SOUTHERN PALM BEACH ISLAND COMPREHENSIVE SHORELINE STABILIZATION PROJECT

Final
Environmental Impact Statement

U.S. Army Corps of Engineers
Jacksonville District

June 2016

SOUTHERN PALM BEACH ISLAND COMPREHENSIVE SHORELINE STABILIZATION PROJECT FINAL ENVIRONMENTAL IMPACT STATEMENT

Responsible Agency: The lead agency is the U.S. Army Corps of Engineers, Jacksonville District. There are no Cooperating Agencies.

ABSTRACT

The Town of Palm Beach and Palm Beach County (County) propose to construct two shoreline protection projects in Palm Beach County, Florida. The U.S. Army Corps of Engineers (USACE) will evaluate the projects as two independent, but similar, actions. The resulting comprehensive project is known as the Southern Palm Beach Island Comprehensive Shoreline Stabilization Project (the Project) and includes approximately 2.07 miles of shoreline along the Atlantic Ocean in eastern Palm Beach County, Florida between Florida Department of Environmental Protection (FDEP) Range Monuments R-129-210 and R-138+551. The project proposal by the Town of Palm Beach includes filling an approximately 1.24 mile segment of beach between FDEP R-monuments R-129-210 and R-134+135 with 65,200 cubic yards of beach compatible sand. This includes approximately 3,400 cubic yards placed below the Mean High Water (MHW) line and the remaining 61,800 cubic yards placed at or above MHW to partially restore the beach and dune. This sand would be dredged from an offshore borrow area or obtained from an upland sand mine, transported to the beach, offloaded to an upland area, temporarily staged and then transported to the Project Area. The County has proposed filling a 0.83 mile segment of beach between FDEP monuments R-134+135 and R-138+551 with approximately 77,600 cubic yards of beach compatible sand derived from an upland sand mine. This includes approximately 26,600 cubic yards placed below the MHW line and the remaining 51,000 cubic yards placed at or above MHW to partially restore the beach and dune. Additionally, the County project includes construction of coastal structures consisting of seven (7) low-profile king pile and panel groins placed perpendicular to the shoreline extending from the existing seawalls to the post-construction (beach nourishment) MHW (approximately 90-feet seaward from the seawall). Construction of both projects would occur between November 1 and April 30 to avoid peak turtle nesting season. Sand for both projects will meet FDEP quality guidelines for beach sand compatibility (62B-41.007(2)(j)). The Town of Palm Beach and the County are required to obtain Department of the Army (DA) permits pursuant to Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899. This Final Environmental Impact Statement (FEIS) evaluates the environmental effects of seven (7) alternatives: 1) the No Action Alternative (Status Quo); 2) the Applicants' Preferred Alternative - Beach Fill and Dune Restoration with Shoreline Protection Structures; 3) the Applicants' Preferred Alternative without Shoreline Protection Structures, 4) The Town of Palm Beach Preferred Project and County Increased Sand Volume Project without Shoreline Protection Structures; 5) The Town of Palm Beach Increased Sand Volume and County Preferred Project; 6) The Town of Palm Beach Increased Sand Volume Project and County Increased Sand Volume without Shoreline Protection Structures Project; and 7b) The Town of Palm Beach Increased Sand Volume with Two Shoreline Protection Structures (The Coalition to Save Our Shorline, Inc. (SOS) Alternative) and the Country Preferred Project. The overall project purpose, as defined by the USACE, is to achieve shoreline stabilization that prevents damage to upland property during a 15-year storm event in areas with seawalls or in areas where seawalls can be state qualified and damage to habitable buildings currently without seawalls in areas where seawalls cannot be state qualified during a 25-year storm event within the southern portion of Reach 8, all of Reach 9, and the northern portion of Reach 10, in Palm Beach County, Florida. To achieve this, the Applicants have proposed nourishing the beach and dune with sand to reduce the potential effects of waves and storm surge.

THE OFFICIAL CLOSING DATE FOR THE RECEIPT OF COMMENT IS 30 DAYS FROM THE DATE ON WHICH THE NOTICE OF AVAILABILITY OF THIS FEIS APPEARS IN THE <u>FEDERAL REGISTER</u>

If you require further information on this document, contact:

Ms. Krista Sabin
U.S. Army Corps of Engineers
4400 PGA Boulevard, Suite 500
Palm Beach Gardens, Florida 33410
Telephone: 561-472-3529
E-mail: Krista.D.Sabin@usace.army.mil

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LIST OF ABBREVIATIONS

ac	acre
AICW	Atlantic Intracoastal Waterway
BA	Biological Assessment
BBCS	Bureau of Beaches and Coastal Systems
BRT	Biological Review Team
BO	Biological Opinion
BMA	Palm Beach Island Beach Management Agreement (FDEP, 2013)
CAA	Clean Air Act
CBIA	Coastal Barrier Improvement Act of 1990
CBRA	Coastal Barrier Resources Act of 1982
CEQ	Council on Environmental Quality
CIA	Cumulative Impacts Analysis
CFR	Code of Federal Regulations
cm	centimeter
County	Palm Beach County
CPE	Coastal Planning & Engineering, Inc.
CTOF	Construction Toe of Fill
CWA	Clean Water Act
cy	cubic yards
CZMA	Coastal Zone Management Act
CZMP	Coastal Zone Management Program
DA	Department of the Army
DCH	Designated Critical Habitat
DFEIS	Draft Final Environmental Impact Statement
DHR	Florida Department of State Division of Historical Resources

DPS	Distinct Population Segment
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EPA	Environmental Protection Agency
ESA	Endangered Species Act of 1973
ETOF	Equilibrium Toe of Fill
F.A.C.	Florida Administrative Code
FDACS	Florida Department of Agriculture and Consumer Services
FDEP	Florida Department of Environmental Protection
FEIS	Final Environmental Impact Statement
FMC	Fisheries Management Council
FWC	Florida Fish and Wildlife Conservation Commission
FWRI	Fish and Wildlife Research Institute
FMP	Fisheries Management Plan
FMP	Florida Marine Patrol
F.S.	Florida Statutes
ft	foot or feet
FPL	Florida Power & Light
HCD	Habitat Conservation Division
HMS	Highly Migratory Species
in	inch
JCP	Joint Coastal Permit
kg	kilograms
km	kilometer
lbs	pounds
LEDPA	Least Environmentally Damaging Practicable Alternative
LWL	Lake Worth Lagoon
m	meter
MERIT	Multi-Species/Ecosystem Recovery Implementation Team
MHW	Mean High Water
MLW	Mean Low Water

MBTA	Migratory Bird Treaty Act of 1918
mi	mile
mm	millimeter
MMPA	Marine Mammal Protection Act of 1972
MPP	Manatee Protection Plan
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act
MYA	Million Years Ago
NAAQS	National Ambient Air Quality Standards
NEPA	National Environmental Policy Act of 1969
NHPA	National Historic Preservation Act of 1966
NMFS	National Marine Fisheries Service
NOA	Notice of Availability
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NPDES	National Pollution Discharge Elimination System
NTU	Nephelometric Turbidity Unit
NWA	Northwest Atlantic Ocean
PBC-ERM	Palm Beach County's Department of Environmental Resources Management
P^3BO	Piping Plover Programmatic Biological Opinion
PCE	Primary Constituent Element
PDEIS	Preliminary Draft Environmental Impact Statement
ppm	parts per milion
PRD	Protected Resources Division (NMFS)
RHA	Rivers and Harbors Act of 1899
ROD	Record of Decision
RTK GPS	Real Time Kinematic Global Positioning System
SAFMC	South Atlantic Fishery Management Council
SAP	Species Action Plans
SARBO	South Atlantic Regional Biological Opinion
SD	Standard Deviation

SOS	The Coalition to Save our Shoreline, Inc.
SSC	Species of Special Concern
SOF	Statement of Findings
SPBO	USFWS Statewide Programmatic Biological Opinion
SWPBO	NMFS Statewide Programmatic Biological Opinion
UMAM	Uniform Mitigation Assessment Methodology
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
yr	year
VOC	Volatile Organic Compounds
WQC	Water Quality Certification

EXECUTIVE SUMMARY

FINAL ENVIRONMENTAL IMPACT STATEMENT

SOUTHERN PALM BEACH ISLAND COMPREHENSIVE SHORELINE STABILIZATION PROJECT IN PALM BEACH COUNTY, FLORIDA

A. BACKGROUND

The Town of Palm Beach and Palm Beach County (County) are requesting regulatory authorization from the United States Army Corps of Engineers (USACE) in the form of Department of the Army (DA) permits pursuant to Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899, to construct two contiguous, but individual, shoreline protection projects which are being reviewed by the USACE as "similar actions." As a result, USACE determined that, when viewed collectively, the separate proposed beach stabilization projects have similarities that provide a basis for evaluating their direct, indirect, and cumulative environmental impacts in a single Environmental Impact Statement (EIS). This Final EIS (FEIS) evaluates the environmental and socioeconomic impacts of the two proposed beach stabilization projects (the Applicants' Preferred Alternatives), as well as the impacts associated with a No Action Alternative and other reasonably foreseeable alternatives along the shoreline between R-129-210 to R-138+551. In compliance with the National Environmental Policy Act (NEPA), this FEIS will support decision making on the existing permit applications and will inform agencies, other stakeholders, and the public of the impacts of, and alternatives to, the Applicants' two similar permit applications for beach stabilization projects. This FEIS will be used by the USACE to determine whether to issue, issue with modifications or conditions, or deny Section 404 CWA permits and Section 10 permits in response to the two similar permit applications. As indicated in the scoping process, the USACE will conduct the public interest reviews and CWA Section 404(b)(1) analyses for the two similar permit applications in the project-specific Records of Decision – Statements of Finding (ROD-SOF). For clarification, in the Notice of Intent (NOI) dated July 13, 2013, USACE stated the Town of Palm Beach and the County's projects were being reviewed as “connected actions”; however, based on additional project review since the NOI, the USACE’s current understanding is that the two projects are single and complete and are not “connected”. The USACE is exercising its discretion to evaluate the two projects in a single EIS since the projects share common timing and geography. This FEIS serves as an analysis of the affected environment and the potential cumulative impacts of the proposed similar actions within the geographical area. Additionally, the USACE is aware that the Town of Palm Beach’s currently proposed project has potential associated connections to other ongoingbeach projects in the Town of Palm Beach since their preferred source of beach compatible sand would be derived from dredging offshore borrow areas. This would involve dredging excess sand during the Reach 7 Phipps Ocean Park Beach Restoration Project and/or the Mid-Town Nourishment Project, and then transporting the sand by truck to the proposed Project Area. Therefore, a discussion of dredging offshore borrow areas is also included in this FEIS.

The resulting comprehensive project is known as the Southern Palm Beach Island Comprehensive Shoreline Stabilization Project (the Project). The Project site is approximately 2.07 miles in length, and is bordered to the east by the Atlantic Ocean, to the south by the southern property boundary of the Eau Palm Beach Resort in the Town of Manalapan, to the west by multi-family residential condominiums and other upland facilities, and to the north by the City of Lake Worth Municipal Beach.

The overall project purpose, as defined by the USACE, is to achieve shoreline stabilization that prevents damage to upland property during a 15-year storm event in areas with seawalls or in areas where seawalls can be state qualified and damage to habitable buildings currently without seawalls in areas where seawalls cannot be state qualified during a 25-year storm event within the southern portion of Reach 8, all of Reach 9, and the northern portion of Reach 10, in Palm Beach County, Florida.

B. NEED FOR PROPOSED ACTION

The goals and objectives for the shoreline protection projects are to provide more sand into the littoral system,create a stable beach and dune profile that will buffer the effects of storm surge and wave action, provide wildlife habitat, allow for recreational use, and protect upland infrastructure. The Project will minimize future adverse storm-induced effects by nourishing the beach to replace the sand that has been lost due to erosion, and also ameliorate the current erosion rate. The Town of Palm Beach has stated a desired maintenance interval (renourishment) of four years and the County has stated a desired maintenance interval of three years.

C. SCOPE OF ANALYSIS

The scope of analysis has two distinct elements: determining the USACE federal action area and how USACE will evaluate the environmental impacts. Because any environmental consequences of the proposed projects are essentially products of the USACE permit action, the scope of the federal permitting action includes all construction activities associated with these actions within the Project Area. The USACE is required to evaluate the effects of proposed construction (i.e the scope of project) activities on the environment within the Project Area, and to identify and consider the magnitude and extent of the anticipated effects (i.e scope of effects) resulting from the Project. The combination of these two evaluations constitutes the scope of analysis.

The USACE determined that the scope of the Project includes the 2.07-mile segment of beach where sand and shoreline stabilization structures would be constructed. The scope of effects will consider direct, indirect and cumulative impacts of the Project. Therefore, USACE will include the adjoining nearshore hardbottom habitat, as well as the updrift and downdrift beach areas in the evaluation as these areas are potentially directly or indirectly affected by the Project.

Additionally, the evaluation will include reasonably anticipated routes utilized by trucks transporting sand to the Project Area from the upland mine(s) to the fill site and from the stockpile to the fill site. The sand in the stockpile area would be obtained from dredging sand from offshore borrow areas associated with Reach 7 Phipps Ocean Park Beach Restoration Project (Phipps), authorized under DA Permit No. SAJ-2000-00380, and with the Mid-Town Nourishment Project (Mid-Town), authorized under DA Permit No. SAJ-1995-03779. Thus, the FEIS includes reasonably anticipated effects associated from that offshore dredging. However, the USACE acknowledges that the offshore dredging activities and the stockpile of sand in the Phipps and Mid-Town project templates were included in a separate NEPA evaluation associated with those permit application processes. The stockpile of sand is considered an interdependent and interrelated action, while obtaining sand from an upland mine is independent of the proposed Project. The activities associated with mining upland sand are not part of the USACE evaluation since it is assumed the site has obtained prior state and/or federal approval.

The projects are adjoining waters that are tidal and considered to be “navigable waters of the United States” under Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbor Act. Therefore, the USACE’s regulatory jurisdiction under Section 404 of the Clean Water Act includes the construction sites as well as aquatic resources that will be directly or indirectly affected as a result of the projects. A number of federally listed species utilize these areas as well as other natural areas that will be affected by the projects. Taking these factors into consideration, the proposed projects are subject to substantial federal control and responsibility.

In summary, the following activities and the reasonably anticipated direct, indirect and cumulative environmental consequences constitute the scope of analysis for this FEIS (additional information is provided in Sections 1.1.1. and 4.1.1.):

- Construction activities associated with any of the proposed build alternatives including placing sand in waters of the United States and constructing groins.
- Dredging and associated activities within tidal waters.
- The associated upstream and downstream changes to the aquatic environment and shoreline as a result of constructing coastal armoring structures, such as groins.
- Environmental effects associated with trucks transporting sand to the Project Area from upland mines within southern Florida or stockpile areas within the Town of Palm Beach.
- The effects of sand placed within waters of the United States on the shoreline and aquatic environment.
- Effects associated with dredging sand from offshore borrow areas.

- Effects associated with placing sand within the dune area above the Mean High Water (MHW) line.
- The effects of the alternatives on fish, plant, and wildlife resources including for instance, species protected by the State of Florida, Endangered Species Act and/or Magnuson-Stevens Act.

D. ALTERNATIVES CONSIDERED

This FEIS evaluates construction of the Applicants' (Town of Palm Beach and Palm Beach County) Preferred Alternative, which consists of sand placement within the Town of Palm Beach and sand placement with seven (7) low-profile groins in the County's project area. The USACE also analyzed a range of alternatives to determine if the Applicants' Preferred Alternative is the least environmentally damaging practicable alternative (LEDPA), and if the Applicants' Preferred Alternative is not contrary to the public's interest. The range of alternatives considered in this FEIS include: 1) the No Action (Status Quo) Alternative; 2) the Applicants' Preferred Alternative - Beach Fill and Dune Restoration with Shore Protection Structures; 3) the Applicants' Preferred Alternative without Shore Protection Structures; 4) The Town of Palm Beach Preferred Project and County Increased Sand Volume without Shoreline Protection Structures Project; 5) The Town of Palm Beach Increased Sand Volume Project and County Preferred Project; 6) The Town of Palm Beach Increased Sand Volume Project and County Increased Sand Volume without Shoreline Protection Structures Project; and 7b) The Town of Palm Beach Increased Sand Volume with Two Shoreline Protection Structures (The Coalition to Save Our Shoreline, Inc (SOS) Alternative) and the County Preferred Project. The No Action and additional alternatives are presented to compare the differences in shoreline protection to effectively meet the USACE's overall Project purpose and to quantify and describe the environmental impacts associated with each alternative. The potential effects associated with each alternative are dependent upon the design template of each alternative and whether or not structures are included.

The volume of sand required for each alternative is template-based and varies based on the conditions of the beach at the time of the physical survey conducted. All fill volumes will be updated based on beach profile and hardbottom delineation surveys conducted immediately prior to construction. The volumes of sand presented in this FEIS are based on the 2014. Table 2-1 in Chapter 2, presents the volumes required to implement each alternative based on physical surveys conducted in 2008/2009, 2011/2012 and 2014. All three of these conditions are presented for the following reasons: 1) the original project was developed based on 2008 conditions; 2) the modeling conducted during the initial analysis for this FEIS in 2013 was based on the most recent conditions at the time (2011/2012); and 3) based on public comments, even more recent data was analyzed (2014), which was included in the Storm Induced Beach Change (SBEACH) analysis.

E. DESCRIPTION OF ACTION ALTERNATIVES

Alternative 1

Alternative 1 is the No Action (Status Quo) alternative where the Applicants would not place sand or construct groins below Mean High Water (MHW) and seasonal High Tide Line. However, the dunes may continue to be enhanced periodically through placement of small volumes of sand in portions of the Project Area. Efforts to protect the dune and upland infrastructure would be limited to construction activities located wholly in uplands, and could include dune restoration, upland retaining or seawalls, shoreline armoring, or other structures or work in uplands.

Alternative 2

Alternative 2 is the Applicants' Preferred Project Alternative, which includes placement of approximately 142,800 cy of sand, with approximately 65,200 cy of sand placed on the Town of Palm Beach shoreline and 77,600 cy placed along the County shoreline within the Towns of South Palm Beach, Lantana and Manalapan. This alternative also includes the construction of seven (7) low-profile groins placed perpendicular to the shoreline in South Palm Beach, Lantana and Manalapan (R-134+135 to R-138+551). Alternative 2 was assumed to include the following components, at a minimum:

- Approximately 142,800 cy of sand

    - Approximately 65,200 cy of sand dredged from an offshore borrow area, staged in the uplands at the Phipps or Mid-Town project sites, and truck hauled to the Town of Palm Beach project shoreline
  - Approximately 77,600 cy of sand truck hauled from an upland sand source and placed along the County project shorelineFill placement above and below MHW (dune and beach)
  - Seven (7) low-profile king pile and panel groins along the County project shoreline
  - Town of Palm Beach shoreline project life expectancy = 2-4 years
  - County shoreline project life expectancy = 2-3 years
- The USACE is considering authorization under a 10-year permit to allow for initial project construction and maintenance for no more than three (3) renourishment events

Alternative 3

Alternative 3 provides the same project as Alternative 2, but would not include construction of the seven low-profile groins between R-134+135 and R-138+551. Alternative 3 was assumed to include the following components, at a minimum:

- Approximately 142,800 cy of sand
    - Approximately 65,200 cy of sand dredged from an offshore borrow area, staged in the uplands at the Phipps or Mid-Town project sites, and truck hauled to the Town of Palm Beach project shoreline
- Approximately 77,600 cy of sand truck hauled from an upland sand source and placed along the County project shorelineFill placement above and below MHW (dune and beach)
- Town of Palm Beach shoreline project life expectancy = 2-4 years
- County shoreline project life expectancy = 1 year

- The USACE is considering authorization under a 10-year permit to allow for initial project construction and maintenance for no more than three (3) renourishment events

Alternative 4

Alternative 4 includes the Preferred Alternative along the Town of Palm Beach shoreline and a larger volume of sand without shoreline protection structures along County shoreline within the Towns of South Palm Beach, Lantana and Manalapan. The sand volume along the Town of Palm Beach shoreline would remain the same at 65,200 cy. The sand volume from R-134+135 to R-138+551 would increase from 77,600 cy to 187,800 cy. Alternative 4 was assumed to include the following components, at a minimum:

- Approximately 253,000 cy of sand
    - Approximately 65,200 cy of sand dredged from an offshore borrow area, staged in the uplands at the Phipps or Mid-Town project sites, and truck hauled to the Town of Palm Beach project shoreline
- Approximately 187,800 cy of sand truck hauled from an upland sand source and placed along the County project shorelineFill placement above and below MHW (dune and beach)
- Town of Palm Beach shoreline project life expectancy = 2-4 years
- County shoreline project life expectancy = 2-3 years

- The USACE is considering authorization under a 10-year permit to allow for initial project construction and maintenance for no more than three (3) renourishment events

Alternative 5

Alternative 5 includes a larger sand project along the Town of Palm Beach shoreline and the County's Preferred Alternative project along the Towns of South Palm Beach, Lantana and Manalapan. The sand volume along the Town of Palm Beach would increase slightly from 65,200 cy to 121,700 cy but the distribution would vary from the preferred alternative design. The sand volume along the County shoreline would remain the same at 77,600 cy. Alternative 5 was assumed to include the following components, at a minimum:

- Approximately 199,300 cy of sand
    - Approximately 121,700 cy of sand dredged from an offshore borrow area, staged in the uplands at the Phipps or Mid-Town project sites, and truck hauled to the Town of Palm Beach project shoreline
- Approximately 77,600 cy of sand truck hauled from an upland sand source and placed along the County project shorelineFill placement above and below MHW (dune and beach)
- Seven (7) low-profile king pile and panel groins along the County project shoreline
- Town of Palm Beach shoreline project life expectancy = 3-4 years
- County shoreline project life expectancy = 2-3 years
- The USACE is considering authorization under a 10-year permit to allow for initial project construction and maintenance for no more than three (3) renourishment events

Alternative 6

Alternative 6 includes a larger sand project along both project shorelines without shoreline protection structures along County shoreline within the Towns of South Palm Beach, Lantana and Manalapan. The sand volume along the Town of Palm Beach shoreline would increase from 65,200 cy to 121,700 cy and the sand volume along the County shoreline within the Towns of South Palm Beach, Lantana and Manalapan would increase from 77,600 cy to 187,800 cy. Alternative 6 was assumed to include the following components, at a minimum:

- Approximately 309,500 cy of sand
    - Approximately 121,700 cy of sand dredged from an offshore borrow area, staged in the uplands at the Phipps or Mid-Town project sites, and truck hauled to the Town of Palm Beach project shoreline

- Approximately 187,800 cy of sand truck hauled from an upland sand source and placed along the County project shorelineFill placement above and below MHW (dune and beach)
- Town of Palm Beach shoreline project life expectancy = 3-4 years
- County shoreline project life expectancy = 2-3 years
- The USACE is considering authorization under a 10-year permit to allow for initial project construction and maintenance for no more than three (3) renourishment events

Alternative 7b

Alternative 7b includes the placement of a larger volume of sand and two T-head groins along the Town of Palm Beach, and the Preferred Alternative along the County's shoreline. The volume of sand required to construct Alternative 7b is approximately 253,100 cy. This includes increasing sand placement in the Town of Palm Beach from 65,200 cy to approximately 175,500 cy and maintaining the County's Preferred template, which would require approximately 77,600 cy. The Town of Palm Beach would maintain its preference of stocked piled dredged sand and would likely increase the volume of sand that would be dredged from offshore borrow areas.

- Approximately 253,100 cy of sand
    - Approximately 175,500 cy of sand dredged from an offshore borrow area, staged in the uplands at the Phipps or Mid-Town project sites, and truck hauled to the Town of Palm Beach project shoreline
    - Approximately 77,600 cy of sand truck hauled from an upland sand source and placed along the County project shoreline
- Fill placement above and below MHW (dune and beach)
- Seven (7) low-profile king pile and panel groins along the County project shoreline
- Two (2) T-head groins along the Town of Palm Beach shoreline
- Town of Palm Beach shoreline project life expectancy = 3-4 years

County shoreline project life expectancy = 2-3 years

- The USACE is considering authorization under a 10-year permit to allow for initial project construction and maintenance for no more than three (3) renourishment events

Sand Sources

In order to construct the proposed Project alternatives, beach compatible sand will be required. Sources of sand include upland sand mines and stockpiled sand dredged from offshore borrow areas. Sand from either source must meet FDEP requirements for beach sand compatibility as per Florida Administrative Code, Rule 62B-41.007(2)(j). In addition, any sand source used for the Town of Palm Beach project must be consistent with the Palm Beach Island Beach Management Agreement (BMA) cell-wide sediment quality specifications (FDEP, 2013). The sand source used for the County project must also meet the County's technical sand specifications outlined in Section 2.1.1 in the County’s Annual Dune and Wetlands Restoration contract provided as Appendix B.

Upland Sand. The County has proposed to utilize sand from E.R. Jahna Industries, Inc. Ortona Sand Mine (Ortona) and/or Stewart Mining Industries, Inc. in Ft. Pierce. Sand placed along the County shoreline will meet the County’s technical sand specifications, in addition to Florida Administrative Code, Rule 62B-41.007(2)(j).

Stockpiled sand dredged from offshore borrow areas. A stockpile of dredged sand will be obtained from dredging sand from offshore borrow areas associated with Reach 7 Phipps Ocean Park Beach Restoration Project (Phipps), federally authorized under DA Permit No. SAJ-2000-00380, and with the Mid-Town Nourishment (Mid-Town) Project, authorized under DA Permit No. SAJ-1995-03779 and authorized by under BMA (FDEP, 2013). Future Phipps and Mid-Town projects may dredge sand from North Borrow Area 1 (NBA1), South Borrow Area 2 (SBA2), South Borrow Area 3 (SBA3) or any offshore sand source that is consistent with the BMA cell-wide sediment quality specifications. The stockpiled sand will be located within the permitted Phipps or Mid-Town template (alternating between the two projects) and will be considered an active stockpile so that sand is removed for transport to the Town of Palm Beach’s project area soon after it is piled. If timing of the Phipps and Mid-Town projects does not allow for use of dredged sand, the Town of Palm Beach would consider using sand from an upland source. Sand placed along the Town of Palm Beach shoreline will meet the BMA cell-wide sediment quality specifications, in addition to Florida Administrative Code, Rule 62B-41.007(2)(j).

F. ISSUES ELIMINATED FROM DETAILED ANALYSIS

Detailed analysis of the affected environment and the anticipated environmental consequences of the proposed action and alternatives is a requirement of the EIS. Detailed analysis is commensurate with the importance of the impact, therefore to concentrate effort and attention the following issues were eliminated from detailed analysis since the effects are not anticipated to be significant.

Noise Pollution. No measurable changes in noise are expected to occur as a result of any of the alternatives. Noise impacts are expected during construction activities; however, this would be temporary in nature and limited to the immediate area of construction.

Transportation. Any effect on highways/infrastructure from construction traffic would be short term and would not cause extended delays on adjacent highways. These impacts could be considered negligible. However, the cost and potential environmental effects (i.e. disturbance to listed species along truck routes) associated with the transport of sand to the Project Area is considered within this EIS.

Water Supply and Drinking Water. The project purpose does not involve increasing or decreasing system performance for water supply or drinking water.

Hazardous, Toxic and Radioactive Waste. There are currently no hazardous, toxic, and radioactive waste producers adjacent to the project site that discharge effluents near the Palm Beach County shoreline and no known records of such activities in the past exist.

G. SUMMARY OF POTENTIALLY SIGNIFICANT EFFECTS

The effects of the alternatives were analyzed in the FEIS. Many of the effects were similar between the Preferred Project Alternative and Alternatives 3-7b; however, differences in the level of impact to the affected environment exist between alternatives based on the duration of shoreline protection provided, the effects to downdrift and/or updrift beaches, rates of erosion and accretion, and quantity of hardbottom resources impacted. Table ES-1 lists the alternatives and summarizes the major features and effects of each alternative.

Nearshore Hardbottom. Direct and indirect effects to nearshore hardbottom are anticipated from placement of sand and construction of coastal armoring structures within waters of the United States. All of the proposed alternatives have the potential for impacts to nearshore hardbottom within the Project footprint or within the adjoining waters. Construction activities could result in indirect impacts to offshore, downdrift, or updrift nearshore hardbottom.

Shoreline Erosion and Accretion. Direct and indirect effects to shoreline erosion and accretion are anticipated from placement of sand and construction of coastal armoring structures within waters of the United States. Constructing any of the build alternatives could permanently alter the shoreline within the Project Area by establishing an artificially created beach and dune profile, which is expected to require future maintenance in the form of renourishment. While artificially created, the design template will replicate dune and beach profiles that may have existed historically in the Project Area prior to long term erosion trends and upland development. All of the proposed alternatives have the potential for impacts to nearshore hardbottom within the project footprint or within the adjoining waters. Construction activities could result in indirect impacts to offshore, downdrift, or updrift nearshore hardbottom through sand spreading or as a result of scour resulting from shoreline stabilization structures.

Water Quality. Direct and indirect effects to water quality may occur from placement of sand and construction of coastal armoring structures within waters of the United States. Constructing any of the build alternatives with beach compatible sand may affect water quality through the introduction of suspended solids, silts, or other fine particles that reduce water quality. All of the proposed alternatives have the potential for impacts on water quality within the project footprint or within the adjoining waters.

Table ES-1. Summary of impacts to resources based on Alternatives 1 through 7b.

Impacts to Resources	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6	Alternative 7b
Protected Species	Sea turtle nesting would continue to decrease as beach erodes; dune species would be at risk as dune erodes.	Available sea turtle nesting habitat increased; temporary adverse impacts to sea turtle nesting due to elevated berm and potential compaction; potential for groins to create obstacle to nesting; between 3.86 and 3.99 ac permanent and between 9.53 and 9.93 ac temporary impacts to nearshore hardbottom foraging resources; elevated turbidity during sand placement and groin construction.	Available sea turtle nesting habitat increased; temporary adverse impacts to sea turtle nesting due to elevated berm and potential compaction; between 2.70 and 2.87 ac permanent and between 12.13 and 12.41 ac temporary impacts to nearshore hardbottom foraging resources; elevated turbidity during sand placement.	Available sea turtle nesting habitat increased; temporary adverse impacts to sea turtle nesting due to elevated berm and potential compaction; between 6.51 and 6.71 ac permanent and between 13.17 and 13.57 ac temporary impacts to nearshore hardbottom foraging resources; elevated turbidity during sand placement.	Sea turtle nesting habitat increased; potential for temporary adverse impacts to sea turtle nesting due to nourished beach; potential for groins to create obstacle to nesting; between 3.45 and 4.23 ac permanent and between 14.34 and 15.60 ac temporary impacts to nearshore hardbottom foraging resources; elevated turbidity during sand placement and groin construction.	Sea turtle nesting habitat increased; potential for temporary adverse impacts to sea turtle nesting due to nourished beach; between 6.07 and 6.92 ac permanent and between 17.42 and 18.34 ac temporary impacts to nearshore hardbottom foraging resources; elevated turbidity during sand placement.	Sea turtle nesting habitat increased; potential for temporary adverse impacts to sea turtle nesting due to nourished beach; between 5.74 and 11.25 ac permanent and between 9.45 and 18.80 ac temporary impacts to nearshore hardbottom foraging resources; elevated turbidity during sand placement.
Live/ Hardbottom	Hardbottom would continue to be buried and exposed.	Permanent impacts to between 3.86 and 3.99 ac and temporary impacts to between 9.53 and 9.93 ac of nearshore hardbottom habitat; indirect impact (elevated turbidity) to hardbottom habitat during sand placement and groin construction.	Permanent impacts to between 2.70 and 2.87 ac and temporary impacts to between 12.13 and 12.41 ac of nearshore hardbottom habitat; indirect impact (elevated turbidity) to hardbottom habitat during sand placement.	Permanent impacts to between 6.51 and 6.71 ac and temporary impacts to between 13.17 and 13.57 ac of nearshore hardbottom habitat; indirect impact (elevated turbidity) to hardbottom habitat during sand placement.	Permanent impacts to between 3.45 and 4.23 ac and temporary impacts to between 14.34 and 15.60 ac of nearshore hardbottom habitat; indirect impact (elevated turbidity) to hardbottom habitat during sand placement and groin construction.	Permanent impacts to between 6.07 and 6.92 ac and temporary impacts to between 17.42 and 18.34 ac of nearshore hardbottom habitat; indirect impact (elevated turbidity) to hardbottom habitat during sand placement.	Permanent impacts to between 5.74 and 11.25 ac and temporary impacts to between 9.45 and 18.80 ac of nearshore hardbottom habitat; indirect impact (elevated turbidity) to hardbottom habitat during sand placement.
Shoreline Erosion	Shoreline would continue to erode.	Minimizes erosion losses over the life of the Project; maintains a high quality beach for recreation and storm protection.	Minimizes erosion losses over the life of the Project; maintains a high quality beach for recreation and storm protection.	Minimizes erosion losses over the life of the Project; maintains a high quality beach for recreation and storm protection.	Minimizes erosion losses over the life of the Project; maintains a high quality beach for recreation and storm protection.	Minimizes erosion losses over the life of the Project; maintains a high quality beach for recreation and storm protection.	Minimizes erosion losses over the life of the Project; maintains a high quality beach for recreation and storm protection.

Table ES-1 (cont.). Summary of impacts to resources based on Alternatives 1 through 7b.

Impacts to Resources	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6	Alternative 7b
Fish and Wildlife	Continued erosion would decrease habitat for beach and dune species.	Temporary impacts to infauna at the fill site and groin template; potential disturbance to foraging and roosting shorebirds due to construction vehicles on the beach; permanent impact to between 3.86 and 3.99 ac of nearshore hardbottom may displace motile faunal populations; reduction in fish recruitment and foraging resource.	Temporary impacts to infauna at the fill site; potential disturbance to foraging and roosting shorebirds due to construction vehicles on the beach; permanent impact to between 2.70 and 2.87 ac of nearshore hardbottom may displace motile faunal populations; reduction in fish recruitment and foraging resource.	Temporary impacts to infauna at the fill site; potential disturbance to foraging and roosting shorebirds due to construction vehicles on the beach; permanent impact to between 6.51 and 6.71 ac of nearshore hardbottom may displace motile faunal populations; reduction in fish recruitment and foraging resource.	Temporary impacts to infauna at the fill site and groin template; potential disturbance to foraging and roosting shorebirds due to construction vehicles on the beach; permanent impact to between 3.45 and 4.23 ac of nearshore hardbottom may displace motile faunal populations; reduction in fish recruitment and foraging resource.	Temporary impacts to infauna at the fill site; potential disturbance to foraging and roosting shorebirds due to construction vehicles on the beach; permanent impact to between 6.07 and 6.92 ac of nearshore hardbottom may displace motile faunal populations; reduction in fish recruitment and foraging resource.	Temporary impacts to infauna at the fill site; potential disturbance to foraging and roosting shorebirds due to construction vehicles on the beach; permanent impact to between 5.74 and 11.25 ac of nearshore hardbottom may displace motile faunal populations; reduction in fish recruitment and foraging resource.
Vegetation	Continued erosion would further impact dune vegetation.	Increase in vegetation density where plantings occur; potential for temporary impact during construction activities; increased protection of dune vegetation due to wider beach.	Increase in vegetation density where plantings occur; potential for temporary impact during construction activities; increased protection of dune vegetation due to wider beach.	Increase in vegetation density where plantings occur; potential for temporary impact during construction activities; increased protection of dune vegetation due to wider beach.	Increase in vegetation density where plantings occur; potential for temporary impact during construction activities; increased protection of dune vegetation due to wider beach.	Increase in vegetation density where plantings occur; potential for temporary impact during construction activities; increased protection of dune vegetation due to wider beach.	Increase in vegetation density where plantings occur; potential for temporary impact during construction activities; increased protection of dune vegetation due to wider beach.
Water Quality	No impact.	Temporary, localized increase in turbidity during sand placement and groin construction; turbidity monitoring will ensure water quality standards are maintained.	Temporary, localized increase in turbidity during sand placement; turbidity monitoring will ensure water quality standards are maintained.	Temporary, localized increase in turbidity during sand placement; turbidity monitoring will ensure water quality standards are maintained.	Temporary, localized increase in turbidity during sand placement and groin construction; turbidity monitoring will ensure water quality standards are maintained.	Temporary, localized increase in turbidity during sand placement; turbidity monitoring will ensure water quality standards are maintained.	Temporary, localized increase in turbidity during sand placement; turbidity monitoring will ensure water quality standards are maintained.
Historic Properties	No impact.	No impact.	No impact.	No impact.	No impact.	No impact.	No impact.
Recreation	Continued erosion will decrease recreational beach area.	Increased area for recreational use; temporary disturbance during construction activities due to limited site access; potential for decreased water clarity due to elevated turbidity during construction; potential to affect fishing conditions.	Increased area for recreational use; temporary disturbance during construction activities due to limited site access; potential for decreased water clarity due to elevated turbidity during construction; potential to affect fishing conditions.	Increased area for recreational use; temporary disturbance during construction activities due to limited site access; potential for decreased water clarity due to elevated turbidity during construction; potential to affect fishing conditions.	Increased area for recreational use; temporary disturbance during construction activities due to limited site access; potential for decreased water clarity due to elevated turbidity during construction; potential to affect fishing conditions.	Increased area for recreational use; temporary disturbance during construction activities due to limited site access; potential for decreased water clarity due to elevated turbidity during construction; potential to affect fishing conditions.	Increased area for recreational use; temporary disturbance during construction activities due to limited site access; potential for decreased water clarity due to elevated turbidity during construction; potential to affect fishing conditions.

