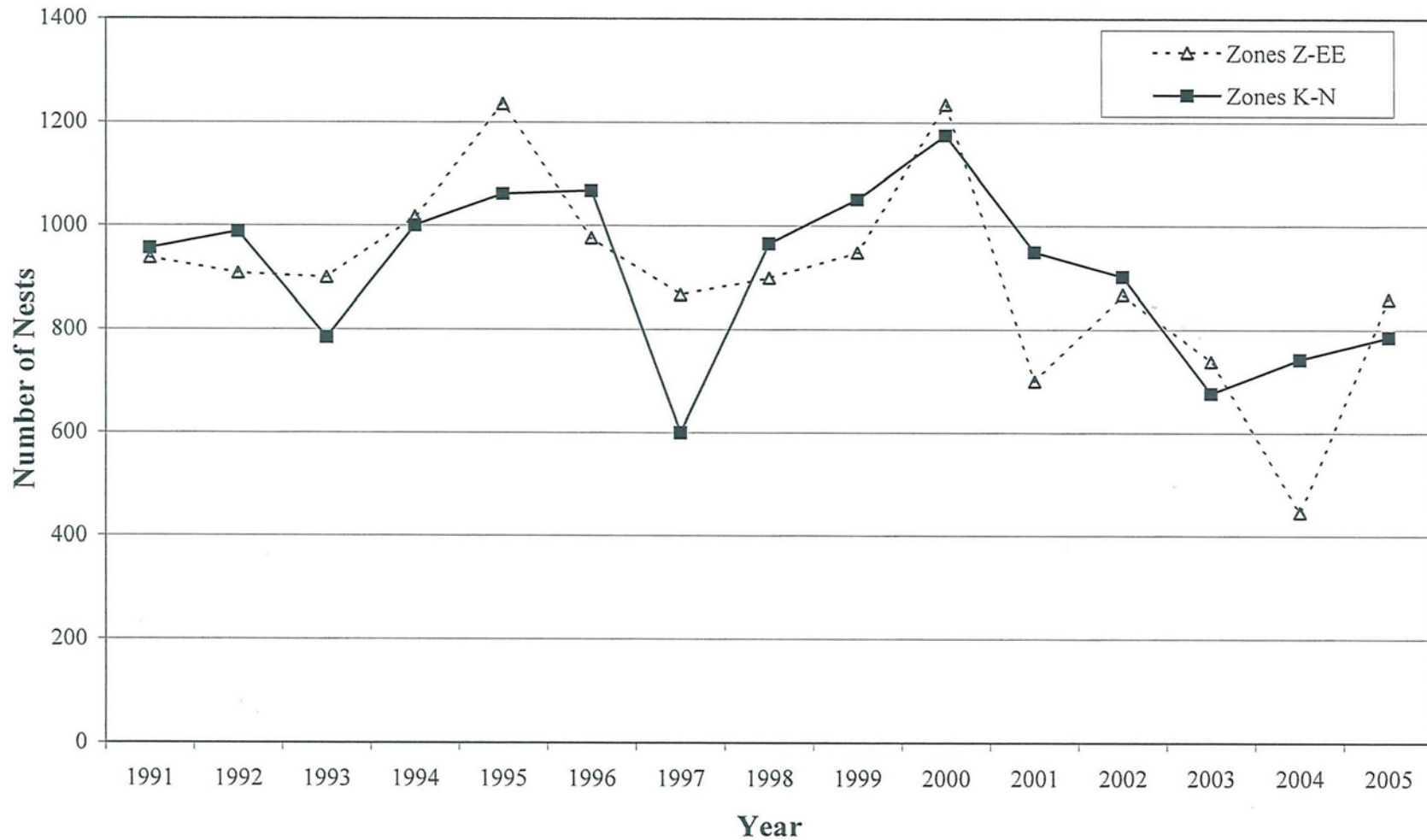


Figure 4.3-1. Annual numbers of loggerhead turtle nests along six kilometers of beach (Zones Z-EE) within the 2005 Martin County Beach Renourishment Project and four kilometers of control/natural beach (Zones K-N). The Martin County Beach Renourishment Project was completed on 30 April 2005 at the beginning of the 2005 loggerhead nesting season. Zones Z-EE were first nourished just prior to the 1996 nesting season so 1991-1995 represent baseline years. Portions of Zones Z-EE were renourished just prior to the 2001 and 2002 nesting seasons. Data Source: EAI 2005.



Figure 4.3-2. Annual loggerhead turtle nesting success along six kilometers of beach (Zones Z-EE) within the Martin County Beach Renourishment Project and four kilometers of control/natural beach (Zones K-N). The Martin County Beach Renourishment Project was completed on 30 April 2005 at the beginning of the 2005 loggerhead nesting season. Zones Z-EE were first nourished just prior to the 1996 nesting season so 1991-1995 represent baseline years. Portions of Zones Z-EE were renourished just prior to the 2001 and 2002 nesting seasons. Data Source: EAI 2005.

4.3.1.1(b) Inner Shelf Habitat

Juvenile and subadult loggerhead, Kemp's ridley, and green turtles use central east Florida inner shelf waters as developmental habitat, foraging on benthic organisms primarily on inner-shelf hardbottom habitats (Hammer et al. 2005). Impact-producing factors (IPFs) associated with the beach nourishment along the project reach using material from borrow area C1-B that may potentially affect sea turtles include:

- Vessel traffic
- Entrainment by hopper dredge dragheads
- Alteration of nearshore hardbottom habitat
- Foraging
- Turbidity
- Underwater noise from dredging equipment

Vessel Traffic

Dredge, dredge support, and construction vessel traffic associated with this project gives rise to a chance of collision between these vessels and sea turtles. The risk would vary depending upon location, vessel speed, and visibility. As discussed in Section 3.3.1.2, all life stages (hatchling, juvenile or subadult, and adult) may occur within the project area. During the hatching season, it is believed that hatchling turtles leave their nesting beaches and swim offshore to areas of water mass convergence. A moving vessel may 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 will comply with the "Sea Turtle and Smalltooth Sawfish Construction Conditions" (NOAA Fisheries 2006) and "Vessel Strike Avoidance Measures and Reporting for Mariners" issued by NOAA Fisheries, Southeast Region. The dredge vessel will be manned with trained and NMFS-approved protected species observers, and dredge support vessel operators and crews will be instructed to maintain a vigilant lookout for turtles during offshore transits and maneuvers. Despite these precautions, turtles may 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. It is assumed, however, that a collision between a sea turtle and moving vessel is unlikely. Adult, subadult, and perhaps juvenile turtles are capable of avoiding moving dredge related vessels, especially when these vessels operate within these limited areas at slow to relatively slow speeds. Impacts from collisions are, consequently, not likely to adversely affect marine turtle populations within the project area.

Entrainment by Hopper Dredge Dragheads

Incidental takes of sea turtles have been documented from hopper dredge operations that use trailing suction dragheads (NMFS 1997). However, numerous methods have been implemented to reduce the number of turtle takes during hopper dredge operations, including special turtle deflecting hopper dredge dragheads, relocation trawling, dredging windows, and the use of trained protected species observers during

dredging operations (NMFS 1997). All recommendations of the 1997 NMFS Regional Biological Opinion (RBO) for hopper dredging operations will be implemented to ensure that incidental take is minimized, and the environmental window for hopper dredging within the southeastern United States as recommended by NMFS (December 1 through March 31) will be adhered to. Environmental windows (periods when dredging is allowed) for turtle protection generally involve winter months when sea turtle abundances are known to be low.

The sea turtle deflecting draghead is required year-round for all hopper dredging projects in Southeast Florida. For offshore borrow area dredging projects in southeast Florida, the 1997 RBO also recommends 100% inflow screening and 100% outflow screening. If conditions prevent 100% inflow screening, then inflow screening can be reduced, but 100% outflow screening is required along with a justification for the change noted in the preliminary dredging report. Preliminary dredging reports that summarize the results of the dredging and note any sea turtle takes must be submitted within 30 working days of completion of any given dredging project. Logs will be maintained of any sea turtle injuries or deaths caused by hopper dredging activities, with immediate notification to USACE, Jacksonville District and NMFS.

Relocating sea turtles away from dredging sites is another management practice developed by the USACE Engineer Research and Development Center (ERDC) and recommended by NMFS in the Gulf Regional Biological Opinion (GRBO) as a potential method to reduce incidental takes (NMFS 2003). Modified shrimp trawling equipment is used to sweep bottoms to remove turtles that might be encountered by an approaching dredge and relocate captured sea turtles 3 to 5 miles from the dredging area (Dickerson et al. 2007). However, relocation trawling can severely impact hopper dredging schedules, inflate project costs, and be potentially hazardous for the threatened and endangered species intended for protection due to the rigors and stress of trawling and on-deck handling (Dickerson et al. 2007). This method of sea turtle protection is typically held as a last resort due to the high financial costs, logistical difficulties, and safety risks required to undertake such efforts (Dickerson et al. 2004). Due to these potential impacts, it is important to fully evaluate the pros and cons of this technique as a mitigation tool.

Alteration of Nearshore Hardbottom Habitat

Impacts to juvenile sea turtle species from the proposed project due to the loss of developmental nearshore habitat (hardbottom) will depend on the extent of buried nearshore hardbottom within the project area and the longevity of that burial (before currents disperse the sand). The project will displace juvenile turtles (i.e., prevent them from using these areas) as long as macroalgae and seafloor structure are covered by project sand.

Between the St. Lucie/Martin County line and the St. Lucie Inlet, there are approximately 150 acres of nearshore hardbottom communities, of which, approximately 80% are of the sabellariid worm reef type (ATM 1991). During initial project construction, nearshore hardbottom was impacted and nearshore artificial reef

was created within three separate sites totaling 6 acres and located approximately 900 feet offshore monuments R-12, R-18, and R-20 to mitigate for impacts. These reefs were constructed over the summer of 2000 using steel and concrete components of the dismantled Evans Cray bridge. These reefs were monitored annually from 2002 to 2006 and copies of the reports are provided in Appendix G. Overall, the results indicate that these artificial reefs have become an active living artificial reef community and are used by both fish and benthic organisms (Harris 2006). Since the same template will be used for future nourishments, no additional impacts to nearshore hardbottoms within the ETOF are anticipated; therefore, no additional mitigation for these resources is proposed. However, a contingency mitigation plan has been developed by Martin County and details how unanticipated impacts would be compensated.

Foraging

During project construction, foraging activities of juvenile sea turtles may be temporarily impacted in the immediate vicinity of construction activities (i.e., pipeline placement and beach fill deposition). These impacts would be short-term and restricted to the immediate vicinity of the activity. Foraging sea turtles would most likely be displaced to adjacent areas of nearshore hardbottom or farther offshore.

Foraging activities of juvenile sea turtles are also affected by direct burial of hardbottom habitat. Studies by Dr. Llewellyn Ehrhart and his students at the University of Central Florida show that some nearshore reefs provide important developmental and foraging habitat for juvenile turtles (<http://www.cccturtle.org>). The potential exists for long-term secondary impacts to hardbottom communities adjacent to the ETOF resulting from sedimentation and/or chronic turbidity. Secondary impacts to sea turtle foraging habitat could include reductions in photosynthetic rates of macroalgae and potential burial of macroalgal species. Overall, secondary impacts to the foraging habitat of green sea turtles adjacent to ETOF should be minimal. However, there is concern that the recurrent burying of these nearshore habitats could potentially result in cumulative harmful impacts to sea turtles and numerous fish species.

Dredging activities at the borrow site can reduce food availability both by removing potential food items and altering the benthic habitat (NMFS 1996). These effects would be temporary, as benthic populations within these softbottom habitats would be expected to recover over a period of months to years, depending on the grain size and stability of subsurface sediments exposed after dredging (Hammer et al. 2005). In addition, borrow sites represent only a small portion of this type of benthic habitat available in the study area. Additional information on impacts to benthic resources is discussed in Section 4.5.1.2.

Turbidity

Several activities during construction will affect water quality, including dredging and sand placement on the beach face, producing 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) are expected to reduce the magnitude and extent of temporary impacts of project activities.

Therefore, any potential impacts on sea turtles are considered negligible and therefore not likely to adversely affect sea turtles within the project area.

Underwater Noise from Dredging Equipment

Little is known of how turtles may respond to noise from offshore activities. In contrast to marine mammals, relatively little is known about sea turtle 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 but rather is structured for sound conduction through bone and water (Békésy 1948; Lenhardt 1982; Lenhardt and Harkins 1983). Auditory testing and behavioral studies show that turtles can detect low frequency sounds (Ridgway et al. 1969, Bartol et al. 1999).

It is likely that sea turtles could 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 be short-term behavioral changes such as evasive maneuvers, disruption of activities, or short-term departure from the area. Impacts are considered negligible and therefore not likely to adversely affect sea turtles within the project area.

4.3.1.2. Marine Mammals

Potential impacts from dredging operations in the borrow area that may affect marine mammals (including endangered, threatened, and non-threatened species) offshore include:

- Vessel traffic
- Turbidity
- Underwater noise from dredging equipment

Vessel Traffic

Dredge, dredge support and construction vessel traffic associated with the project gives rise to a chance of collision between these vessels and listed marine mammals. The risk would vary depending upon location, vessel speed, and visibility. As discussed in Section 3.3.2, North Atlantic right whales may be present 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, it is anticipated that they will 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 not likely to occur within the project area.

Marine mammals are unlikely to be physically injured by dredging *per se* because they generally do not rest on the bottom and most can avoid contact with dredging vessels and equipment (Hammer et al. 2005). However, physical injury from vessel strikes as the dredge and support vessels travel to and from the borrow area is a concern, particularly for the North Atlantic right whale and humpback whale. Right whales are

particularly susceptible due to their surface resting and slow swimming habits. Vessel strikes account for the largest number of confirmed right whale deaths (Zani et al. 2008). According to the NMFS Large Whale Ship Strike Database, as of 2004, North Atlantic right whales were the fourth most commonly struck whale species in the world. The region comprised of the southeast United States and Caribbean had the fifth highest number of vessel strikes on all whale species in the world and was the leader in vessel strikes for all of North America. When speed was recorded for individual vessel strike events, the most common vessel speed was 13 to 15 knots. Substantially fewer strikes occurred for vessels traveling at speeds less than 10 knots (Jensen and Silber 2004); however, the project area is outside of the Early Warning System areas between Brunswick, Georgia, and St. Augustine, Florida, and the Cape Cod Bay and Mid-Atlantic 10-knot speed zones. NMFS published regulations in February 1997 restricting vessel approaches of North Atlantic right whales. These regulations prohibit all approaches within 460 meters of any North Atlantic right whale, whether by boat, aircraft, or other means (NMFS 1998). The project study area does not include right whale critical habitat; therefore, the possibility of encounters with right whales is limited.

Impacts to West Indian manatees are not expected at the beach fill site or the borrow area. Sightings of manatees have been restricted to warm freshwater, estuarine, and extremely nearshore coastal waters (Department of the Navy 2007). West Indian manatees rarely occur in offshore waters, where abundant seagrass and vegetation are not available (Reynolds III and Odell 1991). Manatees are uncommon to rare within offshore waters of the inner shelf. However, they are extremely vulnerable to vessel strikes within inshore waters from transiting vessels. Measures to minimize the potential for vessel strikes of endangered whales and manatees are discussed in Section 4.35, Environmental Commitments.

Turbidity

Marine mammals in and near the borrow area may encounter turbid water during dredging. This turbidity could temporarily interfere with feeding or other activities, but the animals could easily swim to avoid turbid areas. Proper implementation of the approved design and construction BMPs should prove effective in reducing the magnitude and extent of impact resulting from project activities. Turbidity generation will cease at the completion of construction. Due to the limited extent and short duration of the reduced water clarity, potential impacts on marine mammals are considered negligible.

Noise

Hopper dredge sounds consist of a combination of sounds emitted from two relatively continuous sources: engine and propeller noise similar to that of large commercial vessels, and sounds of dragheads moving in contact with the substrate (Clarke et al. 2003; Thomsen et al. 2009). Noise levels are not sufficient to cause hearing loss or other auditory damage to marine mammals (Richardson et al. 1995). However, some observations in the vicinity of dredging operations and other industrial activities have documented avoidance behavior, while in other cases, animals seem to develop a tolerance for the industrial noise (Malme et al. 1983; Richardson et al. 1995). The

main concern would be that dredging noise could cause avoidance of the dredging area during humpback whale and (especially) North Atlantic right whale migrations (Hammer et al. 2005).

4.3.1.3. Smalltooth Sawfish

IPFs associated with the project that may potentially impact smalltooth sawfish include:

- Turbidity
- Underwater noise from dredging equipment
- Entrainment by hopper dredge dragheads

Turbidity

Several activities during construction will affect water quality. The main source of water quality impacts is borrow area dredging and sand placement on the beach face, which will produce turbidity at the borrow site and along shore. Proper implementation of the approved design and construction BMPs should limit the level and extent of construction-related turbidity. Turbidity generation will 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 are considered negligible.

Underwater Noise from Dredging Equipment

In general, the sources and levels of underwater noise generated during the project are expected to be short term and cause only negligible impacts on smalltooth sawfish. Smalltooth sawfish that may visit the project area during the construction period are likely move away from or avoid disturbance caused by construction activities. These temporary avoidance behaviors are expected to incur negligible impacts on smalltooth sawfish.

Entrainment by hopper dredge dragheads

The smalltooth sawfish normally inhabits shallow waters (10 meters or less) 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 2006). There is a small risk of sawfish being entrained in the hopper dredge draghead, as sand is being extracted from the borrow area. To reduce the risk of impacts from dredging and vessel strikes, the project will comply with the “Sea Turtle and Smalltooth Sawfish Construction Conditions” (NOAA Fisheries 2006). Entrainment risks will be minimized through mitigation measures that include the use of sea turtle deflecting draghead deflector which would also assist with deflecting smalltooth sawfish.

These activities may affect, but are not likely to adversely affect, smalltooth sawfish individuals in the project area. Smalltooth sawfish that may visit the project area during the construction period are likely to be displaced by disturbance from ongoing activities. These disturbances may result in temporary movement or avoidance of the area.

4.3.1.4. Piping Plovers

Wintering grounds for piping plovers 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 renourishment construction phase, there may be some displacement of foraging and resting birds including piping plovers. This displacement is expected to be short-term, and habitat exists north and south of the project area with similar characteristics that may be used by displaced species while construction activities are ongoing.

Birds that use the beach for nesting and breeding are more likely to be affected by beach nourishment than those that use the area for feeding and resting during migration (USDOI/MMS 1999). Piping plovers may be displaced by dredges, pipelines, and other equipment along the beach, or may avoid foraging along the shore if they are aurally affected (Peterson et al. 2001). 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 in the sand (Greene 2002). Fine sediment that reduces water clarity can also decrease the feeding efficiency of birds (Peterson et al 2001).

Direct impacts to piping plovers from project construction are expected to be minimal as birds are motile and can avoid construction activities. The disposal of sand on the beach may temporarily interrupt foraging and resting activities of shorebirds that utilize the project beach area. This interruption would be limited to the immediate area of disposal and duration of construction. The prey base for many shorebirds, which includes the benthic organisms mentioned in Section 3.5.1, would be temporarily reduced in the project area. This impact would be short-term as recovery of beach infauna is expected within 1 year after sand placement.

Piping plovers are protected by the Endangered Species Act of 1973, the Florida Threatened and Endangered Species Act of 1977, and the Federal Migratory Bird Treaty Act of 1918. The Atlantic coast population of the piping plover was listed as a threatened species in 1985. To prevent impacts to piping plovers during construction, the project would be constructed in compliance with the USACE-Jacksonville district-wide migratory bird protection policy. Complete migratory bird protection specifications for contracts can be found at the following website: http://www.saj.usace.army.mil/Divisions/Planning/Branches/Environmental/Protection_Environment.htm.

4.3.2. BEACH NOURISHMENT USING AN UPLAND SAND SOURCE

The material obtained from an upland source would be beach-quality sand of similar grain size to the native beach sand. It is not expected that the upland sand itself would be detrimental to nesting sea turtles or emergence success. However, the other potential impacts previously discussed with respect to nesting success and physical alterations of the beach (i.e., sand compaction, potential for scarp formation, artificial lighting effects, etc.) would still apply.

4.3.3. NO ACTION ALTERNATIVE (STATUS QUO)

Under present conditions, the shoreline is expected to continue to erode. Sea turtles would be affected by the No Action Alternative because the eroding beach continues to reduce sea turtle nesting habitat.

4.4. HARDGROUNDS

4.4.1. PREFERRED ALTERNATIVE, BEACH NOURISHMENT USING OFFSHORE BORROW AREA C1-B

IPFs associated with the project 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 pipelines
- Turbidity

Alteration (Burial) of Exposed Nearshore Hardbottom

Distribution of hardbottom in the project area is patchy and likely ephemeral in nature (CSA 2011). Hardbottom burial and exposure result from a variety of factors, including natural processes such as longshore sediment transport (shore-parallel), cross-shore sediment transport (shore-perpendicular), storms (i.e., northeasters and hurricanes), shifting shoals, and anthropogenic activities such as beach nourishment. Storms erode and deposit sand throughout the intertidal and nearshore areas, perpetually exposing and burying hardbottom in the process. As a variety of forces cause continual transport of sand through the nearshore littoral zone, hardbottom burial, whether direct or secondary, man-made or natural, is often ephemeral (Stites et al. 2007). Regardless of beach nourishment activities, annual differences in storm intensity, duration, and frequency greatly influence the amount of hardbottom exposure. Therefore, re-exposure of nearshore hardbottom may likely occur due to high-energy dynamics of the area and downdrift and cross-shore erosion of fill material after equilibration of beach fill.

The extent of impacts to nearshore hardbottom from this project depends on depth of burial, sand characteristics, and duration of coverage. However, despite numerous beach nourishment projects, little is known about sedimentation effects, especially on coral reef or other hardbottom communities located in immediate proximity (Peterson and Bishop 2005). Ephemeral hardbottom in this area is characterized by high turf, macroalgae, hydroids, bryzoans, sponges, tunicates, and wormrock (CSA 2011). Beach nourishment activities associated with the Martin County HSDR project may directly bury nearshore hardbottom habitat within the beach design template that provide a habitat for fish, juvenile green sea turtles, and invertebrates and may have secondary impacts on adjacent (waterward and downdrift) hardbottom habitat. Burial of nearshore hardbottom would result in a local reduction of macroalgae and invertebrates that could potentially modify the nearshore food web. Sponges seem to survive burial for longer durations and hydroids and bryzoans rapidly colonize exposed substrate

(Lybolt and Tate 2008). Therefore, these organisms will likely re-colonize re-exposed substrates in the same fashion they colonize any previously buried hardbottom. At a beach nourishment project site in Florida, Lindeman and Snyder (1999) observed dramatic decreases in fish species and numerical abundance of individuals following the burial of nearshore hard bottom. The number of species detected 12 months prior to and 15 months after burial decreased by nearly one order of magnitude, from 54 to eight species (Lindeman and Snyder 1999). At several other beach nourishment projects in Florida, added sand was documented to redistribute offshore from the beach via cross-shelf currents, covering hard bottom habitat (Marsh and Turbeville 1981; Continental Shelf Associates 2002b).

Impacts hardbottom resources within the 1996 ETOF have been previously mitigated; therefore, no additional mitigation is proposed for the fill area. There was concern that sand would gradually erode from the project beach and flow south with the longshore current and impact as much as 20.5 acres of hardbottom habitat south of the project area between monuments R-23 and R-42. This southern transport of sand represents a potential secondary impact to these hardbottom structures and associated flora and fauna. However, because of the dynamic physical oceanographic conditions that currently exist in the nearshore environment and the resiliency of the hardbottom habitat along the shoreline, USACE does not anticipate that significant adverse impacts will occur south of the project area from the beach renourishment project. This conclusion is based in part on results from a recent baseline survey conducted on hardbottom resources that occur within and downdrift of the proposed project area. A long-term study was conducted to evaluate hardbottom exposure in the project area (R-1 to R-25) and downdrift of the project site (R-25 to R-30) (Stites et al. 2007; Taylor Engineering, Inc 2009a) (Appendix H). Analysis of the downdrift areas found similar consistency in exposed hardbottom acreage (**Table 3.4-1**), with exposed hardbottom acreage and distribution differing little between 2001, 2004, and 2008. Therefore, USACE does not anticipate that additional mitigation would be required for hardbottom habitat south of the project area. However, post-construction monitoring will occur and a contingency mitigation plan has been developed by the Sponsor that would compensate for any secondary or indirect impacts due to burial that may occur downdrift of the project area or outside of the ETOF that have not been previously mitigated for. The final amount of mitigation for unanticipated impacts, if any, will be evaluated based on the post-construction monitoring report.

Alteration of Exposed Nearshore Hardbottom (Pipeline Placement)

Pipeline placement impacts to nearshore hardbottom resources depend on the placement location, size, and duration of sand delivery pipelines within the project area. If possible, previously established pipeline corridors will be used to transfer material from the dredge to the beach fill areas. However, the exact location of the pipelines will be determined prior to construction to make sure no hardbottom resources are present. The 3-foot-diameter pipelines may be collared to minimize contact with the ocean bottom; therefore, potential impacts to hardbottom would be limited to shading of benthos immediately under the pipeline and crushing of biota beneath the support collars. Shading will have the greatest impact on photosynthetic organisms (e.g., macroalgae).

Potential impacts by shading are considered minor as microalgae recolonizes quickly. Anchors or spuds will be located entirely in sand bottom. Daily monitoring of all pipelines to shore will be performed to check for sand movement and leaks. Continuous leak monitoring will be required of the dredging contractor through fluctuation in pressure through the pipelines. Implementation of proper design and BMPs is expected to reduce the magnitude and extent of impact resulting from project activities; therefore, potential impacts from pipeline placement/removal activities are considered minor and not likely to adversely affect the nearshore hardbottom within the project area.

Turbidity

Several activities during construction will affect water quality. The main source of water quality impacts to nearshore hardbottom is sand placement on the beach face, which will produce turbidity at the beach sand placement site and adjacent waters. Impacts to nearshore hardbottom from turbidity depend on sediment grain size and duration of pumping activities. Finer sediments will have a longer suspension time compared with coarser sediments. Increased turbidity in nearshore waters would result in temporary shading of photosynthetic organisms (e.g., macroalgae), siltation of sessile organisms, and potentially cause interference to suspension feeders. The sabellariid polychaete, *Phragmatopoma lapidosa*, is able to tolerate high levels of turbidity and can survive direct burial for limited periods of time. Because of the resiliency of the hardbottom habitat (being periodically exposed, buried, and re-exposed) in this area, it is likely that these organisms would be able to survive in highly turbid conditions that may be temporarily present during beach renourishment. Since the duration of the construction activity is anticipated to be relatively short, the potential impacts from turbidity are considered minor.

4.4.2. BEACH NOURISHMENT USING AN UPLAND SAND SOURCE

Impacts to nearshore hardbottom habitat from using an upland sand source will be the same as using as an offshore sand source because the design footprint is the same.

4.4.3. NO ACTION ALTERNATIVE (STATUS QUO)

With the No Action Alternative, no excavation, suspension/dispersion, or deposition of sediment will occur as a result of dredging. Therefore, no impacts on the nearshore environment, offshore borrow area, or any of their associated resources are anticipated.

4.5. WILDLIFE RESOURCES

This section discusses potential direct and indirect impacts of each alternative to birds, benthic assemblages, and marine mammals at the beach fill site and offshore borrow area, as applicable. Impacts to fish are discussed in Section 4.6, Fish and Essential Fish Habitat.

4.5.1. PREFERRED ALTERNATIVE, BEACH NOURISHMENT USING OFFSHORE BORROW AREA C1-B

IPFs associated with the beach nourishment along the project reach using material from borrow area C1-B that may potentially affect fish and wildlife resources include:

- Alteration of bird foraging and nesting habitat related to dredging and construction activities
- Disturbance of the sand bottom habitats and associated benthic communities of the borrow area and beach fill site during nourishment activities
- Effects of dredging activities on non-threatened marine mammals

4.5.1.1. Shorebirds and Migratory Birds

Potential Effects

A large number of avian species including, but not limited to, sanderlings, gulls, terns, plovers, and skimmers forage, winter, and/or breed along Hutchinson Island. While coastal development has reduced important beach habitat for a number of avian species, (USACE 1998), beach nourishment can restore beach habitat for many nesting shore birds (Greene 2002). However, during the beach renourishment construction phase, there may be some displacement of foraging and resting birds as well as small mammals and reptiles that use the project area. This displacement is expected to be short-term, and ample areas exist north and south of the project area with similar characteristics that may be used by displaced species while construction activities are ongoing.

Birds that use the beach for nesting and breeding are more likely to be affected by beach nourishment than those that use the area for feeding and resting during migration (USDOI/MMS 1999). Birds may be displaced by dredges, pipelines, and other equipment along the beach, or may avoid foraging along the shore if they are aurally affected (Peterson et al. 2001). Sand placed on the beach has the potential to crush eggs, hatchlings, and adult birds (USDOI/MMS 1999). If the sediment is too coarse or high in shell content, it can inhibit the birds' ability to extract food particles in the sand (Greene 2002). Fine sediment that reduces water clarity can also decrease feeding efficiency of birds (Peterson et al 2001).

Direct impacts to shorebirds from project construction are expected to be minimal as birds are motile and 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 interruption would be limited to the immediate area of disposal and duration of construction. The prey base for many shorebirds, which includes the benthic organisms mentioned in Section 3.6.2, would be temporarily reduced in the project area. This impact would be short-term as recovery of beach infauna is expected within 1 year after sand placement. In addition, shorebirds usually take advantage of the opportunity to forage on borrow area infauna as the sand from the borrow areas is pumped onto the beach. After the initial construction, re-colonization of dune grasses and other beach vegetation will provide additional refuge and foraging opportunities to birds and other wildlife.

The Martin County nearshore waters are naturally turbid because of the highly dynamic physical conditions present in the area. Organisms inhabiting this shoreline must be readily adapted to these turbid conditions in order to successfully survive. Therefore,

elevated turbidity levels from placement of fill material on the beach is not expected to have a significant detrimental impact to such sightfeeders as the brown pelican (*Pelecanus occidentalis*) or other shorebirds, waterfowl, or wading birds.

In general, gulls are likely to be of low sensitivity to the effects of dredging activities as they have a broad diet, are able to use a wide variety of habitats, and are generally less affected by disturbance (Cook and Burton 2010). In fact, dredging activity may attract gulls to an area as bottom sediments are stirred up, releasing benthic organisms into the water column where they can be preyed on by gulls (Tasker et al. 1986; Herron Baird 1990).

Most tern species forage within 10 km of the coast (Becker et al. 1993; Furness and Tasker 2000; Bertolero et al. 2005; Perrow et al. 2006; Rock et al. 2007), hovering several metres above the water's surface, before plunging after prey. Prey species may vary between locations, depending on availability and include fish species such as sandeel and herring (Monaghan et al. 1989; Furness and Tasker 2000; Garthe and Hüppop 2004; King et al. 2009). As they are constrained to a short foraging range, they are highly vulnerable to reduced food availability (Furness and Tasker 2000; Garthe and Hüppop 2004; King et al. 2009). Thus any changes in food availability at a local level could have an impact on populations. As they require clear water for foraging (Essink 1999), terns may thus be particularly sensitive to the turbidity caused by dredging operations and the re-suspension of sediment.

Monitoring Requirements

Bird nesting areas are protected by the Florida Threatened and Endangered Species Act of 1977 and the Federal Migratory Bird Treaty Act in 1918. To prevent impacts to migratory bird species during construction, the project would be constructed in compliance with the Jacksonville District Corps of Engineers district-wide Migratory Bird Protection Policy (USACE 1993). According to USACE policy, should nesting begin within the construction area, a temporary 200-foot buffer will be created around the nests and marked to avoid entry. The area will be left undisturbed until nesting is completed or terminated and the chicks fledged. Complete migratory bird protection specifications for contracts can be found at the following website: http://www.saj.usace.army.mil/Divisions/Planning/Branches/Environmental/Protection_Environment.htm.

In accordance with the JCP permit, monitoring of breeding shorebirds within the project boundaries shall begin on April 1 or 10 days before construction-related activities begin. Nesting surveys shall occur daily throughout the construction period or through August if no shorebird nesting activity is observed. Non-breeding shorebird monitoring within the project boundaries shall begin 2 weeks before construction-related activities begin and occur every 2 weeks for at least 1 year post-construction. Additional information on USACE protection specifications for contracts as related to migratory bird protection is provided in Section 4.35, Environmental Commitments.

4.5.1.2. Benthic Infauna

Brooks et al. (2006) reviewed existing literature on offshore benthic assemblages along the U.S. East and Gulf of Mexico continental shelf. From the few studies available, it

appears that general “recovery” from anthropogenic disturbance by offshore benthic assemblages occurs within three months to 2.5 years. However, the authors concluded that presently it is difficult to draw conclusions about approximate recovery benthic faunal times following anthropogenic activities such as sand mining and/or disposal operations because of the paucity of studies.

Impacts within Beach Fill Area

Placement of sand on the beach will result in the burial and subsequent loss of most of the beach infauna. The Hutchinson Island beach area is typical of other sandy beaches that are subject to coastal processes. The biological diversity of the sandy beach is low, but the populations of individual species are often immense. Species found in the project area, such as annelid worms, coquina clams, ghost shrimp, and mole crabs, are highly specialized and adapted to the harsh and dynamic environment. Since these sandy beaches are populated by small, short-lived organisms with great reproductive potential, these communities usually recover quickly from most environmental disturbances such as beach restoration projects (ATM 1991). Several studies have investigated the recolonization of beach infauna following nourishment and found that beach and surf zone populations recover to pre-nourishment levels within 1 year after completion of nourishment (Reilly and Bellis 1983; Gorzelany and Nelson 1987; Hurme and Pullen 1988; Dodge et al. 1991, 1995; Hackney et al. 1996). Hackney et al. (1996) suggest that to help minimize impacts to beach infauna, construction should take place in late fall and winter months to coincide with periods of low recruitment and low biological standing stock, and that sand used should be a close match to native beach sand. However, Lindquist and Manning (2001) have suggested that repeated renourishments in the same project area could continue to reduce the proportion of large adult coquina clams and mole crabs in the population, which could have far-reaching consequences. The sand source for the proposed project is compatible with the existing beach sediments and contains a relatively low silt/clay content (average of 5%), which should promote rapid recovery of beach infauna within 1 year after sand placement. Therefore, impacts to beach infauna are expected to be short-term.

Impacts within Borrow Area

Infaunal invertebrates and any motile macrobenthic invertebrate species will most likely be injured during entrainment as part of the dredging operations. Dredging of offshore borrow areas will result in the loss of benthic organisms, including the arrowhead sand dollar (*Encope emarginata*), which is a common species found throughout the sandy substrate. Sessile and slow-moving invertebrates are at the greatest risk of being removed from the borrow areas, resulting in a reduction in the number of individuals, species, and biomass in the dredged area. These organisms will be impacted by direct removal and burial due to increased turbidity. However, these highly fecund invertebrates are expected to repopulate after dredging activities cease.

Brooks et al. (2006) found in most cases, polychaetes were the first to recolonize dredged or disposal sites, with crustaceans, specifically amphipods, also recolonizing relatively quickly. Some studies notes that carnivores recolonized dredged areas in a short amount of time, speculating that this response may be tied to the food resources

available in dredged areas due to dead and injured organisms resulting from the dredging process itself. Measurements of recovery, however, were varied, with some studies looking at general abundance of organisms, and others evaluating community structure. Those evaluating entire communities often indicated that while abundances of organisms may increase to background levels relatively quickly, community structure may remain altered for some time, and, in repetitively mined areas, may have difficulty ever recovering to the original state.

Hammer et al. (2005) identified that potential impacts from dredging within the proposed borrow areas are expected to be localized and short-term because surrounding areas can serve as a primary source for re-colonization of the benthos. Many studies have concluded that the borrow site is fully recovered within 1 year post-dredging, with the taxonomic diversity and density often restored because of the organisms' ability to adapt to their new environment (ATM 1991; Welker 1974; McCauly et al. 1977; Oliver et al. 1977; Goldberg 1988; Deis et al. 1992). Bowen and Marsh (1988) observed recovery to pre-dredging levels of the macroinfaunal communities in a borrow area offshore of Delray Beach, Florida within 1 year of construction. Burlas et al. (2001) monitored borrow sites with bathymetric high points off northern New Jersey and found essentially all infaunal assemblage patterns recovered within 1 year after dredging disturbance except recovery of average sand dollar weight and biomass composition, which required 2.5 years. Based on previous studies, Byrnes et al. (2004) concluded that levels of infaunal abundance and diversity may recover within 1 to 3 years, but recovery of species composition may take longer. Benthic infauna monitoring performed during previous beach nourishment projects in Broward County indicated that, although the borrow areas were rapidly colonized following dredging, individual species recovered at different rates based upon their regeneration time, ability to disperse, and reproductive strategies (Dodge et al. 1995).

Based on the results of these studies, it is anticipated that recolonization of the borrow areas by benthic macroinfaunal species will occur within 1 to 2 years after dredging is completed. Changes in infaunal community structure are anticipated based upon differences in generation time and reproductive strategies of infaunal organisms and these changes may persist for 2 to more than 3 years. Grazers and detritivores that feed upon the macroinvertebrate communities within the proposed borrow areas will be temporarily displaced during dredging activities. If infaunal community structure changes persist for a period of years, short-term impacts to selective bottom feeders may also occur due to loss of specific prey species within the dredged borrow sites. Van Dolah et al. (1984) suggest that the recovery time for the benthic species may be dependent upon the extent and intensity of active dredging. Infauna recovery is not only dependent upon dredging activities but is reliant on natural variability and temporal changes (Byrnes et al. 2004). Adjacent sandy areas and shoals would provide alternative feeding habitat for grazers and detritivores during infaunal recolonization of the borrow areas. These undisturbed areas that surround the borrow sites would also serve as a primary source of recolonizing fauna for the excavated borrow sites (Van Dolah et al. 1984).

Mining sand from an offshore borrow area can also modify the texture of the sediment or cause the site to become a reservoir of fine sediments and organic material (NRC 1995) while increasing the bottom depth of the borrow site. This can lead to heavily anoxic sediments and to colonization by a community which differs considerably from that in the original deposits (Dickson and Lee 1972; Shelton and Rolfe 1972; Kaplan et al. 1975; Bonsdorff 1983; Hily 1983; van der Veer et al 1985; Hall 1994).

To minimize impacts and promote recolonization of mined areas the total removal of substrate should be avoided (Diaz et al. 2004). Small areas within the borrow site should be left to serve as refuge patches that would promote recolonization and serve as habitat for mobile species. Facilitating rapid recolonization of a mined site by established community members would minimize alteration of community structure and function and reduce potential effects upon trophically dependent fishes (Diaz et al. 2004).