Table ES-1 (cont.). Summary of impacts to resources based on Alternatives 1 through 7b.

Impacts to Resources	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6	Alternative 7b
Aesthetics	Continued erosion may degrade aesthetics due to decreased beach width.	Temporary impact due to construction equipment on the beach; long-term improvement due to wider beach.	Temporary impact due to construction equipment on the beach; long-term improvement due to wider beach.	Temporary impact due to construction equipment on the beach; long-term improvement due to wider beach.	Temporary impact due to construction equipment on the beach; long-term improvement due to wider beach.	Temporary impact due to construction equipment on the beach; long-term improvement due to wider beach.	Temporary impact due to construction equipment on the beach; long-term improvement due to wider beach.
Navigation	No impact.	No impact.	No impact.	No impact.	No impact.	No impact.	No impact.
Economics	Continued erosion may reduce potential tourism due to decreased beach width and recreational opportunities; increased potential for storm damage to upland infrastructure.	Temporary impacts due to limited site access; long-term benefits due to storm damage risk reduction and wider beach for recreation.	Temporary impacts due to limited site access; long-term benefits due to storm damage risk reduction and wider beach for recreation.	Temporary impacts due to limited site access; long-term benefits due to storm damage risk reduction and wider beach for recreation.	Temporary impacts due to limited site access; long-term benefits due to storm damage risk reduction and wider beach for recreation.	Temporary impacts due to limited site access; long-term benefits due to storm damage risk reduction and wider beach for recreation.	Temporary impacts due to limited site access; long-term benefits due to storm damage risk reduction and wider beach for recreation.
EFH	Hardbottom would continue to be buried and exposed.	Short-term infaunal community impacts; Permanent impacts to between 3.86 and 3.99 ac and temporary impacts to between 9.53 and 9.93 ac of nearshore hardbottom habitat; relocation of motile species due to hardbottom burial; temporary elevated turbidity in the water column and over hardbottom; reduction in feeding success.	Short-term infaunal community impacts; Permanent impacts to between 2.70 and 2.87 ac and temporary impacts to and between 12.13 and 12.41 ac of nearshore hardbottom habitat; relocation of motile species due to hardbottom burial; temporary elevated turbidity in the water column and over hardbottom; reduction in feeding success.	Short-term infaunal community impacts; Permanent impacts to between 6.51 and 6.71 ac and temporary impacts to between 13.17 and 13.57 ac of nearshore hardbottom habitat; relocation of motile species due to hardbottom burial; temporary elevated turbidity in the water column and over hardbottom; reduction in feeding success.	Short-term infaunal community impacts; Permanent impacts to between 3.45 and 4.23 ac and temporary and impacts to between 14.34 and 15.60 ac nearshore hardbottom habitat; relocation of motile species due to hardbottom burial; temporary elevated turbidity in the water column and over hardbottom; reduction in feeding success.	Short-term infaunal community impacts; Permanent impacts to between 6.07 and 6.92 ac and temporary impacts to between 17.42 and 18.34 ac of nearshore hardbottom habitat; relocation of motile species due to hardbottom burial; temporary elevated turbidity in the water column and over hardbottom; reduction in feeding success.	Short-term infaunal community impacts; Permanent impacts to between 5.74 and 11.25 ac and temporary impacts to between 9.45 and 18.80 ac of nearshore hardbottom habitat; relocation of motile species due to hardbottom burial; temporary elevated turbidity in the water column and over hardbottom; reduction in feeding success.

H. CUMULATIVE EFFECTS

The Mid-Town Project (SAJ-1995-03779) was renourished in winter 2014-2015 between R-90.4 and R-101.4 with approximately 1.4 million cy of sand from an offshore borrow area. Nearly 35,000 cy of dredged sand was stockpiled, transported and placed within the Reach 8 dune project area. The Phipps Ocean Park Beach Restoration Project (SAJ-2000-0380) was renourished from R-116 to R-127 with approximately 1,010,000 cy of beach fill from an offshore borrow area in the winter of 2015-2016. Just over 10,00u0 cy of dredged sand was stockpiled, transported and placed within the Reach 8 dune project area and approximately 15,000 cy was stockpiled, transported and placed within the Mid-Town dune between R-90 and R-93.

The USACE is aware of the Town of Palm Beach's plan to utilize beach compatible sand originating from offshore borrow areas that would be dredged in excess of the volume needed to restore either a future Phipps or a Mid-Town beach renourisment project. The excess dredged sand would be temporarily stockpiled on the beach during construction, and actively transported by truck from Phipps or Mid-Town to the proposed Project Area on local public roads. Cumlulative effects of dredging sand from an offshore borrow area, as well as future Phipps and Mid-Town beach renourishment are considered in the cumulative impacts analysis (CIA) in Chapter 4 and Appendix J of this EIS.

I. AREAS OF POTENTIAL CONTROVERSY

During the scoping period, no comments were received to indicate that conflicts or controversy would be anticipated. However, stakeholders did provide comments and noted concerns about the methodologies used to assess impacts to hardbottom communities and coral species, downdrift impacts, sea level rise, the quality of fill material, impacts to recreational opportunities including surfing, impacts to property values, and impacts to wildlife habitat (specifically, sea turtle nesting habitat). These issues were addressed in development of the Draft EIS (DEIS). After scoping, however, the Town of Palm Beach indicated their preference to utilize dredged sand that would be stockpiled during the active dredge and fill projects for Mid-Town and/or Phipps Ocean

Park, which are permitted to place sand from an offshore borrow area. This stockpiled dredged sand would be transported to the Project Area by truck-haul. Many comments were submitted to the USACE based on this change in sand source during the public comment period (Appendix K Comment Report).

J. LIST OF OTHER GOVERNMENT ACTIONS REQUIRED

The Town of Palm Beach and the County shall be responsible for obtaining federal Department of the Army (DA) permits and Florida Department of Environmental Protection (FDEP) joint coastal permits (JCP) and authorization to use sovereign submerged lands. Any additional local permits and licenses and other consultation requirements for the proposed projects are described in this section and Chapter 6 of the main report.

The USACE's permitting decision is required to comply with many federal requirements including the National Environmental Policy Act (NEPA), Clean Water Act (CWA), Endangered Species Act (ESA), Rivers and Harbors Act (RHA) Coastal Zone Management Act (CZMA), Fish and Wildlife Coordination Act of 1958, and the National Historic Preservation Act (NHPA). The USACE will consider other relevant environmental laws as well as protection of nearshore hardbottom resources, floodplain management, environmental justice, and invasive/exotic species.

State requirements that may need to be satisfied for this Project include a National Pollution Discharge Elimination System (NPDES) Permit, Clean Air Act Permit (if needed), and a State Water Quality Certification. Local permitting authority for the proposed County project resides with the local municipalities while the Town of Palm Beach has jurisdiction for local building permits within the Town of Palm Beach's portion of the proposed Project. Primary coordination of local permit review will be administered by Palm Beach County's Planning, Zoning and Building (PZB) Division.

The USACE has determined that the proposed Project may affect, but is not likely to adversely affect the piping plover, Rufa red knot, smalltooth sawfish, swimming sea turtles, Florida manatee, and Florida panther. The Project is likely to adversely affect nesting loggerhead, green and leatherback sea turtles. The Project would have no effect on *Acropora* spp., listed coral species, beach jacquemontia, whales, Johnson's seagrass, Gulf sturgeon, shortnose sturgeon or the eastern indigo snake. The proposed Project is not likely to adversely modify designated *Acropora* critical habit or loggerhead critical habitat (nesting beach and nearshore waters). The USACE will complete ESA Section 7 Consultation with the USFWS and NMFS.

K. UNRESOLVED ISSUES

The potential effects associated with direct effects (burial) to nearshore hardbottom resources and indirect effects to updrift and downdrift beaches due to the coastal shoreline armoring structures (seven groins) were evaluated. The modeling analysis has identified areas of hardbottom that may be exposed as a result of the groins or other aspects of the Project. The ecological benefits of exposed hardbottom have not been specifically identified.

L. COMPENSATORY MITIGATION TO OFFSET THE LOSS OF NEARSHORE HARDBOTTOM ECOLOGICAL FUNCTIONS AND SERVICES

The Town of Palm Beach and the County's compensatory mitigation plans include creation of nearshore hardbottom habitat in the form of artificial reefs to provide ecological functions and services similar to those associated with the nearshore hardbottom proposed for impact. The USACE has prepared a Uniform Mitigation Assessment Methodology (UMAM) evaluation and the Town of Palm Beach and County have drafted mitigation and monitoring plans, provided as appendices to this FEIS.

M. COORDINATION

Throughout the evolution of project design alternatives, federal and state agencies, County officials, local municipalities and the public have been kept informed through a scoping meeting, a public meeting, and public notices designed to inform, gather input, and respond to questions regarding the proposed Project. The public, government agencies, federally-recognized Native American Tribes, and interested parties are afforded the opportunity to provide input regarding this Project by reviewing and commenting on the Draft and Final EIS. Figure ES-1 provides a summary of the NEPA milestones involved in the EIS process. Project information, schedules, documents, and presentations to the public are also kept updated and available on the USACE website:

http://www.saj.usace.army.mil/Missions/Regulatory/ItemsofInterest.aspx.

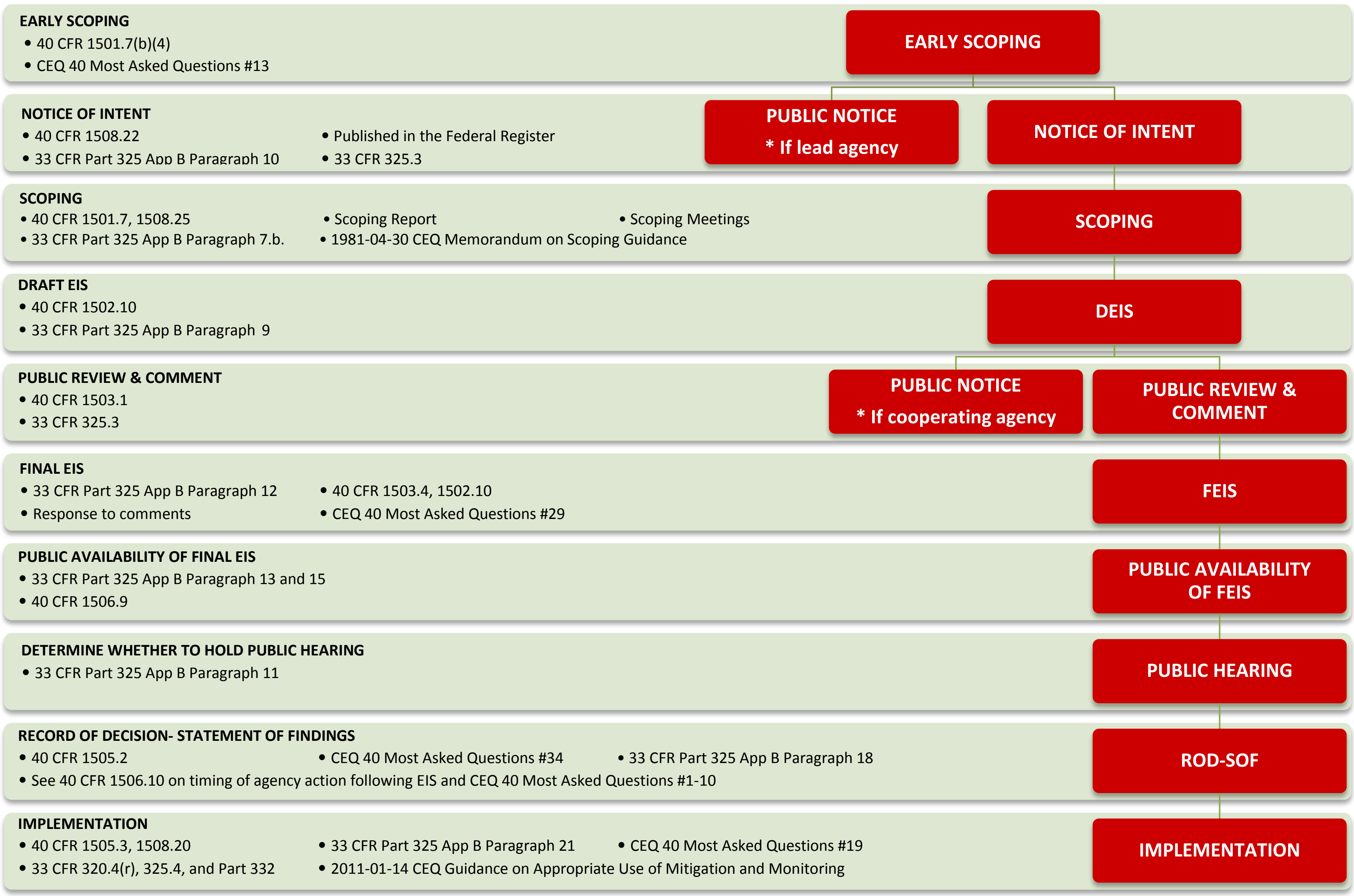

Figure ES-1. NEPA summary milestones.

CHAPTER 1

PURPOSE OF AND NEED FOR PROJECT ACTION

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1.0. PURPOSE OF AND NEED FOR PROJECT ACTION

1.1. INTRODUCTION

The Town of Palm Beach and Palm Beach County (County) have submitted applications to the U.S. Army Corps of Engineers (USACE), Jacksonville District, Regulatory Division for Department of the Army (DA) permits authorizing the discharge of dredged or fill material into waters of the United States (US), under Section 404 of the Clean Water Act (CWA) for construction of two shoreline stabilization projects, collectively referred to as the Southern Palm Beach Island Comprehensive Shoreline Stabilization Project (the Project). Additionally, DA authorization in accordance with Section 10 of the Rivers and Harbors Act of 1899 (RHA) (33 U.S.C. 403) is required for dredging or constructing structures within tidal waters. The Project proposes to nourish a 2-mile segment of the beaches along shorelines of the Towns of Palm Beach, South Palm Beach, Lantana and Manalapan between Florida Department of Environmental Protection (FDEP) Range Monuments R-129-210 and R-138+551, and to construct coastal armoring structures (groins) between R-134+135 and R-138+551.

Under Section 404 of the CWA, the USACE was granted authority to issue permits for discharges of dredged or fill material into waters of the United States. The USACE and U.S. Environmental Protection Agency (EPA) have developed several Memorandums of Agreement clarifying each agency’s role in implementing Section 404. The USACE serves as the lead agency for jurisdictional determinations and permit actions and has set forth implementing regulations in Title 33 of the *Code of Federal Regulations* (CFR) Parts 320–332.

The USACE has determined its issuance of DA permits for the Project would be a “major federal action” significantly affecting the human environment and, therefore, an Environmental Impact Statement (EIS) is necessary to inform any final decision on the permit application. The USACE’s decision will be to either issue, issue with modifications to the applicant’s proposal, or deny a DA permit for the proposed action.

A primary purpose of a USACE regulatory program EIS is to provide full and fair discussion of the significant environmental impacts of a proposal or project seeking a USACE permit. The EIS is used to inform agency decision-makers and the public of alternatives to an applicant's project that might avoid or minimize adverse impacts or enhance the quality of the human environment. An EIS is not a USACE regulatory decision document. It is used by agency officials in conjunction with other relevant information in a permit application file, including public and agency comments presented in the EIS, to support the final decision on a permit application.

This EIS is being prepared pursuant to: (1) Section 102(2)(c) of the National Environmental Policy Act (NEPA) of 1969 (42 U.S.C. 4321 *et seq*.); (2) the Council on Environmental Quality (CEQ) regulations on preparing EISs (40 CFR Parts 1500-1508); (3) Section 404 of the CWA on permitting disposal sites for dredged or fill material (33 U.S.C. 1344), as amended; and (4) NEPA Implementing Procedures for the Regulatory Program (33 CFR 325, Appendix B). USACE will conduct the public interest review and CWA Section 404(b)(1) analyses (Appendix L) in the project-specific records of decision-statements of findings (RODSOF).

1.1.1. ORGANIZATION OF THE DOCUMENT

The content and organization of this EIS for the Southern Palm Beach Island Comprehensive Shoreline Stabilization Project follows NEPA's requirements. The document includes the following Chapters:

Chapter 1 Purpose of and Need for Project Action

Chapter 1 provides a statement of the purpose and need to which the Corps is responding in proposing the alternatives including No Action. In addition, Chapter 1 provides this overview of the organization of the EIS, the scope of the Project, the Project location, a description of the proposed action, the Project permitting and consultation history, the history of shoreline management in the Project Area and a list of the key environmental documents that contributed to the generation of this document.

Chapter 2 Project Alternatives

Chapter 2 provides an overview of the process used to identify alternatives for consideration in the EIS. The EIS considers in detail the No Action Alternative, the Applicants' Preferred Alternative, and five additional alternatives.

Chapter 3 Affected Environment

Chapter 3 includes a description of the general environmental setting, an inventory of federally listed threatened and endangered species that may occur in the area, an assessment of the essential fish habitat located within the Project Area, as well as a discussion regarding various public interest factors.

Chapter 4 Environmental Consequences

Chapter 4 discusses potential impacts to each resource detailed in Chapter 3 as a result of each alternative described in Chapter 2. These include analysis of the direct, indirect, and cumulative impacts.

Chapter 5 Mitigation

Chapter 5 details the avoidance and minimization measures that would be implemented as part of the Applicants' Preferred Alternative. These include application of protection guidelines outlined by various agencies. This chapter also details the mitigation measures that each applicant intends to implement due to anticipated and unavoidable impacts. Also included is a description of the biological and physical monitoring plans that will be finalized during permitting for implementation prior to, during, and following construction activities.

Chapter 6 Permits, Licenses and Compliance with Environmental Regulations

Chapter 6 summarizes the federal permits and licenses that will be required for the action alternatives and includes a narrative of environmental regulations that this EIS is in compliance with.

Chapter 7 Preparers, Reviewers and Recipients

Chapter 7 lists the individuals who prepared the EIS, the USACE reviewers, and the entities that received notification and/or copies of the EIS.

Chapter 8 Literature Cited

Chapter 8 lists all of the references used in developing the EIS.

Chapter 9 Index

Chapter 9 is designed to provide easy reference to items discussed in the main text of the EIS.

Appendices

Appendix A	Public Scoping Report
Appendix B	Technical Specifications for Palm Beach County Annual Dune and Wetlands Restoration Project No. 2013ERM01
Appendix C	2013 Acropora Survey Report (PBC-ERM, 2013)
Appendix D	2013 Habitat Characterization Report (CB&I, 2014)
Appendix E	Biological Assessment (BA)
Appendix F	Essential Fish Habitat (EFH) Assessment
Appendix G	Engineering Analysis and Numerical Modeling Study
Appendix H	UMAM Analysis
Appendix I	Mitigation Plan
Appendix J	Cumulative Impacts Analysis
Appendix K	Public Comment Report
Appendix L	Section 404(B)(1) Guidelines Evaluation
Appendix M	Coastal Zone Management Act Consistency Evaluation

1.1.2. SCOPE

The scope of this EIS considers the range of actions, alternatives and impacts to be evaluated. The USACE determined that two projects proposed by the Town of Palm Beach and the County are “similar actions” and therefore the alternatives and environmental effects of these projects should be evaluated together. The Preferred Alternative in the County includes placing sand in the dune and beach and constructing seven king pile and panel groins between R-134+135 and R-138+551. The County proposes to utilize sand from upland sand mines. The Preferred Alternative in the Town of Palm Beach includes placing sand on the dune and beach between R-129-210 and R-

134+135 utilizing sand dredged from an offshore borrow area. The Town of Palm Beach plans to renourish the shorelines along the Reach 7 Phipps Project (SAJ-2000-0380) area and the Mid-Town Project (SAJ-1995-03779) area in the foreseeable future and so to minimize environmental impact and maximize efficiency, the Town of Palm Beach plans to dredge excess sand for the proposed Project at the same time as Phipps or Mid-Town. The sand would be temporarily stockpiled at Phipps and Mid-Town, mechanically loaded on trucks, and then hauled to the Project Area for placement and grading. The action of dredging and stockpiling sand from an offshore borrow area during another project is considered a “cumulative action” and is discussed as such herein (see Section 1.1.5). Chapters 3 and 4 present the location of the borrow areas (see Figure 3-1) and discussion of the effects of this activity.

In order to appropriately assess the Applicants’ Preferred Alternative, six other reasonable alternatives were evaluated. This seven alternatives are discussed in detail in Chapter 2 and include:

1. No Action Alternative (Status Quo)
2. The Applicants’ Preferred Alternative (Proposed Action): Beach and Dune Fill with Shoreline Protection Structures Project
3. The Applicants’ Preferred Project without Shoreline Protection Structures
4. The Town of Palm Beach Preferred Project and County Increased Sand Volume Project without Shoreline Protection Structures
5. The Town of Palm Beach Increased Sand Volume Project and County Preferred Project
6. The Town of Palm Beach Increased Sand Volume Project and County Increased Sand Volume Project without Shoreline Protection Structures

7b. The Town of Palm Beach Increased Sand Volume with Two Shoreline Protection Structures (Coalition to Save Our Shoreline, Inc. (SOS) Alternative) Project and County Preferred Project

For each of these alternatives, direct, indirect and cumulative impacts are evaluated in Chapter 4. Both applicants are proposing to mitigate impacts by constructing mitigation reefs within the nearshore environment.

1.1.3. PROJECT LOCATION

Palm Beach County is located on Florida's east coast approximately 97 km (60 mi) north of Miami (Figure 1-1). There are 38 incorporated municipalities within the County, four of which are located within the Project Area (R-129-210 to R-138+551). These include the Towns of Palm Beach, South Palm Beach, Lantana and Manalapan. Generally, the Project is in a densely populated urbanized residential setting on the coastal barrier island, referred to as Palm Beach Island, separated from the main Florida peninsula by the Lake Worth Lagoon (LWL) and Atlantic Intracoastal Waterway (AIWW).

Bridges spanning the LWL provide access to the island and Project Area. Approximately 1.3 million people live within the County and 8,348 people live on Palm Beach Island (U.S. Census Bureau, 2010). The Lake Worth Inlet/Port of Palm Beach is located approximately 17.7 km (11.0 mi) north of the Project Area and the South Lake Worth Inlet is located approximately 4.0 km (2.5 mi) south of the Project Area. The Town of Palm Beach is bounded to the north by Lake Worth Inlet and to the south by the Town of South Palm Beach. The shoreline of the Town of Palm Beach is divided up into segments known as reaches, which are numbered 1 through 11 (ATM, 1998). The Town of Palm Beach's proposed project is located in Reach 8. The County's proposed project is located within the Towns of South Palm Beach, Lantana and the north end of Manalapan (Reach 9 and a portion of Reach 10). The total Project Area includes approximately 3.33 km (2.07 mi) of shoreline along the Atlantic Ocean between R-129-210 and R-138+551 (Figure 1-1).

As of June 2014, the Florida Department of Environmental Protection (FDEP) has classified this entire Project shoreline as "critically eroded", which is a designation applied to areas where erosion has been determined to threaten development interests (FDEP, 2014). The Project Area beaches, which provide storm protection to residential and public infrastructure and serve as nesting areas for sea turtles, have experienced erosion from hurricanes, tropical storms, strong high pressure systems (Nor'easters) and wave events.

The annual shoreline change along the Project Area from June 2004 to winter 2011/2012 averaged a loss of 0.69 m/yr (2.25 ft/yr) (CPE, 2013; ATM, 2010). The Project Area and site conditions are strongly influenced by natural coastal processes due to its location within the littoral cell and the amount of sand entrained in the littoral sand transport system. The erosion rates for this area are driven by many factors, including storm events, upland seawalls, lack of dune habitat, disruptions in littoral sand transport, geographic location on the coast and/or in a littoral cell, proximity to tidal inlets, sea level rise, nearshore beach morphology, hardbottom and adjacent coastal structures. These factors combined with the dynamic nature of coastlines, typically have resulted in a narrow, low-profile beach providing minimal storm protection.

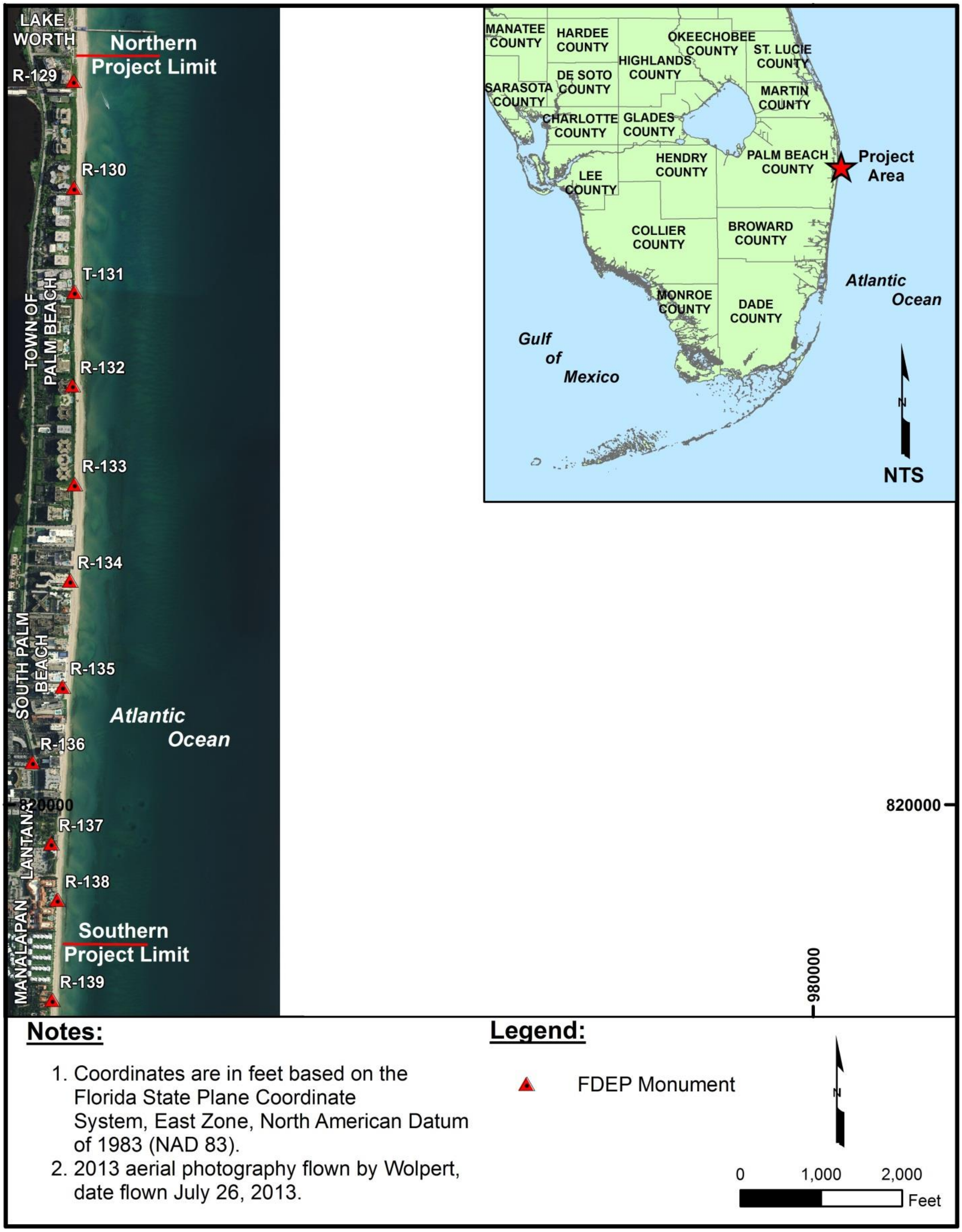

Figure 1-1. Southern Palm Beach Island Comprehensive Shoreline Stabilization Project location map.

1.1.4. DESCRIPTION OF PROPOSED ACTION

The Town of Palm Beach and the County (the Applicants) are seeking Federal and State (Joint Coastal) permits to allow for the implementation of two non-Federal shoreline stabilization projects that would provide more sand to the littoral system, create a stable beach and dune profile that will buffer the effects of storm surge and wave action, provide wildlife habitat, allow for recreational use, and protect upland infrastructure. The Preferred Alternative includes placing sand in the dune and beach (Town of Palm Beach and County) and constructing seven king pile and panel groins (County only). The Town of Palm Beach and the County have stated a desired maintenance interval (renourishment) of four and three years, respectively. The sand placement would also provide approximately 12 m (40 ft) of beach width for recreational use on Lantana's Public Beach, as well as enhance sea turtle nesting habitat. The sand would offset erosional losses and shoreline retreat, while the groins will facilitate stabilization by disrupting a portion of the sand flowing south along the beach and encourage sediment deposition on the updrift side of the structures. The groins would effectively lower the erosion rate once the structures are exposed and increase the Project life by physically holding the sand in place. The groins could provide a mechanism to reduce the footprint of the fill template and volume, but also achieve the desired maintenance interval.

The Town of Palm Beach and the County are proposing these projects to provide long-term storm protection. This would be achieved through the initial issuance of the State and Federal permits, which would ease permitting efforts for maintenance (renourishment) events. The proposed projects would be constructed within a six month period, with an estimated project life of roughly three years, depending on the alternative selected (See Chapter 2 for a description of the proposed alternatives). The USACE is considering authorization under a 10-year permit to allow for initial project construction and maintenance for no more than three renourishment events.

The Town of Palm Beach and the County's preferred projects are discussed in detail in Section 2.4.2. The volumes of sand presented in this EIS are based on the 2014 conditions; however, Table 2-1 in Chapter 2 refers to the volumes required to implement each alternative based on physical surveys conducted in 2008/2009, 2011/2012, and 2014. All three of these conditions are presented for the following reasons: 1) the original project was developed based on 2008 conditions; 2) the modeling conducted during the initial analysis for this EIS in 2013 was based on the most recent conditions at the time (2011/2012); and 3) based on public comments, even more recent data was analyzed (2014), which was included in the Storm Induced Beach Change (SBEACH) analysis. The actual volume of sand needed to construct the project will be dependent on the project template and the condition of the beach (based on results of a physical survey) immediately prior to construction.

The basic components for both projects include the following:

- Overall, the Applicants' beach and dune nourishment projects require placement of approximately 142,800 cubic yards (cy) of sand from R-129-210 to R-138+551.
- Based on the range of grain sizes analyzed, it is anticipated that the combined Applicants' Preferred Project would result in permanent impacts to between 3.86 and 3.99 acres of hardbottom, and temporary impacts to between 9.53 and 9.93 acres of hardbottom.
- The specifics of the Town of Palm Beach's project (R-129-210 to R-134+135) include:
    - Placement of approximately 61,800 cy of sand above the mean high water (MHW) line and approximately 3,400 cy of sand below MHW for a total of 65,200 cy.
    - Dune restoration only is proposed from R-129-210 to R-129+150 and from T-131 to R-134+135.
    - The Town of Palm Beach prefers to utilize beach compatible sand dredged from offshore borrow areas (North Borrow Area 1 [NBA1], South Borrow Area 2 [SBA2], South Borrow Area 3 [SBA3] or any offshore sand source that is consistent with the Palm Beach Island Beach Management

Agreement (BMA) cell-wide sediment quality specifications). The dredged sand would be stockpiled at Mid-Town or Phipps but actively transported by truck along the existing network of public roadways to the Project Area, and temporarily placed on beach landward of the mean high water line until needed. If timing of the Phipps or Mid-Town projects does not allow for use of dredged sand, the Town of Palm Beach would consider using sand from an upland source.

  - Project construction is proposed between November 1 and April 30 to avoid peak sea turtle nesting season.
  - The sand would meet the most stringent of the following sediment criteria: FDEP quality guidelines for beach sand compatibility (62B-41.007(2)(j)) and the BMA cell-wide sediment quality specifications (FDEP, 2013).
  - A desired renourishment interval of four years.

- The specifics of the County's project (R-134+135 to R-138+551) include:
  - Placement of approximately 51,000 cy of sand above the MHW line and approximately 26,600 cy of fill below MHW for a total of 77,600 cy.
  - Construction of seven (7) low-profile groins placed perpendicular to the shoreline extending from the existing seawalls to the post-construction (beach nourishment) water line.
  - The County has proposed an upland sand mine to acquire beach compatible sand which would be transported by truck along the existing network of public roadways.
  - Project construction is proposed between November 1 and April 30 to avoid peak sea turtle nesting season.
  - The sand would meet the most stringent of the following sediment criteria: FDEP quality guidelines for beach sand compatibility (62B-41.007(2)(j)), the

BMA cell-wide sediment quality specifications (FDEP, 2013) and the County's technical sand specifications (Appendix B – Section 2.1.1).

- A desired renourishment interval of three years.

1.1.5. PROJECT PERMITTING AND CONSULTATION BACKGROUND

In 2005, the Town of Palm Beach submitted an application (SAJ-2005-07908) to construct a beach nourishment project along the Reach 8 shoreline from R-125 to R-131; however a permit was not proffered and the project was not constructed. In 2010, the Town of Palm Beach submitted a permit application to nourish two portions of Reach 8 (SAJ-2005-07908). The northern portion included R-125 to R-127+60 and the southern portion included R-129+150 to R-135+350. The proposed project was revised by the applicant and the USACE authorized a portion of the proposed project north of the Lake Worth Pier (R-125 to R-127+75). The Town of Palm Beach has been authorized by FDEP to construct dunes and has done so in Reach 8 throughout this timeframe. The Town of Palm Beach is now requesting authorization to construct the southern portion of Reach 8 from R-129-210 to R-134+135, which is adjacent to the County's proposed project (SAJ-2008-04086). The USACE file number SAJ-2008-04086 for the County's project was originally generated due to discussions about an EIS based on a 2007 feasibility study (CPE, 2007) in the same project area; however, that EIS was never completed. The County then submitted a permit application in September 2014 based on the project discussed herein to include beach nourishment and construction of a series of low profile groins between R-134+135 and R-138+551. The same file number was assigned since the project location was the same. The currently proposed projects by the Town of Palm Beach and the County originally overlapped between R-132 and R-134+135 and now abut one another at R-134+135. The USACE has determined that these two projects are "similar actions" that should be evaluated in a single EIS because the projects share common timing and geography.