Given that only a relatively small area (125 acres) within the 1000-acre C1-B borrow area will be disturbed per dredging event (interval is estimated to be 13 years) and that the expected recovery time of the affected benthic community after sand removal is anticipated to be less than the dredging interval, the potential for significant cumulative benthic impacts is possible but unlikely. In light of recent studies showing the recovery of benthic communities and the ability of benthic organisms to recolonize, the project is not expected to result in a significant long-term adverse impact on benthic communities at the borrow site.

4.5.1.3. Non-Threatened Marine Mammals

Marine mammals species may alter passage routes to avoid noise from ship traffic or from increased water turbidity during or following disposal activities (Thomsen et al. 2009). Vessel noise and plume impacts to marine mammals are temporary and localized to the immediate vicinity of the borrow area, and are not expected to affect breeding, nursery, or feeding areas for adults or juveniles. Therefore, dredging activities at the borrow area are not likely to adversely affect the marine mammals within the project area.

4.5.2. BEACH NOURISHMENT USING AN UPLAND SAND SOURCE

Impacts to the beach and nearshore habitat associated with placing fill from an upland sand source will be similar to those discussed above. However, there would be no impacts to offshore fish and wildlife habitats if an upland sand source was used. There is potential; however, for impacts to terrestrial wildlife habitat associated with mining the quarry site.

4.5.3. NO ACTION ALTERNATIVE (STATUS QUO)

No adverse impacts to fish are expected under the No Action Alternative. It is probable that maintenance of status quo conditions would result in increased exposure of nearshore rock outcrops as the shoreline continues to erode at its present rate. This could provide increased habitat for surf zone fishes. Continued shoreline erosion would

jeopardize the remaining dune habitat along the Martin County shoreline, potentially decreasing the available habitat for migratory birds and dune species.

4.6. FISH AND ESSENTIAL FISH HABITAT ASSESSMENT

The following subsections summarize the direct and indirect impacts of the proposed action and other alternatives on EFH within the beach fill area and the proposed borrow area, federally managed fisheries, and associate species such as major prey species, including affected life history stages. An EFH Assessment has been prepared for this project and is provided in Appendix E.

The Atlantic States Marine Fisheries Commission (ASMFC) is concerned that some fish species may suffer direct mortality, sub-lethal impairment, or degraded habitat (Greene 2002). In March 2003, SAFMC established policies regarding protection of the EFHs and HAPCs impacted by beach dredge and fill activities and large-scale coastal engineering projects. In general, SAFMC found that the array of large-scale and long-term beach dredging projects and related disposal activities constitute a real and significant threat to EFHs under their jurisdiction, and the cumulative effects of these projects have not been adequately assessed (SAFMC 2003b).

Nourishment activities for the original beach nourishment project and future renourishment activities have the potential to directly and indirectly harm fish and wildlife resources. Potential direct impacts of sand dredging to fisheries are virtually unknown, but may include effects from loss of essential habitat and alteration in trophic energy transfer from the benthos to fish populations (Coastal Tech 2007).

4.6.1. PREFERRED ALTERNATIVE, BEACH NOURISHMENT USING OFFSHORE BORROW AREA C1-B

IPFs associated with the project that may potentially affect EFH include:

- Alteration (burial) of exposed nearshore hardbottom and associated epibenthos during and subsequent to nourishment activities
- Disturbance of the sand bottom habitats and modification of the shoal feature at the offshore borrow area
- Turbidity
- Impacts to managed fisheries

4.6.1.1. Nearshore Hardbottom Habitat

Nearshore hardbottom and worm reefs are identified by SAFMC as EFH and HAPC. These reefs help reduce wave energy, stabilize shorelines (Kirtley 1966; Kirtley and Tanner 1968), and provide structural habitat for fish (Gore et al. 1978; Nelson 1989; Lindeman and Snyder 1999). The loss (burial) of nearshore hardbottom habitat will result in impacts to the young stages of several reef fish species that use the nearshore hardbottom habitat including species within the SAFMC Reef Fishes and Spiny Lobster Management Units. Nearshore hardbottom is an important component of the cross-shelf developmental pathways used by many reef fishes (Lindeman et al. 2000). It is

expected that juvenile fishes will be displaced (i.e., prevented from using these impacted areas) as long as the associated epiflora, epifauna, and seafloor structure are covered. Re-colonization of re-exposed hard substrates by wormrock and turf and macroalgae is probable as these organisms have high recruitment capability and coverage and re-exposure of hardbottom substrate is a common occurrence in the project area.

Increased turbidity due to suspended sediments in the water column may physically stress fish by clogging their gills and reducing the absorption of dissolved oxygen. Adults can avoid the suspended material by moving out of the area, but juvenile fish may be more vulnerable and susceptible to stress (SAIC 1986).

Hardbottom impacts within the ETOF during initial project construction have been previously mitigated and no additional impacts are anticipated during subsequent nourishment events because the fill template is the same. Since the impacted area a minor portion of the total habitat available for use along the coast of Martin County, the impact to EFH within the beach fill area is considered minor. Therefore, reef fish assemblages are not expected to be significantly adversely impacted within the beach fill area.

4.6.1.2. Nearshore Sand Bottom Habitat

Members of the penaeid shrimps 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 that are contiguous with the nearshore hardbottom as foraging areas. Since the temporal duration of the nourishment activities associated with the Martin County HSDR project is short (3 to 4 months) and the soft bottom infaunal invertebrate assemblages recover relatively rapidly (forage habitat), impacts to the EFH within the nearshore beach fill site is expected to be relatively minor, and therefore not likely to significantly adversely affect the soft bottom EFH within the project area.

4.6.1.3. Offshore Shoal Habitat

The next renourishment is scheduled for 2012 and requires removal of approximately 787,000 cy of sand from borrow area C1-B. Each nourishment event is expected to impact approximately 125 acres within the 1,000-acre site approximately every 13 years. Borrow area C1-B has relatively less vertical relief than those shoals located within the St. Lucie Shoal complex.

Sand shoals have been identified as EFH for coastal pelagic species and some highly migratory species, particularly coastal sharks. In addition, offshore sand shoal habitats have been shown to provide fundamental ecological functions for demersal and pelagic fish species and motile macrobenthic invertebrates that include categories of spawning, shelter, or foraging (CSA International, Inc. et al. 2009). Recent local studies (Gilmore 2008) have determined that 200 fish species use the sand shoal habitats along southeast Florida. Gilmore (2008) postulates that the shoal habitats are an intermediate habitat integrated in the cross-shelf migration used by many EFH managed groups.

These shoal habitats also function as aggregation areas for small pelagic fishes, which are important prey for the coastal pelagic fish, dolphin and wahoo, and highly migratory species groups. SAFMC identifies sandy shoals as EFH for migratory pelagic fish, including king mackerel, Spanish mackerel, cobia, and dolphin. Further, anecdotal evidence suggests that this shoal area is biologically unique and diverse, supporting fisheries that are economically and recreationally important, such as the migratory species listed above, sailfish, and prey species consumed by these fishery species. Michel et al. (2001) note that the geomorphology of offshore shoals provide a unique assembly of micro-habitats that facilitate high biological productivity. Removal or modification of the borrow area C1-B shoal feature could impact EFH for multiple SAFMC-managed species groups that use this feature. In addition, multiple SAFMC-managed species groups, both fish and invertebrates, may be impacted during dredging activities within the borrow area by entrainment including penaeid shrimps, spiny lobster, and red drum species group.

Environmental impact assessments for Outer Continental Shelf mining have predicted that effects from dredging on fish assemblages will be minimal based on the assumption that resident fish are wide-foraging or migratory and spend only a portion of their life cycle at the borrow site (Hammer et al. 1993; Louis Berger Group 1999). Hobbs (2002) proposes that the habitat impacted by dredging will have minimal effects on transitory fish, given the small percentage of the overall geographic range the dredge site represents. However, contrasting opinion suggests that fish (and other secondary production) may be dependent on the areal extent of required habitat(s), and that every unit of loss of habitat function results in a decrease in production (Peterson et al. 2001).

Fish that prey on exclusively non-motile organisms, and fish that are less motile themselves, are anticipated to suffer the greatest effects from dredging (Greene 2002). The degree to which fish that prey on benthic invertebrates are affected depends on the recovery rate of the benthic communities. With the loss of autotrophic and heterotrophic invertebrates, small fish would lose a valuable food source. If full recovery of benthic communities is measured in terms of years and not months as some researchers have asserted, then recovery of predator species would require a similar or greater amount of time (Peterson et al. 2001).

Secondary impacts to fish species may occur as a result of sedimentation/siltation adjacent to borrow areas. Suspension of sediment can cause mortality of eggs and larvae of marine and estuarine fish (Newcombe and Jensen 1996) and feeding reduction in juvenile and adult fish. These impacts would be short-term and limited to the vicinity of the borrow areas and duration of the project.

Numerous benthic organisms and fishes inhabit offshore shoal areas, but specifics regarding species, assemblages, and ecological interrelationships between the topographic features and associated biota are not well known. A 2-year study was conducted on the inner continental shelf of the Middle Atlantic Bight, USA, to compare finfish and invertebrate assemblages at sand shoal and nearby flat-bottom habitats (Slacum, Jr. et al. 2010). Results from this study indicate there was a trend toward

greater abundance, species richness, and species diversity in flat-bottom habitats than in shoal habitats, and all of these community measures were generally lower during the winter than in spring, summer, or fall. In addition, among shoals, a trend toward greater abundance at shoals with a steeper grade was evident. Since this study indicated that winter was the period of lowest finfish and invertebrate use of shoal habitat, winter months would be the best time of year for dredging sand to minimize acute impacts.

Potential long-term physical and biological impacts could occur if dredging significantly changes the physiography of shoals (Hammer et al. 2005). The magnitude of such effects is expected to be correlated with the timing, duration, and scale of sand mining activities (Pickett and White 1985). Since only a relatively small area (125 acres) within the borrow area will be disturbed per dredging event (at an estimated interval of 13 years) and the close proximity of similar, relatively undisturbed, adjacent habitat, effects on fish and EFH within the borrow area are expected to be short-term and localized.

4.6.1.4. Managed Fisheries

This section describes more specific details regarding potential effects to specific managed fisheries as a result of beach nourishment using the offshore borrow area C1-B.

Coastal Migratory Pelagics

Coastal migratory pelagic species are migratory water column dwellers; however, most of these species have some affinity for man-made or natural structures. Hardbottom features, sandy bottoms, and shoal areas occurring from the surf zone to the shelf break encompass EFHs for coastal pelagic fishes. EFHs could be affected by turbidity that could alter migratory routes or temporarily disrupt feeding activity in shelf or nearshore waters. Coastal pelagic species such as cobia, jacks, king and Spanish mackerels, round scad, and Spanish sardine could be attracted to a dredge and its attendant structures (Hammer et al. 2005). Loss of shoal habitat is a substantial and long-term effect. The temporal scale of shoal morphology precludes quick recovery for species that are dependent on these types of relief features, including prey of the coastal migratory pelagic complex (Hammer et al. 2005).

Snapper-Grouper Complex

Snapper-grouper EFH/HAPC exists on all hardbottom areas throughout the study area; therefore, effects of attraction, entrainment, and turbidity are possible. Negative effects could be substantial and measures should be taken to protect hardbottom areas and avoid effects to snapper-grouper (Hammer et al. 2005).

Red Drum

Oceanic high-salinity surf zones and artificial reefs are considered EFH/HAPC for adult red drum. However, threats to the red drum's adult habitat are not as numerous as those faced by post-larvae, juveniles, and sub-adults in the estuarine and coastal waters. Threats to the nearshore and offshore habitats that adult red drum utilize include dumping of dredged material and mining for sand. Associated threats with

mining sand for beach nourishment projects include burial of bottoms near disposal sites, release of contaminants directly or indirectly associated with mining (i.e., mining equipment and materials), increase in turbidity to harmful levels, and hydrologic alterations that could result in diminished desirable habitat (ASMFC 2002).

Spiny Lobster

Spiny lobster EFH exists in all hardbottom areas throughout the study region. Hardbottom areas meeting spiny lobster HAPC criteria are not found north of Jupiter Inlet. Measures should be taken to protect hardbottom areas and avoid dredging impacts to spiny lobster EFH (Hammer et al. 2005).

Penaeid Shrimp

Effects of entrainment on EFH for penaeid shrimp are expected to be minimal. Van Dolah et al. (1992) estimated the mortality of postlarval shrimp from entrainment to be no more than 1,883 shrimp per day during dredging. Given that one female white shrimp produces 500,000 to 1 million eggs per spawn (Anderson et al. 1949) and natural post-larval penaeid shrimp mortality is estimated at greater than 60% (Minello et al. 1989), the number entrained was considered inconsequential.

Highly Migratory Species

As with coastal pelagic fishes, highly migratory species could be affected by turbidity generated during a dredging project. Turbidity plumes could alter normal migratory and feeding patterns, but these effects would be of short duration. Some highly migratory species could be attracted to a dredge or related structures (Hammer et al. 2005). Effects of dredging are expected to be minimal; however, utilization by sailfish could decrease as a result of shoal removal.

EFH exists throughout the study area for several species and species groups. Effects to the water column, such as turbidity, are expected to be temporary. In addition, BMPs would be employed to monitor and control turbidity in order to minimize unavoidable impacts. Direct effects of entrainment are not expected to be substantial due to the motility of the majority of species involved. Non-motile organisms that serve as prey could be affected.

Díaz-Delgado et al. (2004) predicted that mobile species would be displaced with shoal removal and have to search for replacement habitat. Gilmore (2008) states that removal of a portion of EFH will proportionally reduce fish species that are dependent on EFH, particularly if they are species that typically saturate the habitat. If local shoals constitute EFH for sardines, menhaden, and herring, it must be assumed that their removal will result in reduction of forage fish populations (Gilmore 2008), which in turn could result in a reduction in the various commercial and recreational species, such as mackerel, that depend on shoal forage as a food source. This was a prediction also made by Vassilides and Able (2008). Although there was nothing in the literature surveyed that presented hard comparative data on planktivorous fish on shoals versus artificial reef formations, it is possible that artificial reefs may offer schooling

planktivorous fishes an alternative habitat if their natural shoal habitat is removed (Gilmore 2008).

Gilmore (2008) concluded that without some additional *in situ* studies of local sand shoals, it would be difficult to make accurate predictions of the effects of sand-shoal mining on regional fisheries. It is recommended that the targeted shoals off South Hutchinson Island be examined for potential fishery impacts.

4.6.2. BEACH NOURISHMENT USING AN UPLAND SAND SOURCE

Impacts to nearshore EFH (i.e., nearshore hardbottom) will be the same from using an upland sand source as an offshore sand source because the design template is the same. However, there would be no impacts to offshore EFH associated with using an upland sand source.

4.6.3. NO ACTION ALTERNATIVE (STATUS QUO)

No adverse impacts to EFH are expected under the No Action Alternative. It is probable that maintenance of status-quo conditions would result in increased exposure of nearshore rock outcrops as the shoreline continues to erode at its present rate. This could provide increased EFH habitat for surf zone fishes.

4.7. CURRENTS AND CIRCULATION

4.7.1. PREFERRED ALTERNATIVE, BEACH NOURISHMENT USING OFFSHORE BORROW AREA C1-B

The preferred borrow area for this project, C1-B, is a relatively low relief shoal located approximately 6 miles offshore. It lies approximately 3 miles south-southeast of the St. Lucie Shoal complex and has less vertical relief than C1-A and C1-C, which are located directly on the St. Lucie Shoal.

Nearshore Wave Environment

Mining shoals for sand may alter the local wave climate and cause erosion within or in the vicinity of the project area. Hayes and Nairn (2004) conducted an evaluation of the potential impacts from dredging linear shoals in the U.S. Gulf and Atlantic continental shelves and concluded that the deflation of a shoal feature could change wave patterns between the shoal and the shoreline. In turn, such dredging could change sand-transport patterns, both along the shore and across the shore, and change erosion and accretion rates along the shore. Kelley et al. (2004) verified this conclusion in their examination of a borrow site offshore of Martin County (depths were approximately 8 to 10 m) and recommended using wave transformation numerical modeling tools that recognize the random nature of incident waves as they propagate onshore when examining incremental and cumulative changes from sand dredging on the continental shelf. The excavation of a borrow area sufficiently close to shore can focus incident waves on specific regions of the shoreline, increasing the potential for beach erosion in those areas (USACE 2009).

USACE performed a similar analysis that expanded on the study conducted by Kelley et al. (2004) to address the potential impacts and determine if excavating portions of the C1-B borrow area could potentially influence wave refraction patterns across the region, possibly resulting in wave energy focusing and increased erosion along the adjacent shoreline (USACE 2009). The same numerical wave refraction model (STWAVE) was used to simulate the nearshore wave environment landward of the proposed borrow area. A new high-resolution survey was acquired of this region which provided more detailed coverage over a larger geographic area than the previous study. Existing wave refraction conditions were simulated using STWAVE and comparative runs were made using various borrow-area dredging configurations. The goal of this modeling study was to develop designs for borrow-area dredging that would have no significant impacts on wave refraction patterns and littoral processes along the adjacent shorelines. The study concluded that no significant changes to the nearshore wave environment are expected as a result of dredging borrow area C1-B to the maximum limits of excavation as shown in **Figure 3.1-9**.

Offshore Borrow Area

Excavation within the borrow area alters the seabed topography, creating pits that may refill rapidly or may be very slow to fill. Studies show pits are likely to be persistent features of the sea bed topography for several years except where sands are mobile due to high current velocities (Eden 1975, van Der Veer et al. 1985, Newell et al. 1998). 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 (Wright 1977). 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 (PM) and potentially create a biological assemblage much different in composition than the original (Hammer et al. 2005). This action could alter this shoal structure permanently and locally affect the seabed topography within the borrow site. Even though BMPs will be implemented in the design of the dredging profile of the shoal to help minimize the impacts to the shoal, the potential impacts from the modification to the shoal are considered significant; and therefore, could cause detrimental impacts to the benthic community for extended periods of time. However, not all impacts from dredge pits are detrimental. Borrow pits are known to attract numerous fishes and have also been known to provide resting places for sea turtles (Spring and Snyder 1991).

4.7.2. BEACH NOURISHMENT USING AN UPLAND SAND SOURCE

Since the offshore wave climate would not be affected if an upland sand source is used, no adverse impacts to the nearshore wave environment are expected.

4.7.3. NO ACTION ALTERNATIVE (STATUS QUO)

No adverse impacts to the nearshore wave environment are expected under the No Action Alternative.

4.8. CULTURAL RESOURCES

4.8.1. PREFERRED ALTERNATIVE, BEACH NOURISHMENT USING OFFSHORE BORROW AREA C1-B

The Florida SHPO recommended that the proposed borrow sites, Areas C1-A and C1-B, located offshore of St. Lucie County in the vicinity known as the “St. Lucie Shoal” be investigated by a professional underwater archeologist to locate known and unidentified cultural resources, including shipwrecks and submerged prehistoric landforms that might contain prehistoric sites that may be impacted by sand borrowing activities associated with the proposed project. Data from the Florida Master Site Files indicate two documented shipwrecks within close proximity to the proposed borrow areas, the *Halsey* (8SL30) and the *America* (8SL28). No submerged prehistoric sites are recorded.

An underwater remote sensing survey was conducted of the four proposed sand borrow areas for shore protection projects in the region, including relocation of the recorded shipwrecks the *America*, the *Halsey* and the *Amazone*. The *Amazone* (8SL29) and the *Halsey* (8SL30) were relocated outside of the project areas. The previously recorded *America* Wreck (8SL28) was not relocated but it was determined that it does not exist in the project area. C1-A contained a magnetic anomaly indicative of a potentially significant cultural resource, specifically a shipwreck. C1-B did not contain any significant anomalies indicative of cultural resources. Anomalies indicative of submerged landforms and prehistoric sites were not identified in either borrow area. The submerged cultural resources survey cleared the borrow area C1-B, which is the preferred borrow area for the Martin County HSDR project.

Onshore Cultural Resources

The Jensen Beach Site (8MT2), a prehistoric midden recorded within the beach renourishment area of the Martin County HSDR project, is documented as destroyed in the Florida Master Site Files. Therefore, placement of dredged material on the beach will not affect any known terrestrial archeological resources. In a letter dated December 21, 1992, the SHPO concurred with USACE no-effect determination for beach renourishment.

To the south and outside of the project area, the House of Refuge at Gilbert’s Bar is listed on the National Register of Historic Places. The House of Refuge is the only one of 10 houses of refuge erected by the U.S. Life Saving Service in 1876 that still exists. The House of Refuge is situated in back of a rock outcropping that acts as a semi-permanent barrier for natural shore protection.

Coordination with interested agencies has indicated that no detrimental effects are anticipated with implementation of the proposed plan. In 1980, the State Division of Archives, History, and Records Management and the Heritage Conservation and Recreation Service indicated that the proposed project would not adversely impact any sites listed, or eligible for listing, in the National Register of Historic Places.

Nearshore Cultural Resources

There are two, recorded submerged archaeological resources in the nearshore beach renourishment area of the Martin County HSDR project. Two, historic shipwrecks from the mid-nineteenth and early twentieth centuries, the *No Name* shipwreck (8MT17) and the *Coszme Calzado* (8MT44), are located along the nearshore, approximately 250 feet seaward of the shoreline. The condition of these shipwrecks is currently unknown and whether they are covered by sand or exposed. Despite the fact that the project area has been re-nourished several times since 1996, a 300 foot (100 meter) buffer zone will be placed around the location of the wrecks. Pipeline corridors will be surveyed prior to project construction, and vessel anchoring will be prohibited within these buffers so impacts to these submerged cultural resources will not occur due to activities associated with the placement of pipelines or pump-out operations. Coordination with the SHPO and the appropriate federally recognized Native American tribes is ongoing.

Offshore Resources

Between September 2007 and June 2008, SEARCH conducted an underwater remote sensing survey of four proposed sand borrow areas for shore protection projects in the region. This survey included the borrow area C1-B which is the preferred borrow area for the Martin County HSDR project. The remote sensing survey used a magnetometer, sidescan sonar, and sub-bottom profiler, integrated with a Differential Global Positioning System (DGPS), to identify any potentially significant submerged cultural resources within these borrow areas.

Results of the survey in the report titled, *Historic Assessment and Submerged Cultural Resources Remote Sensing Survey of Four Borrow Areas for Martin and St. Lucie Counties Shore Protection Projects, Florida* (SEARCH 2008) identified no potentially significant submerged cultural resources with borrow area C1-B. SEARCH also located two previously recorded historic shipwrecks, the *Amazone* (8SL29) and the *Halsey* (8SL30) outside of the project area. SEARCH did not locate the previously recorded *America Wreck* (8SL28) but determined it does not exist in the project area.

The USACE has determined that no historic properties will be affected by the proposed dredging project in the C1-B borrow area. The SHPO concurred with this determination on April 4, 2008 (DHR Project File No. 2008-05091) and found the submitted report complete and sufficient in accordance with Chapter 1A-46, F.A.C. The letters regarding these findings is provided in Appendix C.

In summary, the USACE has determined that the current Martin County HSDR project will not pose any adverse effect to significant historic resources. This includes the beach renourishment and nearshore project areas, and the offshore preferred alternative borrow area C1-B. Coordination with the SHPO and the appropriate federally recognized Native American tribes is ongoing.

4.8.2. BEACH NOURISHMENT USING AN UPLAND SAND SOURCE

Impacts to cultural resources are not anticipated with the placement of upland sand within the beach renourishment area. Impacts to the submerged cultural resources

nearshore will be eliminated by buffering the recorded shipwrecks to avoid placement of pipelines, anchors, or pump-out operations within the recorded site boundaries.

4.8.3. NO ACTION ALTERNATIVE (STATUS QUO)

For beach renourishment of the Martin County HSDR project, the No-Action Alternative would have no adverse impact to historic properties. Within the nearshore, the impacts of continued erosion and deflation of the sand surrounding the recorded shipwrecks could have the potential for adverse effect. There are no adverse effects to submerged cultural resources within the proposed borrow areas under the no-action alternative.

4.8.4. NATIONAL HISTORIC PRESERVATION ACT OF 1966 (INTER ALIA)

Federal undertakings will comply with the Archeological and Historical Preservation Act of 1974 (16 USC 469-469c); Executive Order 11593, the Abandoned Shipwreck Act of 1987 (PL 100-298; 43 U.S.C. 2101-2106); the National Historic Preservation Act of 1966, as amended (16 USC 470); and the Advisory Council on Historic Preservation's implementing regulations under 36CFR800 (*Protection of Historic Properties*). Section 106 of the National Historic Preservation Act requires federal agencies to provide the SHPO (as agent to the Advisory Council on Historic Preservation) reasonable opportunity to evaluate and comment on any federal undertaking. The act requires the agency to coordinate with SHPO whether or not the agency believes there would be impacts to significant historic resources. The project is in compliance with each of these federal laws.

4.9. SOCIOECONOMIC

Martin County's economy is largely based on tourism. The tourist dollars brought into Martin County each year account for a large portion of the County's revenue base. Many businesses, particularly along the coast, are tourist-oriented and rely on revenue generated from tourists (<http://www.martin.fl.us>). Short-term economic impacts to beach-associated tourism revenues will likely occur during project construction. No permanent impacts on commercial or recreational fishing are expected. There was some concern from surf and bait/tackle shop owners that the project could have an economic impact on their businesses due to degradation of surfing conditions as a result of fill placement in the nearshore environment (Appendix C, Pertinent Correspondence). However, local businesses could potentially benefit from increased tourism revenues after project construction.

A social-effects assessment was conducted after the 2004 hurricane season to explore how the shore protection project in Martin County affected social conditions compared to St. Lucie County, which had no shore protection project in place (Leigh Goldstein, Marstel-Day, LLC 2008). The study concluded that the presence of a shore protection project likely affected socioeconomic conditions. Regarding economic indicators, Martin County appeared to be slightly less vulnerable. The most significant of these indicators appeared to be social stressors and economic hardship, represented by domestic violence filings and bankruptcy rates. St. Lucie County exhibited significant increases in both of these categories following the hurricanes, while Martin County did not.

The shore protection project appears to have reduced damages and permitted a faster recovery. Martin County residents appear to have returned to their homes sooner and in higher numbers than residents of St. Lucie County. This may be attributed, at least in part, to having a shore protection project in place which allowed a quick response to the hurricanes with little bureaucracy and allowed Martin County personnel to focus on other needs.

Insurance rates will likely continue to increase as development in coastal areas increases and damage from storms becomes more costly. With increased evidence of the infrastructure protection provided by a shore protection project, such protection may be included in the methodology for determining approved rate changes. Ultimately, this could mean that the presence of a shore protection project would reduce insurance costs. These lowered costs, in addition to the reduced stressors resulting from the shore protection project, would protect lower-income residents. A shore protection project may have greater impact in more economically disadvantaged areas because of these suggested advantages.

4.9.1. PREFERRED ALTERNATIVE, BEACH NOURISHMENT USING OFFSHORE BORROW AREA C1-B

The 2012 cost of placing 787,800 cy of material from the proposed offshore borrow area is estimated at \$9.09/cy. The cost estimate including mobilization/demobilization, dredging and beach fill, tilling, construction/vibration controls and monitoring, endangered species observers, sea turtle trawling, and sea turtle relocation trawling is \$9,700,297.

4.9.2. BEACH NOURISHMENT USING AN UPLAND SAND SOURCE

The price per cy for most of the suppliers of upland sand exceeds the 2012 estimated total unit cost of \$9.09/cy for sand from the offshore borrow areas (**Table 2.2-4**). The 2007 total unit cost of upland sand material delivered to project area ranges from \$9.00/cy (note: this price does not include delivery) to \$32.00/cy. Therefore the cost of 787,800 cy yards of sand from an upland source ranges from \$7,090,200 to \$25,209,600. It is important to consider that this estimate does not include equipment needed to move the sand to the desired grade and template design, and these unit prices are likely to increase by 2012.

Transportation of the sand from the inland borrow site to the project area is also expected to be an issue of concern among local residents since the project area, which is located on Hutchinson Island, is not easily accessible by highway and can only be reached by driving through the city of Stuart. Nourishing the beach by a trucking operation can have substantial secondary impacts associated with traffic congestion, road damage, spilled sand along roadways, noise, and numerous safety and aesthetic concerns at the beach fill site where dump trucks must drive along the beach (NRC 1995). Because of these potential drawbacks and the large number of truck loads involved, upland sand sources may be rejected as logistically and economically unpractical as a borrow source for large-scale nourishment projects such as this.

4.9.3. NO ACTION ALTERNATIVE (STATUS QUO)

In general, socioeconomic losses result from storm damages to buildings and land along the Atlantic coastline, as well as losses in revenue to Martin County. Shoreline recession can potentially undermine the oceanfront structures and recreational amenities that have been developed in the public parks along the project area. Continued erosion of the existing beach would result in increased potential for storm damage; increased energy requirements associated with post-storm clean-up activities; and a likely reduction in beach-associated tourism revenues, property tax, and jobs.

4.10. AESTHETICS

IPFs associated with the Martin County HSDR project that could potentially impact aesthetic resources include:

- Presence of construction equipment
- Noise
- Turbidity

4.10.1. PREFERRED ALTERNATIVE, BEACH NOURISHMENT USING OFFSHORE BORROW AREA C1-B

The pipeline coming out of the water and along the beach, earthmoving equipment spreading sand along the beach, and associated construction activities will temporarily affect the aesthetics in the project area. Earth moving equipment used to distribute the sand will temporarily create visual disturbance as well as noise and exhaust fumes, which will decrease the overall aesthetic value in the immediate vicinity of the project activities. Earth moving equipment will be operating from along the beach front to effectively distribute the sand 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 will correspond closely with the existing sand. With restoration of the currently eroded beaches the overall aesthetic value within the project beach area will increase.

Noise and viewshed impacts caused by dredging activities at the preferred borrow area would be short-term and negligible since the site is located approximately 6 miles offshore. Therefore, the overall impacts are not likely to adversely affect aesthetics within the project area.

4.10.2. BEACH NOURISHMENT USING AN UPLAND SAND SOURCE

Nourishing the beach by a trucking operation can have substantial aesthetic impacts associated with traffic congestion, road damage, spilled sand along roadways, and noise at the beach fill site where dump trucks must drive along the beach (NRC 1995). A typical street-legal dump truck carries about 9 to 16 cy of material; therefore

approximately 34,088 to 60,600 truck-loads must be hauled to the site to meet the renourishment requirement of 787,800 cy. It is estimated that approximately 189 to 337 dump trucks per day for 6 months would have to arrive at the site to meet project requirements.

4.10.3. NO ACTION ALTERNATIVE (STATUS QUO)

With the No Action alternative, the aesthetic value of the beach will continue to diminish as the beachfront continues to erode and narrow. In addition, the potential for the construction of numerous emergency shoreline armoring structures and other stopgap measures that would very likely continue to narrow the beach would increase, diminishing the aesthetic value of the area and resulting in long-term, permanent impacts to the aesthetics of the area.

4.11. RECREATION

IPFs associated with the Martin County HSDR project potentially impacting recreational resources include:

- Limited and/or restricted access
- Turbidity

4.11.1. PREFERRED ALTERNATIVE, BEACH NOURISHMENT USING OFFSHORE BORROW AREA C1-B

Recreational activities on the public beaches such as swimming, snorkeling, diving, birdwatching, surfing, and fishing would be temporarily interrupted during project construction. However, the resulting advantages gained by a wider and more stable public beach surface area would enhance the quality and opportunities for recreational experiences enjoyed by the public along Hutchinson Island while providing for conservation of the shorefront as a natural resource. Increases in water column sedimentation and burial of hardbottom areas may affect diving, snorkeling, and surfing in the area. However, increases in turbidity and sedimentation are expected to be temporary in nature.

The sand color of the post-construction beach may be different from that of the current beach, and may detract from the aesthetic quality of the project beach. This impact would be short-term as natural working of the dredged sediments by sunlight, rain, and wind will lighten the sediments with time. Increased beach area and restoration of the natural shoreline would result in an overall improved aesthetic quality.

Offshore boating, fishing, and diving at the borrow site would be temporarily interrupted during dredging activities. However, there are ample opportunities for fishing and boating in other locations nearby.

4.11.2. BEACH NOURISHMENT USING AN UPLAND SAND SOURCE

Impacts to swimming, snorkeling, diving, fishing, and surfing in the nearshore, beach fill area would be similar to the Preferred Alternative, as described above. Offshore

recreational opportunities (e.g., fishing, snorkeling, or scuba diving) would not incur impacts.

4.11.3. NO ACTION ALTERNATIVE (STATUS QUO)

With the No Action Alternative, the shoreline would continue to erode, resulting in the loss of existing shoreline and reduction in both the visual aesthetics and recreational opportunities. Offshore recreational opportunities (e.g. fishing, snorkeling, or scuba diving) would not incur impacts.

4.12. COASTAL BARRIER RESOURCES

There are no designated coastal barrier resources within the project area that will be affected by implementation of this project. The project area is not part of the Coastal Barrier Resources System.

4.13. WATER QUALITY

4.13.1. PREFERRED ALTERNATIVE, BEACH NOURISHMENT USING OFFSHORE BORROW AREA C1-B

Dredged material will be obtained from the offshore borrow areas using a hopper dredge. Material would be discharged directly onto the beach via pipeline following pre-established pipeline corridors (if possible) to avoid hardbottom areas. The initial discharge of material would be formed into a shore-parallel dike that would advance alongshore ahead of the construction template backfill. The dike would help to contain the discharge effluent, allowing time for sediments to drop from the flow. Construction would generally commence at the south end of the project and work toward the north. The material will be graded and shaped by earthmoving equipment in order to achieve the desired beach profile.

Implementation of the beach fill plan will likely temporarily elevate turbidity levels during the dredging and nourishment phases. The quality and general characteristics of the material used to nourish the beach will determine if the beach fill material will be environmentally acceptable to the nearshore area. The identified borrow area material has an acceptable silt content (5%) and is coarse enough to stabilize the beach without rapidly eroding down slope.

There would be temporary adverse effects caused by turbidity during dredging operations and nourishment of the beaches. The potential effects of dredging include sedimentation during dredging and an increase in turbidity, which reduces penetration of light required by photosynthetic organisms. This short-term, localized increase may have an adverse impact on non-motile autotrophs and heterotrophs such as periphyton, drifting phytoplankton, sponges, soft corals, and mollusks. These highly fecund organisms usually repopulate the project shoreline within a matter of weeks to months. The elevated turbidity level will be temporary in nature and is not expected to be significant as state standards for turbidity will not be exceeded [less than 29 nephelometric turbidity units (NTUs) above background levels]. The substrate has minimal silt content, therefore, turbidity and/or oxygen depletion associated with dredging is reasonably predicted to be minimal and of no significant impact.

The oceanographic conditions in this area are very dynamic, and beach material is constantly eroded and resuspended by wave energy. Therefore, short-term elevated turbidity levels during the construction phase are not expected to significantly alter background water clarity seaward of the project area.

The composition of the nearshore hardbottom habitat (ephemeral limestone, worm rock) will likely determine the extent to which these areas may be impacted from the placement of sand onto the eroded project beach. Ephemeral low relief coquina limestone rock may be buried during sedimentation, but will likely be re-exposed during future sand scouring, therefore, the overall impact on these ephemeral reef areas is considered negligible. Worm rock (*P. lapidosa*) may actually benefit from a temporary increase in turbidity if the increase is not exceedingly large or long in duration. *P. lapidosa* are capable of using the resuspended sand grains to further build and enlarge their rock tubes. As has been discussed throughout this SEIS, the beach nourishment project is expected to directly impact 1.3 acres of hardbottom habitat within the project area. Although eroded sand from the renourished beach is expected to flow south, this sand is not expected to significantly adversely impact any hardbottom areas south of the project beach. However, the overall short-term and long-term impact of increased turbidity and sedimentation will be quantitatively assessed during an extensive monitoring plan at both the borrow site and the beach fill area. In any instance, state water quality standards for turbidity will not be exceeded (within 29 NTUs of background conditions).

Although remote, accidental spills and releases of waste and/or fuel could potentially impact water quality. As part of the USACE standard contractual requirements, a marine pollution control plan will be followed in the event of a spill to contain the spill and minimize impacts to water quality.

4.13.2. BEACH NOURISHMENT USING AN UPLAND SAND SOURCE

Impacts to the water quality within the beach fill area would be similar to the Preferred Alternative. There would be no impacts to water quality at the borrow area if an upland sand source is used.

4.13.3. NO ACTION ALTERNATIVE (STATUS QUO)

There would be no adverse impacts to the water quality within the beach fill or borrow area with the No Action Alternative.

4.14. HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE

The offshore dredge areas, onshore staging area, and the vehicles and earth-moving equipment all represent potential sources of pollution due to the possibility of accidental spillage. However, accident and spill prevention plans delineated in the contract specifications should prevent most spills. All motorized vehicles will be maintained and appropriate precautions taken to ensure that no hazardous or toxic wastes are dumped either on the beach or into the nearshore waters. The No Action Alternative would not create situations to cause these potential impacts.

4.15. AIR QUALITY

4.15.1. PREFERRED ALTERNATIVE, BEACH NOURISHMENT USING OFFSHORE BORROW AREA C1-B

Some airborne pollutants can be expected to originate from project vehicles and machinery during the beach fill construction phase. These vehicles and machines will be well maintained to reduce the unnecessary release of airborne pollutants into the atmosphere. Any toxicant released into the atmosphere would likely be rapidly dispersed away from the project area by ocean-generated breezes.

BOEMRE prepared an air quality analysis using project-specific parameters to estimate emissions for the preferred alternative. Criteria air pollutant emissions were estimated for the preferred action using estimates of power requirements, duration of operations, and emission factors for the various equipment types. Multiplying horsepower (hp) rating, activity rating factor (percent of total power), and operating time yields the energy used. The energy used multiplied by an engine-specific emission factor yields the emission estimate. Operational data from the 2001-2002 nourishment cycles were used to estimate power requirements and duration for each phase of the proposed hopper dredging activity. The horsepower (hp) rating of the dredge plant was assumed for each activity as follows: 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 estimated duration of dredging was approximately 127 days. The estimated time to each complete dredge cycle, including idle time, was approximately 8.27 hours per load. It was assumed that about 2,353 cy of material would be moved in each cycle, requiring about 367 loads to excavate enough material to place 0.6 million cy of sand on the beach. The placement and relocation of the nearshore mooring buoys used during pump-out may involve up to two tender tugboats, a derrick barge, two work barges, and pipeline hauler/crane. It was assumed that the buoy would need to be moved at most five times during the project, with each move taking approximately 12 hours. It was assumed that a crew/supply vessel would operate daily for 4 hours as well.