For clarification, in the Notice of Intent (NOI) dated July 13, 2013, USACE stated that the Town of Palm Beach and the County's projects were being reviewed as "connected actions". However, based on additional project review since the NOI, the USACE's current understanding is that the two projects are not “connected actions” because: 1) the implementation of these projects does not trigger other actions that may require an EIS, 2) they do not depend on another action to proceed, and 3) they are not part of a larger action that would justify their action. The components required to implement these two projects will require an additional EIS since dredging and mining the sand sources discussed have already been permitted. Impacts that may occur during transportation of the sand by truck to the Project Area are evaluated herein. Each project will be implemented by separate entities (Town of Palm Beach and Palm Beach County) and although they abut one another, permits will be issued for each project as a complete and separate action, and therefore, they will not depend on one another to proceed. Similarly, there is no larger action that each of these projects are part of and depend on to justify their action. Nonetheless, because the actions’ similarities provide a basis for evaluating their environmental consequences together, the USACE is exercising its discretion to evaluate the two projects in a single EIS.

The USACE is aware of the Town of Palm Beach’s plan to utilize beach compatible sand originating from offshore borrow areas that would be dredged in excess of the volume needed to restore either a future Phipps (SAJ-2000-0380) or Mid-Town (SAJ-1995-03779) beach renourishment project. The excess dredged material would be temporarily staged during construction and actively transported by truck to the Project Area. Figure 1-2 presents the conceptual overview of transporting upland sand to the Project Area and transporting dredged sand to the stockpile areas (Phipps and Mid-Town) and then trucking the sand to the Project Area. The dredging activities associated with either the Mid-Town or Phipps are within the USACE jurisdiction, and are considered in the cumulative impacts assessment in Chapter 4 and Appendix J since they are reasonably expected to occur in the foreseeable future. Both projects have recently been constructed (Mid-Town in winter 2014-2015 and Phipps in winter 2015-2016) and dredged sand was transported by truck and placed on the dunes in Reach 8 (approximately 35,000 cy from Mid-Town and approximately 10,000 cy from Phipps). If the timing of Project construction does not coincide with future Mid-Town or Phipps construction projects, the Town would consider using upland sand.

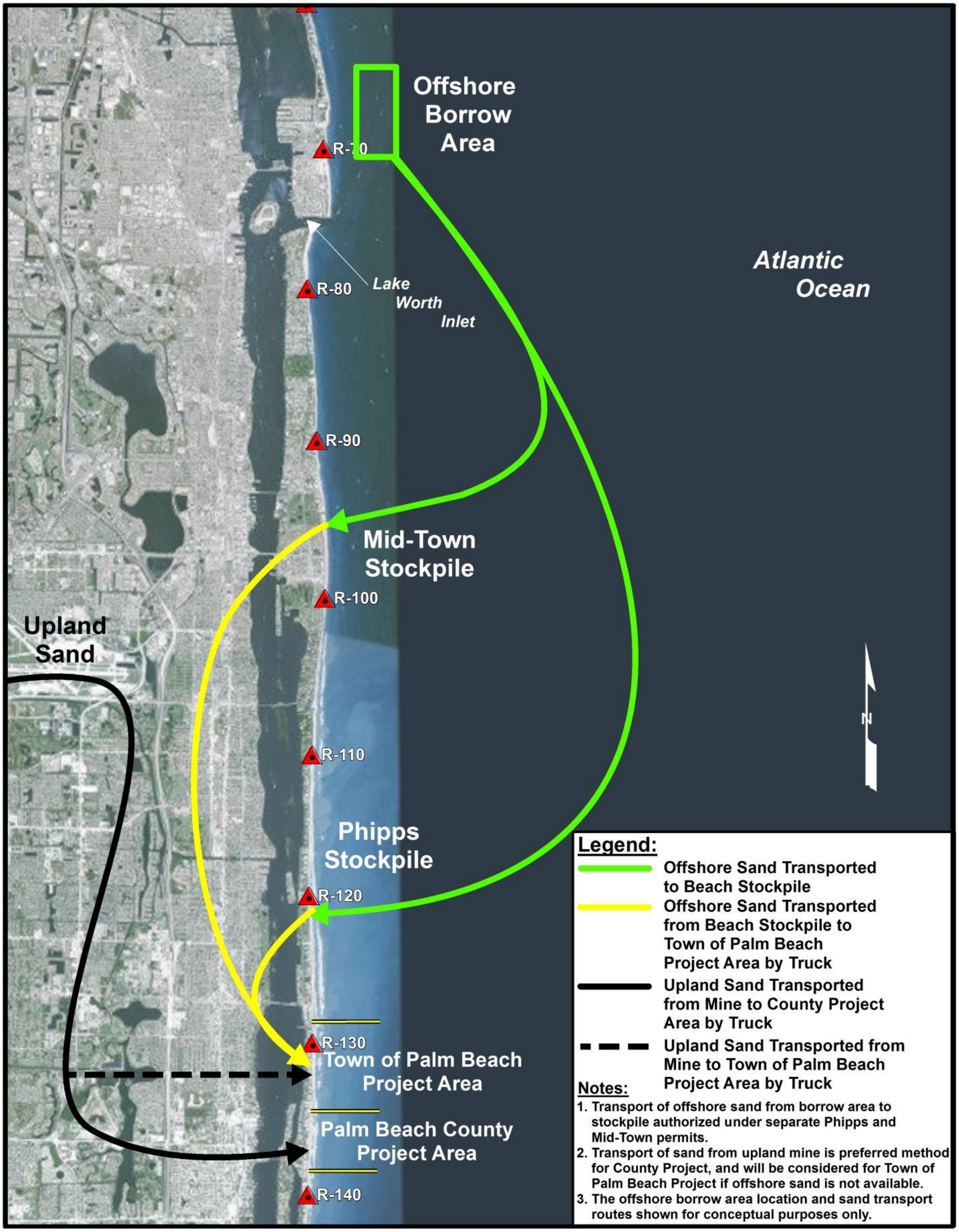

Figure 1-2. Conceptual drawing of the transportation of upland and dredged sand to the Project Area. Offshore and onshore route is variable depending on sand sources used.

1.1.6. HISTORY OF SHORELINE MANAGEMENT IN THE PROJECT AREA

This section provides the history of shoreline management in the Project Area and specifically details actions that have focused on stabilizing and protecting the shoreline and upland infrastructure within the Project Area.

Numerous dune restoration measures have been implemented by the Town of Palm Beach and the County by placing sand within the dune above the MHW line (Table 1-1). These dune projects do not provide a substantial degree of long-term protection, but they do provide a nominal degree of sand to the local sand budget as well as some buffering for the existing seawalls.

Table 1-1. History of shoreline protection projects implemented by the Town of Palm Beach and County within the proposed Project Area.

Date	Local Sponsor	Project Name	Project Limits	Volume (cy)	Sand Source
2003	County	SPB/Lantana Dune Restoration	R-135+460 to R-137+410	1,000	Upland
2005	County	SPB/Lantana Dune Restoration	R-135+460 to R-137+410	3,132	Upland
2005	County	SPB/Lantana Dune Restoration	R-135+460 to R-137+410	5,814	Upland
2005	Town of Palm Beach	Reach 8 Dune Restoration		20,000	Upland
2006	Town of Palm Beach	Reach 8 Dune Restoration	R-129+200 to R-133+500	141,458*	Upland
2007	County	SPB/Lantana Dune Restoration	R-135+460 to R-137+410	6,750	Upland
2008	County	SPB/Lantana Dune Restoration	R-135+460 to R-137+410	11,000	Upland
2009	County	SPB/Lantana Dune Restoration	R-135+460 to R-137+410	10,000	Upland
2011	Town of Palm Beach	Reach 8 Dune Restoration	R-128+500 to R-133	56,000	Upland
2015	Town of Palm Beach	Reach 8 Dune Restoration	R-128+500 to R-134	34,902	Offshore from Mid-Town Project
2016	Town of Palm Beach	Reach 8 Dune Restoration	R-128+500 to R-134	10,026	Offshore from Phipps Project

SPB = South Palm Beach
* The dune was restored as part of the FDEP Hurricane Recovery Program Dune Restoration Project, which also included placement of fill at R-116.5 to R-119-300, R-126 to R127+100. The volume in the table includes the volume for the entire project.

1.2. PROJECT PURPOSE AND NEED

In accordance with NEPA, an EIS “shall briefly specify the underlying purpose and need to which the agency is responding” (40 CFR §1502.13). When considered together, the “purpose” and the “need” for the Project establish the basic parameters for identifying the range of alternatives to be considered in an EIS. Pursuant to the USACE Regulatory Program’s NEPA implementing regulations (33 CFR Part 325, Appendix B) and pursuant to the CWA Section 404(b)(1) Guidelines (40 CFR Part 230), there are three ways that the USACE examines the underlying goals, or purpose, of a project: 1) the Applicants’ stated purpose and need (i.e., Town of Palm Beach and County’s stated purpose and need), 2) a “basic” project purpose defined by the USACE specifically for addressing a project’s water dependency pursuant to 40 CFR § 230.10 (a), and 3) an “overall” project purpose defined by the USACE for the CWA Section 404(b)(1) alternatives analysis. Pursuant to the USACE Regulatory Program’s NEPA implementing regulations, when defining the purpose and need for a project, “while generally focusing on the applicant's statement, the [USACE] will in all cases, exercise independent judgment in defining the purpose and need for the Project from both the applicant’s and the public’s perspective.” 33 CFR Part 325, Appendix B, Paragraph 9.b.(4). Section 1.5.1 defines the Public’s Need as applied to the proposed projects, which are also referred to as the Applicants’ Preferred Alternatives.

1.2.1. APPLICANTS’ PROJECT PURPOSE AND NEED STATEMENT

The applicant’s project purpose and need statement is an expression, typically in the applicant’s own words, of the intent and underlying goals for a proposed project. The USACE takes an applicant’s purpose and need into account when determining the overall purpose and the Project purpose and need. In this case, each of the two applicants provided their own purpose and need statement.

The Town of Palm Beach’s purpose and need statement is as follows:

> Use cost effective beach fill placement and/or coastal protection structures when environmentally possible, which may enhance stability to existing seawalls and enhance the existing beach and dune system for 15-year storm protection to upland property, and, at a minimum, demonstrate 25-year storm protection to

habitable buildings currently without seawalls (see Figure 3-2 for location of exposed and buried seawalls in the Project Area) in areas where seawalls cannot be state qualified and the combination of upland property with the existing beach and dune system serves as the habitable building's last line of defense from the ocean.

Palm Beach County's purpose and need statement is as follows:

> The intent of the project is to stabilize the beach where it is most critically eroded and maintain a moderate beach width. Palm Beach County proposes construction of seven (7) low-profile groins placed perpendicular to the shoreline extending from the existing seawalls to the post-construction waterline. Construction of these structures will help stabilize the shoreline by disrupting a portion of the sand flowing south along the beach and depositing it on the updrift side of the structure. The project also includes optimized placement of approximately 75,000 cy of material along the most critically eroded areas within the project template. Anticipated benefits of the project include restoration of the recreational beach, additional area for nesting sea turtles and shorebirds, and increased storm protection to upland properties and park infrastructure.

1.2.2. USACE INTERPRETATION OF THE APPLICANTS' PROJECT PURPOSE AND NEED STATEMENT

The USACE's interpretation of the Applicants' project purposes is to minimize future adverse storm-induced effects by nourishing the beach to replace the sand that has been lost and also ameliorate the current erosion rate to an extent that nourishment intervals would likely occur no less than every three to four years.

1.2.2.1. USACE BASIC PROJECT PURPOSE

The USACE uses the basic project purpose to determine water dependency pursuant to 40 CFR § 230.10(a)(3). If a project is not water dependent, other alternatives that would not result in impacts to special aquatic sites are presumed to be available. The Section 404(b)(1) Guidelines state that practicable alternatives to non-water dependent activities that do not involve a discharge into special aquatic sites are presumed to be available unless clearly demonstrated otherwise. Furthermore, practicable alternatives which do not involve a discharge into a special aquatic site are presumed to have less adverse impact on the aquatic ecosystem unless clearly demonstrated otherwise by the applicant. 40 CFR §230.10 (a)(3). Pursuant to Section 404 CWA, there are no known special aquatic sites within the anticipated impact areas.

The basic project purpose is to stabilize a shoreline and provide storm protection to upland property; therefore, the USACE finds that the basic project purpose is not water-dependent. The Project sites are located in an area consisting of dunes, beach, supra- and intertidal beach, open waters of the Atlantic Ocean and nearshore hardbottom aquatic resources.

1.2.2.2. USACE UNDERSTANDING OF THE APPLICANTS' OVERALL PROJECT PURPOSE

The USACE will use the overall project purpose to identify alternatives for evaluation in this EIS and to determine if the Applicants' proposed Project is the least environmentally damaging practicable alternative (LEDPA) under the Section 404(b)(1) Guidelines. The overall project purpose should be specific enough to define the applicant's needs, but not so restrictive as to constrain the range of alternatives that must be considered under the Section 404(b)(1) Guidelines. Defining the overall project purpose is the USACE's responsibility. However, the applicant's needs and the type of project being proposed should be considered.

For this project, the overall project purpose, as defined by the USACE, is to achieve shoreline stabilization that prevents damage to upland property during a 15-year storm event in areas with seawalls or in areas where seawalls can be state qualified and damage to habitable buildings currently without seawalls in areas where seawalls cannot be state qualified during a 25-year storm event within the southern portion of Reach 8, all of Reach 9, and the northern portion of Reach 10, in Palm Beach County, Florida.

1.3. PUBLIC INVOLVEMENT

Under the National Environmental Policy Act (NEPA), all agencies are required to consider all environmental impacts for federal projects and federal rules. NEPA also requires agencies to cooperate with other federal agencies, with state and local governments, and to involve public stakeholders or citizens. All persons and organizations that have a potential interest in the Proposed Action are urged to participate in the NEPA environmental analysis process. These persons and organizations may include federal, state, and local agencies; federally recognized Indian tribes; interested stakeholders; and minority, low-income, or disadvantaged populations. Throughout this process, the public may obtain information on the status and progress of the EIS by contacting:

Ms. Krista Sabin
U.S. Army Corps of Engineers, Jacksonville District
4400 PGA Boulevard, Suite 500
Palm Beach Gardens, FL 33410
E-mail: Krista.D.Sabin@usace.army.mil
By phone: (561) 472-3529

The EIS is being prepared in compliance with NEPA to identify and assess the effects of the Proposed Action and its alternatives in order to provide a basis for rendering an informed decision on the proposed Project. The USACE's decision will be to either issue, issue with modifications, or deny the Department of the Army (DA) permits for the Proposed Action.

1.3.1. EIS PUBLIC INVOLVEMENT

The Council on Environmental Quality (CEQ) regulations direct federal agencies that have made a decision to prepare an EIS to engage in a public scoping process. Scoping is intended to ensure that issues of concern are identified early and properly studied, that issues of little significance do not consume time and effort, that the DEIS is thorough and balanced, and that delays occasioned by an inadequate DEIS are avoided. The scoping process should:

- Identify the public and agency concerns;

- Clearly define the environmental issues and alternatives to be examined in the EIS including the elimination of insignificant issues;
- Identify related issues which originate from separate legislation, regulation, or Executive Order (e.g., historic preservation or endangered species concerns); and
- Identify state and local agency requirements which must be addressed

An effective scoping process can help reduce unnecessary paperwork and time delays in preparing and processing the EIS by clearly identifying all relevant procedural requirements. The list of stakeholders and other interested parties is also updated and generally expanded during the scoping process. This section describes the processes in which the public has been involved with the development of the EIS.

1.3.2. NOTICE OF INTENT

On July 3, 2013, the USACE published a Notice of Intent (NOI) to prepare the EIS in the Federal Register (78 FR 40128). As stated within the NOI, the EIS must comply with all provisions of NEPA of 1969, as amended; CEQ regulation implementing NEPA; Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403), Section 404 of the Clean Water Act (CWA) (33 U.S.C. 1344), and other associated laws and regulations. This NOI announced the initiation of a 45-day scoping and commenting period which requested the public's involvement in the scoping and evaluation process of the DEIS. Table 1-2 presents the coordination meetings held with regulatory agencies and the public to date.

Table 1-2. Coordination meetings held with regulatory agencies and with the public.

Date, Location and Purpose	Agency/Entity and Name(s)
July 3, 2013 Town of Palm Beach Informal Introduction of EIS Team	Town of Palm Beach: Paul Brazil and Rob Weber USACE: Leah Oberlin CB&I: Tom Pierro, Stacy Prekel, Lauren Floyd and Brad Rosov
July 16, 2013 USACE USACE Kick-off Meeting	USACE: Leah Oberlin and Garett Lips CB&I: Tom Pierro, Samantha Danchuk and Brad Rosov

August 12, 2013 Town of Palm Beach Town Hall Public Scoping Meeting	Private Citizens: USACE: Town of Palm Beach: Palm Beach County CB&I:	38 (attendance count) Lieutenant Colonel Greco, Garett Lips and Leah Oberlin Paul Brazil and Rob Weber Kim Miranda and Leanne Welch Tom Pierro, Stacy Prekel, Lauren Floyd, Samantha Danchuk and Brad Rosov
September 3, 2013 Conference Call Scoping Comments	USACE: CB&I: NMFS-HCD:	Garett Lips Lauren Floyd Jocelyn Karazsia
January 7, 2015 Town of Palm Beach Town Hall DEIS Public Meeting	Private Citizens: USACE: Town of Palm Beach: Palm Beach County: CB&I:	57 (attendance count) Garett Lips Rob Weber Kim Miranda, Mike Stahl and Leanne Welch Tom Pierro, Stacy (Prekel) Buck, Lauren Floyd, Katy Brown, Brad Rosov, Dave Swigler

1.3.3. PUBLIC SCOPING MEETING

Pursuant to NEPA requirements, a scoping meeting was held on August 12, 2013 at the Town of Palm Beach Town Hall to provide an opportunity for the public to submit comments on the scope of the EIS, the alternatives to be considered, and the environmental and socioeconomic issues to be addressed. The NOI included a notification to stakeholders and all parties who expressed interest in the public scoping meeting. The USACE invited federal agencies, American Indian Tribal Nations, state and local governments, and other interested private organizations and parties to attend and provide comments in order to ensure that all significant issues were identified and the full range of issues related to the proposed Project were addressed. Notifications of the public scoping meeting were announced in several local media outlets, including the Palm Beach Post, Palm Beach Daily News, Town of Palm Beach and the County websites, as well as within Palm Beach County's Department of Environmental Resource Management (PBC-ERM) July 2013 Project Status Report. The public scoping meeting and request for comments on the proposed Project were also announced on the USACE Jacksonville District Website. Targeted stakeholders, including property owners within the Project Area, were notified by mail (see Section 1.3.4.).

The public scoping meeting commenced at 5:30 pm with an opportunity for attendees to view posters depicting aspects of the proposed Project including the beach fill limits, location of the groin field, cross-section profiles, and the location of hardbottom resources in proximity to the Project. USACE and Third Party Contractor (TPC) representatives were available to informally answer questions attendees had regarding the proposed Project and the EIS process. At 6:00 pm Lieutenant Colonel Greco, Deputy District Commander for the Jacksonville District of the USACE, welcomed the attendees and introduced Garett Lips, Project Manager for the USACE Palm Beach Gardens Section. Mr. Lips gave a presentation providing an overview of the NEPA process and a description of the proposed Project. Leah Oberlin, Section Chief for the USACE Palm Beach Gardens Section at the time, provided additional information regarding the Project and answered general project-related questions following Mr. Lips' presentation. After the presentation, the public commenting portion of the meeting began. Of the thirty-eight (38) attendees who signed the sign-in sheet (two were County representatives), five (5) attendees provided oral comments and six (6) written comments were submitted during the scoping meeting. The complete transcript is available in the Pubic Scoping Report (Appendix A). The comment period was extended another 15 days to close on September 3, 2013. All comments received during the meeting, along with others received during the commenting period, are summarized in Section 1.3.5.

The USACE considered the results of the scoping process to develop the alternatives described in Chapter 2, including the No Action Alternative, as well as to examine specific issues of interest. The comments received will also be considered in the final permit decision. The overall scoping process consisted of the following elements:

- Developing a public participation plan, in accordance with NEPA, as guidance for conducting outreach to the public;
- Publishing and announcing public scoping meetings in the Federal Register;
- Distributing a public notice announcing public scoping meetings and locations to federal, state, and local agencies and officials, stakeholders, and other interested parties;

- Distributing a press release to media outlets;
- Sending agency and tribal consultation letters by mail;
- Holding a public scoping meeting to inform the public about the Proposed Action and to solicit oral and written comments on the issues that should be addressed in the EIS; and
- Reviewing and categorizing oral and written comments to be evaluated in the draft EIS.

1.3.4. STAKEHOLDER / EIS RECIPIENT LIST

The Public Scoping Report (Appendix A) provides the list of people and organizations identified by the USACE, the Town of Palm Beach, and the County as stakeholders or potential stakeholders and those individuals or organizations requesting involvement in the EIS process through submittal of comments or requests for EIS documents. All individuals and organizations were notified of the August 12, 2013 public scoping meeting via postcard mailed through the U.S. Postal Service. A similar notification was distributed to announce the availability of this DEIS and the January 7, 2015 public meeting. A comprehensive recipient list to date is included in Chapter 7. The USACE will continue to add new names to the list as necessary or requested until completion of the Record of Decision (ROD).

1.3.5. SCOPING COMMENTS RECEIVED

The public scoping period began on July 3, 2013 when the NOI was published in the Federal Register. The scoping period closed on September 3, 2013. During this time, the USACE accepted comments related to the Project via mail, email, or oral comments delivered during the August 12, 2013 public scoping meeting. During the scoping period, one (1) comment was submitted via mail, one (1) comment was submitted via email, five (5) comments were submitted orally at the public scoping meeting and six (6) written comments were submitted at the public scoping meeting. In addition, the meeting minutes from a conference call with the USACE, TPC, and National Marine Fisheries Service (NMFS) were submitted as a comment. The TPC also contacted an attendee from the public scoping meeting via telephone to clarify his comments further. The summary of the telephone conversation was also submitted as a public comment. Together, a total of seventeen (17) comments were received as part of the public record. The public scoping meeting transcript includes the oral comments received during the meeting. In addition, Appendix A includes the written comments submitted at the public scoping meeting, letters, emails, and meeting minutes.

Of the comments received, there were several issues raised by more than one commenter (Table 1-3). Four individuals made comments regarding the Project alternatives under consideration. This included the request for the inclusion of the shoreline protection project entitled “Coalition to Save Our Shoreline, Inc. (SOS) Beach Nourishment Plan & Design for Reach 8” designed by Erickson Consulting Engineers, Inc. Other comments included concerns over the methodologies used to assess impacts to hardbottom communities and coral species, downdrift impacts, sea level rise, the quality of fill material, impacts to recreational opportunities including surfing, and impacts to property values.

Table 1-3. The nature of the comments received.

Nature of Comment	Number of Comments
Project Alternatives	4
Hardbottom Impact Evaluation	3
Downdrift Impacts	3
Coral Survey Methodologies	2
Sea Level Rise	1
Quality of Fill Material	1
Recreational Opportunities	1
Property Values Impacts	1

1.3.6. ISSUES EVALUATED IN DETAIL

The following issues identified during the EIS scoping period and by the preparers of this document have received evaluation in Chapters 3 and 4 within this document:

- General Environmental Setting
- Vegetation

- Threatened and Endangered Species
- Coral Reef and Hardbottom Resources
- Fish and Wildlife Resources
- Essential Fish Habitat
- Offshore Borrow Area Resources
- Coastal Barrier Resources
- Water Quality
- Air Quality
- Aesthetic Resources
- Recreation Resources
- Navigation
- Cultural Resources and Historic Properties
- Socioeconomics
- Environmental Justice

1.3.7. NOTICE OF AVAILABILITY

On December 12, 2014, the EPA published a Notice of Availability (NOA) to announce the release of the DEIS in the Federal Register (79 FR 73890). As stated within the NOA, Section 309(a) of the Clean Air Act requires that EPA make public its comments on EISs issued by other Federal agencies. This NOA announced the initiation of a 45-day comment period which requested the public's involvement in the evaluation process of the DEIS.

1.3.8. DEIS PUBLIC MEETING

Pursuant to NEPA requirements, a public meeting was held on January 7, 2015 at the Town of Palm Beach Town Hall to provide an opportunity for the public to submit comments on the DEIS, the alternatives considered, and the environmental and socioeconomic issues addressed. The USACE invited federal agencies, American Indian Tribal Nations, state and local governments, and other interested private organizations and parties to participate in an open exchange of information and submission of comments on the DEIS. Stakeholders were notified by postcard and/or email of the public meeting and the meeting was also announced on the Town of Palm Beach website.

The public meeting commenced at 5:00 pm with an opportunity for attendees to view informational displays illustrating the study area; the purpose, need, and objectives of the plan; and summaries of the proposed alternatives. Attendees also signed in, registered to present oral comments, and submitted written comments at this time. USACE and TPC representatives were available to informally answer questions attendees had regarding the proposed Project and the EIS process. At 5:30 pm Garett Lips, Project Manager for the USACE Palm Beach Gardens Section welcomed the attendees. Mr. Lips gave a presentation providing an overview of the NEPA process and a description of the proposed Project. Following the presentation, the public was invited to ask questions on the EIS process and provide oral comments. Of the fifty-seven (57) attendees, sixteen (16) attendees provided oral comments and eight (8) written comments were submitted during the public meeting. The complete transcript is available in the DEIS Public Comment Report (Appendix K, Sub-Appendix K-4). In response to stakeholder concerns and comments at the public meeting, the comment period was extended 30 additional days to close on February 25, 2015. This extension was announced on January 30, 2015 in the Federal Register (80 FR 5109).

1.3.9. DEIS COMMENTS RECEIVED

The public comment period began on December 12, 2014 when the NOA was published in the Federal Register. The comment period closed on February 25, 2015. During this time, the USACE accepted comments related to the Project via mail, email, or oral comments delivered during the January 7, 2015 public meeting. During the comment period, fifty-three (53) correspondences were submitted via email and letter, sixteen (16) comments were submitted orally at the public meeting and eight (8) written comments were submitted at the public meeting. In total, the 77 correspondences received were broken down into 551 comments and those comments were further organized by the subject. The comments were distributed among nine (9) major subjects, which included: cost, Delft3D modeling, environmental (species/habitat concerns, etc.), geotechnical (grain size; sand source), impact analysis, mitigation reef, storm protection, UMAM, and other (legal; NEPA; alternatives; permitting; etc.). Further details regarding the comments received and responses are provided in Appendix K – DEIS Public Comment Report.

1.3.10. CONTINUATION OF CONSULTATION PROCESS

The EPA will publish a NOA in the Federal Register to announce the release of the FEIS. It will be determined thereafter if a public hearing is required. The final step in the EIS is process is for the USACE to prepare a Record of Decision (ROD)/Statement of Findings (SOF). The ROD/SOF identifies the selected alternative, presents the basis for the decision, identifies all the alternatives considered, specifies the "environmentally preferable alternative," and provides information on the adopted means to avoid, minimize and compensate for environmental impacts.

1.4 RELATED ENVIRONMENTAL DOCUMENTS

A number of previously published environmental documents contain information relevant to this EIS. While Chapter 9 provides a complete list of references used in developing this EIS, brief summaries of some of the most relevant environmental documents regarding the Project or the Project Area are provided below:

1.4.1. Applied Technology & Management (ATM). 1998. Comprehensive Coastal Management Plan Update, Palm Beach Island, Florida. Prepared for the Town of Palm Beach, August 1998.

The Comprehensive Coastal Management Plan (CCMP) update provides data on past efforts conducted along 25.3 km (15.7 mi) of the Palm Beach Island shoreline, extending from Reach 1 to Reach 11. Importantly, it discusses changes which occurred to the shoreline between the original CCMP (1986) and the development of the updated CCMP (1997), and these changes were taken into account to develop new objectives and an improved methodology to restore and sustain the shoreline.

1.4.2. Applied Technology & Management (ATM). 2005. Town of Palm Beach Feasibility Study – Reach 8. Prepared for the Town of Palm Beach, January 2005.

Reach 8 hardbottom resources are discussed and temporal comparisons using existing literature and data from field investigations are made, suggesting that the hardbottom resources are highly ephemeral. The study evaluated five beach fill design alternatives for the shore protection project and determined their feasibility in regards to accomplishing the Project goals and their impact to the hardbottom.

1.4.3. Coastal Planning & Engineering, Inc. (CPE). 2007. Town of South Palm Beach/Town of Lantana Erosion Control Study. Prepared for Palm Beach County, February 2007.

Biological and physical data, both onshore and offshore, for the Town of South Palm Beach and the Town of Lantana are summarized and used to evaluate the feasibility of eight project alternatives, including the combination of alternatives, to improve beach conditions. As part of one of the alternatives, details of existing coastal armoring structures, including location, type, and condition are presented.

1.4.4. Coastal Planning & Engineering, Inc. (CPE). 2009. Town of Palm Beach Reach 7, Phipps Ocean Park Beach Mitigative Artificial Reef, 48-Month Post-Mitigation and FDEP Hurricane Recovery Dune Restoration Project Biological Monitoring Report. Boca Raton, Florida: Coastal Planning & Engineering, Inc., 74 pp.

This report provides discussion on two projects. The 3.1-ac Phipps mitigation reef is compared to the surf-zone and nearshore natural hardbottom resources in Reach 7 and conditions on the intertidal and subtidal hardbottom are presented in conjunction with an emergency dune restoration in Reaches 7 and 8. Results from both monitoring efforts are discussed in light of the highly dynamic environment within the Project Area.

1.4.5. Coastal Planning & Engineering, Inc. (CPE) and Coastal Systems International, Inc. (CSI). 2011. Biological Assessment for the Town of Palm Beach South End (Reach 8) Beach Restoration Project. Original prepared for the Town of Palm Beach by CPE, October 2007. Updated by CSI, December 2011.

The Biological Assessment discusses potential impacts to federally listed and proposed species and designated or proposed critical habitats that may be impacted in Reach 8 by the proposed project. Details are provided for each species regarding their status, threats, distribution, habitat, and presence in the Project Area. Taking into all potential project effects, a determination is made for each species indicating if the species will be significantly affected.

1.4.6. Coastal Planning & Engineering, Inc. (CPE) and Coastal Systems International, Inc. (CSI). 2011. Essential Fish Habitat Assessment for the Town of Palm Beach South End (Reach 8) Beach Restoration Project. Original prepared for the Town of Palm Beach by CPE, October 2007. Updated by CSI, December 2011.

The Essential Fish Habitat (EFH) and Habitat Areas of Particular Concern (HAPC) for fisheries managed under the South Atlantic Fisheries Management Council (SAFMC) within Reach 8 are listed and potential impacts due to the proposed project are discussed. Within the managed fisheries, specific species that are known to occur within the Project Area are described and the potential impacts are evaluated.

1.4.7. Florida Department of Environmental Protection (FDEP). 2013. Palm Beach Island Beach Management Agreement (BMA). In the matter of an application for a binding Ecosystem Management Agreement between the Department of Environmental Protection (Department), the Florida Fish and

Wildlife Conservation Commission (FWC), and the Town of Palm Beach (TOPB), and Palm Beach County (County). Executed September 26, 2013. This document is located at: http://www.dep.state.fl.us/beaches/pb-bma/docs/BMA-MainAgreement.pdf

The goal of the BMA is to establish mutually agreeable methods among all parties involved in order to execute coastal erosion control, coastal ecosystem protection, and monitoring protocols on a regional scale, which will address the management needs of the Palm Beach Island's coastline more effectively and efficiently. The BMA discusses specifications relating to regulatory requirements, agreement area location, authorized activities, and net ecosystem benefits.

1.4.8. Palm Beach County Environmental Resources Department (PBC-ERM). 2013. Southern Palm Beach Island Comprehensive Shoreline Stabilization Project *Acropora* Survey – October 22, 2013.

A reconnaissance survey was conducted to determine if the federally threatened species of *Acropora* spp. and the seven coral species proposed for listing at the time of the survey (five of which were listed in October 2014) occur within or adjacent to the proposed Project Area, covering the area between R-127 and R-141 (Reaches 7-10). The results of the survey are presented and include other benthic organisms, such as gorgonians and algae, as well as observations of the hardbottom habitat and areas of unconsolidated sediment. This report is provided as Appendix C.

1.4.9. U.S. Army Corps of Engineers (USACE) and Florida Department of Environmental Protection (FDEP). 2013. Southeast Florida Sediment Assessment and Needs Determination (SAND) Study.

The SAND study quantifies the domestic sand resources needed to support planned beach nourishment projects through year 2062 in St. Lucie, Martin, Palm Beach, Broward and Miami-Dade Counties. Details of the study include categorization of offshore sand sources by quality of material (proven, potential, unverified, or depleted), a geomorphologic assessment describing the geological setting of the region, and the determination of the specific needs for each county.

1.4.10. Woods Hole Group. 2013. Town of Palm Beach Technical Review of Proposed Coastal Management Program. Prepared for the Town of Palm Beach, February 2013.

The Technical Review is a comprehensive assessment analyzing activities occurring after the previous CCMP (1998) and all proposed projects between the 2009 Shore Protection Board (SPB) Plan and the 2013 fiscal year (FY). The Review serves as an unbiased analysis of the SPB's recommendations and suggests the most feasible course of action for the Town of Palm Beach.

1.4.11. CB&I Coastal Planning & Engineering, Inc. (CB&I). 2014. 2013 Habitat Characterization Report. Prepared for the Town of Palm Beach and Palm Beach County, July 2014.

The 2013 Habitat Characterization Report assesses the existing conditions of the beach and nearshore hardbottom resources within and adjacent to the Southern Palm Beach Island Comprehensive Shoreline Stabilization Project Area. In addition, the current hardbottom habitat resources were compared to previous benthic characterization surveys conducted in May and July 2006 to analyze the conditions over time. A dune vegetation assessment was also conducted by examining aerial images followed by and *in situ* investigation. The 2013 Habitat Characterization Report is provided as Appendix D.

CHAPTER 2

PROJECT ALTERNATIVES

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2.0 PROJECT ALTERNATIVES

This chapter outlines the process followed by the USACE to determine the range of reasonable alternatives to the Proposed Action, and presents each alternative to be considered. Several alternatives to the Applicants' (Town of Palm Beach and Palm Beach County [County]) proposals are evaluated for their ability to meet the overall project purpose as presented in Chapter 1, including the feasibility, timeliness, and responsiveness to the issues and concerns identified during public scoping. This evaluation process concludes with a range of seven reasonable project alternatives, including:

1. No Action Alternative (Status Quo)
2. The Applicants' Preferred Alternative (Proposed Action): Beach and Dune Fill with Shoreline Protection Structures Project
3. The Applicants' Preferred Project without Shoreline Protection Structures
4. The Town of Palm Beach Preferred Project and County Increased Sand Volume Project without Shoreline Protection Structures
5. The Town of Palm Beach Increased Sand Volume Project and County Preferred Project
6. The Town of Palm Beach Increased Sand Volume Project and County Increased Sand Volume Project without Shoreline Protection Structures

7b. The Town of Palm Beach Increased Sand Volume with Two Shoreline Protection Structures (The Coalition to Save Our Shoreline, Inc. (SOS) Alternative) Project and the County Preferred Project

The Draft EIS considered a modified SOS alternative (more volume than the original SOS alternative) as Alternative 7 and provided a detailed analysis of the effects of the alternative in the Engineering Analysis and Modeling Study found in Appendix G. The USACE initially considered Alternative 7 but eliminated it from detailed review because the EIS evaluated other alternatives with less impacts that provided a larger fill template along the Town of Palm Beach shoreline. As a result of public comments, the USACE is now including the original SOS Alternative in the detailed alternatives analysis, but renamed as Alternative 7b. Details of Alternative 7 (the modified SOS alternative) are still described in Appendix G. A brief summary of the seven alternatives is provided below, with additional details provided in Section 2.4. The volumes of sand presented in this EIS are based on the 2014 conditions; however, Table 2-1 refers to the volumes required to implement each alternative based on physical surveys conducted in 2008/2009, 2011/2012, and 2014. All three of these conditions are presented for the following reasons: 1) the original project was developed based on 2008 conditions; 2) the modeling conducted during the initial analysis for this EIS in 2013 was based on the most recent conditions at the time (2011/2012); and 3) based on public comments, even more recent data was analyzed (2014), which was included in the Storm Induced Beach Change (SBEACH) analysis. The actual volume of sand needed to construct the project will be dependent on the project template and the condition of the beach (based on results of a physical survey) immediately prior to construction.