All dredging was assumed to occur on the OCS, whereas 55% of hopper transport and crew/supply vessel activities were assumed to occur over state waters or 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 were obtained from EPA's *Compilation of Air Pollutant Emissions Factors, AP-42, Volume 1* (2002). Emission factors for tiered equipment used in beach construction were derived from NONROAD model (5a) estimates. Total project emissions of nitrates (NO_x), sulfur dioxide (SO₂), carbon monoxide (CO), volatile organic compounds (VOCs), and particulate matter are presented in **Table 4.15-1**.

The proposed action may result in small, localized, temporary increases in concentrations of nitrogen dioxide (NO₂), SO₂, CO, VOCs, and PM. Since the project is located in an attainment area, there is no requirement to prepare a conformity determination. Nonetheless, estimates were tallied to determine the portion of total emissions that would occur within state limits. Since the federal OCS waters attainment status is unclassified, there is no provision for any classification in the Clean Air Act for waters outside of the boundaries of state waters. Calculating the increase in emissions that may occur within the state limits was done by subtracting out the dredging-related and 45% of transport emissions, since those activities would take place entirely over federal waters.

Emissions associated with the dredge plant would be the largest contribution to the inventory. However, the total increases are relatively minor in context of the existing point and nonpoint and mobile source emissions in Martin County (**Table 4.15-1**). Any pollutant released into the atmosphere would quickly disperse from the project area by prevailing winds.

Table 4.15-1 Estimated Emissions for the Preferred Alternative (tons per year)

Activity	Emissions (tons)					
	NOx	SO ₂	CO	VOC	PM _{2.5}	PM ₁₀
Dredge Plant (Hopper)						
Dredging/Operation	12.5	0.2	2.9	0.3	0.2	0.2
Turning/Sail	59.7	1.0	13.7	1.6	1.0	1.0
Pump-out	13.7	0.2	3.1	0.4	0.2	0.2
Idle/Connect-Disconnect	3.9	0.1	0.9	0.1	0.1	0.1
Supporting Offshore Activities	11.2	0.2	2.6	0.2	0.3	0.08
Beach Fill	9.6	1.8	4.5	0.7	0.8	0.8
Total Emissions	110.6	3.5	27.7	3.3	2.5	2.4
Total Emissions within State	69.1	2.8	18.2	2.2	1.8	1.7
Total Emissions within OCS	41.5	0.7	9.5	1.1	0.7	0.7
2002 Countywide Emissions Nonpoint + Mobile (Point and Nonpoint + Mobile)	10,077 (19,296)	2,271 (19,313)	73,578 (85,599)	13,006 (14,004)	1,426 (3,188)	3,893 (5,857)
Martin County 2002 emissions from EPA National Emission Inventory http://www.epa.gov/air/data/						

4.15.2. BEACH NOURISHMENT USING AN UPLAND SAND SOURCE

The short-term impacts from emissions by dump trucks and other construction equipment associated with the project could be significant given the number of dump trucks required to transport the sand from the upland mine area. Because the period of construction activity is brief, exhaust emissions from vehicles and construction equipment associated with the project would have a temporary effect on air quality.

However, this impact would not just be within the local project area, it would have short-term impacts along the entire route that the dump trucks would make on a daily basis from the mine to the beach fill area.

4.15.3. NO ACTION ALTERNATIVE (STATUS QUO)

The No Action alternative would have no impact on air quality.

4.16. NOISE

4.16.1. PREFERRED ALTERNATIVE, BEACH NOURISHMENT USING OFFSHORE BORROW AREA C1-B

The project construction activities would result in short-term minor adverse effects to the noise environment in the vicinity of both the beach fill and borrow area sites. Construction will include temporary sources of noise. This noise has the potential to adversely impact biological resources such as fishes, sea turtles, marine mammals, and seabirds as discussed above in [Sections 4.3 and 4.5](#). Any such impacts, however, are expected to be minor and temporary. Noise generated from activities at the borrow area site would not be expected to affect noise-sensitive receptors onshore due to the distance from shore.

Proper maintenance of construction and dredging equipment would minimize the noise impacts and construction activities would occur for a short period. Construction noise would have a short-term, minor effect on sound levels in the vicinity of the construction activities.

4.16.2. BEACH NOURISHMENT USING AN UPLAND SAND SOURCE

The project construction activities would result in short-term minor adverse effects to the noise environment in the vicinity of both the beach fill area and along the dump truck travel routes. The noise has potential to impact shorebirds and other wildlife on the beach. Construction noise would have a short-term, minor effect on sound levels in the vicinity of the construction activities.

4.16.3. NO ACTION ALTERNATIVE (STATUS QUO)

The No Action alternative would not result in noise impacts.

4.17. PUBLIC SAFETY

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

The No Action alternative would assume continued erosion, allowing the surf zone to advance landward, with the potential of negative impacts to public safety due to storm damage.

4.18. ENERGY REQUIREMENTS AND CONSERVATION

Energy requirements for the proposed alternative would be limited to fuel for the dredging equipment, fuel for trucks during transportation, and fuel for other construction equipment. The use of sand from the proposed offshore borrow areas would require less energy expenditure than obtaining sand from an inland source and transporting the sand to the project site.

The No Action alternative would allow erosion to continue and would require a greater energy expenditure of on-site preventative measures and post-storm clean-up in the event of a storm (USACE 1996).

4.19. NATURAL OR DEPLETABLE RESOURCES

No natural energy resources occur within the project area. The borrow area proposed as a source for beach-quality sand is considered a depletable resource. Project dredging will reduce the quantity of sand in the borrow area. Shoals provide important physical habitat for fish that rely on shoals to optimize feeding along an otherwise featureless substrate (Caruso 2002; Tinsman 2002). There is concern among coastal managers and commercial and recreational fishermen that a decline in the sandy shoal habitat would lead to a decline in local fisheries and possibly a loss of local productivity (Caruso 2002; Tinsman 2002).

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 seabed topography, creating pits that may refill rapidly or cause detrimental impacts to the benthic community for extended periods of time. 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 (Newell et al. 1998). 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). Therefore, the impacts are considered minor and not likely to adversely affect the soft bottom infaunal invertebrate assemblages within the sand bottom areas of borrow site. However, this action could alter this shoal structure permanently and locally affect the seabed topography within the borrow site. Even though BMPs will be implemented in the design of the dredging profile of the shoal to help minimize the impacts to the shoal, the potential impacts from the modification to the shoal are considered significant; and therefore, could cause detrimental impacts to the benthic community for extended periods of time.

However, not all impacts from dredge pits are detrimental. Borrow pits are known to attract numerous fishes and have also been known to provide resting places for sea turtles (Spring and Snyder, personal observations off Hobe Sound, FL).

The No Action alternative would allow the sand in the borrow areas to remain relatively intact, although some redistribution would likely occur with natural cycles and storm events.

4.20. SCIENTIFIC RESOURCES

There are no known impacts to scientific resources associated with the proposed project or the No Action Alternative.

4.21. NATIVE AMERICANS

None of the proposed project activities occur on land belonging to Native Americans; therefore, the implementation of the proposed project would not result in any impacts to Native Americans or land belonging to Native Americans.

4.22. RE-USE AND CONSERVATION POTENTIAL

There is no potential for re-use associated with the proposed project activities; therefore, this is not applicable to the proposed renourishment project. Energy requirements for the proposed alternatives would be confined to fuel for the dredge, labor transportation, and other construction equipment.

4.23. URBAN QUALITY

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 presence of construction equipment would temporarily detract from the aesthetics of the environment, thereby possibly temporarily affecting the localized visual aesthetics associated with urban quality in Martin County.

The commercial businesses and residential properties along the project beach would benefit from the storm protection afforded by the project and incur less risk of property damage. After the 2004 hurricane season, an assessment was conducted to evaluate the performance and damages prevented by the shore protection project in Martin County. Results indicate that in the absence of the federal project, about \$9.5 million would have been spent by landowners and/or local and state governments prior to the 2004 tropical season to protect private property and to slow erosion and mitigate storm damages (Lent et al. 2007). The difference in damages between “with” and “without” project conditions is estimated at more than \$11.3 million (Lent et al. 2007).

The No Action alternative would assume continued shoreline erosion, reduction of storm protection, and continued loss of recreational beach area with repercussions to tax revenues and tourism commerce.

4.24. SOLID WASTE

No impacts related to solid waste are expected as a result of this project. Precautionary measures will be included in the contract specifications for proper disposal of solid wastes. These 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 will not be permitted.

4.25. DRINKING WATER

No municipal or private water supplies are located in or near the project site; therefore, drinking water supplies will not be impacted by implementation of the proposed project.

4.26. CUMULATIVE IMPACTS

Cumulative impact is the "impact on the environment which results 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" (40CFR1508.7). The proposed action, in addition to past projects and any future actions, would primarily impact the beach, nearshore hardbottom resources, and offshore sand borrow areas and adjacent habitats. Significant issues to be addressed include potential long-term and cumulative effects on protected species, water quality, EFH and HAPC, fish and wildlife resources, benthic communities, sediment transport, wave modification from dredging offshore, cultural and socioeconomic resources, and aesthetics and recreation.

Until this project expires in 2046, the beach will continue to be maintained as an area suitable for shoreline protection, recreation, and wildlife habitat. The proposed C1-B offshore borrow area will likely last the life of the project. Cumulative impacts will be assessed over the life of the project with continued monitoring and comparison to existing baseline data. Monitoring requirements are discussed in detail in Section 2.3.2 and Environmental Commitments are summarized in Section 4.35.

Table 4.26-1 summarizes the impacts of such cumulative actions by identifying the past, present, and reasonably foreseeable future conditions of the various resources that are directly or indirectly impacted by the proposed action and its alternatives. The table also illustrates the with-project and without-project conditions (the difference being the incremental impact of the project). Also illustrated is the future condition with any reasonable alternatives (or range of alternatives). Appendix D contains more detailed information of how the cumulative impacts were examined using the 11 steps identified by the Council on Environmental Quality (CEQ 1997).

The No Action alternative would result in continued erosion of beaches, increased potential for storm-related property damage, and decreased property values. No adverse environmental impacts to nearshore and offshore hardbottom habitats and fish communities are anticipated due to the No Action alternative. An increased exposure of nearshore hardbottom due to continued beach erosion is probable which, in turn, could provide increased habitat for surf zone fishes. Continued erosion of the beach could

threaten the existing dune habitat along the project area, potentially decreasing habitat for birds and dune species. Continued shoreline recession would also reduce the amount of dry beach available for sea turtle nesting and may result in poor site selection by nesting females.

Table 4.26-1. Summary of Cumulative Impacts (Page 1 of 3)

Resource	Past and Present (Baseline/Existing Condition)	Future Without Project	Future With Proposed Action
Threatened and Endangered Species: Sea Turtles	<p>Hutchinson Island supports the greatest concentration of sea turtle nesting activity in Florida. 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.</p> <p>The entire project reach has been previously renourished using an offshore sand source (Gilbert Shoal). The most recent renourishment was in 2005. Sea turtle nesting surveys have been conducted in a consistent manner on Hutchinson Island every year since 1981. Nesting activity is summarized in Section 3.3.1.</p>	<p>Sea turtle nesting and nearshore habitat use will continue in the area. Project-specific impacts will be avoided, but ongoing threats to sea turtle populations will continue. In the absence of the project, property owners may construct seawalls or other armoring to protect their property, which may result in loss of nesting habitat and possible impacts on nearshore hardbottom habitat.</p>	<p>In addition to ongoing threats, the project resulted in loss of 1.3 acres of juvenile developmental habitat (nearshore hardbottom) which has been mitigated for. 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 will be minimized through vessel-strike avoidance and dredge-related impact mitigation measures. Negative effects on nesting and hatching success would be most pronounced during the first nesting season following nourishment. However, there would be an increase in suitable nesting habitat after the beach reaches equilibrium. Due to the small spatial extent and short duration of project impacts, no significant cumulative impacts are expected.</p>
Threatened and Endangered Species: Marine Mammals	<p>Three endangered marine mammal species may occur in the area: Florida manatee, humpback whale, and North Atlantic right whale. Only the manatee is common, but the manatee is not expected to be present in offshore borrow area. Past and current threats to marine mammal populations include vessel strikes, fishing gear entanglement, ingestion of marine debris, pollution, and underwater noise.</p>	<p>Marine mammals will continue to occur in the area. Project-specific impacts will be avoided, but ongoing threats to marine mammal populations will continue.</p>	<p>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 will be minimized through vessel-strike avoidance and dredge impact –related mitigation measures.</p>
Threatened and Endangered Species: Smalltooth Sawfish	<p>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.</p>	<p>Smalltooth sawfish will continue to inhabit the area. Project-specific impacts will be avoided, but ongoing threats to sawfish populations will continue and may result in further decreases in population size and range.</p>	<p>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 will be minimized through mitigation measures. Due to the small spatial extent and short duration of project impacts, no significant cumulative impacts are expected.</p>

14

Table 4.26-1. Summary of Cumulative Impacts (Page 2 of 3)

Resource	Past and Present (Baseline/Existing Condition)	Future Without Project	Future With Proposed Action
Nearshore Hardbottom	<p>Prior to initial project construction, numerous investigations including sidescan sonar with ground-truthing, aerial photography, and underwater diver-verified reef characterization studies were conducted along the project reach. These investigations revealed the presence of hardbottom reef tracts consisting of ephemeral limestone outcrops and the marine bristle worm, <i>P. lapidosa</i>. It was estimated that between the St. Lucie/Martin County line and the St. Lucie Inlet there was approximately 150 acres of hardbottom communities, approximately 80 percent of which are of the sabellariid worm reef type (ATM 1991). These communities have historically been subjected to the dynamics of the nearshore environment including sand movement, scouring, and alternating burial/exposure.</p>	<p>Nearshore hardbottom areas will continue to exist in the area, subject to the natural dynamics of the nearshore environment including sand movement, scouring, and alternating burial/exposure. Natural physical stresses would continue to limit biodiversity. In the absence of the project, the potential for secondary and cumulative impacts of chronic sedimentation to nearshore hardbottom communities would be eliminated, however, property owners may construct seawalls or other armoring to protect their property, which may result in impacts to nearshore hardbottom.</p>	<p>During initial project construction, 1.3 acres of nearshore hardbottom was impacted and represents a small percentage of the similar habitat in the area. Impacts were mitigated through the construction of artificial reef habitat. Renourishment of the project area should result in minimal cumulative impacts on nearshore hardbottom provided appropriate monitoring and mitigation is conducted.</p>
Fish and Wildlife Resources	<p>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.</p> <p>Terrestrial wildlife in the project area consists of small mammals such as raccoon, opossum, rabbit, and rodents; multiple species of coastal shorebirds, amphibians, and reptiles. Birds are abundant on the beaches and in estuarine habitats, with shore and wading birds comprising the majority of the avifauna.</p>	<p>Project-specific impacts will be avoided, but soft bottom communities would continue to be affected by natural sand movement. Nearshore hardbottom edge 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 seawalls or other armoring 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.</p>	<p>In addition to ongoing processes affecting soft bottom fish and wildlife resources, there will 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. . Species could be impacted in a number of different ways, including direct mortality, sublethal impairment, and degraded habitat. Effects are not likely to be significant 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 site. No significant cumulative impacts are expected.</p>

Table 4.26-1. Summary of Cumulative Impacts (Page 3 of 3)

Resource	Past and Present (Baseline/Existing Condition)	Future Without Project	Future With Proposed Action
Essential Fish Habitat	<p>Managed species and species groups in the project area include <i>Sargassum</i>; live/hardbottom habitats; penaeid shrimps; spiny lobster; red drum; coastal pelagic fishes; reef fishes; dolphin and wahoo; and highly migratory pelagic species. Habitats of Particular Concern (HAPCs) for and live/hardbottom habitats of the eastern Florida area include the <i>Phragmatopoma</i> worm reefs found in nearshore waters.</p>	<p>Project-specific impacts will 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 seawalls or other armoring to protect their property; which may result in impacts to nearshore EFH.</p>	<p>In addition to ongoing processes affecting nearshore EFH, the project will result in the burial of 1.3 acres of nearshore hardbottom habitat resulting in an incremental loss of EFH for reef fishes. However, the impact represents a small percentage of the similar habitat in the area. Unavoidable impacts were mitigated through the construction of artificial reef habitat consisting of low to medium-relief to mimic the structure of the affected areas. Dredging will affect EFH by temporarily altering the sand shoal habitat (e.g., reducing shoal height, creating pits). However, the impact is reversible and represents a small percentage of the similar habitat in the area.</p>
Water Quality	<p>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 due to stormwater and effluent runoff resulting in increased nutrients and freshwater inputs to the nearshore coastal areas. .</p>	<p>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.</p>	<p>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 will 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 significant cumulative impacts are expected.</p>

4.26.1. CUMULATIVE ACTIVITIES SCENARIO

The geographic scope of this analysis includes the shoreline of Martin County with the Indian River Lagoon to the west, St. Lucie Inlet to the south, and St. Lucie County to the north and borrow area C1-B located in the Atlantic Ocean approximately 6 miles offshore of Martin and St. Lucie Counties, Florida. The project impact area extends from R-1 to R-25 (4-mile project fill area) and R-26 to R-29 which includes an area south of the project fill area that may be susceptible to potential downdrift (southerly) transport of sand in the nearshore area. Other similar projects to the north and south and all the other reasonably foreseeable actions along the shoreline of Hutchinson Island may, together with the proposed project, result in cumulative impacts. In addition to the coastline, the project area includes the offshore borrow area located in a sand ridge approximately 6 miles offshore. Cumulatively, this project and other similar projects may impact sand shoals 3 to 6 miles offshore.

4.26.1.1. Past Conditions and Activities

The coastline of Martin County is low-lying and vulnerable to storm surge and other storm event damages. The problem along the project area is one of sand erosion and lowering of the beach profile with subsequent recession of the shoreline and dunes. From 1996 to 2005, the project area was nourished four times (1996, 2001, 2002, and 2005) to address the damage sustained from a series of significant storms, including a strong “northeaster” during project construction in 1996, three hurricanes in 1999, two hurricanes in 2004, and three hurricanes in 2005. The initial 1996 nourishment placed a much greater volume of sand on the beach (advanced nourishment) than the subsequent three nourishment events (**Table 1.2-1**).

North of the project area, the federal Ft. Pierce Shore Protection Project area (about 1.3 miles) has received nourishment sand since 1971. The federal project began in 1980. Since that time, 14 nourishments have placed sand on various portions of the project beach. Most recently, Martin County nourished Bathtub Beach, about 1,000 feet of shoreline, in the Spring of 2010. SailFish Point Beach, just to the south and about 1,500 feet in length, received sand in 2005 and 2009.

4.26.1.2. Present/Ongoing Activities

There are no ongoing beach restoration activities in the project area. The proposed borrow area C1-B is not currently being used for any other beach restoration projects. 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.

4.26.1.3. Reasonably Foreseeable Future Activities

The Martin County HSDR project authorizes construction of a protective and recreational beach along 4 miles of shorefront southward from the St. Lucie County line to near the limit of Stuart Public Beach Park (R-1 to R-25). The authorized project was initially constructed in 1996 with a planned periodic renourishment interval of 11 years, now estimated at a 13 year interval. Federal participation (cost-sharing) is authorized for 50 years from date of initial construction and expires in 2046. The previously approved borrow area has been depleted. Therefore, borrow area C1-B is proposed as a potential source of beach-compatible sand. The total sand needed for the remainder of the 50-year life of the project is estimated to be between 2.4 and 4.0 million cubic yards. The next renourishment phase is scheduled for 2012 and will involve the placement of approximately 787,000 cubic yards of material along the 4-mile project area.

Regionally, beach nourishment is expected to continue in the coming years, compounding opportunities for recurring impacts. In southeast Florida alone, approximately 100 dredging events are projected to occur between 1969 and 2050 using at least 100,000,000 cubic yards of sediment in an area that is 4 miles wide by 120 miles long (from Dade County to Martin County) (USACE 1996). **Table 4.25-2** summarizes beach nourishment projects in Martin and St. Lucie Counties which are in the immediate vicinity (north and south) of the Martin County HSDR project. A complete summary of beach nourishment projects funded from 1995-2010 along the Atlantic coast of Florida (including sand bypassing) and total miles of beach nourished is provided in Table 2 of Appendix D.

Immediately north of the project area, St. Lucie County has initiated a beach renourishment project to address the deteriorated shoreline and emergency conditions as soon as possible with parallel development of a future federal Shore Protection Project to provide for future re-nourishment of south County beaches. More than a decade ago, the USACE recommended a “feasibility study” for a study area extending from just south of Blind Creek (R-77) to the Martin County Line. However, due to limited funding, the USACE only partially advanced that Feasibility Study, which until recently remained substantially incomplete and without sufficient federal funding to substantially advance any USACE project. USACE is currently completing the feasibility study but will not likely complete their project feasibility study and implementation process prior to 2012. The renourishment interval and volume are 10 years and 200,161 cubic yards, respectively. The proposed borrow area for Project re-nourishment are offshore St. Lucie County in reasonable proximity to the project fill-area; they can also likely yield the 50-year total estimated volume of beach compatible sand.

Table 4.26-2. Summary of Martin and St. Lucie Counties Beach Nourishment Projects

		Initial Nourishment				Re-nourishment			
County	Project	Year	Estimated Quantity (cy)	Location/Segment	Re-nourishment Interval (Years)	Re-Nourishment Year	Estimated Quantity (cy)	Location/ Segment	Comments
St. Lucie	Fort Pierce SPP Beach Nourishment	1971	1970 - initial construction (718,000)	South jetty at Ft. Pierce Inlet to Surfside Park (R-34 to R-46) 2.3 miles	4	1980; 1999; 2003; 2005	1980 - 346,000; 1999 - 830,000; 2003 - 336,000; 2005 - 517,000	1999 - R34-R41 & R41-R46; 2003 - R34-R41; 2005 - R34-R41	A 2-year renourishment interval may be more realistic here below the inlet. This area acts as a feeder beach to downdrift beaches to the south.
						March 1999	830,000	Ft. Pierce Inlet to R-41	Fill source: Capron Shoal
						April 2003	336,000	Ft. Pierce Inlet to T-36	
						April 2004	406,000	Ft. Pierce Inlet to T-36.5	
						May 2005	616,000	Ft. Pierce Inlet to R-41	
						April 2007	503,800	Ft. Pierce Inlet to R-41	
	May 2009	189,600	Ft. Pierce Inlet to R-35						
	St. Lucie County South Beach Emergency Dune Restoration	2005	162,000	R-98.4 to R-101.5; R-103.3 to R-115 + 1000 ft.	n/a	n/a	n/a	n/a	Upland truck haul
	St. Lucie County Beaches - Reconnaissance Study	--	--	St. Lucie County Beaches	--	--	--	--	--
Martin	Martin County HSDR - Hutchinson Island	Dec. 1995 - April 1996	1,340,000	St. Lucie/Martin county line to Stuart Beach Park (R-1 to R-25)	13	Winter 2001 - Spring 2002	304,000	R-1 to R-25	Fill source: Gilbert Shoal
						2005	885,000	R-1 to R-25	
	Jupiter Island Beach Restoration Project	1973-1974		Town of Jupiter Island; R-75 to R-117	3-4 (through 1996)	1996; 1999	1996 - 1,740,000	1996 - R77-R106; 1999 - R78-R84; R92-R100	--
	Bathtub Beach Nourishment	Spring 2010	35,000	R-34.5 to R-35.5	n/a	Spring 2010	n/a	n/a	Fill source: St. Lucie Inlet Flood Shoal
Sailfish Point Nourishment	Winter/spring 2005	25,000	R-36 to R-37.5	n/a	Winter/spring 2009	50,000	R-36 to R-37.5	Fill source: St. Lucie Inlet North Channel	

4.26.2. CUMULATIVE IMPACTS BY RESOURCE

In accordance with the approach recommended by the Council on Environmental Quality (1997), this analysis focuses on the potential impacts that are most important or meaningful. The marine resources of most interest for the cumulative analysis are threatened and endangered species, hardbottom, fish and wildlife resources, EFH, and water quality.

4.26.2.1. Threatened and Endangered Species

Sea Turtles

As discussed in Section 3.3.1, five endangered or threatened 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 ledges for feeding (macroalgae), resting, and shelter from predators.

Species recovery plans indicate that 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 marine debris (NMFS and USFWS, 1991a, 1992a,b, 1993, 2008). These impacts are widespread, diffuse, and ongoing, and will continue in the future regardless of whether this project is conducted.

The proposed project will affect only 4 miles of the approximately 1,400 miles of available sea turtle nesting habitat in the southeastern U.S. Research has shown that the principal effect of beach nourishment on sea turtle reproduction is a temporary reduction in nesting success during the first year following project construction. Research has also shown that the impacts of a nourishment project on sea turtle nesting habitat are typically short-term because a nourished beach will be reworked by natural processes in subsequent years, and beach compaction and the frequency of escarpment formation will decline.

Many of the direct effects of beach nourishment may persist over time and become indirect impacts. These indirect effects include increased susceptibility of relocated nests to catastrophic events, consequences associated with potential increased beachfront development, changes in the physical characteristics of the beach, the formation of escarpments, and future sand migration.

Approximately 1.3 acres of nearshore hardbottom foraging habitat for juvenile sea turtles will be directly impacted by beach construction and gradual beach fill equilibration, which represents an incremental loss of developmental habitat for juvenile sea turtles. The animals will be prevented from using the buried hardbottom habitat as long as macroalgae and seafloor structures are covered. However, the area impacted is a small percentage of the total habitat area available in the region. Therefore, the impact to sea turtle developmental habitat is considered minor. Suitable replacement habitat was created in 2000 to mitigate for direct impacts to nearshore hardbottom habitat.

In addition to the habitat loss, sea turtles may be disturbed by turbidity and noise during construction, and there is a small risk of a sea turtle being struck by a construction vessel or entrained in the hopper dredge draghead. However, measures can be implemented to minimize impacts to sea turtles. The 2010 USFWS Biological Opinion contains terms and conditions that implement the reasonable and prudent measures that USACE must comply with during project construction and post-construction monitoring. In addition, to reduce the risk of impacts from dredging and vessel strikes, the project will comply with the “Sea Turtle and Smalltooth Sawfish Construction Conditions” (NOAA Fisheries 2006) and “Vessel Strike Avoidance Measures and Reporting for Mariners” issued by NOAA Fisheries, Southeast Region. Trained and NMFS-approved protected species observers will be used on board the dredge vessel during all dredging operations, and dredge support vessel operators and crews will be instructed to maintain a constant lookout for sea turtles during transits and maneuvers. With mitigation measures in place, the potential for sea turtle “takes” due to dredging and vessel strikes is expected to be significantly reduced.

Although there is a risk of a small number of sea turtle “takes” due to dredging and vessel strikes, the impacts would not likely be detectable cumulatively, based on the other known sources of impact to sea turtles. In a 1990 study, the National Academy of Sciences estimated that between 5,000 and 50,000 loggerheads were killed annually by the shrimping fleet in the southeastern Atlantic and Gulf of Mexico (National Research Council 1990). Mortality associated with shrimp trawls was estimated to be 10 times greater than that of all other human-related factors combined. Most of these turtles were neritic juveniles, the life stages most critical to the stability and recovery of sea turtle populations (NMFS and USFWS 2008).

The FPL nuclear power plant just north of the project area regularly entrains marine turtles in their cooling water intake system, and FPL holds an incidental take permit for this impact. The plant has an ongoing program that captures almost all turtles before they enter the plant, where they would die. Some turtles are killed each year and hatchlings and juveniles may pass through the net and die without the notice of the plant personnel. Mortality at the plant represents the most significant ongoing impact to marine turtles along the Hutchinson Island shoreline

In the 2010 Biological Opinion, USFWS determined that the anticipated level of take associated with a beach nourishment project, as proposed, is not likely to jeopardize the continued existence of sea turtles. Critical habitat has not been designated in the project area; therefore, the project will not result in destruction or adverse modification of critical habitat. However, if future projects in southern St. Lucie County are conducted concurrently with Martin County, cumulative of minor local habitat loss due to burial of hardbottom areas in multiple areas may elevate the level of the impacts. Also, the range of influence from noise, vessel traffic, and turbidity could overlap. However, projects impacting hardbottom resources will require mitigation for their permanent impacts.

Future federal actions unrelated to the proposed action require separate consultation pursuant to Section 7 of the ESA.

Marine Mammals

As discussed in Section 3.3.2, three endangered marine mammal species may occur in the area: the Florida manatee, humpback whale, and North Atlantic right whale. Of these, only the manatee is common regionally. The two endangered whales are rare and may be present seasonally (December to March). Manatees are usually found in quiescent inshore waters and are unlikely to be present along the beach or in borrow areas.

Historically, the most significant threat presently faced by Florida manatees is death or serious injury from boat strikes (USFWS 2001a). Other known causes of manatee deaths include entrapment or crushing in water control structures and navigational locks, poaching and vandalism, entanglement in shrimp nets, monofilament line (and other fishing gear), entrapment in culverts and pipes, and ingestion of debris. Natural causes of death include disease, parasitism, reproductive complications, and other non-human-related injuries, as well as occasional exposure to cold and red tide. Vessel strikes will continue to be a significant threat to the Florida manatee population regardless of whether this project is conducted.

For humpback whales and right whales, ship collisions and fishing gear entanglements are the most common anthropogenic causes of mortality (NMFS 1991a, 1991b, 2005). Other potential threats are habitat degradation, noise, contaminants, underwater explosive activities, climate and ecosystem change, and commercial exploitation. These impacts are widespread, diffuse, and ongoing, and will continue in the future regardless of whether this project occurs.

Vessel strikes comprise the most important potential impact on marine mammals. Because the existing manatee and Northern Right Whale populations are so small any vessel striking a manatee or North Atlantic right whale during the project would represent a significant cumulative impact. To reduce the risk of vessel strikes, the project will comply with the "Vessel Strike Avoidance Measures and Reporting for Mariners" issued by NOAA Fisheries, Southeast Region. Trained and NMFS-approved protected species observers will be used on board the dredge vessel during all dredging operations, and dredge support vessel operators and crews will be instructed to maintain a constant lookout for marine mammals during transits and maneuvers. With these mitigation measures in place, the potential for marine mammal "takes" due to vessel strikes is expected to be significantly reduced.

Due to the small spatial extent and short duration of activities, a single nourishment event will not likely produce significant impacts on endangered or threatened marine mammals. However, the project may result in temporary disturbance of marine mammals due to turbidity and noise during construction. These are minor impacts that are not likely to be significant cumulatively in context with existing stresses on marine mammal populations. The proposed 13-year nourishment interval through 2046, will

help keep the potential for significant cumulative impacts from repeated individual nourishment projects low. The timing of beach nourishment project(s) in St. Lucie County, may increase concurrent, project-related impacts on local marine mammals. If future projects in southern St. Lucie and northern Martin County are conducted concurrently, the range of influence from turbidity, noise, and vessel traffic will extend spatially, if not temporally.

Smalltooth Sawfish

As discussed in Section 3.3.3, the smalltooth sawfish is an endangered demersal fish species inhabiting shallow, nearshore waters. Historically, its population has declined and its range has contracted, mainly due to fisheries bycatch (NMFS 2009). Other past and current threats are habitat loss and degradation, entanglement in marine debris, pollution, and anthropogenic disturbance (NMFS 2009). These widespread ongoing impacts are expected to continue in the future regardless of whether this project is conducted.

Construction-related turbidity and noise may disturb the smalltooth sawfish. To reduce the risk of impacts, the project will comply with the “Sea Turtle and Smalltooth Sawfish Construction Conditions” (NOAA Fisheries 2006). These measures are intended to reduce the potential for “takes” of smalltooth sawfish during construction. Consultation was initiated on April 30, 2007 with the NMFS regarding a new South Atlantic Division Regional Biological Opinion (SADRBO) to update the 1997 SADRBO for “the continued dredging of channels and borrow areas in the Southeastern United States”. Per October 24, 2007 NMFS guidance letter (NMFS, 2007), until the new SADRBO is issued the Corps will follow the reasonable and prudent measures, and implementing terms and conditions outlined in the 1997 SADRBO. These include NOAA’s updated construction conditions described above.

The small spatial extent and short duration of construction activities suggest that any single nourishment event is not very likely to impact smalltooth sawfish. Project construction may result in temporary disturbance or dislocation of these animals from dredging, turbidity and noise. These are minor impacts not likely to produce significant cumulative impacts in context with existing stresses on the population. Until 2046, assuming a 13-year renourishment interval, the potential for significant cumulative impacts from repeated individual nourishment projects in the same area is low. The timing of beach nourishment project(s) in St. Lucie County, may result in concurrent, overlapping impacts on smalltooth sawfish from the construction of two projects at the same time. If future projects in southern St. Lucie and northern Martin County are conducted concurrently, the range of influence from noise, vessel traffic, and turbidity could overlap. Also, if the projects use the same sand shoal(s), dredging-related impacts could overlap.

4.26.2.2. Nearshore Hardbottom

Beach nourishment activities may directly bury hardbottom habitat within the beach design template and may have secondary impacts on adjacent (waterward and

downdrift) hardbottom habitat south of the project area. Numerous investigations including sidescan sonar with ground-truthing, aerial photography, and underwater diver-verified reef characterization studies were conducted along the project reach. These investigations revealed the presence of hardbottom reef tracts consisting of ephemeral limestone outcrops and the marine bristle worm, *P. lapidosa*. These hardbottom areas are considered unique natural habitat for fish, juvenile green sea turtles, and invertebrates. During initial construction, it was estimated that 1.3 acres of hardbottom habitat was be directly impacted by the nourished sand sloughing seaward as it seeks equilibrium with the ocean bottom.

Dredging and nourishment will likely cause no significant ecological impacts to those reefs that are permanent and subjected to fewer scouring events. Computer models predicted and USACE coastal engineers concurred that it is likely that no reef tracts outside the project's influence (other than the 1.3 acres previously mentioned) or south of the project area will be directly impacted by the beach nourishment project.

Secondary impacts, such as scouring of encrusting sponges and sessile algae from rock surfaces due to the increase in water column turbidity, may occur. Holes, crevices, and hanging rock ledges may be partially or fully filled in from the increase in sand sloughing along the bottom. Increases in water column sedimentation and burial of hardbottom areas may result; however, increases in turbidity and sedimentation are expected to be temporary in nature. Because background turbidity and sedimentation levels are naturally high in this area, no significant, long-term changes attributable to the beach nourishment project are expected.

4.26.2.3. Fish and Wildlife Resources

As discussed in Sections 3.6 and 3.7, 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.

The project will result in 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. Significant effects are unlikely 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 site. No significant cumulative impacts are expected.

Until 2046, assuming a 13-year renourishment interval, the potential for significant cumulative impacts on fish and wildlife resources from repeated individual nourishment projects in the same area is low. However, if the interval is reduced due damage caused by storm events, the potential for significant cumulative impacts will increase. In addition, beach restoration projects in St Lucie County use nearby sand shoals for beach sand and create the potential for concurrent and overlapping impacts on benthic communities in the borrow area. The potential for significant cumulative impacts will be reduced by leaving portions of the existing shoals undisturbed as "refuge patches" and

will help reduce the potential for significant cumulative impacts by providing a nearby source of plant and animal re-colonization propagules for the disturbed borrow area.

4.26.2.4. Essential Fish Habitat

As discussed in Section 3.7, managed species and species groups with EFH in the project area include *Sargassum*; live/hardbottom habitats; penaeid shrimps; spiny lobster; red drum; coastal pelagic fishes; reef fishes; dolphin and wahoo; and highly migratory pelagic species. HAPCs for live/hardbottom habitats of the eastern Florida area include the *Phragmatopoma* worm reefs found in nearshore waters.

The project will result in the burial of 1.3 acres of nearshore hardbottom habitat which resulted in an incremental loss of EFH for hardbottom as well as reef fishes. However, the area buried is a small percentage of the total habitat area available in the region. Due to the small spatial extent and short duration of project impacts, no significant cumulative impacts on EFH are expected. Assuming a 13-year renourishment interval, the potential for significant cumulative impacts from repeated individual nourishment projects in the same area is low. However, if the renourishment interval decreases due to unanticipated damages from storms, the potential for significant cumulative impacts on EFH will increase.

4.26.2.5. Water Quality

Beach nourishment projects, as well as local inlet management activities along the central east coast of Florida, could result in several localized, short-term turbidity plumes and sedimentation adjacent to the beach fill sites and offshore borrow areas during project construction. Currently, the general consensus is that the cumulative impacts of localized turbidity plumes generated from these projects is expected to minimally impact the adjacent hardbottom epibenthic communities, provided appropriate protective and mitigative measures and monitoring are applied during these projects. Wave and current action should also help dissipate elevated sediment levels and assist in removing accumulated sediment from hardbottom resources adjacent to fill and borrow areas.

Previous studies conducted by Van Dolah et al. (1992, 1994) found that dredging appeared to have little impact on bottom turbidities at various borrow sites. However, potential long-term chronic effects of sedimentation and turbidity from these concurrent nourishment and dredging actions are unknown. There is some concern that the added effect of recurrent localized, short-term turbidity and sedimentation upon hardbottom resources adjacent to the borrow site and nourishment area may cumulatively impact these resources. Chronic perturbations could cause long-term reductions in primary and secondary productivity of hardbottom epibenthic communities by reducing the amount of light available for photosynthesis. However, the suitability of the proposed sediment source should minimize these impacts. Construction sedimentation and long-term monitoring for the proposed project will provide the data to accurately judge the effectiveness of the sediment rate value and predict the future impacts of turbidity and sedimentation related to authorized renourishments.

Continued urbanization and population growth in Martin and St. Lucie Counties also contributes to coastal water quality degradation. Water quality may deteriorate due to unrelated anthropogenic sources, such as stormwater and effluent runoff, resulting in increased nutrients and freshwater inputs to the nearshore coastal areas. In 2000, the U.S. Census Bureau estimated the population of Martin County at 126,731. In 2006, the population was 139,393, an increase of approximately 10%. In 2000, the population in St. Lucie County was approximately 192,695. In 2006, the population was 252,724, an increase of approximately 31.2% (<http://quickfacts.census.gov/qfd/states.html>).

4.26.2.6. Currents and Circulation

According to Hammer et al. (2005), the analysis of current patterns resulting from this study suggests that proposed sand mining will have negligible impacts on large-scale circulation along the shelf. The proposed sand mining locations are small relative to the entire shelf area, and it is anticipated that project-related dredging will not remove enough material to significantly alter major bathymetric features in the region. Therefore, the forces and/or geometric features that principally affect circulation patterns will remain relatively unchanged. In some cases, sand extraction from the OCS may prove environmentally preferable to nearshore borrow areas because potential changes to waves and currents resulting from dredging large quantities of sand from the seafloor may be more pronounced in shallow water (Byrnes et al. 2004).

4.27. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

4.27.1. IRREVERSIBLE

An irreversible commitment of resources is one in which the ability to use and/or enjoy the 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 area is estimated to contain a sufficient amount of sand to last the life the project which expires in 2046.