Table 2-1. Construction template fill volumes (cy) based on surveys between 2008-2014.

Construction Template Fill Volumes (CY)				
Alternative	**Survey Area**	**2008/2009 Survey**	**2011/2012 Survey**	**2014 Survey**
Alternative 1	TOPB	0	0	0
	PB County	0	0	0
	Total	**0**	**0**	**0**
Alternative 2	TOPB	75,000	53,800	65,200
	PB County	75,000	63,500	77,600
	Total	**150,000**	**117,300**	**142,800**
Alternative 3	TOPB	75,000	53,800	65,200
	PB County	75,000	63,500	77,600
	Total	**150,000**	**117,300**	**142,800**
Alternative 4	TOPB	75,000	53,800	65,200
	PB County	160,000	172,100	187,800
	Total	**235,000**	**225,900**	**253,000**
Alternative 5	TOPB	96,000	100,900	121,700
	PB County	75,000	63,500	77,600
	Total	**171,000**	**164,400**	**199,300**
Alternative 6	TOPB	96,000	100,900	121,700
	PB County	160,000	172,100	187,800
	Total	**256,000**	**273,000**	**309,500**
Alternative 7b	TOPB	n/a	166,500	175,500
	PB County	n/a	63,500	77,600
	Total	**--**	**230,000**	**253,100**

Alternative 1 – No Action Alternative

Alternative 1 is the No Action alternative where the Applicants would continue the measures presently being implemented in the Project Area without any additional actions. No sand placement or groin construction would occur below the mean high water (MHW) and seasonal high tide line. However, the dunes may continue to be enhanced periodically through placement of small volumes of sand in portions of the Project Area. Efforts to protect the dune and upland infrastructure would be limited to construction activities located wholly in uplands and could include dune restoration, upland retaining walls, shoreline armoring, or other structures or work in uplands.

Alternative 2 – The Applicants' Preferred Alternative: Beach and Dune Fill with Shoreline Protection Structures Project

Alternative 2 is the Applicants' Preferred Project alternative, which includes placement of approximately 142,800 cubic yards (cy) of sand, with 65,200 cy of sand placed on the Town of Palm Beach shoreline (R-129-210 to R-134+135) and 77,600 cy placed along the County shoreline within the Towns of South Palm Beach, Lantana and Manalapan (R-134+135 to R-138+551). This alternative also includes the construction of seven low-profile groins placed perpendicular to shore in the County portion of the Project Area. This alternative is described in greater detail in Section 2.4.2. Alternative 2 was assumed to include the following components, at a minimum:

- Approximately 142,800 cy of sand
    - Approximately 65,200 cy of sand dredged from an offshore borrow area, staged at the Phipps or Mid-Town project sites, and truck hauled to the Town of Palm Beach project shoreline
    - Approximately 77,600 cy of sand truck hauled from an upland sand source and placed along the County project shoreline
- Fill placement above and below MHW (dune and beach)
- Seven (7) low-profile king pile and panel groins along the County project shoreline
- Town of Palm Beach shoreline project life expectancy = 2-4 years

- County shoreline project life expectancy = 2-3 years
- The USACE is considering authorization under a 10-year permit to allow for initial project construction and maintenance for no more than three (3) renourishment events

Alternative 3 – The Applicants' Preferred Project without Shoreline Protection Structures

Alternative 3 provides the same project as Alternative 2, but would not include construction of the seven low-profile groins. This alternative is described in greater detail in Section 2.4.3. Alternative 3 was assumed to include the following components, at a minimum:

- Approximately 142,800 cy of sand
    - Approximately 65,200 cy of sand dredged from an offshore borrow area, staged in the uplands at the Phipps or Mid-Town project sites, and truck hauled to the Town of Palm Beach project shoreline
    - Approximately 77,600 cy of sand truck hauled from an upland sand source and placed along the County project shoreline
- Fill placement above and below MHW (dune and beach)
- Town of Palm Beach shoreline project life expectancy = 2-4 years
- County shoreline project life expectancy = 1 year
- The USACE is considering authorization under a 10-year permit to allow for initial project construction and maintenance for no more than three (3) renourishment events

Alternative 4 – The Town of Palm Beach Preferred Project and County Increased Sand Volume Project without Shoreline Protection Structures

Alternative 4 includes the Preferred Alternative along the Town of Palm Beach shoreline and a larger volume of sand without shoreline protection structures along the County shoreline. The sand volume along the Town of Palm Beach shoreline would remain the same at 65,200 cy. The sand volume along the County shoreline would increase from

77,600 cy to 187,800 cy. This alternative is described in greater detail in Section 2.4.4. Alternative 4 was assumed to include the following components, at a minimum:

- Approximately 253,000 cy of sand
    - Approximately 65,200 cy of sand dredged from an offshore borrow area, staged in the uplands at the Phipps or Mid-Town project sites, and truck hauled to the Town of Palm Beach project shoreline
    - Approximately 187,800 cy of sand truck hauled from an upland sand source and placed along the County project shoreline
- Fill placement above and below MHW (dune and beach)
- Town of Palm Beach shoreline project life expectancy = 2-4 years
- County shoreline project life expectancy = 2-3 years
- The USACE is considering authorization under a 10-year permit to allow for initial project construction and maintenance for no more than three (3) renourishment events

Alternative 5 – The Town of Palm Beach Increased Sand Volume Project and County Preferred Project

Alternative 5 includes a larger volume of sand along the Town of Palm Beach shoreline and the Preferred Alternative along the County shoreline. The sand volume along the Town of Palm Beach would increase from 65,200 cy to 121,700 cy but the distribution would vary from the preferred alternative design. The sand volume along the County shoreline would remain the same at 77,600 cy. This alternative is described in greater detail in Section 2.4.5. Alternative 5 was assumed to include the following components, at a minimum:

- Approximately 199,300 cy of sand
    - Approximately 121,700 cy of sand dredged from an offshore borrow area, staged in the uplands at the Phipps or Mid-Town project sites, and truck hauled to the Town of Palm Beach project shoreline
    - Approximately 77,600 cy of sand truck hauled from an upland sand source and placed along the County project shoreline

- Fill placement above and below MHW (dune and beach)
- Seven (7) low-profile king pile and panel groins along the County project shoreline
- Town of Palm Beach shoreline project life expectancy = 3-4 years
- County shoreline project life expectancy = 2-3 years
- The USACE is considering authorization under a 10-year permit to allow for initial project construction and maintenance for no more than three (3) renourishment events

Alternative 6 – The Town of Palm Beach Increased Sand Volume Project and County Increased Sand Volume Project without Shoreline Protection Structures

Alternative 6 includes a larger volume of sand along both project shorelines and does not include shoreline protection structures. The sand volume along the Town of Palm Beach shoreline would increase from 65,200 cy to 121,700 cy and the sand volume along the County shoreline would increase from 77,600 cy to 187,800 cy. This alternative is described in greater detail in Section 2.4.6. Alternative 6 was assumed to include the following components, at a minimum:

- Approximately 309,500 cy of sand
    - Approximately 121,700 cy of sand dredged from an offshore borrow area, staged in the uplands at the Phipps or Mid-Town project sites, and truck hauled to the Town of Palm Beach project shoreline
    - Approximately 187,800 cy of sand truck hauled from an upland sand source and placed along the County project shoreline
- Fill placement above and below MHW (dune and beach)
- Town of Palm Beach shoreline project life expectancy = 3-4 years
- County shoreline project life expectancy = 2-3 years
- The USACE is considering authorization under a 10-year permit to allow for initial project construction and maintenance for no more than three (3) renourishment events

Alternative 7b – The Town of Palm Beach Increased Sand Volume with Two Shoreline Protection Structures (The Coalition to Save Our Shoreline, Inc. (SOS) Alternative) and the County Preferred Project

Alternative 7b includes a larger volume of sand along the Town of Palm Beach's project shoreline with two T-head groins and the Preferred Alternative along the County shoreline. Alternative 7b would require 175,500 cy of sand along the Town of Palm Beach shoreline and 77,600 cy along the County shoreline. This alternative is described in greater detail in Section 2.4.7. Alternative 7b was assumed to include the following components, at a minimum:

- Approximately 253,100 cy of sand
    - Approximately 175,500 cy of sand dredged from an offshore borrow area, staged in the uplands at the Phipps or Mid-Town project sites, and truck hauled to the Town of Palm Beach project shoreline
    - Approximately 77,600 cy of sand truck hauled from an upland sand source and placed along the County project shoreline
- Fill placement above and below MHW (dune and beach)
- Seven (7) low-profile king pile and panel groins along the County project shoreline
- Two (2) T-head groins along the Town of Palm Beach project shoreline
- Town of Palm Beach shoreline project life expectancy = 3-4 years
- County shoreline project life expectancy = 2-3 years
- The USACE is considering authorization under a 10-year permit to allow for initial project construction and maintenance for no more than three (3) renourishment events

2.1. REGULATORY SETTING FOR ALTERNATIVES ANALYSIS

Both the Council of Environmental Quality's (CEQ) National Environmental Policy Act (NEPA) implementing regulations [40 Code of Federal Regulations (CFR) §1502.14] and the United States Army Corps of Engineers' (USACE) NEPA Implementation Procedures for the Regulatory Program (33 CFR Part 325, Appendix B) require consideration of a range of reasonable alternatives for a proposed action. Defining a range of reasonable alternatives is a key element for subsequent analyses in an Environmental Impact Statement (EIS). The CEQ (1981) describes the alternatives as being the “heart of the environmental impact statement (40 CFR 1502.14)” and alternatives that are considered *reasonable* under NEPA include those alternatives “that are practical or feasible from a technical and economic standpoint and using common sense (46 FR 18206 – CEQ, Forty Most Asked Questions Concerning CEQ’s NEPA Regulations).” The USACE’s NEPA Implementation Procedures define reasonable alternatives as “those that are feasible, and such feasibility must focus on the accomplishment of the underlying purpose and need (of the applicant or the public) that would be satisfied by the proposed Federal action (permit issuance).” The USACE‘s regulations further provide that only reasonable alternatives need to be considered in detail and that the reason for eliminating alternatives from detailed study should briefly be discussed in the EIS [33 CFR Part 325, Appendix B, sec. 9.a. (5) (a)]. NEPA regulations require that agencies consider a range of reasonable alternatives to the proposed action, including consideration of a “No Action” alternative; the regulations do not, however, require consideration of every conceivable variation of an alternative (40 CFR §1502.14). In addition, these regulations provide that, while the USACE shall not prepare a cost benefit analysis of the alternatives, the EIS should indicate any cost considerations that are likely to be relevant to a decision [33 CFR Part 325, Appendix B, sec. 9.a.(5)(d)].

The substantive criteria used by the USACE to evaluate a permit are the Section 404(b)(1) Guidelines (40 CFR Part 230) promulgated by the United States Environmental Protection Agency (USEPA). The guidelines require the evaluation of “practicable alternatives,” and are used to identify the Least Environmentally Damaging Practicable Alternative (LEDPA) to ensure that “no discharge of dredged or fill material shall be permitted if there is a practicable alternative to the proposed discharge which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences.” The guidelines define an alternative as practicable “if it is available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes” (40 CFR §230.10

[a][2]). The Section 404(b)(1) Guidelines indicate that the analysis of alternatives for NEPA environmental documents will in most cases provide the information required to evaluate the alternatives under the guidelines (40 CFR §230.10 [a][4]).

The USACE evaluated and screened the alternatives mindful of both the NEPA requirements and the 404(b)(1) Guideline requirements. As a result, the alternatives analysis in this EIS satisfies the requirements under both NEPA and the Section 404(b)(1) Guidelines. As described below, the USACE examined the full scope of possible alternatives and components and systematically arrived at the range of reasonable and practicable alternatives. Through this process, the USACE believes that it has captured all of the alternatives and components necessary to determine whether the Applicants' proposed Project is the LEDPA. This chapter describes the USACE's process of identifying and evaluating alternatives for meeting the established overall project purpose for the proposed Project, which, as discussed in Chapter 1, is to achieve shoreline stabilization that prevents damage to upland property during a 15-year storm event in areas with seawalls or in areas where seawalls can be state qualified and damage to habitable buildings currently without seawalls in areas where seawalls cannot be state qualified during a 25-year storm event within the southern portion of Reach 8, all of Reach 9, and the northern portion of Reach 10, in Palm Beach County, Florida.

2.2. PRELIMINARY SCREENING OF ALTERNATIVES

The USACE implemented a structured process to develop and screen alternatives for the shoreline protection project, with a goal to consider the broadest range of possible alternatives and identify the range of reasonable and practicable alternatives that would advance for comparative analysis. The intent of an iterative process is to eliminate impracticable and unreasonable alternatives as early in the process as practical to allow the USACE to focus detailed evaluation on practicable and reasonable alternatives. For some proposals there may exist a very large or even an infinite number of alternatives as a result of incremental changes to another alternative (e.g., various sand volumes). Nevertheless, only a range of reasonable and practicable alternatives need be considered.

The initial step in the process was identification of possible alternative concepts for achieving the purpose and need of the Project. Two alternatives that are always examined in an EIS are the No Action Alternative and the applicant's Preferred Alternative. The CEQ regulations direct Federal agencies which have made a decision to prepare an EIS to engage in a public scoping process to ensure that issues of concern are identified early and are subsequently properly studied. The 45-day public scoping and commenting period for the Southern Palm Beach Island Comprehensive Shoreline Stabilization Project began on July 3, 2013 when the Notice of Intent (NOI) to prepare the EIS was published in the Federal Register, and the scoping period was extended to close on September 3, 2013. Pursuant to NEPA requirements, a public scoping meeting was held on August 12, 2013. The scoping comments which were received are documented in Appendix A. At the conclusion of the scoping period, the USACE considered the purpose and need of the proposed Project in determining reasonable and practicable alternatives that would meet the goals of the Project.

2.3. RESULTS OF PRELIMINARY SCREENING OF ALTERNATIVES

Based on a consideration of the overall project purpose of the Project and the practicability of each alternative, the USACE determined that the seven project alternatives identified in Section 2.0 will be evaluated in detail in Section 2.4. In addition to these seven alternatives, the following alternatives were reviewed to determine if they would meet the overall Project purpose and were practicable:

- Rezoning of Beach and Dune Complex
- Construction Moratorium or No-Growth Program
- Evacuation Planning
- Condemnation of Land Structures
- Relocate or Retrofit Structures
- Modification of Building Codes
- Construction Setback Line
- Seawalls and Revetments
- Nearshore Berm

- Breakwaters
- Breakwater with Dune and Beach Nourishment
- Groin Field without Beach Nourishment
- Transport of Offshore Borrow Area Sand via Onshore Pipeline

2.3.1. REZONING OF BEACH AND DUNE COMPLEX

This alternative would include rezoning the beach and dune complex to restrict development. The entire shoreline within the Project Area is already extensively developed and is mostly in private ownership. Rezoning the beach area to restrict or limit future upland construction would not result in any substantial reduction in potential risks to upland property. No fill would be placed within waters, and no impacts would result from any construction related activity; however, the natural coastal systems of the area would continue eroding the shoreline until there is a natural equilibration. Logistically, re-zoning the beach would not minimize future storm effects. This alternative does not achieve the overall project purpose, and does not warrant detailed evaluation.

2.3.2. CONSTRUCTION MORATORIUM OR NO-GROWTH PROGRAM

This alternative would implement a construction moratorium in order to halt future development. There is currently extensive development along the Project Area shoreline and only one remaining undeveloped parcel at 100 N Ocean Blvd in Lantana, which is currently a public park. Therefore, a construction moratorium or no-growth program in the Project Area would have little to no impact on the goal of protecting upland infrastructure. This alternative would also not stabilize the shoreline or protect against the risk of adverse impacts from storms and erosion. This alternative does not achieve the overall project purpose and does not warrant further detailed evaluation.

2.3.3. EVACUATION PLANNING

This alternative would enhance evacuation planning due to a severe storm. Improved evacuation could potentially reduce the loss of life during severe storms. Appropriate state and local emergency management officials may pursue such planning. This alternative would provide assurances there would be fewer risks to human life. However, this alternative would not reduce the potential effects of storms on the existing beach and adjoining infrastructure, lower the erosion rate, and would not help in achieving a consistently stable shoreline. This alternative would not achieve the overall project purpose and will not receive detailed evaluation.

2.3.4. CONDEMNATION OF LAND STRUCTURES

This alternative would condemn buildings along the Project Area. No direct impacts to aquatic resources would occur from this alternative, but the indirect effects of persistent natural erosion may cause downdrift/updrift changes to nearshore hardbottom resources. This alternative is not practicable since it would displace residents and would still not reduce the potential effects of storms on the existing beach, lower the erosion rate, or provide storm protection to upland infrastructure. The alternative does not meet the overall project purpose and did not receive detailed evaluation.

2.3.5. RELOCATE OR RETROFIT STRUCTURES

This alternative would relocate or retrofit buildings to minimize or eliminate potential danger and damage from a severe storm. Relocation and retrofitting structures to provide flood-proofing would first require condemnation of the structures and necessitate complete cooperation from the residents who live in these structures. This alternative, similar to condemnation of land structures, is not practicable since it would displace residents and would still not reduce the potential effects of storms on the existing beach, lower the erosion rate, or storm protection to upland infrastructure. Implementation of this alternative is not practicable and did not receive detailed evaluation.

2.3.6. MODIFICATION OF BUILDING CODES

This alternative would require the modification of building codes. The existing Florida Building Code includes structural requirements intended to minimize potential impacts to the beach-dune system and reduce building damage in severe storms. In the extensively developed Project Area, most of the structures were constructed prior to the adoption of the Florida Building Code, and were landward of the coastal construction control line (CCCL) (Section 62B-33, Florida Administrative Code (F.A.C.)) at the time of their construction and may not conform to all of the current building standards. Modification of the building code is not practicable since it would not reduce the potential effects of storms on the existing beach and upland infrastructure. Therefore, this alternative did not receive detailed evaluation.

2.3.7. CONSTRUCTION SETBACK LINE

This alternative would revise the construction setback line. A more restrictive construction setback line would not affect existing development but may affect any new construction that replaces structures that are razed or destroyed by storms. Florida has established coastal construction control lines (CCCL) along the shores of coastal counties, which is the basis for regulation of coastal development along Florida's coastline. This alternative would not reduce the potential effects of storms on the existing beach and upland infrastructure or lower erosion rates. Thus, this alternative did not warrant detailed evaluation.

2.3.8. SEAWALLS AND REVETMENTS

This alternative would implement seawall construction along the entire length of the Project Area. Seawalls and revetments already make up 86% (2,865 m [9,400 ft]) of the Project Area shoreline (3,332 m [10,930 ft]). Although they do provide storm damage protection to upland property, any wave energy reflecting off seawalls and revetments may result in steepening of the beach profile and loss of beach width. This can then result in loss of recreational beach and wildlife habitat, including sea turtle nesting, and shorebird nesting and foraging habitat, and may create hazardous conditions such as increased undertow currents and run outs. The effects of additional seawall and revetment construction without beach nourishment could result in substantial environmental impact and economic loss to the area by exacerbating the effects of a steep beach profile and decreased beach width. This alternative may protect upland infrastructure from storms but does not align with the Town of Palm Beach or the County’s coastal programs. Consequently, this alternative did not receive detailed evaluation.

2.3.9. NEARSHORE BERM

A nearshore berm alternative entails placing sand into the nearshore zone adjacent to the beach, typically in less than 9 m (30 ft) of water. Construction of a nearshore berm may reduce beach erosion and provide a measure of storm protection to upland property, but it does not necessarily result in a widened beach (the primary storm protection aspect of the beach). Therefore, this alternative did not receive detailed evaluation.

2.3.10. BREAKWATERS

This alternative would include construction of breakwaters in the nearshore marine habitat of the Project Area. The County pursued a permit to construct breakwaters off of Singer Island, located north of Palm Beach Inlet, in 2008. After extensive coordination with state and federal agencies, the permit was withdrawn due to concerns regarding the potential for significant impacts to nesting and hatchling sea turtles. Additionally, a feasibility study was conducted regarding construction of breakwaters within the southern portion of the proposed Project Area, adjacent to the South Palm Beach, Lantana and Manalapan shorelines (CPE, 2010). The County elected not to pursue this project once the Singer Island breakwater project was not permitted. This alternative would not achieve the overall project purpose and was eliminated from further consideration.

2.3.11. BREAKWATERS WITH DUNE AND BEACH NOURISHMENT

This alternative would include construction of breakwaters in the nearshore marine habitat of the Project Area with dune and beach nourishment. This alternative could provide benefits to the shoreline by reducing the effects of storm surge and waves, but the uncertainty and potential effects to downdrift beaches, sea turtle hatchlings, surfing areas, and nearshore hardbottom prevent this alternative from achieving the overall project purpose (see Section 2.3.10.). Therefore, this alternative was not evaluated further.

2.3.12. GROIN FIELD WITHOUT BEACH NOURISHMENT

This alternative would include construction of a groin field along the Project Area without supplemental A groin field (i.e., a series of groins along a stretch of coastline) without beach nourishment would not meet the project purpose and need. The need for the project results from a limited sand supply in the area. Without an adequate sand supply, the groins cannot function as intended nor could they stabilize a wider more protective beach. Downdrift impacts would be expected as the groins interrupted the littoral transport of limited quantity of sand. This alternative would not provide any sand to the sand budget and would not reduce the potential effects of storms on the existing beach and upland infrastructure. Therefore, this alternative was not evaluated further.

2.3.13. TRANSPORT OF OFFSHORE BORROW AREA SAND VIA ONSHORE PIPELINE

The Town of Palm Beach has proposed to utilize sand originating from offshore borrow areas which would be transported to the beach via pipelines at the Phipps and/or Mid-Town project sites. The sand would then be stockpiled and transported to the Project Area by truck. Sand for the Project Area would be dredged under authorization for the Phipps or Mid-Town projects. The proposed volume of sand for placement in the Project Area is relatively small compared to larger dredge and fill projects such as Phipps or Mid-Town. Dredging the proposed volume for the Town of Palm Beach portion of the proposed project is not practicable in terms of cost.

2.4. ALTERNATIVES EVALUATED IN DETAIL

Based on a consideration of the goals of the Project and the practicability of each alternative, the USACE determined that the following seven project alternatives will be evaluated in detail:

1. No Action Alternative (Status Quo)
2. The Applicants' Preferred Alternative (Proposed Action): Beach and Dune Fill with Shoreline Protection Structures Project
3. The Applicants' Preferred Project without Shoreline Protection Structures
4. The Town of Palm Beach Preferred Project and County Increased Sand Volume Project without Shoreline Protection Structures

5. The Town of Palm Beach Increased Sand Volume Project and County Preferred Project
6. The Town of Palm Beach Increased Sand Volume Project and County Increased Sand Volume without Shoreline Protection Structures Project

7b. The Town of Palm Beach Increased Sand Volume with Two Shoreline Protection Structures (The Coalition to Save Our Shoreline, Inc. (SOS) Alternative) and the County Preferred Project

This EIS is intended to evaluate the impacts of the two similar actions; therefore, the alternatives evaluated consist of various combinations of three potential Town of Palm Beach (T) projects and three potential County (C) projects.

The Town of Palm Beach separated alternatives include:

1. Alternative 2T - fill placed on beach and dune
2. Alternative 6T - an increased volume of fill placed on the beach and dune
3. Alternative 7bT - an increased volume of fill placed on beach with two T-head groins

The County separated alternatives include:

1. Alternative 2C - fill placed on beach with king pile and panel groins
2. Alternative 3C - fill only placed on beach (same fill volume without groins)
3. Alternative 4C - an increased volume of fill placed on the beach without groins

The various combinations of these projects make up the seven alternatives evaluated as follows:

- Alternative 1 = No Action (status quo)
- Alternative 2 = 2T + 2C
- Alternative 3 = 2T + 3C
- Alternative 4 = 2T + 4C
- Alternative 5 = 6T + 2C
- Alternative 6 = 6T + 4C

- Alternative 7b = 7bT + 2C

Since the Applicants must obtain separate permits, the Town of Palm Beach and County projects were also modeled as standalone projects. “Separated” alternatives were not modeled for every combined alternative because the separated fill templates were captured within other model runs. For example, the combined project for Alternative 2 includes the Town (T) and the County’s (C) preferred projects (Alt 2 = 2T + 2C), whereas Alternatives 3 and 4 also include the Town’s preferred project but the County’s project has been varied (Alt 3 = 2T + 3C and Alt 4 = 2T + 4C). Therefore, during the impact analysis, the model run of Alternative 2 for the Town of Palm Beach (2T) provides the same results as Alternatives 3 and 4, which also include 2T.

The total volume of sand needed to construct each alternative will be dependent on the results from beach surveys conducted immediately prior to construction. Table 2-1 presents the volumes required to implement each alternative based on physical surveys conducted in 2008/2009, 2011/2012 and 2014. During evaluation of each build alternative, a numerical modeling study was conducted to assess potential impacts to the nearshore hardbottom. In the Town of Palm Beach, a range of grain sizes (0.25 mm, 0.36 mm and 0.60 mm) were modeled to bracket the impacts and provide flexibility in the selection of the sand source. Sand will be selected so that it meets FDEP requirements for beach sand compatibility in accordance with Section 62B-41.007(2)(j), F.A.C. The sand source selected for the Town of Palm Beach must also be consistent with FDEP’s sand quality compliance specifications as per the Beach Management Agreement (FDEP, 2013). The County plans to utilize upland sand and only a grain size of 0.36 mm was modeled for their portion of the Project Area. The sand source for the County must also meet the County's technical sand specifications outlined in Section 2.1.1 of the County’s Annual Dune and Wetlands Restoration contract, which is provided as Appendix B. Details on how the different impact types were developed can be found in the UMAM Analysis (Appendix H). Plan view drawings were developed for each alternative and are presented in the following sections. Cross-section plots were also developed for each alternative but are presented in Sub-Appendix G-5 due to the number of drawings.

2.4.1. ALTERNATIVE 1 - NO ACTION ALTERNATIVE

NEPA regulations require consideration of the No Action Alternative, which can be used as a benchmark for comparison of the environmental effects of the various alternatives analyzed. Under the No Action Alternative, the applicants could proceed with a project that does not include activities that require a permit or authorization from the USACE. Without a DA permit, fill could not be discharged within Waters of the U.S. and no work could be done in navigable Waters of the U.S. Under the No Action Alternative, the applicants could continue dune maintenance in the Project Area, where sand is only placed on the dry beach.

Previous dune projects by the Town of Palm Beach and the County have placed at least 93,000 cy of sand within the Project Area (see Table 1-1). Under the No Action alternative, the Applicants could continue to maintain the dunes with placement of sand outside of USACE jurisdiction and contained wholly in uplands. The sand source for continued dune maintenance may include upland sand as well as stockpiled dredged sand from other local beach nourishment projects authorized under separate state and federal permits. In addition to dune restoration, shoreline stabilization efforts could also include construction of upland retaining or seawalls or other types of shoreline armoring. The No Action alternative may include activities that temporarily stabilize the dune area and provide limited storm protection to upland infrastructure. The No Action alternative was modeled for storm protection based on the 2012 conditions. This survey was conducted following dune restoration in the Town of Palm Beach and represents the best-case scenario for storm protection without the use of beach nourishment. At the time of the 2012 survey, the No Action alternative did provide the desired level of storm protection in the Town of Palm Beach but it is apparent that frequent maintenance would be required to sustain it. As a result, the practice of frequent dune maintenance combined with the current and historical conditions, the No Action alternative would not fulfill the overall project purpose in providing the desired level of storm protection for the entire shoreline encompassing the Town of Palm Beach and the County's projects.

2.4.2. ALTERNATIVE 2 – THE APPLICANTS' PREFERRED ALTERNATIVE: BEACH AND DUNE FILL WITH SHORELINE PROTECTION STRUCTURES

The Applicants' Preferred Project Alternative (Proposed Action) is the combination of the preferred project submitted by the Town of Palm Beach and the preferred project submitted by the County. This alternative proposes to use beach sand placement and coastal protection structures (groins, Figure 2-1) to stabilize the shoreline in order to prevent damage to upland property and habitable buildings. The projects would provide more sand to the littoral system, create a stable beach and dune profile to buffer the effects of storm surge and wave action, provide wildlife habitat, allow for recreational use, and protect upland infrastructure. This alternative would also provide the desired nourishment interval of up to 3 to 4 years. The Preferred Project Alternative includes placement of approximately 142,800 cy of sand along the shorelines of the Towns of Palm Beach, South Palm Beach, Lantana and Manalapan from R-129-210 to R-138+551. From north to south, the Project would include placing sand to enhance the dune from R-129-210 to R-129+150, dune and beach berm from R-129+150 to T-131, dune from T-131 to R-134+135 (Town of Palm Beach southern limit), and beach berm from R-134+135 to R-138+551. Seven (7) low-profile groins would be placed within the County portion of the Project Area from R-134+135 to R-138+551 (Figure 2-2). The groins are designed to slow the transport of sand alongshore and extend the nourishment interval between projects.

Figure 2-1. Shoreward view of a concrete king pile and panel groin.

The total volume of sand needed to construct this alternative will be dependent on the results from surveys conducted immediately prior to construction. The total volume of 142,800 cy would be distributed between the two Applicants with 65,200 cy of sand placed in the Town of Palm Beach and 77,600 cy placed in the County portion of the Project Area. Of these totals for each project area, sand placement below MHW includes approximately 3,400 cy within the Town of Palm Beach and approximately 26,600 cy within the County shoreline.

The construction of seven (7) low-profile groins would be placed perpendicular to the shoreline extending from the existing seawalls to the post-construction (beach nourishment) waterline in the County project area (R-134+135 to R-138+551). Construction of these structures will help stabilize the shoreline by disrupting a portion of the sand flowing south along the beach and encouraging sediment deposition on the updrift side of the structure. The groins are designed to be level with the berm and are intended to blend in with the beach. They will be concrete king pile and panel groins with 46 cm (18 in) (+/-) wide H-piles spaced every 2.4-3.0 m (8-10 ft). Exact location and length of the groins will depend on the presence of nearshore hardbottom resources at the time of construction, but it is currently estimated that they will be approximately 27 m (90 ft) long and spaced approximately 91 m (300 ft) apart. As the sand naturally erodes from the beach, the groins would gradually become partially exposed until the next nourishment. The groin will disrupt the natural shoreline erosion by confining and holding the sand between the adjacent groins and the natural erosional forces will be disrupted by the concrete wall. The result will be a disruption of the natural littoral sand transport system along the beach in this area with sand accretion/sediment deposition occurring on the updrift side and erosion on the downdrift side of the groin field. The construction of the groins may occur from either land-based operations or using in-water construction, or a combination of the two methods.

The Project constructed with sand placement and structures would provide sand to the system, reduce the potential effects of storms on the existing beach and adjoining infrastructure, enhance/create sea turtle nesting habitat, impact nearshore hardbottom resources, and ideally achieve a 3-year nourishment interval. Once the groins are exposed, their stabilizing effect would result in a lower erosion rate within the Project Area when compared to a sand-only project. The structures, however, may have adverse effects on updrift/downdrift beaches once exposed since they would interrupt the natural littoral sand transport system.

The County proposes to use sand transported via truck haul from an upland sand mine for their portion of the Project. The County has proposed to utilize sand from E.R. Jahna Industries, Inc. Ortona and/or Stewart Mining Industries in Ft. Pierce. In order to minimize environmental impacts and maximize efficiency, the Town of Palm Beach proposes to dredge sand from a borrow area for the Project at the same time as future planned beach renourishment projects for Phipps and Mid-Town. Although these two projects were recently completed in winter 2015 and 2016, the Town of Palm Beach does plan to continue to renourish the Phipps and Mid-Town project areas in the future. The dredged sand would be temporarily staged in the uplands at Phipps and Mid-Town, mechanically loaded on trucks, and hauled to the Project Area for placement and grading on the Town of Palm Beach's portion of the Project Area.

It is estimated that the life expectancy of the Town of Palm Beach's proposed project will be between 2 and 4 years based on baseline conditions, the proposed quantity of fill, and the current rate of erosion within the littoral cell. The estimated life expectancy of the County portion of the Project is between 2 and 3 years based on baseline conditions, the proposed quantity of fill/construction of groins, and the current rate of erosion within the littoral cell. It is anticipated that implementation of Alternative 2 may result in permanent and temporary impacts to the nearshore hardbottom as presented in Table 2-2.

Table 2-2. Acreages of hardbottom impacts due to implementation of Alternative 2 using a range of grain sizes in the Town of Palm Beach and 0.36 mm grain size only in the County.

Impact Type	0.25 mm Town 0.36 mm County	0.36 mm Town 0.36 mm County	0.60 mm Town 0.36 mm County
Permanent	3.86 ac	3.97 ac	3.99 ac
Temporary	9.93 ac	9.68 ac	9.53 ac

Overall, this alternative will stabilize the shoreline and meets the overall project purpose by protecting upland property during a 15-year storm event in areas with seawalls and by protecting habitable buildings currently without seawalls during a 25-year storm event. It will also provide more sand to the littoral system, create a stable beach and dune profile, provide wildlife habitat, allow for recreational use and achieve the desired nourishment interval of up to 3 to 4 years.

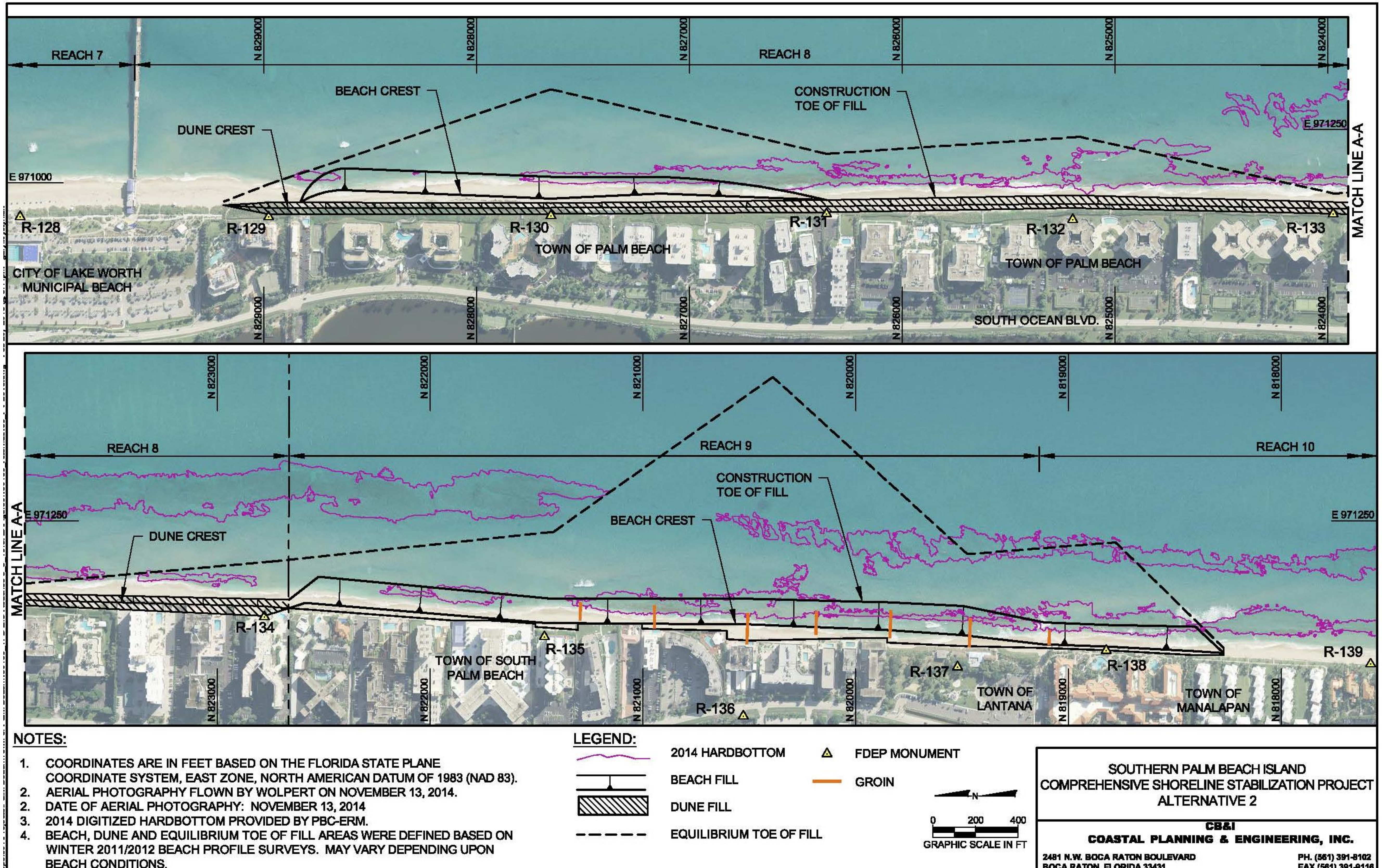


Figure 2-2. Southern Palm Beach Island Comprehensive Shoreline Stabilization Project Preferred Project Design.