Use of sand from offshore borrow areas would also irreversibly preclude its current use as habitat for benthic organisms. However, remaining sand reserves within and adjacent to the borrow area will provide for re-colonization of benthic organisms. Due to the dynamic nature of nearshore benthic environments, sand used to nourish the beach will eventually disperse in the nearshore areas and create habitat for shallow water benthic communities. Impacts of beach restoration on nearshore hardbottom communities are reversible. These nearshore hardbottom areas are cyclically covered and exposed due to seasonal and other temporal changes in beach profiles.

4.27.2. IRRETRIEVABLE

An irretrievable commitment of resources is one in which, due to decisions to manage the resource for another purpose, opportunities to use or enjoy the resource as they presently exist are lost for a period of time. Benthic organisms within the borrow area and beach fill area that would be eliminated during construction would be irretrievably lost for a period of time. However, the high rate of repopulation expected from these organisms reduces the significance of the loss.

4.28. UNAVOIDABLE ADVERSE ENVIRONMENTAL EFFECTS

Species of relatively non-motile infaunal invertebrates that inhabit the borrow area will unavoidably be lost during dredging. Those species that are not able to escape the construction area are expected to recolonize after project completion. There would be an unavoidable reduction in water clarity and increased turbidity and sedimentation that would be limited to the immediate areas of dredging and beach fill operations. This impact will be temporary and should disappear shortly after construction activities cease. There would also be unavoidable impacts to 1.3 acres of nearshore hardbottom. These impacts have been mitigated for by the construction of 6.0 acres of artificial reef. The borrow area is approximately 1,000 acres, and approximately 125 acres of softbottom habitat at the borrow area would be disturbed per event every 13 years to meet the nourishment requirements.

4.29. LOCAL SHORT-TERM USES AND MAINTENANCE/ENHANCEMENT OF LONG-TERM PRODUCTIVITY

The Martin County HSDR Project will result in several localized, short-term turbidity plumes and sedimentation adjacent to the beach fill sites and offshore borrow areas during project construction. Shoreline protection using beach fill with periodic renourishment is an ongoing effort. Beach renourishment projects have a temporary and short-term impact on local offshore and nearshore biological resources. Research has shown that the impacts of a nourishment project on sea turtle nesting habitats are typically short-term because a nourished beach will be reworked by natural processes in subsequent years, and beach compaction and the frequency of escarpment formation will decline (USFWS 2005). Hammer et al. (2005) identified that potential impacts on benthos from dredging are expected to be localized and short-term due to the surrounding areas that could serve as a primary source for re-colonization. Short-term reductions in primary productivity and reproductive and feeding success of invertebrate species and fish are expected. The sustainability of these populations should not be negatively affected provided appropriate monitoring and mitigation measures are taken.

4.30. INDIRECT EFFECTS

Many of the direct effects of beach nourishment may persist over time and become indirect impacts. These indirect effects include the consequences associated with potential increased beachfront development, changes in the physical characteristics of the beach, formation of escarpments, and future sand migration (USFWS 2005). Indirect biological impacts of beach nourishment activities include diminished reproductive success, reduction in biomass of prey food items, and long-term changes to substrate composition at dredging sites (Jutte and Van Dolah 1999; Peterson and Manning 2001).

Pilkey and Dixon (1996) state that beach replenishment frequently leads to more development in greater density within shorefront communities that are then left with a future of further replenishment or more drastic stabilization measures. Dean (1999) also notes that the very existence of a beach nourishment project can encourage more development in coastal areas. Increased shoreline development may adversely affect

sea turtle nesting success. Greater development may support larger populations of mammalian predators, such as foxes and raccoons, than undeveloped areas (NRC 1990), and can also result in greater adverse effects due to artificial lighting.

4.31. COMPATIBILITY WITH FEDERAL, STATE, AND LOCAL OBJECTIVES

The federal objective is to contribute to national economic development consistent with protecting the nation's environment, pursuant to national environmental statutes, applicable executive orders, and other federal planning requirements.

Specific federal and county objectives are as follows:

1. Reduce expected storm damages through beach nourishment and other project alternatives;
2. Re-establish beaches as suitable recreation areas;
3. Maintain suitable habitat for nesting sea turtles, invertebrate species, and shorebirds;
4. Maintain commerce associated with beach recreation in Martin County.

The proposed Martin County HSDR Project is consistent with Federal and local objectives and with the State of Florida's Coastal Zone Management Plan.

4.32. CONFLICTS AND CONTROVERSY

Conflicts and controversy are discussed in Section 1.6 and have been addressed through the coordination with agencies and through the public comments.

4.33. UNCERTAIN, UNIQUE, OR UNKNOWN RISKS

The proposed Martin County HSDR Project does not involve any activities that have not been previously utilized during past nourishment activities performed in Martin County or along the east central Florida coast. Precautionary measures will be included in the contract specifications to ensure there are no impacts related to hazardous, toxic, or solid waste, and necessary corrective measures will be undertaken as required by the permits and laws in the unlikely event that any unacceptable impacts occur.

4.34. PRECEDENT AND PRINCIPLE FOR FUTURE ACTIONS

Initial construction of the Martin County HSDR Project was completed in 1996. Subsequent renourishments of the entire project area or portions of the project area were conducted in 2001, 2002, and 2005. The project area is scheduled for renourishment in 2012. The project is authorized until 2046 and the renourishment interval is estimated at 13 years.

4.35. ENVIRONMENTAL COMMITMENTS

USACE and Martin County as well as its contractors are committed to avoiding, minimizing, or mitigating for adverse effects during and after construction activities by including the following environmental commitments in the project contract plans and specifications.

4.35.1. SEA TURTLES

Considering that hopper dredging will be used for this project, compliance with all recommendations of the 1997 NMFS Biological Opinion regarding hopper dredging will be required to assure that incidental take of sea turtles are minimized during hopper dredging operations. The sea turtle deflecting draghead is required for all hopper dredging projects during the months that turtles may be present, unless a waiver is granted by the USACE in consultation with NMFS. The 1997 amended Biological Opinion mandates that year round, one-hundred percent observer coverage is necessary for beach nourishment project in southeast Florida. One hundred percent inflow screening is required, and 100 percent overflow screening is recommended when observers are required on hopper dredges. If conditions prevent 100 percent inflow screening, inflow screening can be reduced, but 100 percent outflow screening is required, and an explanation must be included in the preliminary dredging report. Preliminary dredging reports which summarize the results of the dredging and any sea turtle take must be submitted within 30 working days of completion of any given dredging project. Logs of any sea turtle injuries or deaths due to hopper dredging activities will be maintained, with immediate notification to USACE-Jacksonville District, USFWS and NMFS as appropriate, and FWC.

To minimize the potential for collisions, vessels transporting dredged materials to the project site are expected to implement protective measures, where feasible, to avoid interactions with sea turtles, including maneuvering away from the animal or slowing the vessel particularly during poor sighting conditions (i.e. fog, high sea state, darkness). During transport of dredged material to the project site and when returning to the dredge site, vessels would use extreme caution and proceed at a safe speed such that the vessel can take proper and effective action to avoid a potential collision with a sea turtle; this preventative action would significantly reduce the potential for a vessel strike with a sea turtle. Any collision with and/or injury to a sea turtle shall be reported immediately to the NMFS's Protected Resources Division and the local authorized sea turtle stranding/rescue organization.

Reasonable and Prudent Measures

The Corps and Martin County agree to comply with the reasonable and prudent measures and non-discretionary terms and conditions stated in the USFWS Biological Opinion for the proposed Martin County HSDR Project. The USFWS believes the following reasonable and prudent measures are necessary and appropriate to minimize take of loggerhead, green, leatherback, hawksbill, and Kemp's ridley sea turtles in the proposed action area.

1. Beach quality sand suitable for sea turtle nesting, successful incubation, and hatchling emergence shall be used on the project site.
2. Sand placement activities shall not occur from May 1 through October 31, the period of peak sea turtle egg laying and egg hatching, to reduce the possibility of sea turtle nest burial, crushing of eggs, or nest excavation.

3. If sand placement activities are conducted during the period from March 1 through April 30, or November 1 through November 30, surveys for early and late nesting sea turtles shall be conducted, respectively, if nests are constructed in the area of sand placement, the eggs shall be relocated.
4. Immediately after completion of the project and prior to the next three nesting seasons, beach compaction shall be monitored and tilling shall be conducted as required by March 1 to reduce the likelihood of impacting sea turtle nesting and hatching activities. The March 1 deadline is required to reduce impacts to leatherbacks that nest in greater frequency along the south Atlantic coast of Florida than elsewhere in the continental U.S.
5. Immediately after completion of the project and prior to the next three nesting seasons starting March 1, monitoring shall be conducted to determine if escarpments are present and escarpments shall be leveled as required to reduce the likelihood of impacting sea turtle nesting and hatching activities.
6. USACE shall ensure that contractors performing the sand placement work fully understand the sea turtle protection measures detailed in this incidental take statement.
7. During the early (March 1 through April 30) and late (November 1 through November 30) portions of the nesting season, construction equipment and supplies shall be stored in a manner that will minimize impacts to sea turtles to the maximum extent practicable.
8. During the early (March 1 through April 30) and late (November 1 through November 30) sea turtle nesting season, lighting associated with the project shall be minimized to reduce the possibility of disrupting and disorienting nesting or hatchling sea turtles.
9. Sand placement activities using an offshore sand source will be restricted to within 500 feet unless nighttime monitoring is conducted.
10. Permanent exterior lighting is prohibited.
11. Pre- and post-construction lighting surveys shall be conducted.
12. The sea turtle permit holder shall be notified if a sea turtle nest is excavated.
13. All reports shall be submitted to FWC and USFWS.
14. State and federal agencies shall be notified immediately upon locating a dead, injured, or sick sea turtle.

4.35.2. RIGHT WHALES AND MARINE MAMMALS

To minimize project impacts on right whales and other marine mammals related to transporting dredged material to the project site, the following protective measures will be implemented:

- During transport of dredged material from the borrow area to the project site and when returning to the dredge site, vessels would use extreme caution and proceed at a safe speed such that the vessel can take proper and effective action to avoid a collision with a right whales or other marine mammals and can be stopped within a distance appropriate to the prevailing circumstances and

conditions. This preventive action would significantly reduce the potential for a vessel strike with a listed species.

- Dredge contractors would participate in the right whale Early Warning System (EWS), where ships are alerted to the presence of right whales in the project area during the calving season with the aid of aerial surveys. To the extent practicable, vessel operations in right whales critical habitat during the calving season would be minimized and transit course altered immediately upon notification of a right whale sighting through the EWS.
- When whales have been sighted in the area, vessels would increase vigilance and take reasonable and practicable actions to avoid collisions and activities that might result in close interaction of vessels and marine mammals. Actions may include changing speed and/or direction and are dictated by environmental and other conditions (e.g., safety, weather).
- From November 15 through April 15, barges or dredges moving through right whale critical habitat shall take the following precautions: During evening hours or when there is limited visibility due to fog or sea states greater than Beaufort 3, the tug/barge or dredge operator shall slow down to 5 knots or slowest safe navigable speed when traversing between areas if whales have been spotted within 15 nmi of the vessel's path within the previous 24 hours.
- From December 1 through 30 March, daily aerial surveys of the EWS area will be conducted by others (i.e., EWS) to monitor for the presence of right whales. Right whale sightings will be immediately communicated to the dredging contractor's dredge. In addition, the tug/barge or dredge operator shall maintain a 500-yard buffer between the vessel and any sighted whale.
- A NMFS-approved observer would be present on hopper dredges 24 hours a day year-round during the transport of dredged materials. Observers would monitor for the presence of marine mammals from the bridge during daylight hours while transiting to and from the disposal area.
- Floating weeds, algal mats, *Sargassum* rafts, clusters of seabirds, and jellyfish are good indicators of the possible presence of sea turtles and marine mammals. Therefore, increased vigilance in watching for sea turtles and marine mammals will be taken where these are present.

4.35.3. MANATEES

Although manatees are not likely to occur in the project area, the following protection measures will be implemented to minimize potential impacts to manatees:

1. The contractor shall instruct all personnel associated with the project of the potential presence of manatees, the need to avoid collisions with these animals and the need to be on constant lookout for manatees during all phases of operation.
2. All construction personnel shall be advised that there are civil and criminal penalties for harming, harassing, or killing manatees and right whales which are protected under the Marine Mammal Protection Act of 1972, the Endangered

Species Act of 1973, and the Florida Manatee Sanctuary Act. The Contractor shall be held responsible for any manatee harmed, harassed, or killed as a result of construction activities.

3. If siltation barriers are used, they shall be made of material in which manatees cannot become entangled, are properly secured, and are regularly monitored to avoid manatee entrapment. Barriers must not block manatee entry to or exit from essential habitat.
4. All vessels associated with the project shall operate at "no wake/idle" speeds at all times while in waters where the draft of the vessel provides less than a four foot clearance from the bottom and vessels shall follow routes of deep water whenever possible. Boats used to transport personnel shall be shallow-draft vessels, preferably of the light-displacement category where navigational safety permits.
5. If a manatee(s) is sighted within 100 yards of the project area, all appropriate precautions shall be implemented by the contractor to ensure protection of the manatee. These precautions shall include the operation of all moving equipment no closer than 50 feet of a manatee. If a manatee is closer than 50 feet to moving equipment or the project area, the equipment shall be shut down and all construction activities shall cease to ensure protection of the manatee. Construction activities shall not resume until the manatee has departed the project area.
6. Prior to commencement of construction, each vessel involved in construction activities shall display at the vessel control station or in a prominent location, visible to all employees operating the vessel, a temporary sign at least 8 1/2" x 11" reading, "Caution: Manatee Habitat/Idle Speed is Required in Construction Area." In the absence of a vessel, a temporary 3' x 4' sign reading "Caution: Manatee Area" will be posted adjacent to the issued construction permit. A second temporary sign measuring 8½" X 11" reading "Caution: Manatee Habitat. Equipment Must Be Shutdown Immediately If A Manatee Comes Within 50 Feet Of Operation" will be posted at the dredge operator control station and at a location prominently adjacent to the displayed issued construction permit. The contractor shall remove the placards upon completion of construction.
7. Any collisions with a manatee or sighting of any injured or incapacitated manatee shall be reported immediately to USACE.
8. The contractor shall maintain a daily log detailing sightings, collisions, or injuries to manatees occurring during the contract period. The data shall be recorded on forms provided by the Contracting Officer (sample form is appended to the end of this section). All data in original form shall be forwarded directly to the Chief of Environmental Resources Branch, P. O. Box 4970, Jacksonville, Florida, 32232-0019, within 10 days of collection, and copies of the data will be supplied to the Contracting Officer. Within 15 days following project completion, a report summarizing the above incidents and sightings, including a list of names and addresses for all observers used during the construction will be submitted to the proper personnel.

9. Furthermore, during hopper dredge operations, NMFS observers will be on board 24 hours a day and will serve as a lookout to alert the vessel pilot of the occurrence of manatees in the project areas. If a manatee is observed, collisions shall be avoided either through reduced vessel speed, course alteration, or both.

4.35.4. SHOREBIRDS AND MIGRATORY BIRDS

Throughout the Jacksonville District there are numerous unique species of migratory birds. These birds are protected by state and federal laws. A large majority of these birds species are shorebirds and colonial nesting birds. During construction and/or dredging along the waterways, habitat for these birds can potentially be affected or created. The Jacksonville District, in conjunction with the State of Florida Fish and Wildlife Conservation Commission (FWC), the Audubon Society, and USFWS, has developed a district-wide policy concerning its activities and migratory bird nesting. A copy of the Migratory Bird Protection Policy can be downloaded from:

www.saj.usace.army.mil/Divisions/Planning/Branches/Environmental/Protection_Environment.htm.

The USACE protection specifications for contracts as related to migratory bird protection are provided below.

1. The Contractor shall keep construction activities under surveillance, management, and control to prevent impacts to migratory birds and their nests. All construction personnel shall be advised that migratory birds are protected by the Florida Endangered and Threatened Species Act of 1977, Title XXVIII, Chapter 372.072, and the U.S. Fish and Wildlife Service pursuant to the Migratory Bird Treaty Act of 1918 and the Endangered and Threatened Species Act of 1982, as amended. The Contractor may be held responsible for harming or harassing the birds, their eggs or their nests as a result of the construction.
2. In order to meet these responsibilities, the Contractor shall conduct monitoring of the construction area beginning 1 April through 31 August, if construction activities occur during that period. Daily monitoring using the attached forms will be conducted during the dawn or dusk time frames by a bird monitor approved by the Contracting Officer or the Contracting Officer's Representative. (Caution will be taken by the monitor to avoid disturbance to the nesting birds.) The Contractor shall maintain a daily log detailing monitoring and nesting activity. Within 30 days after completion of construction, a summary of monitoring shall be submitted to the Corps detailing nesting and nesting success/failure including species, number of nests created, location, number of eggs, number of offspring generated during the project and reasons for nesting success or failure, if known.
3. Any nesting activity observed by the Contractor will be reported immediately to the Contracting Officer or the Contracting Officer's Representative who shall have sole authority for any work stoppages, creation of the buffer area, or restart of construction activities.
4. Should nesting begin within the construction area, a temporary, 200-foot buffer will be created around the nests and marked to avoid entry (the Contracting Officer will provide signs). The area will be left undisturbed until nesting is

completed or terminated, and the chicks fledge. The decision to allow construction in a former nesting site will be determined by the Contracting Officer in consultation with the U.S. Fish and Wildlife Service and the Florida Game and Fresh Water Fish Commission. Access to the nesting sites by humans (except limited access when accompanied by the bird monitor or Contracting Officer), equipment or pets under control of the Contractor is prohibited.

5. If nesting occurs within the construction area, a bulletin board will be placed and maintained by the Contractor in the contracting shed with the location map of the construction site showing the bird nesting areas and a warning, clearly visible, stating that "BIRD NESTING AREAS ARE PROTECTED BY THE FLORIDA THREATENED AND ENDANGERED SPECIES ACT AND THE FEDERAL MIGRATORY BIRD TREATY ACT".
6. NOTE: Birds will find the top of the dike or the flat interior desirable nesting habitat. If construction activity ceases for any period of time, nesting may occur before work can resume. Any stoppage of activity could induce nesting, subsequently, construction could be altered or stopped to avoid impacting the birds unless the State of Florida and the U.S. Fish and Wildlife Service authorizes the interruption of nesting and/or destruction of the eggs. (NOTE: This authorization is highly unlikely.) Areas which are potentially suitable for nesting can be altered to make the area undesirable. One approved method is the placement of stakes at 10- to 15-foot intervals and tie flagging between the stakes in a web fashion. This may dissuade bird nesting until construction can be resumed. In addition, the disposal area basin can be flooded prior to the beginning of nesting season to the elevation required for displacement from the disposal of dredged material in order to make the basin undesirable for bird nesting.
7. The Contractor's Environmental Protection Plan shall contain the qualifications of the bird monitor and the steps to be taken to construct the project in such a manner as not to impact migratory birds or induce their nesting. The qualifications of the bird monitor are a demonstrated ability to identify bird species, general and nesting behavior characteristics, nests and eggs, and a knowledge of habitat requirements. In addition, references must be provided to verify non-educational experience.
8. Delays in work due to the fault of negligence of the Contractor or the Contractor's failure to comply with this specification shall not be compensable. Any adjustments to the contract performance period or price that are required as a result of compliance with this section shall be made in accordance with the Contract Clause entitled "SUSPENSION OF WORK".