2.4.3. ALTERNATIVE 3 – THE APPLICANTS' PREFERRED PROJECT WITHOUT SHORELINE PROTECTION STRUCTURES

This alternative provides the same project as Alternative 2, but would not include construction of the seven low-profile groins between R-134+135 and R-138+551. All sand sources, volumes, and template configurations would remain the same. The beach profile would continue to adjust and retreat until more sand is placed. It is estimated that the life expectancy of this project will be between 2 and 4 years within the Town of Palm Beach. Without the low profile groins, the County portion of the Project Area will be subject to natural alongshore erosion rates and shoreline retreat. This will reduce the life expectancy of the Project within the County to approximately 1 year as compared to 2 to 3 years with the groins in place. It is anticipated that implementation of Alternative 3 may result in permanent and temporary impacts to the nearshore hardbottom as presented in Table 2-3.

Table 2-3. Acreages of hardbottom impacts due to implementation of Alternative 3 using a range of grain sizes in the Town of Palm Beach and 0.36 mm grain size only in the County.

Impact Type	0.25 mm Town 0.36 mm County	0.36 mm Town 0.36 mm County	0.60 mm Town 0.36 mm County
Permanent	2.70 ac	2.87 ac	2.87 ac
Temporary	12.19 ac	12.13 ac	12.41 ac

The predicted permanent impacts are lower for Alternative 3 than Alternative 2 due to the natural alongshore erosion rates that will continue to influence sand movement along the nearshore hardbottom without the groins in place. Essentially, the sand will not stay on the beach as long as it would with the groins in place; thus, the impacts to hardbottom are more temporary as the sand erodes compared to Alternative 2.

Overall, this alternative will stabilize the shoreline and meets the overall project purpose by protecting upland property during a 15-year storm event in areas with seawalls and by protecting habitable buildings currently without seawalls during a 25-year storm event. It will provide more sand to the littoral system, create a stable beach and dune profile, provide wildlife habitat, allow for recreational use and protect upland infrastructure;

however, it does not meet the desired nourishment interval in the County portion of the Project Area.

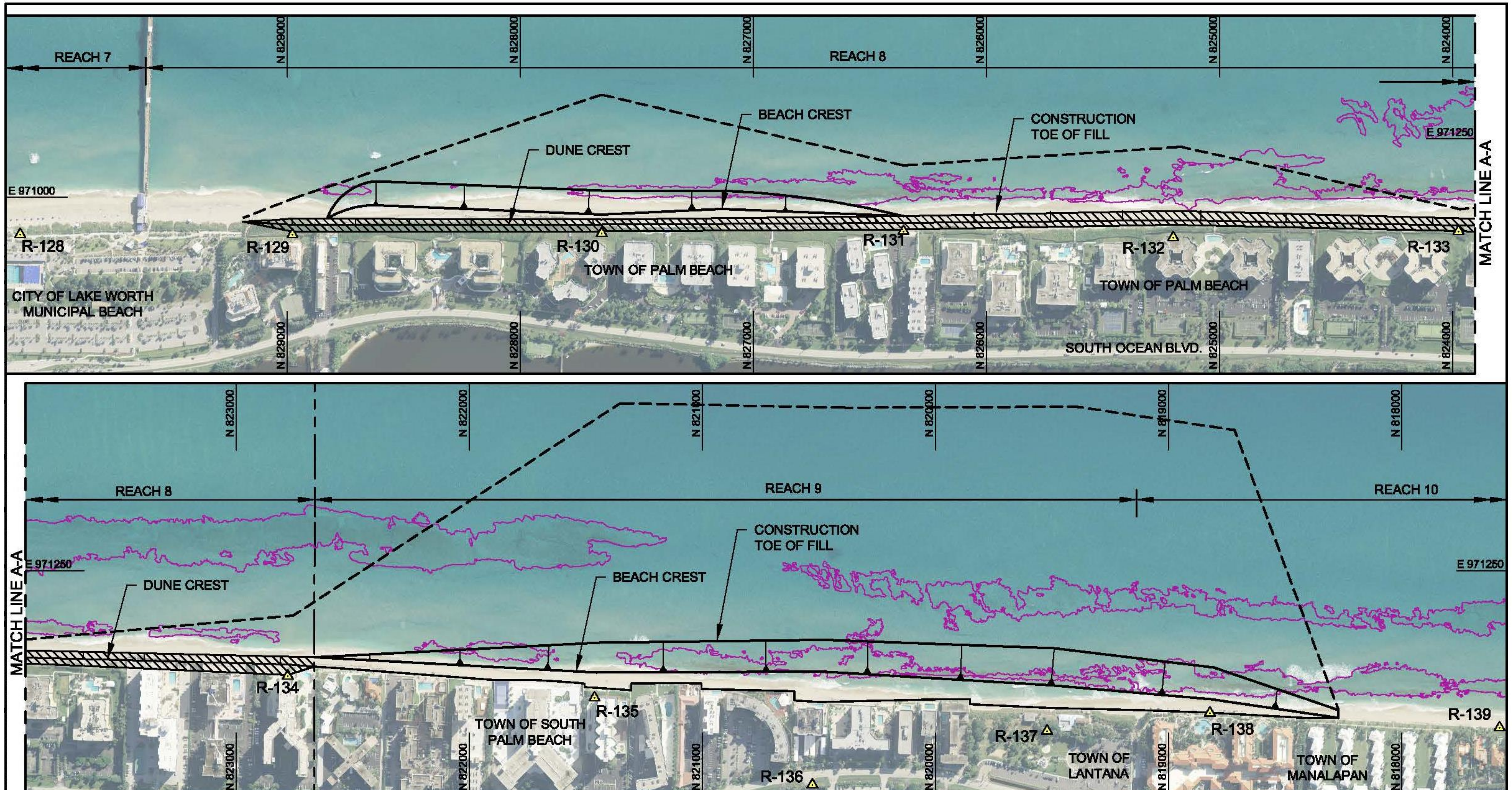
2.4.4. ALTERNATIVE 4 – THE TOWN OF PALM BEACH PREFERRED PROJECT AND COUNTY INCREASED SAND VOLUME PROJECT WITHOUT SHORELINE PROTECTION STRUCTURES

This alternative includes the Town of Palm Beach's Preferred Alternative and a larger volume of sand without shoreline protection structures along the County shoreline (Figure 2-3). The sand source and volume along the Town of Palm Beach would remain the same with 65,200 cy, whereas the sand volume along the County shoreline would increase from 77,600 cy to 187,800 cy and advance the beach berm on average 15 m (50 ft) seaward. Of these totals for each project area, sand placement below MHW includes approximately 3,400 cy within the Town of Palm Beach and approximately 71,800 cy within the County shoreline. Placing a larger sand volume for the County section of the Project would extend the time between renourishment events. Without the low profile groins, the Project Area and adjacent areas will be subject to natural alongshore erosion rates and shoreline retreat. The life expectancy of the sand placed within the Town of Palm Beach shoreline would be between 2 and 4 years. Within the County, the life expectancy would be between 2 to 3 years. It is anticipated that implementation of Alternative 4 may result in permanent and temporary impacts to the nearshore hardbottom as presented in Table 2-4.

Table 2-4. Acreages of hardbottom impacts due to implementation of Alternative 4 using a range of grain sizes in the Town of Palm Beach and 0.36 mm grain size only in the County.

Impact Type	0.25 mm Town 0.36 mm County	0.36 mm Town 0.36 mm County	0.60 mm Town 0.36 mm County
Permanent	6.51 ac	6.71 ac	6.63 ac
Temporary	13.17 ac	13.21 ac	13.57 ac

Overall, this alternative will stabilize the shoreline and meets the overall project purpose by protecting upland property during a 15-year storm event in areas with seawalls and by protecting habitable buildings currently without seawalls during a 25-year storm event. It will provide more sand to the littoral system, create a stable beach and dune profile, provide wildlife habitat, allow for recreational use and achieve the desired nourishment interval of up to 3 to 4 years. However, the impacts to hardbottom from placement of a larger volume of sand in the County are much greater compared to Alternative 2.



NOTES:

1. COORDINATES ARE IN FEET BASED ON THE FLORIDA STATE PLANE COORDINATE SYSTEM, EAST ZONE, NORTH AMERICAN DATUM OF 1983 (NAD 83).
2. AERIAL PHOTOGRAPHY FLOWN BY WOLPERT ON NOVEMBER 13, 2014.
2. DATE OF AERIAL PHOTOGRAPHY: NOVEMBER 13, 2014
3. 2014 DIGITIZED HARDBOTTOM PROVIDED BY PBC-ERM.
4. BEACH, DUNE AND EQUILIBRIUM TOE OF FILL AREAS WERE DEFINED BASED ON WINTER 2011/2012 BEACH PROFILE SURVEYS. MAY VARY DEPENDING UPON BEACH CONDITIONS.

LEGEND:

2014 HARDBOTTOM
BEACH FILL
DUNE FILL
EQUILIBRIUM TOE OF FILL
FDEP MONUMENT

N
0 200 400
GRAPHIC SCALE IN FT

SOUTHERN PALM BEACH ISLAND
COMPREHENSIVE SHORELINE STABILIZATION PROJECT
ALTERNATIVE 4

CB&I
COASTAL PLANNING & ENGINEERING, INC.
2481 N.W. BOCA RATON BOULEVARD
BOCA RATON, FLORIDA 33431
PH. (561) 391-8102
FAX (561) 391-9116

Figure 2-3. Southern Palm Beach Island Comprehensive Shoreline Stabilization Project - Alternative 4 Design.

2.4.5. ALTERNATIVE 5 – THE TOWN OF PALM BEACH INCREASED SAND VOLUME PROJECT AND COUNTY PREFERRED PROJECT

This alternative includes placement of a larger volume of sand along the Town of Palm Beach shoreline and the County's Preferred project (Figure 2-4). The sand volume along the Town of Palm Beach would increase from 65,200 cy to 121,700 cy as compared to the Preferred Project Alternative design. Of these totals for each project area, sand placement below MHW includes approximately 7,700 cy within the Town of Palm Beach and approximately 26,600 cy within the County shoreline. The volume was increased by advancing the dune and beach berm on average 3 m (10 ft) seaward from R-129-210 to T-131 and the dune on average 15 m (50 ft) seaward from T-131 to R-134+135 (Town of Palm Beach southern limit). This would also result in additional needs to dredge, stage, and transport a greater volume of sand by truck haul. The fill configuration was based on a comment received from the SOS during the scoping period, which included a plan for a larger fill project and increased storm protection (see public scoping comments in Appendix A). Placing a larger sand volume within the Town of Palm Beach lengthens the life expectancy in this portion of the Project Area to 3 to 4 years compared to the Preferred Alternative (2 to 4 years). The life expectancy of the County project would remain between 2 and 3 years. It is anticipated that implementation of Alternative 5 may result in permanent and temporary impacts to the nearshore hardbottom as presented in Table 2-5.

Table 2-5. Acreages of hardbottom impacts due to implementation of Alternative 5 using a range of grain sizes in the Town of Palm Beach and 0.36 mm grain size only in the County.

Impact Type	0.25 mm Town 0.36 mm County	0.36 mm Town 0.36 mm County	0.60 mm Town 0.36 mm County
Permanent	3.45 ac	3.97 ac	4.23 ac
Temporary	15.60 ac	14.97 ac	14.34 ac

Overall, this alternative will stabilize the shoreline and meets the overall project purpose by protecting upland property during a 15-year storm event in areas with seawalls and by protecting habitable buildings currently without seawalls during a 25-year storm event. It will also provide more sand to the littoral system, create a stable beach and dune profile, provide wildlife habitat, allow for recreational use and achieve the desired nourishment interval of up to 3 to 4 years. The impacts to hardbottom from placement of a larger volume of sand in the Town of Palm Beach are increased compared to Alternative 2.

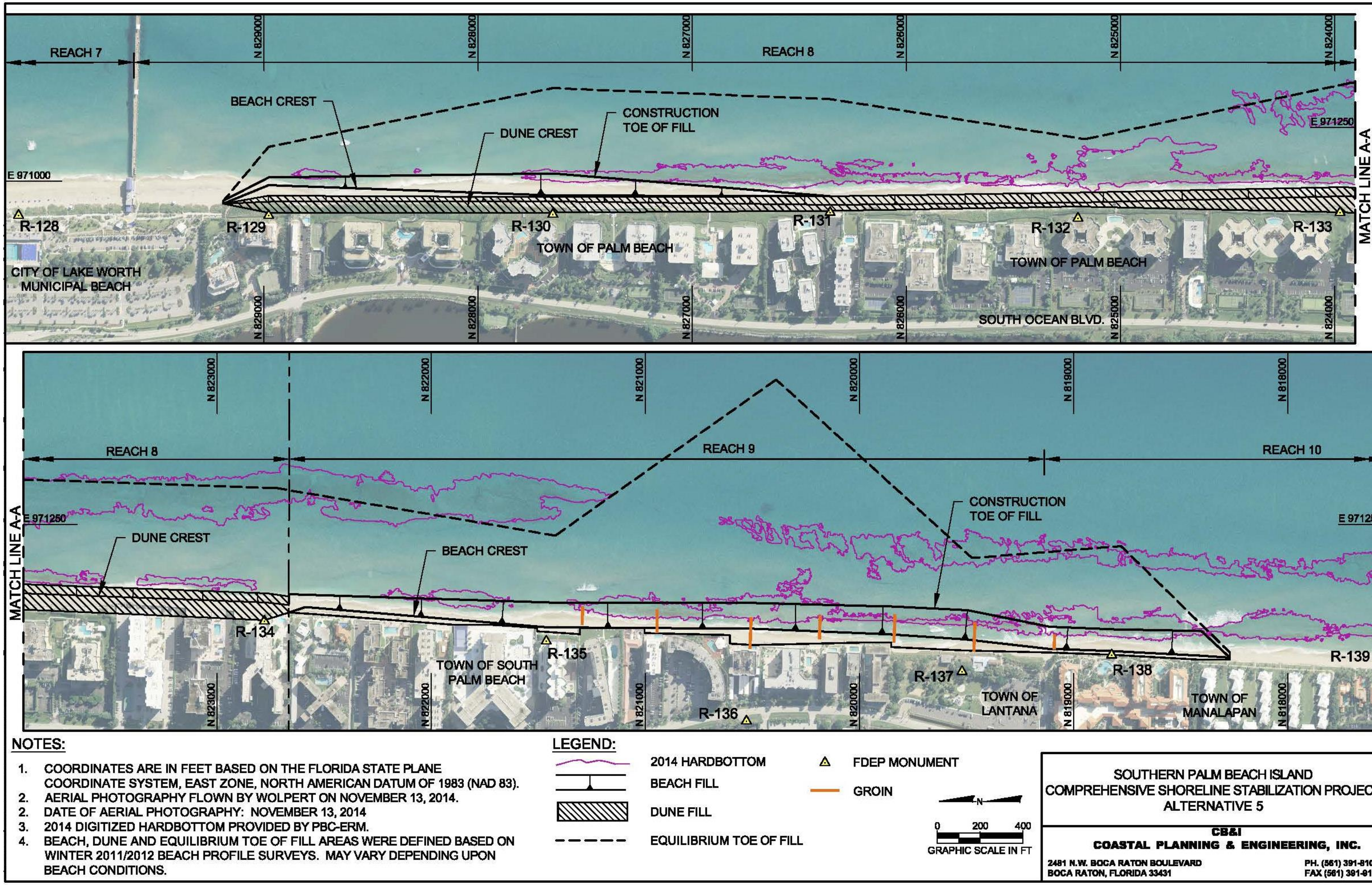


Figure 2-4. Southern Palm Beach Island Comprehensive Shoreline Stabilization Project - Alternative 5 Design.

2.4.6. ALTERNATIVE 6 – THE TOWN OF PALM BEACH INCREASED SAND VOLUME PROJECT AND COUNTY INCREASED SAND VOLUME PROJECT WITHOUT SHORELINE PROTECTION STRUCTURES

This alternative includes placement of a larger volume of sand along both Town of Palm Beach and the County project shorelines as compared to the Applicants' Preferred Project Alternative (Figure 2-5). The sand volume would increase from 65,200 cy to 121,700 cy in the Town of Palm Beach and from 77,600 cy to 187,800 cy along the County shoreline. Of these totals for each project area, sand placement below MHW includes approximately 7,700 cy within the Town of Palm Beach and approximately 71,800 cy within the County shoreline. The Town of Palm Beach would likely increase the volume of sand that would be dredged from offshore borrow areas and the County would propose to utilize additional sand from upland mines. The volume for Alternative 6 was increased by advancing the dune and beach berm on average 3 m (10 ft) seaward from R-129-210 to T-131, the dune on average 15 m (50 ft) seaward from T-131 to R-134+135 (Town of Palm Beach southern limit), and the beach berm on average 15 m (50 ft) seaward from R-134+135 to R-138+551. Similar to Alternative 5, the fill configuration was based on a scoping comment received from SOS during the scoping period, which included a plan for a larger fill project and increased storm protection. Placing a larger volume of sand within both project areas would result in a life expectancy of 3 to 4 years in the Town of Palm Beach and 2 to 3 years along the County shoreline. It is anticipated that implementation of Alternative 6 may result in permanent and temporary impacts to the nearshore hardbottom as presented in Table 2-6.

Table 2-6. Acreages of hardbottom impacts due to implementation of Alternative 6 using a range of grain sizes in the Town of Palm Beach and 0.36 mm grain size only in the County.

Impact Type	0.25 mm Town 0.36 mm County	0.36 mm Town 0.36 mm County	0.60 mm Town 0.36 mm County
Permanent	6.07 ac	6.81 ac	6.92 ac
Temporary	18.34 ac	17.56 ac	17.42 ac

Overall, this alternative will stabilize the shoreline and meets the overall project purpose by protecting upland property during a 15-year storm event in areas with seawalls and by protecting habitable buildings currently without seawalls during a 25-year storm event. It will also provide more sand to the littoral system, create a stable beach and dune profile, provide wildlife habitat, allow for recreational use and achieve the desired nourishment interval of up to 3 to 4 years. However, the impacts to hardbottom from placement of a larger volume of sand throughout the Project Area are much greater compared to Alternative 2.

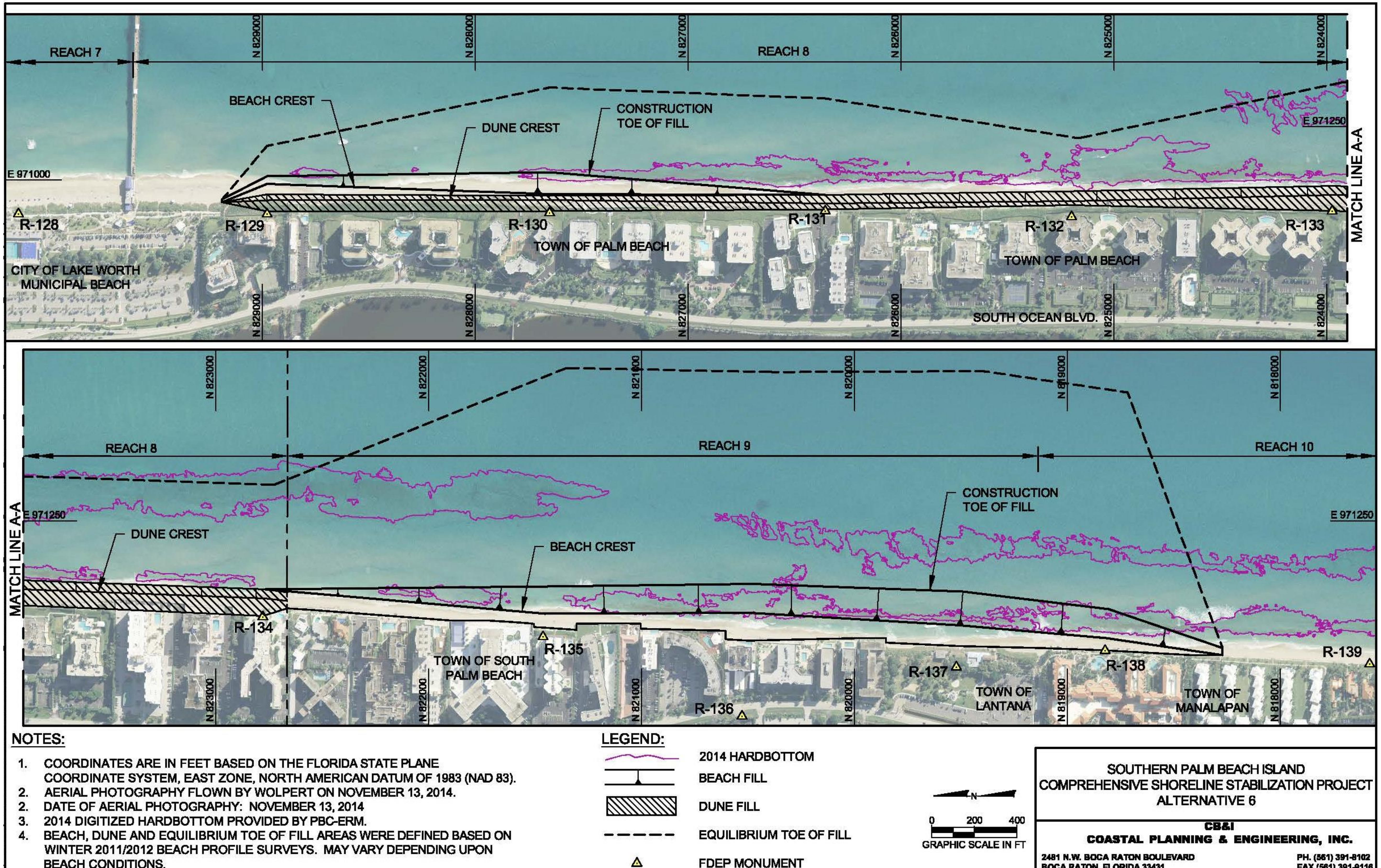


Figure 2-5. Southern Palm Beach Island Comprehensive Shoreline Stabilization Project - Alternative 6 Design.

2.4.7. ALTERNATIVE 7b – THE TOWN OF PALM BEACH INCREASED SAND VOLUME WITH TWO SHORELINE PROTECTION STRUCTURES (THE COALITION TO SAVE OUR SHORELINE, INC. (SOS) ALTERNATIVE) AND THE COUNTY PREFERRED PROJECT

During the scoping period, the SOS, through their consultant, Erickson Consulting Engineers, Inc., presented a plan for the placement of 166,800 cy on a 6-year renourishment interval between FDEP R-monument R-129-210 and R-134+135 (the Town of Palm Beach portion of the Project Area). The SOS alternative proposes use of upland sand from the Ortona sand mine. The fill placement design for the SOS alternative consists of a dune at an elevation of +4.4 m (14.5 ft) NAVD with beach berm at an elevation of +2.3 m (7.5 ft) NAVD. The anticipated constructed beach width within the Project Area would be between 29 m (95 ft) and 33.5 m (110 ft). The SOS alternative also includes two T-head groin structures, constructed of sheet pile, between R-132 and R-134.

Alternative 7b includes the placement of a larger volume of sand along the Town of Palm Beach and two T-head groins and the County's Preferred project (Figure 2-6). The volume of sand required to construct Alternative 7b is approximately 253,100 cy. This includes increasing sand placement in the Town of Palm Beach from 65,200 cy to approximately 175,500 cy and maintaining the County's Preferred template, which would require approximately 77,600 cy. Of these totals for each project area, sand placement below MHW includes approximately 58,700 cy within the Town of Palm Beach and approximately 26,600 cy within the County shoreline.

Placing a larger sand volume within the Town of Palm Beach lengthens the life expectancy in this portion of the Project Area to a 6-year renourishment interval, compared to the Preferred Alternative (2 to 4 years). The life expectancy of the County project would remain between 2 and 3 years. It is anticipated that implementation of Alternative 7b may result in permanent and temporary impacts to the nearshore hardbottom as presented in Table 2-7.

Table 2-7. Acreages of hardbottom impacts due to implementation of Alternative 7b using a range of grain sizes in the Town of Palm Beach and 0.36 mm grain size only in the County.

Impact Type	0.25 mm Town 0.36 mm County	0.36 mm Town 0.36 mm County	0.60 mm Town 0.36 mm County
Permanent	5.74 ac	11.25 ac	8.49 ac
Temporary	14.32 ac	9.45 ac	18.80 ac

Overall, this alternative will stabilize the shoreline and meets the overall project purpose by protecting upland property during a 15-year storm event in areas with seawalls and by protecting habitable buildings currently without seawalls during a 25-year storm event. It will also provide more sand to the littoral system, create a stable beach and dune profile, provide wildlife habitat, allow for recreational use and extend the nourishment interval in the Town of Palm Beach to 6 years. The impacts to hardbottom from placement of a larger volume of sand in the Town of Palm Beach with the addition of two T-head groins are much greater compared to Alternative 2.

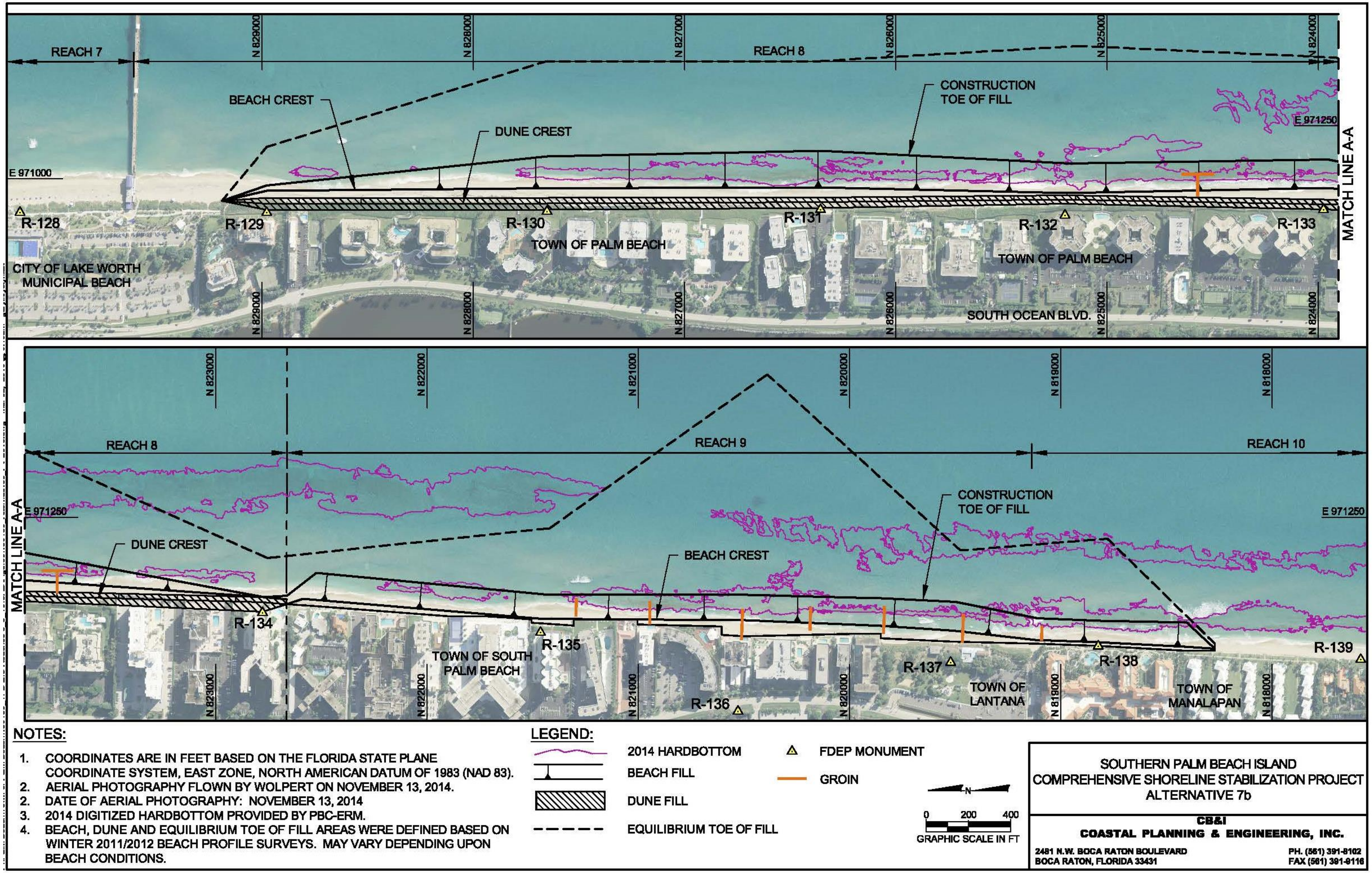


Figure 2-6. Southern Palm Beach Island Comprehensive Shoreline Stabilization Project - Alternative 7b Design.

2.5. GENERAL DESCRIPTION OF PROJECT CONSTRUCTION

For any alternative including beach and dune fill, potential sand sources include stockpiled offshore dredged material and upland mines. The sand would be delivered from these locations to the Project Area via truck haul. Utilizing a truck-haul approach for a beach nourishment project involves several stages of transport: loading of material at the stockpiled area or mine site, road transport via dump trucks, beachside delivery and stockpiling, transfer from stockpile to off-road vehicles, beach transport, placement, and grading. The Town of Palm Beach has proposed to utilize material dredged from offshore borrow areas at the same time as material is dredged for future planned renourishments of the Phipps and Mid-Town projects. If timing of the Phipps or Mid-Town projects does not allow for use of dredged sand, the Town of Palm Beach would consider using sand from an upland source. The sand source for the County portion of the Project would be obtained from upland sand mines in Ortona or Ft. Pierce.

Sand from either source must meet FDEP requirements for beach sand compatibility in accordance with Section 62B-41.007(2)(j), F.A.C. These criteria apply to all beaches in Florida; therefore, additional quality limits may apply so that the sand closely resembles the “native” sand for biological, physical and aesthetic purposes. Offshore sand sources must meet these standards based on geological sampling (vibracores) since screening of fill material during dredging and placement at the nourishment site is limited, as compared to upland sand mines that often have the capability to process the sand to meet a specific set of standards. In addition, any sand source used for the Town of Palm Beach project must be consistent with the BMA cell-wide sediment quality specifications (Table 2-8) (FDEP, 2013).

The sand source used for the County project must also meet the County's technical sand specifications outlined in Section 2.1.1 of the County’s Annual Dune and Wetlands Restoration contract, which is provided as Appendix B. According to these standards, sand must be obtained from a source farther than 244 m (800 ft) landward of the coastal construction control line, be similar in color to the native beach material, be free of construction debris, rocks, clay, or other foreign matter, have less than 1% organic material, be free of coarse gravel or cobbles, have a particle size distribution ranging predominantly between 0.074 (3.75φ) mm and 4.76 (-2.25φ) mm, be well-drained and free of excess water, and have a moisture content of less than 10%. Table 2-9 provides the specific sediment parameters and the corresponding compliance values for the specifications in the County's Annual Dune and Wetlands Restoration contract.

Table 2-8. FDEP sediment quality compliance specifications as per the BMA (FDEP, 2013).

Sediment Parameter	Parameter Definition	Compliance Value
Mean Grain Size	Min and max values (using moment method calculation)	0.25 mm to 0.60 mm
Maximum Silt Content	Passing #230 sieve	2%
Maximum Fine Gravel Content*	Retained on #4 sieve	5%
Munsell Color Value	Moist value (chroma = 1)	6 or lighter

***Shell content is used as the indicator of fine gravel content for the implementation of quality control/quality assurance procedures.**

Table 2-9. Palm Beach County's technical sand specifications outlined in the County's Annual Dune and Wetlands Restoration contract (Appendix B).

Sediment Parameter	Parameter Definition	Compliance Value
Mean Grain Size	Sorting coefficient/standard deviation no greater that 0.9φ	0.30 mm to 0.70 mm
Maximum Silt Content	Passing #200 sieve Passing #230 sieve	1% 0.6%
Maximum Fine Gravel Content*	Retained on #4 sieve	5%
Munsell Color Value	Moist value (5%-10%)	10YR 8/1 (white) to 10YR 7/3 (very pale brown)

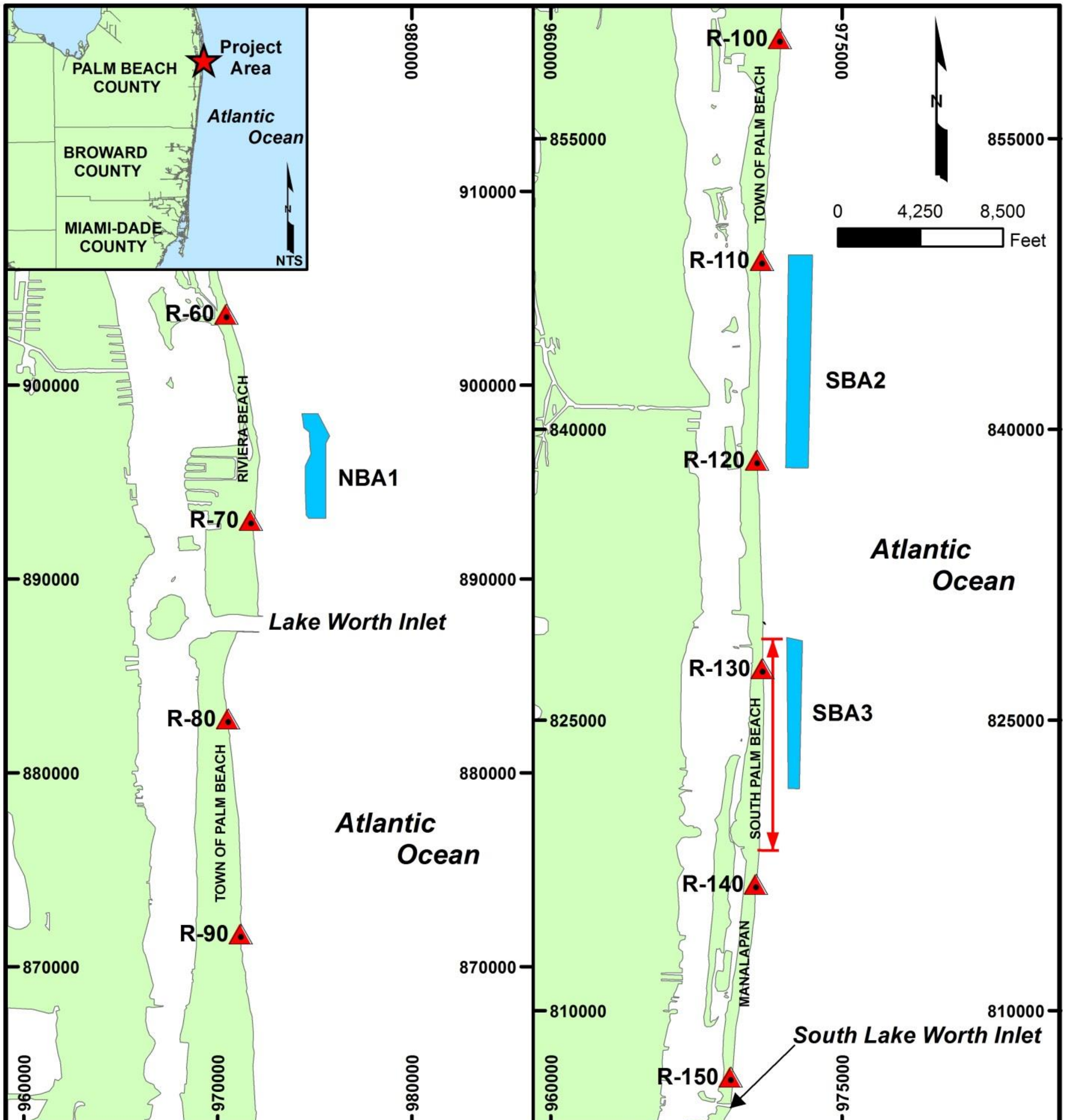
For transport to the Project Area, the Applicants will likely employ a 'mixed fleet' of long-haul road trucks including two-axle and six-axle dump trucks. Long-haul road trucks are capable of transporting 15-20 cy of material and, when fully loaded, have a gross weight of approximately 20-27 tons, respectively. Obtaining sand from more distant upland mines such as Ortona or Ft. Pierce may require the transportation of material via railway. Material can be transported as a single railcar, a group of cars, or a unit train of 80-100 cars each. A single railcar can carry 100 tons of material, or about 74 cy. A unit train could transport between 80,000-100,000 tons of sand and would be the most cost-effective rail method. Once delivered to a nearby stockpile area, material may be offloaded from the rail and then re-loaded onto trucks. Another option for delivery of material from domestic upland sand sources is to do so by barge. Although possible, because this approach would require many steps to transfer sand to and from the barge as well as truck delivery to the beach, it is unlikely that this method would be used.