4.35.5. NEARSHORE HARDGROUNDS

All practical measures will be taken by the construction crew to avoid adverse impacts to hardground habitat and associated communities. These measures will include pre-dredging surveys to locate all hardground areas. Anchoring of any dredge barge will be permitted in sandy areas only.

4.35.6. QUALITY ASSURANCE FOR BEACH FILL SEDIMENT AND DREDGING ACTIVITIES

Attachment D of the FDEP Joint Coastal Permit Application includes a Sand Quality Control (QC) and Quality Assurance (QA) Plan. The purpose of the Sand QC and QA Plan, required by paragraph 62B-41.008 (1) (k) (4b) FAC, is to ensure that the sediment from the permitted borrow area will meet the standards outlined in the permit. In-depth geotechnical investigations for the project have verified that the sediment located within the spatial limits of the permitted borrow area meets the requirements stated in paragraph 62B-41.007 (2) (j). The QC Plan for the project will outline requirements placed on the Contractor to ensure that all work occurs within the horizontal and vertical limits of the permitted borrow area and that the Contractor takes appropriate remedial actions for unsuitable material, if necessary. The QA Plan outlines the steps taken by the Owner (Martin County) to observe, samples, and test the placed sediments to assure compliance with the permit.

4.36. COMPLIANCE WITH ENVIRONMENTAL REQUIREMENTS

4.36.1. NATIONAL ENVIRONMENTAL POLICY ACT OF 1969

Environmental information on the project has been compiled and the Draft SEIS was prepared and circulated to appropriate local, state, and federal agencies, as well as interested academic institutions and citizens, prior to finalization in accordance with NEPA. Comments received from these sources have been addressed in the Final SEIS and in **Appendix C, Pertinent Correspondence**.

4.36.2. ENDANGERED SPECIES ACT OF 1973

Consultation was reinitiated with NMFS on April 30, 2007 requesting an updated South Atlantic Division Regional Biological Opinion (SADRBO) for “The Continued Dredging of Channels and Borrow Areas in the Southeastern United States,” original dated September 25, 1997. By letter dated October 25, 2007, NMFS acknowledged receipt of our reinitiation package and provided the following guidance: “So long as the COE follows the reasonable and prudent measures, and implementing terms and conditions outlined in the SARBO, and continues to ensure that its actions will not jeopardize the continued existence of any listed species or result in the destruction or adverse modification of designated critical habitat, the protective coverage of the biological opinion and the Endangered Species Act (ESA) will not lapse.” Consultation was initiated with USFWS on January 14, 2009, and USACE received a request for additional information (RAI) from USFWS on July 20, 2009. Response to that RAI dated August 7, 2009 is included in Appendix C, Pertinent Correspondence. USFWS issued an updated biological opinion in June 2010. This project has been fully coordinated under the Endangered Species Act and is in full compliance with ESA.

4.36.3. FISH AND WILDLIFE COORDINATION ACT OF 1958

This project has been coordinated with USFWS. A Final Coordination Act Report (CAR) dated January 24, 1994 was submitted by USFWS. This project was re-coordinated with USFWS via letter dated November 25, 2009 and a draft response letter concurring with the Corps determination that the 1994 CAR covers the proposed action was

received via email on December 10, 2009. This project will be in full compliance with the Fish and Wildlife Coordination Act of 1958.

4.36.4. NATIONAL HISTORIC PRESERVATION ACT OF 1966 (INTER ALIA)

Federal undertakings will comply with the Archeological and Historical Preservation Act of 1974 (16 USC 469-469c); Executive Order 11593, the Abandoned Shipwreck Act of 1987 (PL 100-298; 43 U.S.C. 2101-2106); the National Historic Preservation Act of 1966, as amended (16 USC 470); and the Advisory Council on Historic Preservation's implementing regulations under 36CFR800 (*Protection of Historic Properties*). Section 106 of the National Historic Preservation Act requires federal agencies to provide the SHPO (as agent to the Advisory Council on Historic Preservation) reasonable opportunity to evaluate and comment on any federal undertaking. The act requires the agency to coordinate with SHPO whether or not the agency believes there would be impacts to significant historic resources. The project is in compliance with each of these federal laws.

4.36.5. CLEAN WATER ACT OF 1972 (CWA)

The project will be in compliance with the CWA. A Joint Coastal Application permit was submitted by the sponsor on April 17, 2009. A Section 401 water quality certification will be issued by FDEP. All State water quality standards would be met. A Section 404(b) evaluation is included in this report as Appendix A. A public notice was issued in a manner that satisfies the requirements of Section 404 of the CWA.

4.36.6. CLEAN AIR ACT OF 1972

No air quality permits would be required for this project. An air quality emissions analysis was completed by the cooperating agency for this NEPA document, BOEMRE, and is included in Appendix N. The project is expected to be in attainment with EPA air quality standards.

4.36.7. COASTAL ZONE MANAGEMENT ACT OF 1972

A federal consistency determination in accordance with 15CFR930 Subpart C is included in this report as Appendix B. Preliminary state consistency review was performed during the coordination of the NOI and the state has determined that, at this stage, the project is consistent with the Florida Coastal Zone Management Program (see letter dated July 26, 2007, from the Florida State Clearinghouse concurring with our consistency determination in Appendix C).

4.36.8. FARMLAND PROTECTION POLICY ACT OF 1981

No prime or unique farmland would be impacted by implementation of this project. This act is not applicable.

4.36.9. WILD AND SCENIC RIVER ACT OF 1968

No designated Wild and Scenic River reaches would be affected by project-related activities. This act is not applicable.

4.36.10. MARINE MAMMAL PROTECTION ACT OF 1972

Incorporation of the safeguards used to protect threatened or endangered species during dredging and disposal operations will also protect any marine mammals in the area, therefore, this project is in compliance with the Marine Mammal Protection Act of 1972.

4.36.11. ESTUARY PROTECTION ACT OF 1968

No designated estuary would be affected by project activities. This act is not applicable.

4.36.12. FEDERAL WATER PROJECT RECREATION ACT

The principles of the Federal Water Project Recreation Act (Public Law 89-72), as amended, have been fulfilled by complying with the recreation cost-sharing criteria as outlined in Section 2 (a), paragraph (2). Another area of compliance includes the public beach access requirement on which the renourishment project hinges [Section 1, (b)].

4.36.13. FISHERY CONSERVATION AND MANAGEMENT ACT OF 1976

The project has been coordinated with NMFS and will be in compliance with the Fishery Conservation and Management Act. USACE received a preliminary letter dated June 28, 2007 from NMFS. Comments on the SEIS were received from NMFS on January 7, 2011. USACE prepared a response package and submitted it to NMFS on February 22, 2011. All correspondence is provided in **Appendix C, Pertinent Correspondence**.

4.36.14. SUBMERGED LANDS ACT OF 1953

The project would occur on submerged lands within of the state of Florida. The project has been coordinated with the State and is in compliance with the Submerged Lands Act of 1953.

4.36.15. COASTAL BARRIER RESOURCES ACT AND COASTAL BARRIER IMPROVEMENT ACT OF 1990

There are no designated coastal barrier resources in the project area that would be affected by this project. These acts are not applicable.

4.36.16. RIVERS AND HARBORS ACT OF 1899

The proposed work would not obstruct navigable waters of the United States. The proposed action has been subject to public notice, public hearing, and other evaluations normally conducted for activities subject to the Rivers and Harbors Act of 1899. The project is in full compliance.

4.36.17. ANADROMOUS FISH CONSERVATION ACT

Anadromous fish species would not be affected. The project has been coordinated with NMFS and is in compliance with the Anadromous Fish Conservation Act.

4.36.18. MIGRATORY BIRD TREATY ACT AND MIGRATORY BIRD CONSERVATION ACT

Impacts to migratory birds will be mitigated by implementation of conservation measures required by the Migratory Bird Treaty Act and the Migratory Bird Conservation Act; thus the project will be in compliance with both acts.

4.36.19. MARINE PROTECTION, RESEARCH AND SANCTUARIES ACT

The term "dumping" as defined in the Marine Protection, Research and Sanctuaries Act {33 U.S.C. 1402}(f) does not apply to the disposal of material for beach nourishment or to the placement of material for a purpose other than disposal (i.e., placement of rock material as an artificial reef or the construction of artificial reefs as mitigation). Therefore, the Marine Protection, Research and Sanctuaries Act does not apply to this project. The disposal activities addressed in this SEIS have been evaluated under Section 404 of the Clean Water Act.

4.36.20. MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

This act requires preparation of an EFH assessment and coordination with NMFS. An independent EFH assessment is provided in **Appendix E**. USACE provided this EFH assessment to NMFS during the EFH coordination process. NMFS responded with their EFH conservation recommendations via letter dated January 7, 2011. The Corps formally responded to the EFH recommendations via letter dated February 22, 2011. Therefore this project is in compliance with this Act and EFH coordination is complete.

4.36.21. EXECUTIVE ORDER 11990, PROTECTION OF WETLANDS

No wetlands would be affected by project activities. This project is in compliance with the goals of this Executive Order 11990.

4.36.22. EXECUTIVE ORDER 11988, FLOOD PLAIN MANAGEMENT

The project is in the base flood plain (100-year flood) and is being evaluated in accordance with this Executive Order. The project will be in compliance.

4.36.23. EXECUTIVE ORDER 12898, ENVIRONMENTAL JUSTICE

The proposed project would not result in adverse human health or environmental effects, nor would the activity impact subsistence consumption of fish or wildlife. The project is in compliance with Executive Order 12898.

4.36.24. EXECUTIVE ORDER 13089, CORAL REEF PROTECTION

The proposed project may affect U.S. coral reef ecosystems as defined in Executive Order 13089. The offshore borrow areas will be designed to avoid impacts to hardbottom resources by establishing a 500-foot buffer around any identified resources. Additional protective measures will be implemented to minimize impacts to adjacent hardbottom resources, including turbidity monitoring with cessation of construction activities if turbidity exceeds the State limit of 29 NTUs above background, real-time

sedimentation monitoring during project construction, and post-construction monitoring of nearshore hardbottom resources adjacent to the beach fill areas to evaluate potential long-term impacts of turbidity and sedimentation. A mitigation plan was developed in coordination with federal, state, and county agencies to fully compensate for unavoidable impacts to nearshore hardbottom resources. The nearshore hardbottom epibenthic communities landward of the ETOF do not represent irreplaceable resources. With proper placement of artificial reefs, suitable replacement habitat has been created for nearshore epibenthic species. The proposed project will be in compliance with Executive Order 13089.

4.36.25. OUTER CONTINENTAL SHELF LANDS ACT

The federal government administers the submerged lands, subsoil, and seabed, lying between the states' seaward jurisdiction and the seaward extent of federal jurisdiction. The Outer Continental Shelf Lands Act (OCSLA) and subsequent amendments, in later years, outlines the federal responsibility over the submerged lands of the OCS. Additionally, it authorizes the Secretary of the Interior to lease those lands for mineral development. The project has been coordinated with the U.S. Minerals Management Service, which is a cooperating agency for this NEPA document, and is in compliance with the OCSLA.

5. LIST OF PREPARERS

5.1. PREPARERS

A list of preparers, with their qualifications, experience, and corresponding roles in the preparation of this Draft SEIS is provided in **Table 5.1-1**.

Table 5.1-1. List of Preparers

Name	Discipline	Role in SEIS Preparation	Experience
Paul DeMarco, M.S. USACE, Jacksonville District	Biologist	USACE Project Manager	18 Years, Natural Resources Management and Ecology
Michelle Rau, M.S. ANAMAR Environmental Consulting, Inc.	Ecologist	ANAMAR Project Manager, Principle Writer	14 Years, Natural Resources Management and Ecology
Christine Smith, B.A. ANAMAR Environmental Consulting, Inc.	GIS Specialist	Developed Figures and Maps, EFH Assessment	6 Years, Environmental Geography and ArcGIS
Terence Cake, P.E. ANAMAR Environmental Consulting, Inc.	Water Resources Engineer	404(b) Evaluation Report	16 Years, Water Resources and Environmental Engineering
Constance Steen ANAMAR Environmental Consulting, Inc.	Editor	Technical Editing and Document Formatting	>25 Years Working with Environmental Documents
Debra Segal, M.S. Wetland Solutions, Inc.	Senior Scientist	Document Reviewer	18 Years, Natural Resources Management and Ecology

5.2. REVIEWERS

A list of reviewers, their discipline, and corresponding roles in the review of the Draft SEIS is provided in **Table 5.2-1**.

Table 5.2-1. List of Reviewers

Name	Discipline	Role in SEIS Preparation
Geoffrey Wikel, BOEMRE Environmental Division	Oceanographer	Technical Reviewer
Dr. James R. Woehr, BOEMRE Environmental Division	Avian Biologist	Technical Reviewer
Dr. Sally Valdes, BOEMRE Environmental Division	Ecologist	Technical Reviewer
Dr. Brian Jordan, BOEMRE Environmental Division	Marine Archaeologist	Technical Reviewer
Kimberly Skrupky, BOEMRE Environmental Division	Marine Biologist	Technical Reviewer
Melissa Meeker, Hesperides Group	Coastal Engineer	Technical Reviewer
Kathy Fitzpatrick, Martin County	Coastal Engineer	Project Sponsor
Grady Caulk, USACE, Jacksonville District	Archaeologist	Technical Reviewer

6. PUBLIC INVOLVEMENT

6.1. SCOPING AND DRAFT SEIS

An NOI to prepare a Draft SEIS appeared in the Federal Register on June 1, 2007. In addition, the NOI was mailed to interested and affected parties by letter dated June 1, 2007. A copy of the scoping letter, NOI, letters of comment/response are provided in **Appendix C**.

6.2. AGENCY COORDINATION

The proposed project will be coordinated with the following agencies: USFWS, NMFS, USEPA, Florida State Clearinghouse, FFWCC, FDEP, Florida SHPO, BOEMRE and other interested parties. Issues of concern raised by state and federal agencies relevant to the proposed nourishment project are incorporated into this Draft SEIS for detailed evaluation. The proposed action will involve evaluation for compliance with guidelines pursuant to Section 404(b) of the Clean Water Act; application (to the State of Florida) for Water Quality Certification pursuant to Section 401 of the Clean Water Act; certification of state lands, easements, and rights of way; and determination of Coastal Zone Management Act consistency. Agency coordination letters are in **Appendix C**.

As a federal agency with jurisdiction to manage resources available on the OCS, BOEMRE was invited by USACE to participate as a partner on the Martin County HSDR Project in April 2007. This partnership was developed to fulfill BOEMRE's mandatory statutory environmental and leasing requirements for the issuance of a negotiated noncompetitive agreement for the use of OCS sand resources. As a cooperating agency, with respect to NEPA, BOEMRE:

- Participated in the NEPA process;
- Participated in the scoping process;
- Assumed, on the request of USACE, responsibility for developing information and preparing environmental analyses for which BOEMRE has special expertise; and
- Made available staff support at the lead agency's request to enhance the interdisciplinary capability of USACE.

BOEMRE also agreed to participate in the required ESA Section 7 consultation, the Magnuson-Stevens Fishery and Conservation Management Act Essential Fish Habitat consultation (Section 305), the NHPA Section 106 process, and the Coastal Zone Management Act Section 307 consistency determination. As the lead federal agency for ESA Section 7 and the Essential Fish Habitat consultations, USACE notified USFWS and NMFS of its lead role and BOEMRE's cooperating status. Through this partnership USACE jointly submitted, with BOEMRE, the ESA Section 7 and Essential Fish Habitat assessments to USFWS and NMFS. USACE also acted as the lead federal agency for Section 106 compliance in accordance with 36 CFR Part 800.2(2) while BOEMRE acted as a cooperating agency for Section 106 compliance, offering input and consultation as needed.

6.3. LIST OF STATEMENT RECIPIENTS (DRAFT SEIS)

A complete mailing list for the NOI and NOA is in **Appendix C**. The draft SEIS is posted on USACE ftp site:

ftp://ftp.saj.usace.army.mil/pub/Public_Dissemination/Martin%20County%20BEC%20New%20Borrow%20Area/.

6.4. COMMENTS RECEIVED AND RESPONSE

Comments received during the scoping process and DSEIS public comment process are summarized in Section 1.6. Complete letters of comment and response are provided in **Appendix C**.

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INDEX

- AESTHETIC RESOURCES, 148
- AESTHETICS, 193
- AFFECTED ENVIRONMENT, 61
- AGENCY COORDINATION, 232
- AGENCY GOAL OR OBJECTIVE, 7
- AIR QUALITY, 147, 197
- ALTERNATIVES, 15
 - alternatives Previously considered, 15
 - Coastal barrier resources, 146
- COASTAL BARRIER RESOURCES, 195
- COMMENTS RECEIVED and response, 233
- COMPATIBILITY WITH FEDERAL, STATE, AND LOCAL OBJECTIVES, 218
- COMPLIANCE WITH ENVIRONMENTAL REQUIREMENTS, 225
- CONFLICTS AND CONTROVERSY, 218
- Cultural Resources, 150, 189
- currents and circulation, 187
- DRINKING WATER, 202
- ENERGY REQUIREMENTS AND CONSERVATION, 200
 - environmental commitments, 218
- ENVIRONMENTAL EFFECTS, 156
- ESSENTIAL FISH HABITAT, 134
- Fish and ESSENTIAL FISH HABITAT assessment, 182
- FISH AND WILDLIFE RESOURCES, 119
- GENERAL ENVIRONMENTAL EFFECTS, 156
- GENERAL ENVIRONMENTAL SETTING, 61
- General project location, 1
- HARDGROUNDS, 174
- HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE, 147, 196
- INDIRECT EFFECTS, 217
- IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES, 216
- LIST OF PREPARERS, 230
- LIST OF STATEMENT RECIPIENTS (DRAFT SEIS), 233
- LOCAL SHORT-TERM USES AND MAINTENANCE/ENHANCEMENT OF LONG-TERM PRODUCTIVITY, 217
- major differences between the dseis and fseis, 13
- MITIGATION and monitoring, 54
- NATIVE AMERICANS, 201
- NATURAL OR DEPLETABLE RESOURCES, 200
- NAVIGATION, 149
- Nearshore HARDGROUNDS and artificial reefs, 98
- need and Purpose of proposed action, 6
- NOISE, 148, 199
 - offshore Hardbottom, 116
- PERMITS, LICENSES, AND ENTITLEMENTS, 14
- PRECEDENT AND PRINCIPLE FOR FUTURE ACTIONS, 218
- PREPARERS, 230
- PROJECT AUTHORITY, 1
- PROJECT PURPOSE AND NEED, 1
 - Public involvement, 9
- PUBLIC INVOLVEMENT, 232
- PUBLIC SAFETY, 199
- RECREATION, 194
- RECREATION RESOURCES, 148
- REFERENCES, 234
- RELATED ENVIRONMENTAL DOCUMENTS, 8
- RE-USE AND CONSERVATION POTENTIAL, 201
- REVIEWERS, 231
- SCIENTIFIC RESOURCES, 201
- SCOPING AND DRAFT SEIS, 232
- SOCIOECONOMIC, 191
 - Socioeconomics, 152
- SOLID WASTE, 202
- SUMMARY**, i
 - supplemental EIS alternatives, 25
- THREATENED AND ENDANGERED SPECIES, 82, 160
- UNAVOIDABLE ADVERSE ENVIRONMENTAL EFFECTS, 217
- UNCERTAIN, UNIQUE, OR UNKNOWN RISKS, 218
- URBAN QUALITY, 201
- VEGETATION, 81, 159
- WATER QUALITY, 147, 195
- WILDLIFE RESOURCES, 176