Delivery of sand via truck haul would require beach access points along State Road (S.R.) A1A large enough to allow passage of dump trucks and heavy machinery. If space at the access area is too limited to allow efficient transfer from long-haul road truck to off-road truck, a conveyor system may be used. Access points are needed to remove sand from the stockpile and to deliver sand to the Project Area. Sand could be staged in the uplands at the Phipps or the Mid-Town sites. If staged at the Phipps site, it will be accessed at the 3360 Condominium property (3360 S. Ocean Blvd.). If staged at the Mid-Town site, the sand would be accessed at the intersection of Peruvian Avenue and S.R. A1A. For placement of truck-hauled sand, two access points were identified as suitable along the Project Area shoreline, including one within the Town of Palm Beach project area and one within the County project area. Since 2005, the Town of Palm Beach has truck-hauled sand and placed equipment on the beach in Reach 8 from the 3200 Condominium property (3200 S. Ocean Blvd.). The Lantana Public Beach will act as a staging area for the County project, with access via Dorothy Rissler Road. The associated dredging would be required to be included in any DA authorization to dredge, stage, haul, and place sand for the proposed Project, and which is the subject of this EIS.

USFWS has recommended that construction occur during the non-peak sea turtle nesting season. Assuming concurrence from USFWS, construction is proposed to occur between November 1 and April 30. Compliance with this recommendation and construction being limited to daylight hours Monday through Friday, coupled with holiday work restrictions, leaves approximately 120 work days available during a winter season. In addition to work hours, other limitations include truck availability, traffic congestion on the roads and at the access points, and the time associated with re-handling and movement of sand on the beach. Based on information provided by the Town of Palm Beach, during construction of the 2010/2011 Dune Restoration Project, which included sand transported by truck from stockpiled dredged sand from the Mid-Town project and placed in Reach 8, production often exceeded 4,000 tons per day (2,857 cy using a multiplier of 1.4) with often more than 180 truckloads per day. Based on this previous performance rate, the Town of Palm Beach estimates that placing a volume of 65,200 cy would take approximately 23 working days with a production rate of 4,000 tons per day to complete the Preferred Project. According to the County, previous dune restoration projects completed on Singer Island using truck hauled sand from and upland sand source placed approximately 1,300 tons (1,040 cy using a multiplier of 1.25) per day. Therefore, the County estimates that it would take approximately 75 days to place 77,600 cy with a production rate of 1,300 tons per day to complete the Preferred Project. The different multipliers used by the Town of Palm Beach and the County to convert cubic yards to tonnage take into account both the sand characteristics and the moisture content. The Town of Palm Beach production rates are based on transporting sand from a stockpile of dredged sand staged on the beach within a couple miles of the proposed Project Area, while the County production rates are based on transporting sand from an upland mine to the Project Area. The Town of Palm Beach production rates may be less if sand is obtained from upland sand mines further from the Project Area. Nevertheless, both proposed sand sources are feasible to construct in one season.

2.5.1. OFFSHORE SAND SOURCE

The Town of Palm Beach's preferred source of sand for the Town of Palm Beach's portion of the Project is to dredge sand from an offshore borrow area at the same time as sand is dredged for past and future planned renourishments of the Phipps and Mid-Town sites in order to reduce costs and environmental impact. On November 12, 2015 and April 1, 2014, the Corps authorized the renourishment of Phipps (SAJ-2000-00380) and Mid-Town beach (SAJ-1995-03779), respectively. Although these two projects were recently completed in 2015 and 2016, the Town of Palm Beach does plan to continue to renourish the Phipps and Mid-Town project areas in the future; therefore, these reasonably foreseeable actions are considered in the cumulative effects analysis in Chapter 4. The Town of Palm Beach proposes to use staged dredged material in uplands at the Phipps or Mid-Town site and then truck haul the dredged material to the Project Area. This material will be dredged from North Borrow Area 1 (NBA1), South Borrow Area 2 (SBA2), South Borrow Area 3 (SBA3) (Figure 2-3) or any offshore sand source that is consistent with the BMA cell-wide sediment quality specifications (see Table 2-8). The Town of Palm Beach will provide specifications on which borrow area would be used for this Project. The sand will be temporarily staged within the uplands at the Phipps and/or Mid-Town sites and truck hauled to the Project Area soon after it is piled. The Town of Palm Beach's pending action associated with this project would be the appropriate federal authorization to dredge sand from any of the borrow areas.



Notes:

1. Coordinates are in feet based on the Florida State Plane Coordinate System, East Zone, North American Datum of 1983 (NAD 83).

Legend:

Southern Palm Beach Island Comprehensive Shoreline Stabilization Project

- Project Limits
- Borrow Area
- FDEP Monuments

Figure 2-7. Potential borrow areas to be used during Phipps and Mid-Town projects that may supply the sand for the proposed Project within the Town of Palm Beach limits (R-129-210 to R-134+135).

2.5.2. UPLAND SAND SOURCE

Upland sand sources have provided sand for beach and dune restoration projects in Florida for over a decade. Upland sand has historically been used for small projects (less than 50,000 cy) (USACE, 2001) but has recently been utilized for larger projects in Indian River County, Broward County, and Brevard County, and is currently being proposed for a 8 km (5 mi) long project in Broward County. Within the County, upland sand has been used for restoration efforts in Coral Cove Park in Tequesta, Singer Island, Jupiter Beach/Carlin, Town of Palm Beach, Town of South Palm Beach, Town of Lantana and the City of Delray Beach. Specifically within the Project Area, there have been six dune restorations completed in the Towns of South Palm Beach and Lantana since 2003 (Miranda, pers. comm., 2013) and one Town of Palm Beach sponsored dune restoration in Reach 8 in 2011 using upland sand. Additionally, the option of upland sand allows the greatest flexibility in project planning due to the ability of the mines to provide sand that meets sediment quality criteria without additional processing at the nourishment site, as well as addresses the issue of the dwindling supply of available beach compatible sand from offshore borrow areas and the limited availability of dredges.

The sand source for the Project Area within the County project limits is sand from domestic upland sand mines within the state of Florida. The sand would be placed on the beach mechanically, rather than hydraulically. There are known sand mines within 161 km (100 mi) of the Project shoreline that have provided clean, quality material for past nourishment projects in southeast Florida. A study conducted in Broward County found that due to a larger mean grain size and smaller fines content, upland sand is expected to be more stable and produce less turbidity in the nearshore environment than sand obtained from offshore borrow areas (OAI and CB&I, 2013).

To identify potential upland sand sources for this Project, several mines will be selected for evaluation based on successful usage for past projects. Each mine will be evaluated based on compliance with Rule 62B-41.007(2)(j), F.A.C., the BMA cell-wide sediment quality specifications (Table 2-8), the County's technical sand specifications outlined in the County’s Annual Dune and Wetlands Restoration contract (Table 2-9; Appendix B), sediment characteristics, location relative to the Project Area, compliance with state and federal laws and method of transport available. The Town of Palm Beach's preferred upland sand mine is E.R. Jahna Industries, Inc. Ortona Sand Mine (Ortona), which has been previously utilized within the Town of Palm Beach, as well as Stewart Mining Industries, Inc. in Ft. Pierce (see Table 2-10 and Figure 2-4). The County has identified as potential sand sources Ortona and/or Stewart Mining Industries in Ft. Pierce.

Table 2-10. Potential upland sand sources.

Company	Mine Name	Distance from Project Area (km)*	Distance from Project Area (mi)*
E.R. Jahna Industries, Inc.	Ortona	154	96
Stewart Mining Industries, Inc.	Ft. Pierce	127	79

*Distance is the shortest driving distance (km/mi) between each mine and Lantana Municipal Beach Park; actual distance will depend on routes selected by contractor.

One consideration involved with selecting upland sand sources is the availability of material within the mines, as this can affect overall construction rate of the Project. The mine(s) selected must have sufficient total and daily production capacity to meet the Project needs. Sand mines can stockpile some of the material to ensure that they can keep pace with required delivery rates. Other factors to consider include the distance from the mine to the Project Area, the number of trucks and other machinery at the staging and beach nourishment areas, as well as the number of active access points. In the event that delivery rate exceeds handling time on the beach, it may be useful to employ offsite truck waiting areas to avoid congestion at the access points. The Town of Palm Beach has performed truck haul operations multiple times in the Reach 8 area since 2005. The Town has specific restrictions when it comes to construction on the Island. Truck staging areas have been utilized previously on Southern Boulevard in West Palm Beach and along the causeway immediately east of the Southern Boulevard bridge over the Intracoastal Waterway. Waiting areas are considered with any project in the Town to limit traffic disruptions. The location for waiting areas will need to be considered once permitting has been completed and construction for a Reach 8 beach project has been scheduled. Construction of the new Southern Boulevard bridge may impact the location of truck haul waiting areas. Trucks for the County's fill efforts will be staged in a designated section of the Lantana Municipal Beach parking lot.

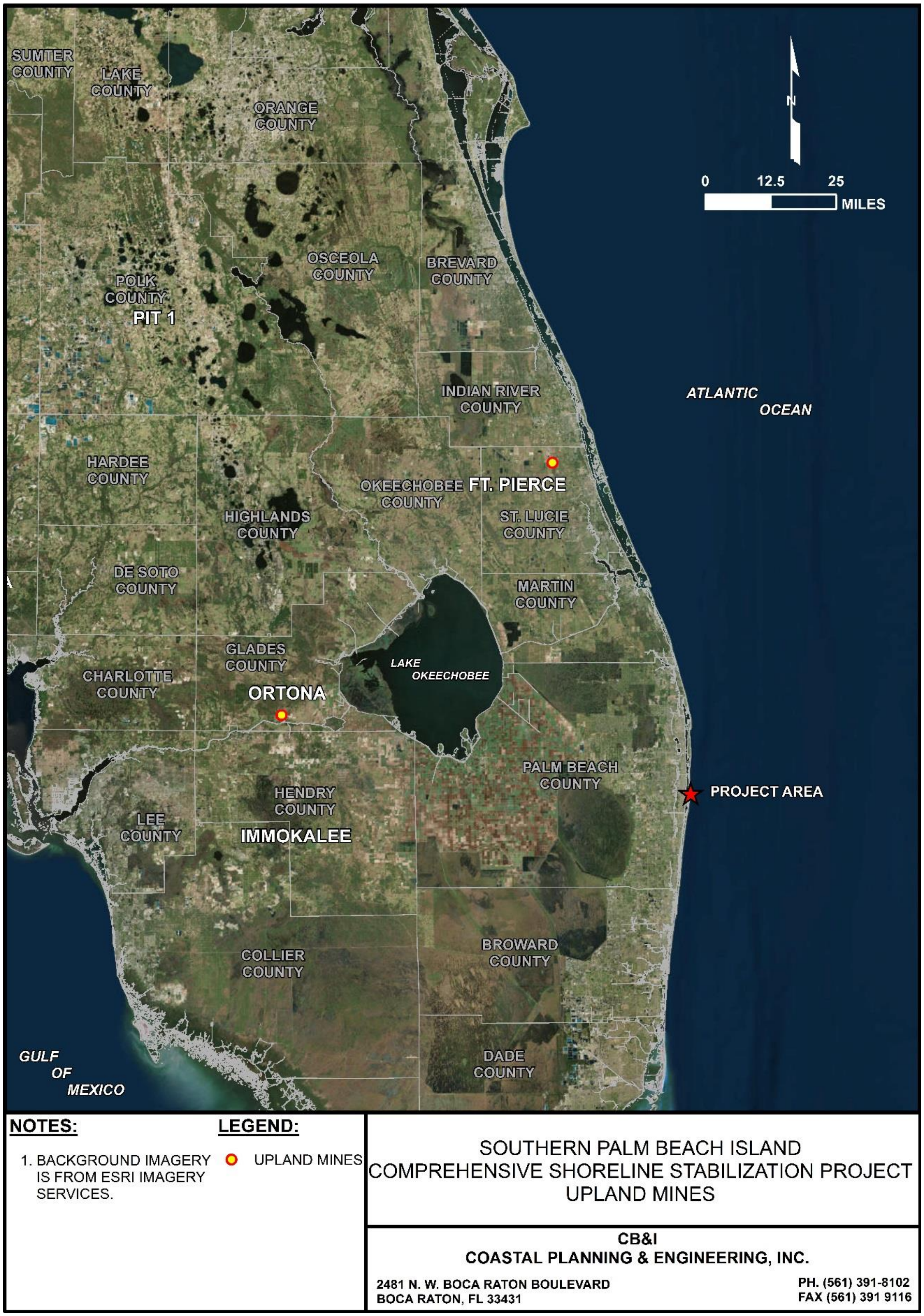


Figure 2-8. Upland sand mines with potentially feasible sources of material that could be considered for a truck-haul project for placement in the proposed Project Area.

2.5.3. CONSTRUCTION BEST MANAGEMENT PRACTICES

Best management practices (BMPs) include methods that are specifically designed to avoid and minimize environmental impacts before, during, and after construction. Since the current proposals include two projects, one by the Town of Palm Beach and one by the County, there are two potential sources of fill material including upland and stockpiled dredged sand. In either case, the activities required to obtain the material could be authorized by unrelated DA permits associated with the mining and/or dredging sand. BMPs for this project will include the following:

- Water quality monitoring plan
- Mitigation program (Appendix I)
- Biological monitoring plan for natural and artificial (mitigative) habitat
- Physical monitoring plan
- Construction window to minimize impacts to sea turtle nesting
- Sea turtle monitoring plan
- Adherence to wildlife protection guidelines such as FWC's *Standard Manatee Conditions for In-water Work* (FWC, 2011) and NMFS's Sea Turtle and Smalltooth Sawfish Construction Conditions (NMFS, 2006)

For the truck haul portion of the process, BMPs will be geared toward ensuring public safety and will require the Contractor to plan and implement a comprehensive Maintenance of Traffic Plan acceptable to the Town of Palm Beach and the County. Sections of the beach being actively used during the construction process will be closed to the public for safety reasons.

The current groin construction methodology is not currently known at this time, but the groins could be constructed from either the land (likely) or water; however, the following BMPs may be implemented (PBS&J, 2008):

- Design, siting, impact avoidance and minimization
- Vessel ingress/egress corridors
- Personnel qualifications

- Adaptive management
- Integrated GPS

2.6. COMPARISON OF ALTERNATIVES

2.6.1. COMPARISON OF COSTS

Although the USACE does not prepare a cost-benefit analysis to weigh various alternatives, cost considerations are considered that are likely to be relevant to a decision. Because the project is a publically funded project with tax-payers' money, the USACE is providing the costs of each alternative for public disclosure. Table 2-11 summarizes the major costs associated with the various aspects of each alternative and provides a summary of the costs for each alternative. These costs were based on previous similar projects, and include costs associated with obtaining, transporting, placing and grading the beach sand in the Project Area. The mobilization, dredging and hydraulic conveyance costs associated with the dredged sand source would be absorbed by the underlying project authorizing the dredging (Phipps or Mid-Town) and are not considered as additional costs in the alternatives evaluated below. Table 2-11 does include the costs required for construction of artificial reefs which would be required to offset hardbottom impacts and/or or the cost of biological and physical monitoring.

Table 2-11. The cost of each aspect of the alternatives evaluated and a summary of costs for Alternatives 2 through 7b based on the impacts and mitigation associated with 0.36 mm grain size.

Aspect of Alternative	Town of Palm Beach			Palm Beach County		Groin Constr[4]	Mitigation[5,6]	Total Cost
	R129-210 to R134+115			R134+115 to R138+551				
	65,200 cy	121,700 cy	175,500 cy	77,600 cy	187,800 cy			
Upland Sand[1]	--	--		$3,569,600	$8,638,800	$100,000 per groin		
Dredged Sand[2,3]	$1,905,796	$3,557,291	$5,129,865	--	--			
Alternative	**Summary of Costs**							
2	$1,905,796	--	--	$3,569,600	--	$700,000	$6,093,900	$12,269,296
3	$1,905,796	--	--	$3,569,600	--	--	$5,160,600	$10,635,996
4	$1,905,796	--	--	--	$8,638,800	--	$10,238,850	$20,783,446
5	--	$3,557,291	--	$3,569,600	--	$700,000	$6,853,350	$14,680,241
6	--	$3,557,291	--	--	$8,638,800	--	$10,897,650	$23,093,741
7b	--	--	$5,129,865	$3,569,600	--	$900,000	$14,621,700	$24,221,165

[1]$39.58-$46.80/cy (Town of Palm Beach Bid No. 2014-13 from E.R. Jahna Industries, Inc., Ortona Sand Mine, 2014). These unit costs include mobilization, transport/delivery, beach placement, grading, demobilization, site restoration, beach tilling, performance and payment bond, and indemnification. Cost estimates in this table are based on a cost of $46.00/cy.

[2]$10/cy based on recent bid to transport dredged stockpiled sand from Mid-Town to Reaches 7 and 8.

[3]Unit rate of $19.23 based on bid volume for Mid-Town (2015).

[4]Approximately $100,000 per groin.

[5]Mitigation cost per acre was provided by the County at $800,000/ac and by the Town of Palm Beach at $915,000/ac. $915,000 was used as a conservative estimate of mitigation cost.

[6]Mitigation acreages calculated from impacts due to implementation of the 0.36 mm grain size were used are presented here because since these results were generally between those of the 0.25 mm and 0.60 mm results.

CHAPTER 3

AFFECTED ENVIRONMENT

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3.0. AFFECTED ENVIRONMENT

This chapter provides a description of the physical, biological, chemical, and human environments that could be affected by the alternatives under evaluation. The existing conditions are presented in either a regional- or an area-specific context depending on the nature of the resource or the anticipated effect to that resource.

3.1. SCOPE OF THE AFFECTED ENVIRONMENT

The scope of the affected environment includes not only activities associated with the proposed Southern Palm Beach Island Comprehensive Shoreline Stabilization Project but it also includes other projects on Palm Beach Island. Specifically, activities associated with the Mid-Town and Phipps projects including dredging sand from offshore borrow areas and stockpiling this sand for placement in the proposed Project Area. Therefore, the geographic scope is defined by: 1) the northern limit of North Borrow Area 1 (NBA1) (see Figure 2-3), approximately 3.2 kilometers (2 miles) north of Lake Worth Inlet; 2) the eastern edge of NBA1, in water depths between 12 and 18 meters (40 and 60 feet) approximately 762 meters (2,500 feet) offshore of Singer Island; 3) the South Lake Worth Inlet (R-151), located approximately 3.2 kilometers (2.5 miles) south of the Project Area, and 4) the westernmost boundary of the potential upland mines in order to encompass the truck routes to the Project Area (see Figures 2-4 and 3-1).

An excess volume of sand from what is needed for the Phipps or Mid-Town projects would be temporarily stockpiled in their respective project templates, mechanically loaded on trucks, and then hauled to the Project Area for placement and grading. Because these projects include dredging sand from offshore borrow areas, this activity is included in the scope of the affected environment. The truck routes that may be used to transport the sand from the stockpiles to the Project Area, as well as from the potential upland mines to the Project Area are also included in the affected environment.

For the measurable resources of the affected environment which can be assessed in an area-specific context (i.e., turtle nesting habitat, dune vegetation, nearshore hardbottom), the extent includes the Project Area as well as adjacent areas to the north and south which may be impacted by construction of the build alternatives. The Project Area extends from R-129-210 to R-138+551, which includes the majority of Reach 8, all of Reach 9, and the northern portion of Reach 10 (Figure 2-2). Potential impacts from project construction are expected to occur updrift and downdrift of the Project Area, therefore, resources were assessed within the Study Area which extends from R-127 to R-141+586. This area includes the shoreline from the dune seaward out to a distance of approximately 400 meters (1,312 feet) in order to include all areas of nearshore hardbottom habitat that have been exposed between 2003 and 2014.

Figure 3-1. Regional location map.

3.2. GENERAL ENVIRONMENTAL SETTING

Palm Beach County (County) is located on the east coast of Florida approximately 97 km (60 mi) north of Miami (see Figure 1-1). The Project Area includes four municipalities, from north to south, the Towns of Palm Beach, South Palm Beach, Lantana, and Manalapan. The Town of Palm Beach prepared comprehensive coastal management plans in 1986 and 1998 which segmented the shoreline into “reaches” in order to examine erosion problems and develop engineering plans for areas with similar coastal processes. These reaches have remained more or less consistent for the past 25 years, with slight revisions. The 1998 revision expanded the reach concept from the southern limits of the Town of Palm Beach to the southern limits of Palm Beach Island. More recently, the Town of Palm Beach extended Reach 7 into the northern section of Reach 8 so that it now extends south to the Lake Worth Pier. This revision was proposed to reflect the Town of Palm Beach’s evolving management strategies presented in the Town of Palm Beach Technical Review of Proposed Coastal Management Program (Woods Hole Group, 2013). Table 3-1 summarizes the current reach designations on Palm Beach Island (FDEP, 2013). Reaches 1-8 are located within the Town of Palm Beach, while reaches 9-11 are within the Towns of South Palm Beach, Lantana, and Manalapan. The Florida Department of Environmental Protection (FDEP) also utilizes range monuments (R-monuments), a statewide network of survey R-monuments, to more precisely identify specific locations on the state’s shoreline.

The Florida beaches on the Atlantic coast are generally composed of mineral sands and shell fragments (USACE, 2012). The beaches within South Florida are characterized by carbonate rich sediments that are formed from the remains of diverse marine flora and fauna. These beaches are typically also lined with a wide variety of vegetation shaped by the tides, winds, and waves. The Study Area includes the tidal waters, intertidal and subtidal unconsolidated bottoms, intertidal and subtidal hardbottom, dry beach, and upland development. The upland development is comprised of hotels, condominiums, homes, and public parks. Much of this upland development is armored with seawalls (USACE, 2013; PBC-ERM, 2013a).

Table 3-1. Palm Beach Island shoreline reach designation (FDEP, 2013).

Reach	R-Monuments	Location	Municipality
1	R-76 to R-78+500	Lake Worth Inlet to Onondaga Ave	Town of Palm Beach
2	R-78+500 to R-90+400	Onondaga Ave to El Mirasol	Town of Palm Beach
3	R-90+400 to R-95	El Mirasol to Via Bethesda	Town of Palm Beach
4	R-95 to R-102+300	Via Bethesda to Banyan Rd	Town of Palm Beach
5	R-102+300 to R-110+100	Banyan Rd to Widener's Curve	Town of Palm Beach
6	R-110+100 to R-116+500	Widener's Curve to Sloan's Curve	Town of Palm Beach
7	R-116+500 to R-128+530	Sloan's Curve to Lake Worth Pier	Town of Palm Beach*
8	R-128+530 to R-134+135	Lake Worth Pier to Town of Palm Beach southern limit	Town of Palm Beach*
9	R-134+135 to R-137+400	Town of Palm Beach southern limit to Lantana Avenue	Towns of South Palm Beach and Lantana
10	R-137+400 to R-145+740	Lantana Avenue to Chillingsworth Curve	Towns of Lantana and Manalapan
11	R-145+740 to R-151+300	Chillingsworth Curve to South Lake Worth Inlet	Town of Manalapan

***The City of Lake Worth has jurisdiction over a small shorefront in this reach.**

3.2.1. REGIONAL GEOGRAPHIC SETTING AND CLIMATE

The Town of Palm Beach is the easternmost town in Florida. It is situated on a 26 km (16 mi) long barrier island and is home to approximately 10,000 full time residents and 30,000 seasonal residents (Palm Beach Florida, 2013). The total area of the Town of Palm Beach is 26.9 km^2 (10.4 mi^2). Of this area, 10.1 km^2 (3.9 mi^2) is land and 16.8 km^2 (6.5 mi^2) is water. Town of Palm Beach is considered to have a tropical climate, with no month having a mean temperature lower than 18 ˚C (64.4˚F). The average monthly temperature between 1981 and 2010 was 24.1 ˚C (75.4°F) and the average monthly rainfall was 131.9 mm (5.19 in). However, precipitation varies considerably month to month with September seeing the most rainfall (FSU, 2010) (Table 3-2).

Table 3-2. Average monthly and yearly temperature and rainfall in West Palm Beach (1981-2010) (FSU, 2010).

MONTH	TEMPERATURE		PRECIPITATION	
	°C	°F	mm	in
January	18.7	65.7	79.5	3.13
February	19.9	67.8	71.6	2.82
March	21.4	70.5	116.6	4.59
April	23.2	73.8	93.0	3.66
May	25.8	78.4	114.5	4.51
June	27.4	81.4	210.8	8.30
July	28.2	82.7	146.3	5.76
August	28.3	83.0	201.9	7.95
September	27.7	81.8	212.1	8.35
October	25.7	78.3	130.3	5.13
November	22.7	72.8	120.6	4.75
December	20.1	68.1	85.8	3.38
Year	24.1	75.4	131.9	5.19

3.2.2. PHYSICAL CONDITIONS

The Study Area includes approximately 5 km (3 mi) of upland developments, dune and beach habitat and nearshore marine environment, including unconsolidated bottoms and hardbottom habitat. These environments are described below.

3.2.2.1. UPLAND DEVELOPMENTS

The upland developments along the shoreline in the Study Area are comprised of hotels, condominiums, homes, and public parks, most of which are armored with seawalls (USACE, 2013; PBC-ERM, 2013a).

3.2.2.2. DRY BEACH

The dry beach is located between the toe of dune or scarp and the MHW line and extends along the entire Study Area, both updrift and downdrift of the Project Area. The dry beach in the Study Area is composed of carbonate-rich sediments formed from the remains of marine flora and fauna (FDEP, 1994). This area does not support much vegetation and is susceptible to wind and storm surge. It also provides recreational areas for human activities and nesting grounds for sea turtles and various species of shorebirds.

3.2.2.3. UNCONSOLIDATED BOTTOMS

Marine unconsolidated substrates are mineral based natural communities located in intertidal and subtidal zones which lack dense populations of epifaunal sessile plant and animal species; however, these communities may support a large population of infaunal organisms. Materials that make up these unconsolidated bottoms include coralgal, marl, mud, mud/sand, sand or shell. These materials originate from organic sources such as decaying plant tissue or from calcium carbonate depositions originating from plants and animals. The intertidal unconsolidated bottom serves as an important feeding ground for many shorebirds and invertebrates, while the subtidal zone is an important feeding ground for bottom feeding fish (FNAI and FDNR, 1990). The subtidal area includes the areas immediately offshore, updrift, and downdrift of the Project Area as well as the borrow area that could be utilized by the Mid-Town or Phipps projects.

3.2.2.4. NEARSHORE HARDBOTTOM

Nearshore hardbottom habitat is classified by FDEP to include the “200-400 meter-wide strip from the shoreline, ranging from the supralittoral zone to the depth of -4 meters”, intermediate hardbottom exists “from the depth of -4 meters to the depth of closure (approximately -8 meters)”, and offshore hardbottom is located in “water depths deeper than -8 meters, beyond the depth of closure to -12 meters” (FDEP, 2013). The hardbottom resources delineated through aerials, and most recently characterized in 2013, are all located within 400 m from the shoreline and generally in depths out to -4 m, though the deepest (eastern) ends of some of the characterization 2013 transects were located at a depth of -5.5 m (-18 ft). Since these areas are continuous formations, for this document will refer to these resources as “nearshore hardbottom”. From 2003 to 2014, the quantity of exposed nearshore hardbottom within the Study Area (R-127 to R-141+586) has varied considerably, ranging from a low of 3.06 ac (2009) to a high of 51.20 ac (2006), with a time-average (see Section 4.4 for details on time-average method) of 28.43 ac between 2003 and 2014 (Figure 3-2; Table 3-3). The maximum extent of exposed hardbottom was determined by layering all delineations between 2003 and 2014 in GIS and calculating the entire area, which could represent potential hardbottom resources. Likewise, the persistent hardbottom was determined by calculating the acreage of hardbottom that remained exposed between 2003 and 2014. The maximum extent of hardbottom was 115.29 ac, while the persistent hardbottom was 0.000392 ac (near R-133). This variability supports the designation of this resource as ephemeral hardbottom. The most recent delineation conducted in 2014 quantified total of 49.77 ac of exposed hardbottom within the Study Area (Figure 3-2). Coral reef and hardbottom resources within the Study Area are described in greater detail in Section 3.5.

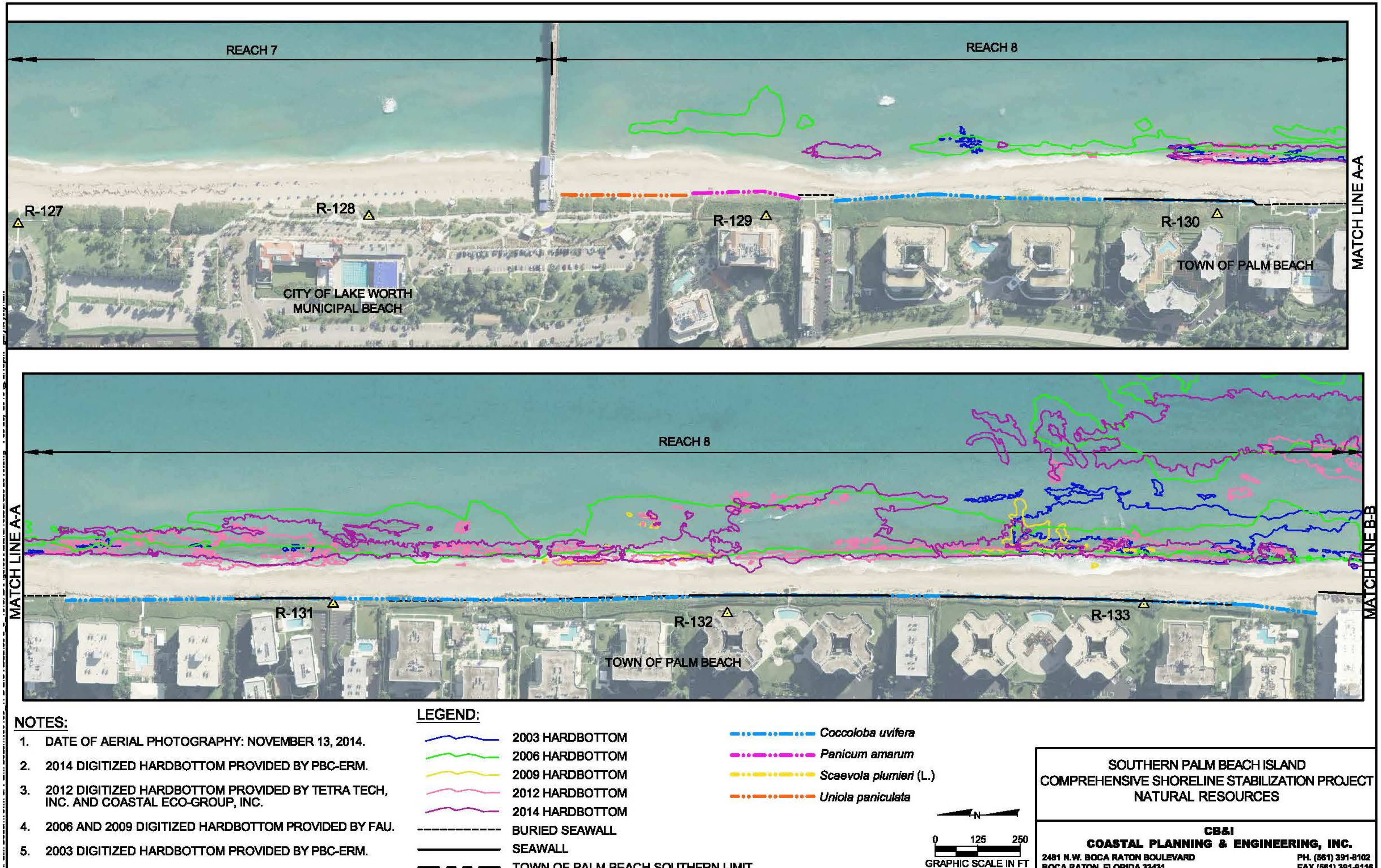


Figure 3-2. Nearshore hardbottom and dune resources within the Study Area (R-127 to R-141+586).

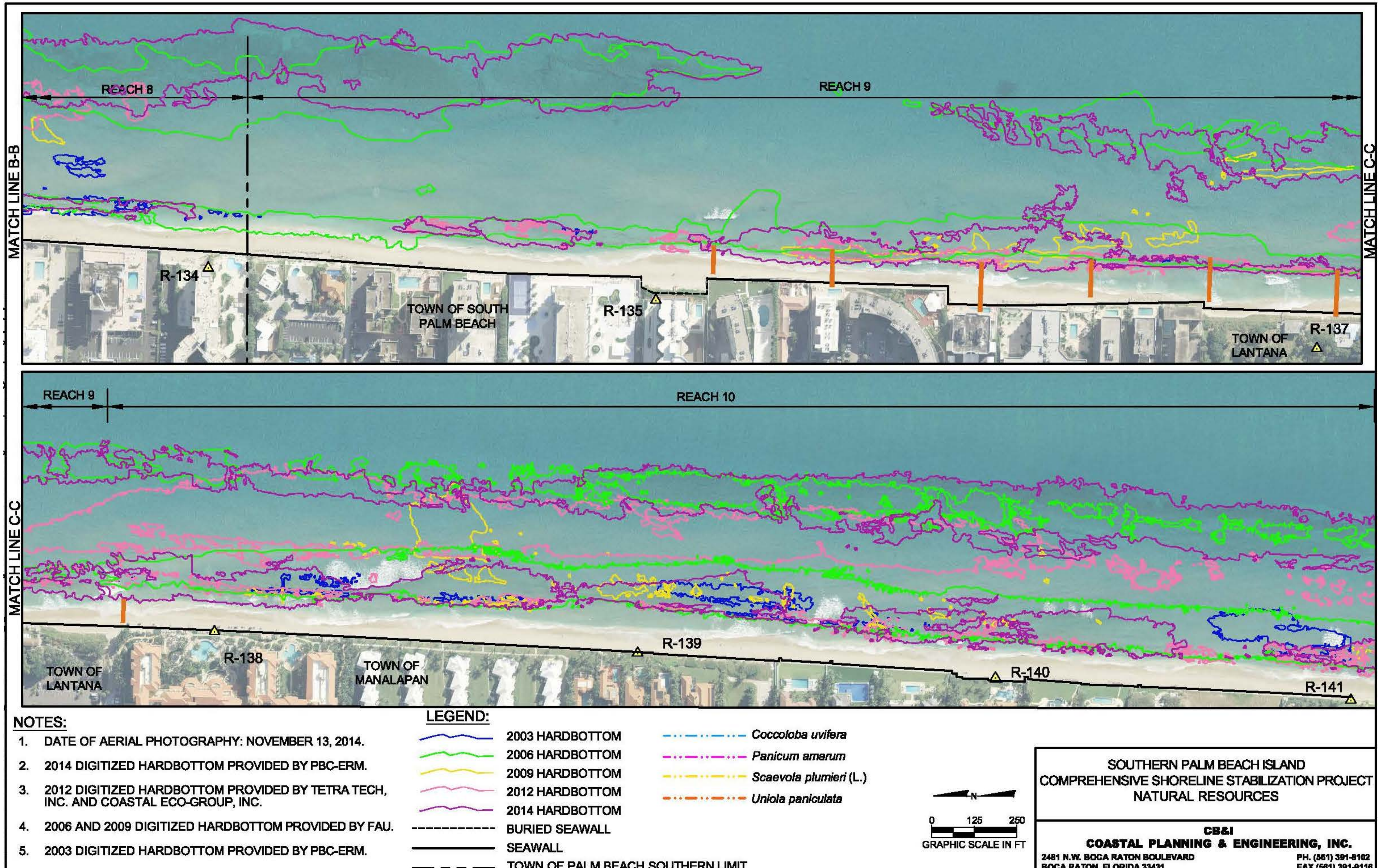


Figure 3-2 (cont.). Nearshore hardbottom and dune resources within the Study Area (R-127 to R-141+586).

Table 3-3. Exposed hardbottom acreage delineated from aerial imagery between 2003 and 2014 in the Study Area (R-127 to R-141+586).

Year of Delineation	Area (ac)
July 2003	5.22
July 2004	27.18
July 2005	37.92
July 2006	51.20
July 2007	41.69
July 2008	29.17
July 2009	3.06
July 2010	18.76
October 2010	8.64
October 2011	15.71
March 2012	16.62
July 2013	39.26
November 2014	49.77

3.2.3. WAVES

Waves are the forward movement of ocean water, as a result of the wind dragging water particles over the waters' surface. Waves vary in size and force due to the fluctuations in wind intensity, and provide an important sediment transport mechanism along the open coast within the Study Area. An examination of hindcast wave data along the southeast Florida coast shows seasonal effects on the wave climate. On average, wave heights are higher during the winter months and smaller during the summer months. The exception is during major storm activity. Figure 3-3 presents a wave rose from 1980-2012 Wave Information Studies (WIS) Station 63461, which is located offshore of the Study Area in 356 m (1168 ft) water depth. Figure 3-3 shows the majority of waves higher than 0.5 m (1.5 ft) arrive from the northeast and east-northeast.

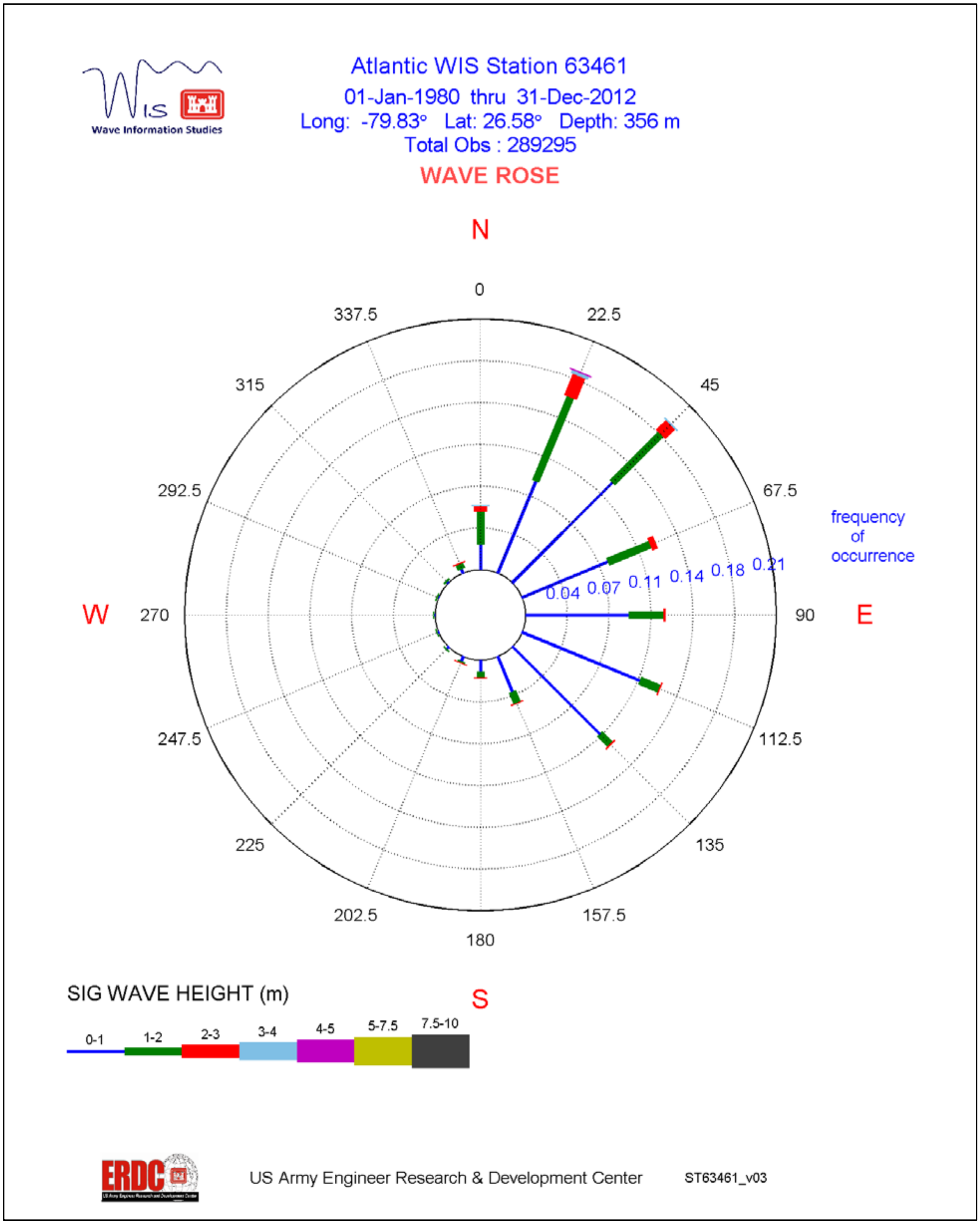


Figure 3-3. Wave rose of WIS station 63461 (1980-2012) located offshore of the Project Area (USACE, 2016).

3.2.4. WINDS

Wind transports sand across dry beaches. Wind also generates waves, which in turn transports sand along wet beaches and subtidal areas. In the absence of available wind from within the Study Area, wind data was collected from a proximate location in West Palm Beach, Florida, from the Southeast Regional Climate Center. Table 3-4 shows the average wind speed (mph) per month for the past 70 years (ending in 2012). The annual average was 9.6 mph, with a range of 7.7 mph to 10.5 mph. Although wind direction is fairly sporadic, the prevailing winds in West Palm Beach (Palm Beach International Airport weather station) come from the east (23%); 17% from the southeast and 10% from the northeast (WeatherSpark, 2014).

Table 3-4. Average monthly wind speed (mph) in West Palm Beach (1942-2012) (SRCC, 2012).

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Yr
Wind Speed	10.1	10.5	11	10.9	9.9	8.3	7.7	7.7	8.8	10.0	10.4	10.0	9.6

3.2.5. STORMS

Although tropical depressions, storms, and hurricanes typically move rapidly through an area, they have the potential to impact the beach and dune system found within their path. Large wave heights, storm surge and high winds brought about by hurricanes and tropical storms can cause significant erosion of a beach and the associated dunes. Studies have shown that the region of West Palm Beach, which is located just northwest of the Project Area, is brushed or hit by a hurricane (winds>74 mph) and/or tropical storm (winds >39 mph) approximately every 2.10 years. In the past 141 years, the area has received tropical storm or hurricane force winds 67 times. Of these storms, 39 (58.21%) were hurricanes with average winds of 107 mph, and 28 (41.79%) were tropical storms (Hurricanecity.com, 2013). In recent history, hurricanes have caused both extensive and localized damage in the County. In 2005, Hurricane Wilma, registered as a Category 2, had maximum sustained winds of 101 mph at Palm Beach International Airport and is estimated to have caused $16.8 billion in damage in south Florida (NOAA, 2009; 2012a). In 2011, Hurricane Irene brushed by south Florida as a Category 3 hurricane (Weather

Underground, Inc., 2014) producing powerful waves that did not result in structural damage, but did cause the loss of beach width and elevation in the Jupiter and Singer Island areas. Most recently in 2012, Hurricane Sandy brushed by south Florida as a Category 1 hurricane and caused an estimated $14 million in damage in the County, primarily affecting beachfront structures in the Town of Manalapan as well as damaging the Lake Worth Pier (NOAA, 2012b). Although hurricanes are highlighted, all storms have the capacity to cause beach and dune erosion.

3.2.6. SHORELINE EROSION AND ACCRETION

The shape and dimensions of beach and dune systems are defined by the forces driving sediment transport in the coastal zone. The dominant forces include waves and currents. Waves and currents transport sediments in the parallel (longshore) and perpendicular (cross-shore) directions within the littoral zone which extends from the shoreline to just beyond the seaward most breaking waves. The transport may result in a local rearrangement of sediments into bars and troughs nearshore, and or into rhythmic embayments alongshore. Alternatively, large volumes of sediments are transported extensive distances longshore. Longshore transport is the dominant process affecting erosion, accretion or stabilization of the shoreline (USACE, 2006).

The seasonal variability of storms and waves results in two distinct classes of waves, storm waves and swell waves, which have completely different effects on the beach profile (USACE, 2006). In general, storm waves erode the beach berm moving sediments to the offshore portion of the profile. Swell waves replace sediments back onshore resulting in beach accretion (Silvester and Hsu, 1993). Storm and swell waves may not have the same net direction, causing a reversal of longshore drift with season. In general, the winter storms create steeper waves that erode the berm and fill the offshore profile. During summer, the mild wave climate and swell events contribute to the accretion and recovery of the beach.

The Project Area is located in one littoral cell, and is comprised of Reaches 8, 9 and 10. Each Reach represents an area with uninterrupted littoral transport and different coastal management considerations. Reach 8 extends from the Lake Worth pier to the southern boundary of the Town of Palm Beach limit. Reach 9 includes the Town of South Palm Beach and Lantana. Reach 10 includes the northern end of the Town of Manalapan. The recent behavior of the reaches is described in the following paragraphs.

North of the Town of Palm Beach portion of the Project Area has exhibited significant long term gains between approximately T-125 and R-129 in response to beach fill projects in Reach 7 and dune projects in portions of Reach 8. Dune projects in Reach 8 are intended to increase the upper beach volume without advancing the shoreline and reduce the additional shoreline recession in the short term. The areas south of approximately R-130 have not benefitted from the Reach 7 projects and have exhibited long term net recession (ATM, 2010).

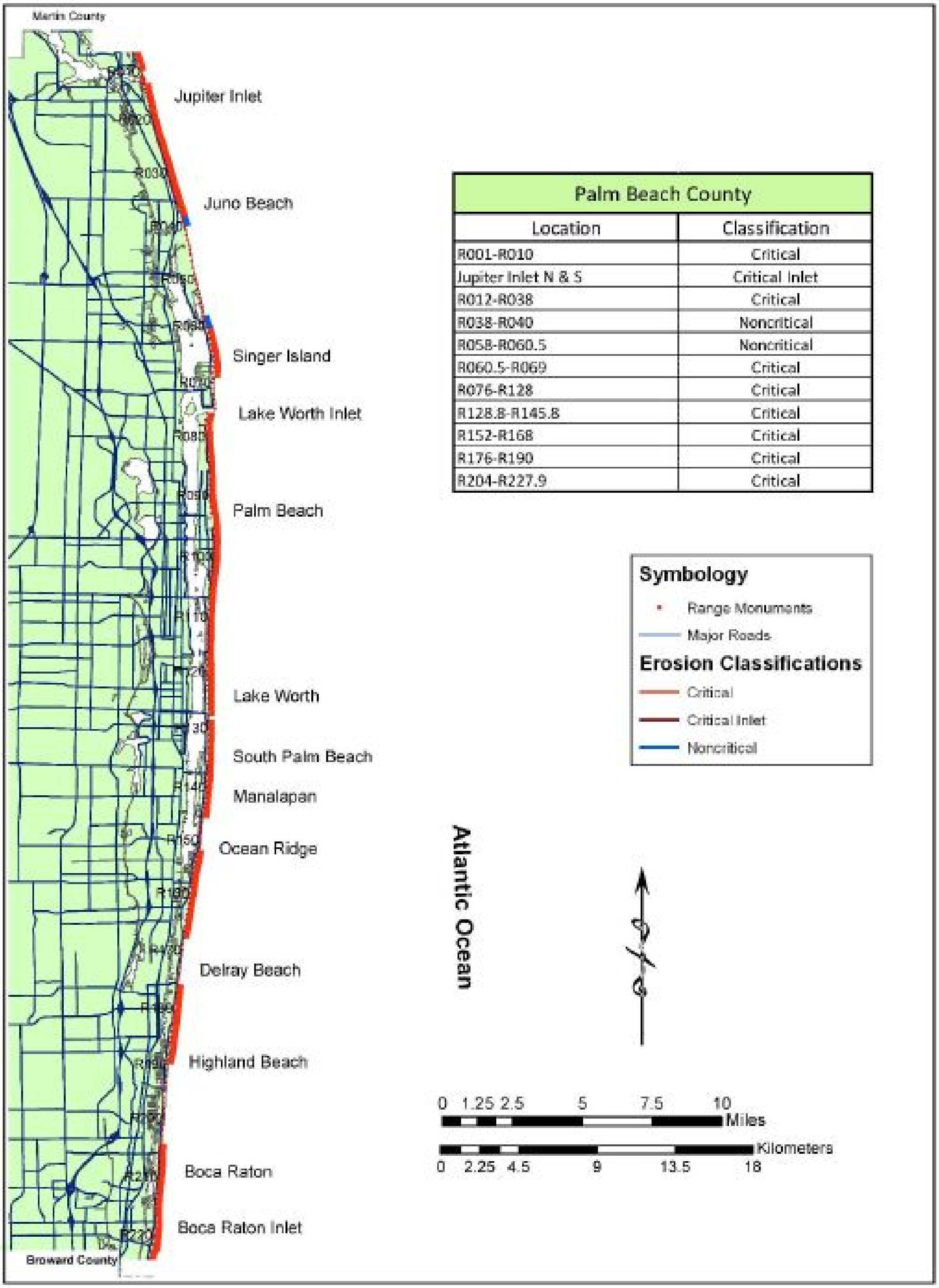
Since 1990, Reach 8 has exhibited a net average annual loss of 10.8 feet of dry beach width, though gains generally occurred at the north end of the reach and recession was evident at the southern boundary. Since 1990, the reach has exhibited a net gain of 381,018 cubic yards (to a depth of -26.2 feet NAVD) (ATM, 2014). In 2013, Reach 8 (previously bounded from T-125 to T-134) exhibited a net shoreline gain of 5.8 feet and overall volumetric gain of 104,929 cubic yards (to a depth of -26.2 feet NAVD) (ATM, 2014). Although the reach has recently exhibited net gains, the volumetric changes typically vary by R-monument with losses occurring at and south of the Lake Worth pier (R-128 to R-129) and at R-131.

The beaches along Reaches 9 and 10 are generally narrow, lack sustained dunes and lack or have narrow berm terraces. A bar and trough system is present along much of the shoreline. Trough elevations are on the order of -5 to -12 feet NAVD, with the deeper troughs located near the south end of the Project Area. Bar elevations are on the order of -3 to -10 feet NAVD, with the shallower bars located near the north end of the Project Area.

From 2008 to 2012, the section of shoreline from R-135 to R-138 has lost 14,200 cy of sand per year with the greatest losses at R-136. From R-138 to R-141, there was an average gain of 9,300 cy of sand with the greatest gains at R-141.

According to FDEP (2015), “A critically eroded area is a segment of the shoreline where natural processes or human activity have caused or contributed to erosion and recession of the beach or dune system to such a degree that upland development, recreational interests, wildlife habitat, or important cultural resources are threatened or lost. Critically eroded areas may also include peripheral segments or gaps between identified critically eroded areas which, although they may be stable or slightly erosional now, their inclusion is necessary for continuity of management of the coastal system or for the design integrity of adjacent beach management projects”.

The County is comprised of 73 km (45.4 mi) of shoreline of which 54.1 km (33.6 mi) have been designated by FDEP as critically eroded. Figure 3-4 presents the critically and non-critically eroded regions within the County. As of June 2015, the FDEP has classified this entire Project shoreline as “critically eroded”, (FDEP, 2015); additional areas were designated within the Project Area due to the effects of Hurricane Sandy in 2012.



Palm Beach County	
Location	Classification
R001-R010	Critical
Jupiter Inlet N & S	Critical Inlet
R012-R038	Critical
R038-R040	Noncritical
R058-R060.5	Noncritical
R060.5-R069	Critical
R076-R128	Critical
R128.8-R145.8	Critical
R152-R168	Critical
R176-R190	Critical
R204-R227.9	Critical

Figure 3-4. Critically and non-critically eroded areas in Palm Beach County (FDEP, 2015).

3.2.7. CLIMATE CHANGE

Recent climate research has documented global warming during the twentieth century, and has predicted either continued or accelerated global warming for the twenty-first century and possibly beyond (IPCC, 2007). This has the potential to increase the frequency and intensity of storm events. As such, he proposed project could therefore be considered a climate resiliency measure.

Potential relative sea-level change must be considered in coastal construction projects subject to tidal influence. The historical record of change in sea level for the study site is considered as the baseline of potential relative sea-level change (USACE, 2011a).

Historical rates of sea level change are determined using tide gauge records from coastal and deep-sea stations. The two stations closest to the Project Area with historical sea level rise data are the Lake Worth Pier and Miami Beach stations (Figure 3-5). The Lake Worth Pier station reported an average of 3.36 mm/year (0.13 in/yr) +/-0.69 mm/year (0.03 in/yr) based on monthly data from 1970 to 2014. This equates to an increased rate of sea level rise of 0.34 m (1.10 ft) per 100 years (NOAA, 2015). The Miami Beach station reported an average increase of 2.39 mm/yr (0.1 in/yr) +/-0.43 mm/yr (0.02 in/yr) based on monthly data from 1931 to 1981. This equates to an approximate rate of sea level rise of 0.24 m (0.78 ft) per 100 years.

According to the Brunn Rule, beaches adjust to sea level rise by retreating landward and upward. For the purposes of this study, recent background erosion rates of the beach at the Project Area were assumed to be indicative of future background erosion rates. Thus, the current rate of sea level rise at the Project Area was included in the estimates of the background erosion rates. If accelerated rates of sea level are experienced in the future, additional fill volumes and/or more frequent nourishment of the beach may be necessary to account for increased erosion rates.

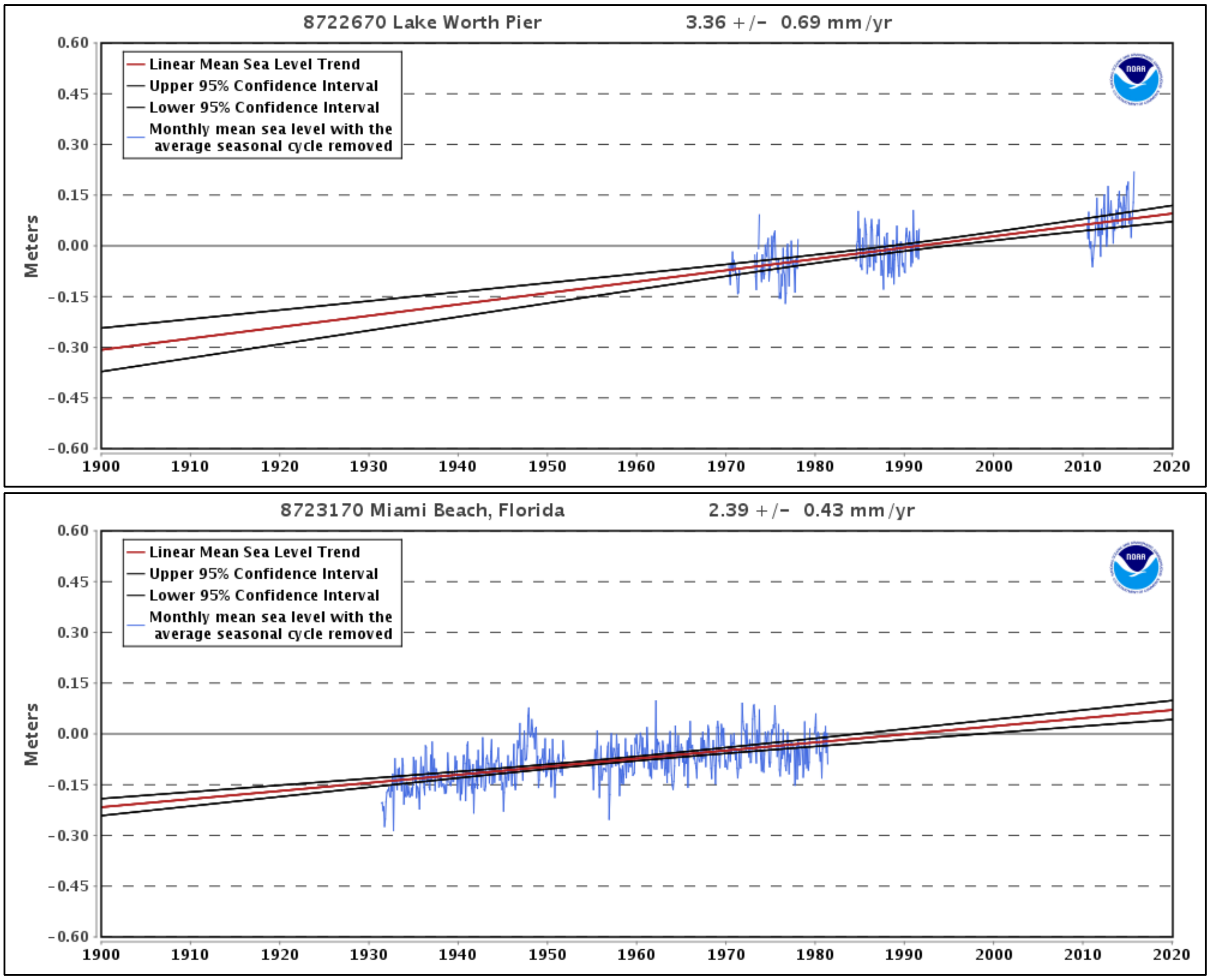
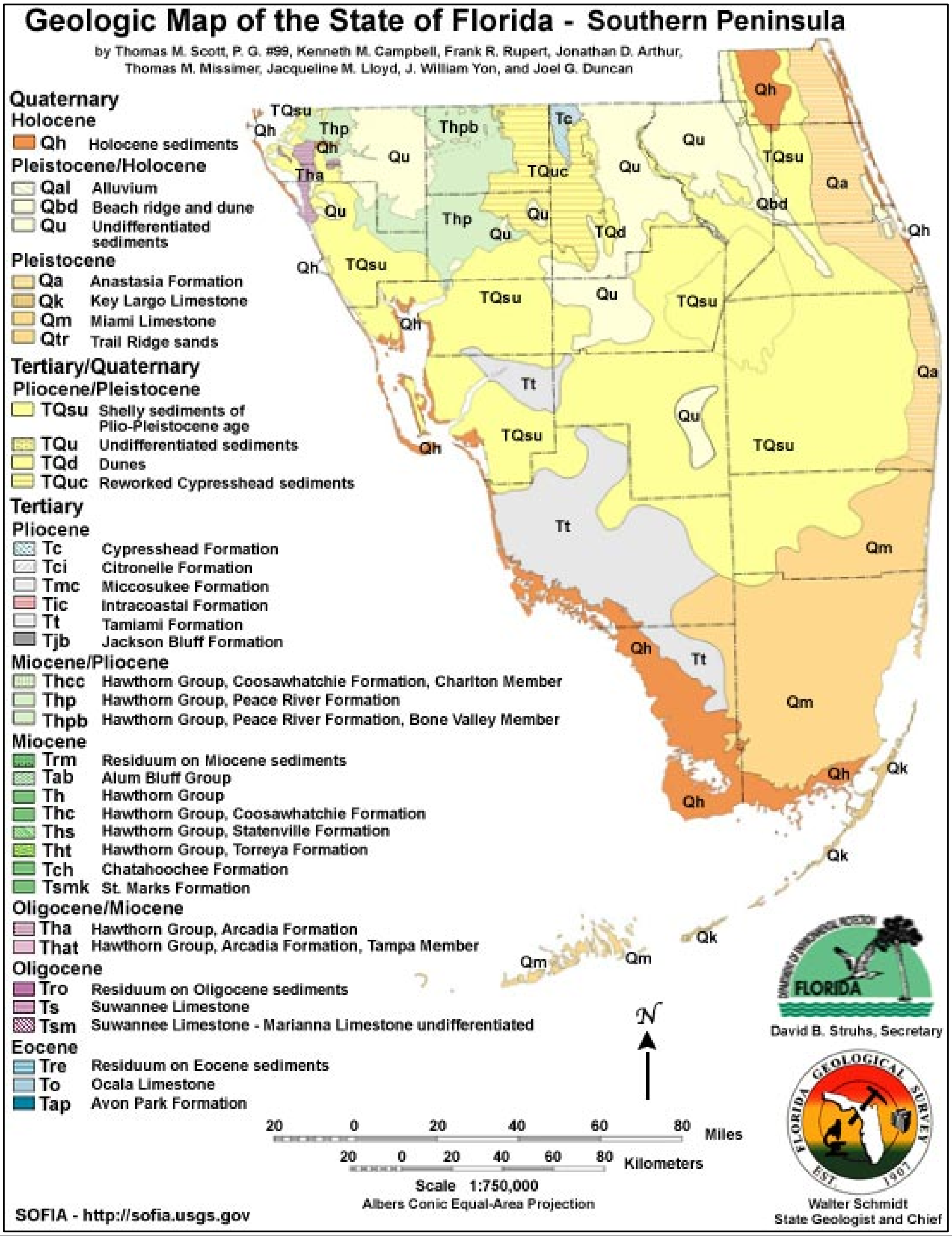


Figure 3-5. Mean sea level trends at the Lake Worth Pier and Miami Beach stations (NOAA, 2015).

3.2.8. GEOLOGY/SEDIMENT CHARACTERISTICS

Geologically, Florida lies on the Floridian Plateau, which has led to the formation of a variety of marine deposits as a result of periods of high sea level (Figure 3-6). Over the course of millions of years these deposits have been moved and transferred by waves and currents, influencing the creation of Florida’s beaches, offshore bars, and barrier islands. The Anastasia Formation was formed in the late Pleistocene and makes up the primary coastal bedrock on the east coast of Florida from St. Johns County to Palm Beach County (Cooke, 1945; Estevez and Finkl, 1999; CPE, 2007). This formation is an interbedded sand and coquina limestone composed primarily from mollusk shells, which provided a stable base where sediments could accumulate as sea level rose throughout the Holocene in response to deglaciation at the end of the Pleistocene (CPE, 2007; Duane and Meisburger, 1969; Finkl and Warner, 2005). Quartozose sands from the Pleistocene and beach and dune sediment from the Holocene now overlay this bedrock with a depth of 0.3-1.8 m (1-6 ft) (Duane and Meisberger, 1969; Finkl, 1993).



Epoch	Holocene	Pleistocene	Pliocene	Miocene	Oligocene	Eocene
MYA	0.01 - present	2.6 - 0.01	5.3 - 2.6	23.0 - 5.3	33.9 - 23.0	56.0 - 33.9

Figure 3-6. Geologic map of southern Florida depicting the epochs described by Millions of Years Ago (MYA) and the corresponding formations (ICS, 2013; Scott et al., 2001).

During the late Oligocene and early Miocene, a significant drop of the global sea level greatly influenced the creation of marine carbonate rocks in Florida. The lower sea level, which exposed marine carbonate rocks to a variety of conditions, promoted increased erosion. Surface runoff eroded early Oligocene carbonates producing a karst topography (White, 1970). Extensive dissolution of this region created large cavities such as caves and caverns (CPE, 2007).

Along Palm Beach County, sediments have accumulated between relict coral reefs along the shore to form inter-reefal sand bodies. These inter-reefal deposits are relatively uniform in composition (siliciclastics with small carbonate fractions) and grain size but there are finer and coarser facies composed of silt lenses or coral reef rubble, especially in basal layers (base of sedimentary sequences) on landward margins of the relict reefs and reef gaps. Generally, inter-reefal sediments are finer in the center of the deposit but coarser within the seaward and landward portions. Adjacent to the reef tracks, sediments are coarser due to the contribution of reef overwash deposits (reef fragments) (CPE, 2007). Overall, as stated above, the nearshore sediment within the Atlantic Ocean along southeast Florida’s coastline is primarily carbonate rich, formed from the remains of diverse marine flora and fauna (FDEP, 1994).

The hardbottom and reef resources offshore of the Project Area are part of the Continental Southeast Florida Reef Tract, which extends from southeast Miami to north of West Palm Beach. This reef tract runs parallel to shore and is comprised of a ridge complex (closest to shore) and an inner, middle and outer reef, all separated by sand deposits of varying thickness. These reefs are not frame-building but are colonized by a rich tropical fauna otherwise characteristic of the West Atlantic reef systems. From Hillsboro Inlet northward, the inner and middle reefs disappear leaving only the outer reef just north of Boca Inlet in the County (Banks et al., 2007; Banks et al., 2008; Walker, 2012). In the Study Area, the nearshore hardbottom of the nearshore ridge complex and the outer reef make up the hardbottom and reef resources adjacent to the Project Area. The nearshore hardbottom within Palm Beach County is also highly colonized by wormrock, which is formed by aggregations of tube building polychaete worms. The tubes consist of sand grains cemented together by proteins produced by the worms.

Table 3-5 summarizes sediment data and distribution collected between R-125 and R-134, specifically, the mean size, median size, and sorting. The Munsell color, which is a direct comparison of soils, examines the hue (specific color), value (lightness and darkness), and chroma (color intensity). Carbonate content of the sediment ranges from 34.8-44.2%.

Table 3-5. Palm Beach (Reach 8) summary of sediment data (ATM, 2010). No data is provided for R-128 because this R-Monument is located within the City of Lake Worth. Sand samples near R-135 were collected on September 17, 2015 by the County.

R-mon	Mean		Median		Sorting		Munsell Color	Carbonate Content (%)	Silt
	(phi)	(mm)	(phi)	(mm)	(phi)	(mm)			
T-125	0.65	0.64	0.64	0.64	0.99	0.50	10YR 5/2	44.1	0.00
R-126	1.31	0.40	1.50	0.35	0.94	0.52	10YR 5/2	36.1	0.00
R-127	1.48	0.36	1.63	0.32	0.89	0.54	10YR 6/2	36.5	0.00
R-129	1.82	0.28	1.88	0.27	0.68	0.62	10YR 6/1	34.8	0.00
R-130	1.66	0.32	1.76	0.30	0.81	0.57	10YR 6/2	35.5	0.00
R-131	1.3	0.41	1.38	0.38	0.78	0.58	10YR 6/2	36.8	0.00
R-132	0.99	0.50	1.01	0.50	0.93	0.52	10YR 6/2	39.4	0.00
R-133	1.07	0.48	1.10	0.47	0.84	0.56	10YR 5/2	40.5	0.00
R-134	0.53	0.69	0.68	0.62	1.10	0.47	10YR 5/2	44.2	0.00
R-135*	1.21	0.45	1.18	-	-	-	2.5Y 5/6	38.0	0.00
Composite	1.21	0.43	1.30	0.41	0.88	0.54	10YR 5.6/1.9	38.6	0.00

***Collected on September 17, 2015 by the County. The moist value is given for the Munsell color.**

The Town of Palm Beach prefers to utilize stockpiled dredged sand from the Phipps and/or Mid-Town projects as the preferred sand source for the Project Area within the Town of Palm Beach limits. The County prefers to use sand from an upland mine for their portion of the Project. See section 2.5. for additional details on the preferred sand sources.

3.3. VEGETATION

The upland developments along the shoreline in the Study Area are comprised of hotels, condominiums, homes, and public parks, most of which are armored with seawalls (USACE, 2013; PBC-ERM, 2013a). Figure 3-7 displays the existing land use data provided by Palm Beach County Planning, Zoning and Building for the Study Area; the Study Area includes primarily residential use.

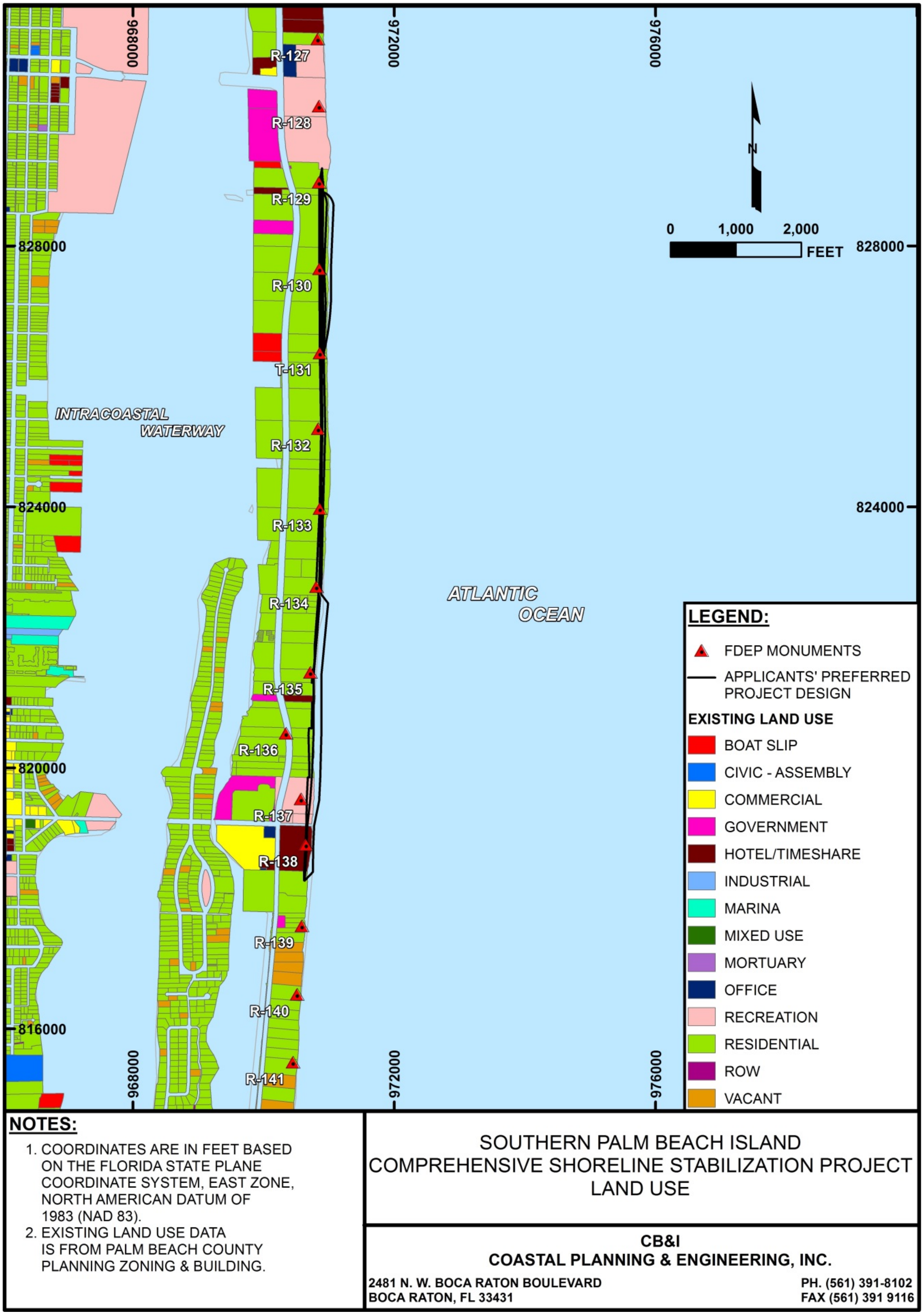


Figure 3-7. Existing land use in the Study Area (R-127 to R-141+586).

Barrier islands are dynamic environments with topographic and vegetation profiles dictated by the interaction of plant growth and physical processes such as wind-driven sand movement, salt spray, and wave-driven erosion and accretion. The dunes on a barrier island system are the vegetated mounds of unconsolidated sediments that lie landward of the active beach. Dune formation occurs when winds carrying beach sediments encounter resistance from vegetation, thereby causing the material to be deposited. Dunes are comprised of relatively finer sands, while those in the berm and beach face are often coarser. Dunes are dynamic geologic features that continually accrete and erode as a result of factors such as seasonal fluctuations in wave height and storm activity (Rogers and Nash, 2003).

Much of the native dune system within the Study Area has been lost to beach erosion and upland development. Within the Project Area (R-129-210 to R-138+551), there is currently 8.52 ac of dune area, 4.83 ac of beach area above (landward) of the berm crest and 16.34 ac of beach area below (seaward) of the berm crest. Severe erosion of the frontal dune community was observed during a 2005 dune survey in Reach 8 (T-125 to R-134). Dune vegetation observed on the site visits consisted primarily of seagrape (*Coccoloba uvifera*), along with sea oats (*Uniola paniculata*), inkberry (*Scaevola plumieri* L.), bitter panicum grass (*Panicum amarum*), bay cedar (*Suriana maritima*), and seashore elder (*Iva imbricata*). Seagrape and inkberry were most prevalent and typically found above eroded and undercut embankments. No vegetation was documented seaward of exposed seawalls in the Study Area (CPE and CSI, 2011a). A dune vegetation survey was also conducted in South Palm Beach (R-134 to R-141) in 2006 (CPE, 2007). The survey showed that 78% of the Study Area contained hardened structures (seawalls and revetments) where only minimal, scattered vegetation was observed seaward of the structures. The remaining 22% of the area included vegetated dune faces, which included a combination of native species typical to South Florida beach dunes and several invasive species; half flower (*Scaveola plumieri*) was the most significant invasive species observed (CPE, 2007).

In 2007, several species of dune vegetation were planted in both Reach 7 and Reach 8 as part of the Phipps Ocean Park Beach Restoration Project and FDEP Emergency Dune

Restoration Project. Approximately 80% of the plants were sea oats, and the remaining 20% consisted of 14 other species (CPE, 2009). A list of the planted species observed and planted is provided in Table 3-6. No threatened or endangered plants were identified during the dune surveys.

In November 2013, a dune vegetation investigation was performed within the Study Area. The 2013 Habitat Characterization Report (CB&I, 2014) is provided as Appendix D. Areas of interest (where vegetation was identified based on aerial photography) were ground-truthed by biologists. Exposed and buried seawalls are intermittently spaced along the shoreline from R-129 to just south of R-133. Dune vegetation exists on the seaward side of buried seawalls in this area. The shoreline includes exposed seawalls south of R-133 to R-141 (Figure 3-2). The dune located immediately south of Lake Worth Pier was dominated by sea oats while the dune located immediately north of the seawall at R-129 was dominated by bitter panicum grass. Seagrapes were the dominant dune vegetation identified throughout the remainder of the survey area, which terminated at R-133+500 where dune habitat ended and upland properties were bordered by seawalls instead of dunes. One exception, near R-133, was observed where dune vegetation was sparse. Overall, just less than half of the Project Area is fronted by dunes. The endangered plant species beach jacquemontia (*Jacquemontia reclinata*) was not present within the surveyed area (CB&I, 2014). Table 3-6 lists the dune and plant species observed during the 2005, 2006 and 2013 dune surveys as well as the species planted in 2007 (CPE and CSI, 2011a; CB&I, 2014).

Table 3-6. Dune vegetation within the Study Area (CPE, 2007, 2009; CPE and CSI, 2011a; CB&I, 2014).

Observed Species (2005, 2006, 2013)		Planted Species (2007)	
Common Name	**Scientific Name**	**Common Name**	**Scientific Name**
2005		Bay bean	*Canavalia rosea*
Bay cedar	*Suriana maritime*	Beach cordgrass	*Spartina patens*
Bitter panicum	*Panicum amarum*	Beach elder	*Iva imbricata*
Inkberry	*Scaevola plumieri L.*	Beach morning glory	*Ipomoea imperati*
Sea oats	*Uniola paniculata*	Beach verbena	*Verbena maritime*
Seagrape	*Coccoloba uvifera*	Bitter panicum	*Panicum amarum*
2006		Blanket flower	*Gaillardia pulchella*
Australian Pine	*Casuarina equisetifolia*	Dune sunflower	*Helianthus debilis*
Bay bean	*Canavalia rosea*	Railroad vine	*Ipomoea pes-caprae*
Beach croton	*Croton punctatus*	Sea lavender	*Limonium carolinianum*
Beach Peanut	*Okenia hypogeaea*	Sea oats	*Uniola paniculata*
Beach spurge	*Chamaesyce mesembryanthemifolia*	Sea purslane	*Sesuvium portulacastrum*
Crowfoot grass	*Dactyloctenium aegyptium*	Shore paspalum	*Pasplam distichum*
Half flower	*Scaveola sericea*	Virginia dropseed	*Sporobolus virginicus*
Purslane	*Portulaca oleracea*		
Railroad vine	*Ipomoea pes-caprae*		
Salt grass	*Distichlis spicata*		
Sea oats	*Uniola paniculata*		
Sea pickle	*Sesuvium portulacastrum*		
Seagrape	*Coccoloba uvifera*		
Seashore elder	*Iva imbricata*		
Silver buttonwood	*Conocarpus erectus*		
Spanish bayonet	*Yucca aloifolia*		
Spider lily	*Hymenocallis latifolia*		
2013			
Bitter panicum	*Panicum amarum*		
Sea oats	*Uniola paniculata*		
Seagrape	*Coccoloba uvifera*		

3.4. THREATENED AND ENDANGERED SPECIES

Federally Listed. The federally endangered and threatened list is maintained by the U.S. Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS) in accordance with the Endangered Species Act (ESA). In the ESA, “endangered” species are in danger of extinction throughout all or a significant portion of its range, “threatened” species are likely to become endangered within the foreseeable future throughout all or a significant portion of its range. A list of federally designated critical habitat for protected species is also maintained by the USFWS and NMFS in accordance with the ESA. The ESA defines “critical habitat” as 1) the specific areas within the geographical area occupied by the species at the time it is listed on which are found physical or biological features essential to the conservation of the species and which may require special management consideration or protection; and 2) specific areas outside of the geographical areas occupied by the species at the time it is listed upon a determination that such areas are essential for the conservation of the species. Listed species and designated critical habitat discussed are those that may be affected by the proposed Project and alternatives. A list of the federally protected species and critical habitat that may occur in the Study Area and along the potential truck route from an upland mine and/or the stockpile area to the Project Area is provided in Table 3-7.

Table 3-7. Federally and state-listed and proposed for listing species and critical habitat that may occur in the vicinity of the Project Area. (Threatened (T); Endangered (E); Federally-designated Nonessential Experimental species (FXN); Species of Special Concern (SSC); Not Listed (NL)).

Common Name	Scientific Name	Federal Listing Status	Current State Listing Status	Recommended State Listing
REPTILES				
Eastern indigo snake	*Drymarchon corais couperi*	T	NL	
Gopher tortoise	*Gopherus polyphemus*	Candidate	T	
Green sea turtle	*Chelonia mydas*	T[1]	NL	
Hawksbill sea turtle	*Eretmochelys imbricata*	E	NL	
Kemp's Ridley sea turtle	*Lepidochelys kempii*	E	NL	
Leatherback sea turtle	*Dermochelys coriacea*	E	NL	
Loggerhead sea turtle	*Caretta caretta*	T[2]/Critical Habitat[3,4]	NL	
AMPHIBIANS				
Gopher frog	*Lithobates capito*	NL	SSC	Remove
MAMMALS				
Finback whale	*Balaenoptera physalus*	E	NL	
Florida manatee	*Trichechus manatus latirostris*	E	NL	
Florida mouse	*Podomys floridanus*	NL	SSC	Remove
Florida panther	*Puma concolor coryi*	E	NL	
Humpback whale	*Megaptera novaeangliae*	E	NL	
North Atlantic right whale	*Eubalaena glacialis*	E	NL	
Sei whale	*Balaenoptera borealis*	E	NL	
Sperm whale	*Physeter catodon*	E	NL	
FISH				
Smalltooth sawfish	*Pristis pectinata*	E	NL	
BIRDS				
Black skimmer	*Rynchops niger*	NL	SSC	T
Burrowing owl	*Athene cunicularia floridana*	NL	SSC	T

Table 3-7 (cont'd). Federally and state-listed and proposed for listing species and critical habitat that may occur in the vicinity of the Project Area. (Threatened (T); Endangered (E); Federally-designated Nonessential Experimental species (FXN); Species of Special Concern (SSC); Not Listed (NL)).

Common Name	Scientific Name	Federal Listing Status	Current State Listing Status	Recommended State Listing
Florida sandhill crane	*Grus canadensis pratensis*	NL	T	
Limpkin	*Aramus guarauna*	NL	SSC	Remove
Little blue heron	*Egretta caerulea*	NL	SSC	T
Piping plover	*Charadrius melodus*	T/E[5]	NL	
Reddish egret	*Egretta rufescens*	NL	SSC	T
Roseate spoonbill	*Platalea ajaja*	NL	SSC	T
Red knot	*Calidris canutus rufa*	T		
Snowy egret	*Egretta thula*	NL	SSC	Remove
Tricolored heron	*Egretta tricolor*	NL	SSC	T
White ibis	*Eudocimus albus*	NL	SSC	Remove
Whooping crane	*Grus americana*	FXN/E[6]	NL	
PLANTS				
Beach jacquemontia	*Jacquemontia reclinata*	E	NL	
Johnson's seagrass	*Halophila johnsonii*	T[7]	NL	
CORALS				
Boulder star coral	*Orbicella annularis*	T	NL	
Elkhorn coral	*Acropora palmata*	T[8]	NL	
Mountainous star coral	*Orbicella faveolata*	T	NL	
Pillar coral	*Dendrogyra cylindrus*	T	T	
Rough cactus coral	*Mycetophyllia ferox*	T	NL	
Staghorn coral	*Acropora cervicornis*	T[8]	NL	
Star coral complex	*Orbicella franksi*	T	NL	

[1] Green turtles are listed as threatened, except for the distinct population segments (DPSs) in the Mediterranean, Central West Pacific, and Central South Pacific, which are listed as endangered.

[2] Northwest Atlantic Ocean (NWA) distinct population segment (DPS). On September 22, 2011, NMFS and USFWS issued a final rule changing the listing of loggerhead sea turtles from a single threatened species to nine distinct population segments (DPSs) listed as either threatened or endangered (FR 76 58868). The NWA DPS was listed as threatened.

[3] The final USFWS critical habitat rule (79 FR 39755) was published on July 10, 2014 and went into effect on August 11, 2014. The Project Area is located with unit LOGG-T-FL-12.

[4]The final NMFS rule (79 FR 39855) was published on July 10, 2014 and went into effect on August 11, 2014. The Project Area falls within the LOGG-N-19 unit.

[5] Piping plovers are listed as threatened, except for the Great Lakes population which is listed as endangered; Florida provides overwintering habitat for both threatened and endangered populations. Critical habitat is designated for the species in Texas.

[6] Whooping cranes are listed as a non-essential experimental population in Florida, however the species is federally listed as endangered in the USFWS Southwest Region, except where FXN.

[7] Critical habitat was designated for Johnson’s seagrass in ten areas spanning from Sebastian Inlet to central Biscayne Bay (65 FR 17787); none of these areas fall within the Project Area.

[8] Critical habitat designated for *A. cervicornis* and *A. palmata* is located outside of the Project Area (73 FR 72210).

Species Eliminated From Further Analysis. Federally listed species and critical habitat which may occur in southeast Florida or the Atlantic waters off the Florida coast but are not likely to occur in the Project Area were eliminated from further consideration. The range of alternatives utilize both stockpiled sand from an offshore borrow area and an upland sand source for the proposed truck haul nourishment project. The effects associated with the in-water construction activities associated with dredging are included in the Mid-Town and Phipps projects. Due to the unlikelihood of potential impacts to whales from this construction method, listed whale species are not discussed in further detail in this analysis. Johnson's seagrass has not been documented in the nearshore habitat of the Project Area but is normally found in the Atlantic Intracoastal Waterway (AICW) west of the Project Area. The Project Area is located in the Consultation Area; however, the Statewide Programmatic Biological Opinion (USFWS, 2015) states the Southeastern beach mouse "is currently restricted to Volusia, Brevard, and Indian River counties. Therefore, the Southeastern beach mouse is not expected to occur within the Project Area. Due to the fact that these federally-listed species are unlikely to be found in the vicinity of the Project Area, it has been determined that the Proposed Action will have "no effect" on whales, Southeastern beach mouse, or Johnson's seagrass. Therefore these species will not be evaluated further in this document.

The following sections provide species descriptions, distribution, and the location of any designated critical habitat for listed species with the potential to occur within or in the vicinity of the Study Area. Table 3-7 provides a summary of federally and state-listed threatened and endangered species as well as those proposed for listing. State-listed species are discussed in Section 3.6.4. In addition, the table includes designated and proposed critical habitat that have the potential to occur within the Study Area based on each species' distribution and habitat preference, as determined by the USFWS, NMFS, and FWC. The Biological Assessment (BA) (Appendix E) discusses federally threatened and endangered species in detail, identifies potential project impacts on the species, and provides recommended protection and conservation measures.

3.4.1. SEA TURTLES

Five species of sea turtles can be found in Florida waters: loggerhead (*Caretta caretta*), green, *(Chelonia mydas)*, leatherback *(Dermochelys coriacea)*, hawksbill *(Eretmochelys imbricata)*, and Kemp's ridley *(Lepidochelys kempii)*. Leatherback, hawksbill, and Kemp's ridley sea turtles are federally listed as endangered, and the Northwest Atlantic population of loggerheads and the North Atlantic population of green turtles are federally listed as threatened. The sea turtle nesting season in Palm Beach County is from March 1 to October 31. Leatherbacks typically nest early in the season followed by loggerheads and greens. Loggerheads arrive in substantial numbers in May. Nesting continues through the summer months and tapers off in early September (PBC-ERM, 2014).

3.4.1.1. SEA TURTLE SPECIES LIFE HISTORY

3.4.1.1.1. Loggerhead Sea Turtles

The loggerhead sea turtle (*Caretta caretta*) was listed on July 28, 1978 as a threatened species under the ESA (43 FR 32800). On September 22, 2011, NMFS and USFWS established a Final Rule to list nine Distinct Population Segments (DPSs) of loggerhead sea turtles that qualify as ‘‘species’’ for listing as endangered or threatened under the ESA (76 FR 58868). Under this rule, four DPSs were listed as threatened (Northwest Atlantic Ocean (NWA), South Atlantic Ocean, Southeast Indo-Pacific Ocean, and the Southwest Indian Ocean) and five were listed as endangered (Northeast Atlantic Ocean, Mediterranean Sea, North Indian Ocean, North Pacific Ocean and South Pacific Ocean). The population found within the Study Area is the threatened NWA DPS.

Loggerhead adults and sub-adults have a large, reddish-brown carapace. Scales on the top and sides of the head and on top of the flippers are also reddish-brown but have yellow borders. The neck, shoulders, and limb bases are dull brown on top and medium yellow on the sides and bottom. The plastron is also medium yellow. Adult average size in the southeast U.S. is approximately 1 m (39 in) straight carapace length; average weight is 116 kg (256 lbs). The relative size of a loggerhead's head, when compared to the rest of its body, is substantially larger than other sea turtle species (NMFS and

USFWS, 2007a; 2008). Adults reach sexual maturity at about 35 years old. Sexually mature females emerge from the water and deposit their eggs in nests on the beach berm between April and September.

The primary threats to loggerhead sea turtle recovery include: bottom trawl, pelagic longline, demersal longline, and demersal large mesh gillnet fisheries; legal and illegal harvest; vessel strikes; beach armoring; beach erosion; marine debris ingestion; oil pollution; light pollution; and predation by native and exotic species (NMFS and USFWS, 2008).

On March 25, 2013, USFWS proposed critical habitat for the NWA DPS of the loggerhead sea turtle under the ESA (78 FR 17999). The final rule (79 FR 39755) was published on July 10, 2014 and went into effect on August 11, 2014. The intended effect of this regulation is to assist with the conservation of the loggerhead sea turtle's habitat under the ESA. The critical habitat areas extend along approximately 1,102 km (685 miles) of shoreline fronting the Atlantic Ocean from North Carolina to Florida and the Gulf of Mexico from Florida to Mississippi. The proposed Project Area includes critical habitat unit LOGG-T-FL-12 which consists of 24.3 km (15.1 mi) of island shoreline along the Atlantic Ocean and extends from Lake Worth Inlet to Boynton Inlet.

As part of the critical habitat designation process the physical and biological features of terrestrial environments are identified in areas occupied at the time of listing that are essential to the conservation of the loggerhead sea turtle. Specifically, the focus is on the primary constituent elements (PCE) of those features. PCEs are defined as the specific elements that are essential to the conservation of the species and provide for a species' life-history processes (79 FR 39755). The USFWS has proposed four terrestrial PCEs for NWA DPS of the loggerhead sea turtle:

(1) PCE 1 - Suitable nesting beach habitat that has (a) relatively unimpeded nearshore access from the ocean to the beach for nesting females and from the beach to the ocean for both post-nesting females and hatchlings and (b) is located above mean high water (MHW) to avoid being inundated frequently by high tides.

(2) PCE 2 - Sand that (a) allows for suitable nest construction, (b) is suitable for facilitating gas diffusion conducive to embryo development, and (c) is able to develop and maintain temperatures and a moisture content conducive to embryo development.

(3) PCE 3 - Suitable nesting beach habitat with sufficient darkness to ensure nesting turtles are not deterred from emerging onto the beach and hatchlings and post-nesting females orient to the sea.

(4) PCE 4 - Natural coastal processes or artificially created or maintained habitat mimicking natural conditions.

The USFWS also determined that protection and special management considerations are required within critical habitat areas to address threats to the essential features of loggerhead sea turtle terrestrial habitat. The primary threats that may impact the habitat are grouped into 12 categories. Ten of these categories apply to the LOGG-T-FL-12 unit: recreational beach use; predation; beach and sand placement activities; in-water and shoreline alterations; coastal development; artificial lighting; beach erosion; climate change; habitat obstructions, and human-caused disasters and response to natural and human-caused disasters (79 FR 39755).

On July 18, 2013 NMFS proposed critical habitat for the loggerhead sea turtle NWA DPS within the Atlantic Ocean and the Gulf of Mexico. Specific areas proposed for designation include 36 occupied marine areas within the range of the NWA DPS. These areas contain one or a combination of nearshore reproductive habitat, winter area, breeding areas, and migratory corridors (78 FR 43005). The final rule (79 FR 39855) was published on July 10, 2014 and went into effect on August 11, 2014. A portion of the critical habitat area LOGG-N-19 is located within the proposed Project Area. Unit LOGG-N-19 contains nearshore reproductive habitat, constricted migratory habitat, and breeding habitat. The unit contains the southern Florida constricted migratory corridor habitat, overlapping southern Florida breeding habitat, and overlapping nearshore reproductive habitat. The southern portion of the Florida concentrated breeding area and the southern Florida constricted migratory corridor are both located in the nearshore waters starting at the

Martin County/Palm Beach County line to the westernmost edge of the Marquesas Keys (82.17° W. long.), with the exception of the waters under the jurisdiction of NAS Key West. The seaward border then follows the 200 m (0.12 mile) depth contour to the westernmost edge at the Marquesas Keys. The overlapping nearshore reproductive habitat within the proposed Project Area includes nearshore waters starting at the Martin County/Palm Beach County line to Hillsboro Inlet (crossing Jupiter, Lake Worth, Boynton, and Boca Raton Inlets) from the MHW line seaward 1.6 km (1.0 mile).

3.4.1.1.2. Green Sea Turtles

The green sea turtle (*Chelonia mydas*) was federally listed as a protected species on July 28, 1978 (43 FR 32800) under the ESA. In this initial listing, breeding populations of the green turtle in Florida and along the Pacific Coast of Mexico were listed as endangered; all other populations were listed as threatened. On April 6, 2016 NMFS and USFWS issued a final rule to list 11 DPSs based on the best available scientific and commercial data (81 FR 20058). Under this rule, three DPSs are endangered species (Mediterranean, Central West Pacific, and Central South Pacific) and eight DPSs are threatened species (North Atlantic, South Atlantic, Southwest Indian, North Indian, East Indian-West Pacific, Southwest Pacific, Central North Pacific, and East Pacific). The threatened North Atlantic DPS is located in the Project Area. Green turtles are the largest of all the hard-shelled sea turtles, but have a comparatively small head. While hatchlings are typically just 50 mm (2 in) long, adults can grow to more than 0.91 m (3 ft) long and weigh 136-159 kg (300-350 lbs) (NMFS, 2013a). Characteristics that distinguish the green turtle from other marine turtle species include four pairs of lateral (or costal) scutes and a single pair of elongated prefrontal scales between the eyes (NMFS and USFWS, 1991). A green turtle's carapace is smooth and can be shades of black, gray, green, brown, and yellow. Their plastron is yellowish white. Hatchlings are distinctively black on the dorsal carapace and white on the ventral plastron. Adult green turtles differ from other sea turtles in that they are herbivorous, feeding primarily on seagrass and algae. This diet is thought to give them greenish colored fat, from which they take their name (NMFS and USFWS, 1991; NMFS, 2013a).

Threats to the green sea turtle include a loss or degradation of nesting habitat from coastal development, beach nourishment and beach armoring, disorientation of hatchlings by beachfront lighting, excessive nest predation by native and non-native predators, degradation of foraging habitat, marine pollution and debris, watercraft strikes, and incidental take from channel dredging and commercial fishing operations. Fibropapillomatosis, a disease of sea turtles characterized by the development of multiple tumors on the skin and internal organs, is also a mortality factor and has seriously impacted green turtle populations in Florida, Hawaii, and other parts of the world. The tumors may interfere with swimming, eating, breathing, vision, and reproduction, which, if grown large enough, can prove to be fatal (NMFS and USFWS, 1991; 2007b).

In 1998, NMFS designated critical habitat for the green sea turtle to include the coastal waters around Culebra Island, Puerto Rico (63 FR 46693). There is no green sea turtle critical habitat in the vicinity of the proposed Project Area.

3.4.1.1.3. Leatherback Sea Turtles

The leatherback sea turtle (*Dermochelys coriacea*) was listed as endangered throughout its range on June 2, 1970 (35 FR 8491). Adult leatherbacks are highly migratory and are believed to be the most pelagic of all sea turtles (NMFS and USFWS, 1992). The leatherback turtle is distributed worldwide in tropical and temperate waters of the Atlantic, Pacific, and Indian Oceans. They are also found in small numbers as far north as British Columbia, Newfoundland, and the British Isles, and as far south as Australia, Cape of Good Hope, and Argentina (USFWS, 2013a). The leatherback is the largest turtle and the largest living reptile in the world. Mature adults can be as long as 2 m (6.5 ft) and weigh almost 900 kg (2000 lbs). The leatherback is the only sea turtle that lacks a hard, bony shell; its carapace consists of leathery, oil saturated connective tissue overlaying loosely interlocking dermal bones. The carapace has seven longitudinal ridges and tapers to a blunt point. Adult leatherbacks are primarily black with a pinkish white mottled ventral surface and pale white and pink spotting on the top of the head. The front flippers lack claws and scales and are proportionally longer than other sea turtles and their back flippers are paddle-shaped. The ridged carapace and large flippers are characteristics that make the leatherback uniquely equipped for long distance foraging migrations, during which their diet consists of gelatinous organisms such as jellyfish and salps (free-swimming, oceanic tunicate of the genus *Salpa*) (NMFS, 2013b).

Leatherback turtles face threats while on nesting beaches and in the marine environment. The crash of the Pacific leatherback population, once the world's largest population, is believed to be the result of exploitation by humans for the eggs and meat, as well as incidental take from commercial fisheries mainly in the Pacific Ocean. The primary threats to leatherbacks worldwide continue to be long-term harvest and incidental capture in fishing gear. Harvest of eggs and adults occurs on nesting beaches while juveniles and adults are harvested on feeding grounds. Incidental capture mainly occurs in gillnets, but also in trawls, traps and pots, longlines, and dredges. Together, these threats are serious ongoing sources of mortality that adversely affect the species' recovery (NMFS, 2013b). Other factors threatening leatherbacks include loss or degradation of nesting habitat from coastal development, disorientation of hatchlings by beachfront lighting, excessive nest predation by native and non-native predators, marine pollution and watercraft strikes (NMFS and USFWS, 1992; 2007c).

In 1978, USFWS initially designated 0.3 km (0.2 mi) of land at Sandy Point Beach on the Western end of St. Croix in the Virgin Islands as critical habitat for the leatherback sea turtle. In 1979, NMFS extended critical habitat to the coastal waters adjacent to Sandy Point (44 FR 17710). The designation was again revised in 2012 to include approximately 43,798 km² (16,910 mi²) along the California coast, and 64,760 km² (25,004 mi²) of coastline between Washington and Oregon (77 FR 4170). There is no leatherback critical habitat in the vicinity of the Project Area.

3.4.1.1.4. Hawksbill Sea Turtles

The hawksbill sea turtle (*Eretmochelys imbricata*) was listed as an endangered species on June 2, 1970 (35 FR 8491). It is small to medium-sized compared to other sea turtle species. Adults weigh 45-68 kg (100-150 lbs) on average, but can grow as large as 91 kg (200 lbs). Hatchlings weigh about 14 g (0.5 oz). The carapace of an adult ranges from 63-90 cm (25-35 in) in length and has a "tortoiseshell" coloring, ranging from dark to golden brown with streaks of orange, red, and/or black. The shells of hatchlings are about 42 mm (1-2 in) long and are mostly brown and somewhat heart-shaped. The plastron is clear yellow. The hawksbill turtle's head is elongated and tapers to a point, with a beak-like mouth that gives the species its name. The shape of the mouth allows the hawksbill turtle to reach into holes and crevices of coral reefs to find invertebrate prey including sponges, their primary food source as adults. Hawksbill turtles are unique among sea turtles in that they have two pairs of prefrontal scales on the top of the head and each of their flippers usually has two claws (NMFS and USFWS, 1993; NMFS, 2013c).

This species is most commonly associated with healthy coral reefs and is found in tropical and subtropical seas of the Atlantic, Pacific, and Indian Oceans. Hawksbills are widely distributed throughout the Caribbean Sea and western Atlantic Ocean, regularly occurring in southern Florida and the Gulf of Mexico (especially Texas), in the Greater and Lesser Antilles, and along the Central American mainland south to Brazil (NMFS and USFWS, 1993; NMFS 2013c).

The decline of the hawksbill species has been primarily due to human exploitation for tortoiseshell. While the legal hawksbill shell trade ended when Japan agreed to stop importing shell in 1993, a significant illegal trade continues. Like other species of sea turtles, the current threats to hawksbills also include loss or degradation of nesting habitat from coastal development, construction of buildings and pilings, beach armoring and nourishment, and sand extraction. These factors may directly or indirectly serve to decrease the amount of nesting area available to nesting females and may evoke a change in the natural behaviors of adults and hatchlings. Sea-level rise resulting from climate change may increase practices to fortify the coast, further exacerbating the problem (NMFS and USFWS, 2013).

Artificial lighting along the coast also presents a threat to hawksbill sea turtles. The presence of lights on or adjacent to nesting beaches alters the behavior of nesting adults and is often fatal to emerging hatchlings as they are attracted to light sources and drawn away from the water or may even cause them to change course offshore. In many countries, coastal development and artificial lighting are responsible for substantial hatchling mortality (NMFS and USFWS, 2013). Another major threat to hawksbills is habitat loss of coral reef communities, which provide food resources and habitat. Coral reefs are vulnerable to destruction and degradation caused by human activities (e.g. pollution, vessel groundings, global climate change). While previously thought to be obligate reef dwellers, it is now thought that hawksbills may occupy a range of habitats that include coral reefs or other hard bottom habitats, seagrass, algal beds, mangrove bays and creeks (NMFS and USFWS, 2013). In the Caribbean, seagrass beds, which are thought to be peripheral habitat for hawksbills, sustain hawksbill foraging aggregations comparable to reef habitat. Although not as common as coral reef or hardbottom habitat, Bjorndal and Bolten (2010) state that hawksbills historically may have used seagrass habitat but abandoned it as green turtle populations collapsed and the pastures went ungrazed decreasing the value of the habitat for hawksbills. Nonetheless, seagrass pastures may become more important as coral reefs decline (NMFS and USFWS, 2013).

Critical habitat for the hawksbill sea turtle has been designated in coastal waters surrounding Mona and Monito Islands, Puerto Rico (63 FR 46693). There is no hawksbill critical habitat in the vicinity of the Project Area.

3.4.1.1.5. Kemp's Ridley Sea Turtles

The Kemp's ridley sea turtle (*Lepidochelys kempii*) was first listed as endangered throughout its range on December 2, 1970 under the ESA (43 FR 32800) (NMFS et al., 2011; NMFS, 2013d). This species was also listed by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) on July 1, 1975, which prohibited all international commercial trade. The International Union for the Conservation of Nature (IUCN) lists the Kemp's ridley as critically endangered (NMFS, 2013d).

The smallest of the sea turtles, the Kemp's ridley has a straight carapace length of approximately 65 cm (25.6 in) with the adult's shell almost as wide as it is long. The dorsal carapace is round to heart-shaped and distinctly light gray. The range of the Kemp's ridley includes the Gulf coasts of Mexico and the U.S., and the Atlantic coast of North America as far north as Nova Scotia and Newfoundland. The Atlantic waters off the eastern seaboard of the U.S. from New England to Florida serve as important foraging grounds for juvenile stages. Adults of this species are usually confined to the Gulf of Mexico although adult-sized individuals sometimes are found on the east coast of the U.S. (NMFS et al., 2011). Male turtles migrate between breeding and foraging grounds that span many different parts of the Gulf of Mexico while females have been tracked migrating from nesting grounds to foraging grounds ranging from the Yucatan Peninsula to southern Florida (NMFS, 2013d).

This species experienced dramatic declines in numbers in from 1948 to the early 2000's mainly due to various anthropogenic causes. In 1947, video footage of nesting activity captured the arrival of upwards of 40,000 females at Rancho Nuevo in Tamaulipas, Mexico (NMFS, 2013d). Collapse of the species was evident twenty years later when only 5,000 nesting females were observed. By 1985, the population declined to record lows with 702 nests representing only 300 females. Today, under strict protection, the population appears to be in the early stages of recovery. Nesting has drastically increased since the 1980s and over 20,000 nests were recorded at nesting beaches in Tamaulipas, Mexico in 2009. However, only 13,302 nests were recorded in 2010 at this location (NMFS et al., 2011). In Texas, nesting data from 2005 to 2010 indicate approximately 5,500 females are nesting annually, which is a dramatic increase from the total of 81 nests recorded between 1948 and 1998 (Shaver and Caillouet Jr., 1998). It should be noted that more nests may have been present during this timeframe but were not recorded due to lack of monitoring resources.

The recent increase in Kemp's ridley populations may be indicative of the success of several fishing regulations designed to reduce impact to sea turtles in the commercial fisheries. The Kemp's ridley has also benefitted from conservation efforts enacted by the Mexican government since the 1960s including a ban on the take of any sea turtle species and designation of the Rancho Nuevo nesting beach as a Natural Protected Area in 2002. Utilizing the current survival rates for hawksbill sea turtles, models predict that the population will grow at a rate of 19% per year (NMFS et al., 2011).

NMFS and USFWS were jointly petitioned in February of 2010 to designate critical habitat for the Kemp's ridley sea turtles' nesting beaches along the Texas coast and marine habitats in the Gulf of Mexico and Atlantic Ocean. This petition is currently being reviewed (NMFS, 2013d). Critical habitat is not found in the vicinity of the Project Area.

3.4.1.2. NESTING HABITAT

Nesting sea turtles and emergent hatchlings are present annually on the beaches of Palm Beach County during nesting season (March 1 - October 31). The Florida statewide sea turtle nesting database provides the nesting results of Florida's surveyed beach in 2015 (FWC, 2015). Overall, 34,215 nests were recorded in 2015 along 74.1 km (46.0 mi) of shoreline in the County. Of these, 70.7% were loggerheads, 27.9% were green, and 1.4% were leatherback. The County constituted approximately 29.7% of the overall nesting of Florida’s eastern coastline and 26.7% of the state (FWC, 2015d). These three species are known to regularly nest on the County’s beaches. Table 3-8 summarizes the sea turtle monitoring data collected within the Study Area (R-127 to R-141+586) between 2009 and 2015. The data provided by FWC Fish and Wildlife Research Institute (FWRI) encompass the survey areas starting in R.G. Kreusler Memorial Park (R-127) extending south to South Lake Worth Inlet (R-151). The nesting data are not referenced by R-monument during the monitoring surveys; therefore, in order to estimate the nesting area within the Study Area, the Manalapan survey area (~4.2 km [2.6 mi]) data were scaled to include only the portion of Manalapan south to R-141+586 (~1.3 km [0.8 mi]). Based on coordination with FWC, presenting a portion of Manalapan survey area as a fraction of the entire area was determined to be an appropriate method to estimate nesting; however, it should be noted that this method assumes an even distribution of nesting along the Manalapan survey shoreline and therefore would not account for any areas that may experience higher (or lower) nesting densities than other areas (Brost, pers. comm., 2013).

Table 3-8. Sea turtle nest and non-nesting emergences (NNE) by species from 2009-2015 within the Study Area (R-127 to R-141+586). Data Source: Brost, pers. comm. (2015) using FWC/FWRI Statewide Nesting Beach Survey Program Database.

Year	Loggerhead		Green		Leatherback	
	Nests	NNE	Nests	NNE	Nests	NNE
2009	776	1265	44	73	19	12
2010	856	1428	60	82	7	6
2011	1097	1659	127	94	15	3
2012	1269	2026	63	39	18	3
2013	1335	1437	172	108	4	0
2014	1616	1953	78	113	14	1
2015	1829	1970	78	116	15	0

3.4.1.2.1. Loggerhead Sea Turtles

The loggerhead sea turtle is found throughout the temperate and tropical regions of the Atlantic, Pacific and Indian Oceans and is the most abundant sea turtle occurring in U.S. waters. Recent data suggests that there are only two locations with greater than 10,000 nesting females: south Florida and Masirah Island in Oman. In the southeast U.S., nesting is estimated at approximately 68,000 to 90,000 nests per year (NMFS, 2013e), with the majority occurring on over 2,400 km (1491 mi) of beaches located along North Carolina (531 km [330 mi]), South Carolina (303 km [188 mi]), Georgia (164 km [102 mi]), Florida (1,327 km [825 mi]), and Alabama (78 km [49 mi]). About 80% of loggerhead nesting in the southeast U.S. occurs in six Florida counties: Brevard, Indian River, St. Lucie, Martin, Palm Beach, and Broward Counties (NMFS, 2013e). Females lay between three to five clutches per season with incubation periods ranging from about 42 to 75 days (NMFS and USFWS, 2008; NMFS, 2013e). During non-nesting years, adult females from U.S. beaches are distributed in waters off the eastern U.S., Bahamas, Greater Antilles, Yucatán, and throughout the Gulf of Mexico (NMFS and USFWS, 2008).

Palm Beach County includes one of the four (possibly more) genetically distinct loggerhead nesting subpopulations, broadly termed the South Florida Nesting Subpopulation. The geographic extent of this subpopulation spans the Florida peninsula stretching from 29˚N on the east coast to Sarasota County on the west coast (TEWG, 2000). Nesting typically occurs within the Study Area between May and August of each year. In 2015, 24,198 loggerhead nests were recorded within the County, which represented 70.7% of the total turtle nests surveyed within this area. Surveys in 2015 recorded the seconded highest count since 1998, and exceeds the previous 18-year average of 14,936 (± 4,457) by approximately 9,000 nests. Figure 3-8 displays the overall upward trend in the number of loggerhead nests recorded each year since 1998.

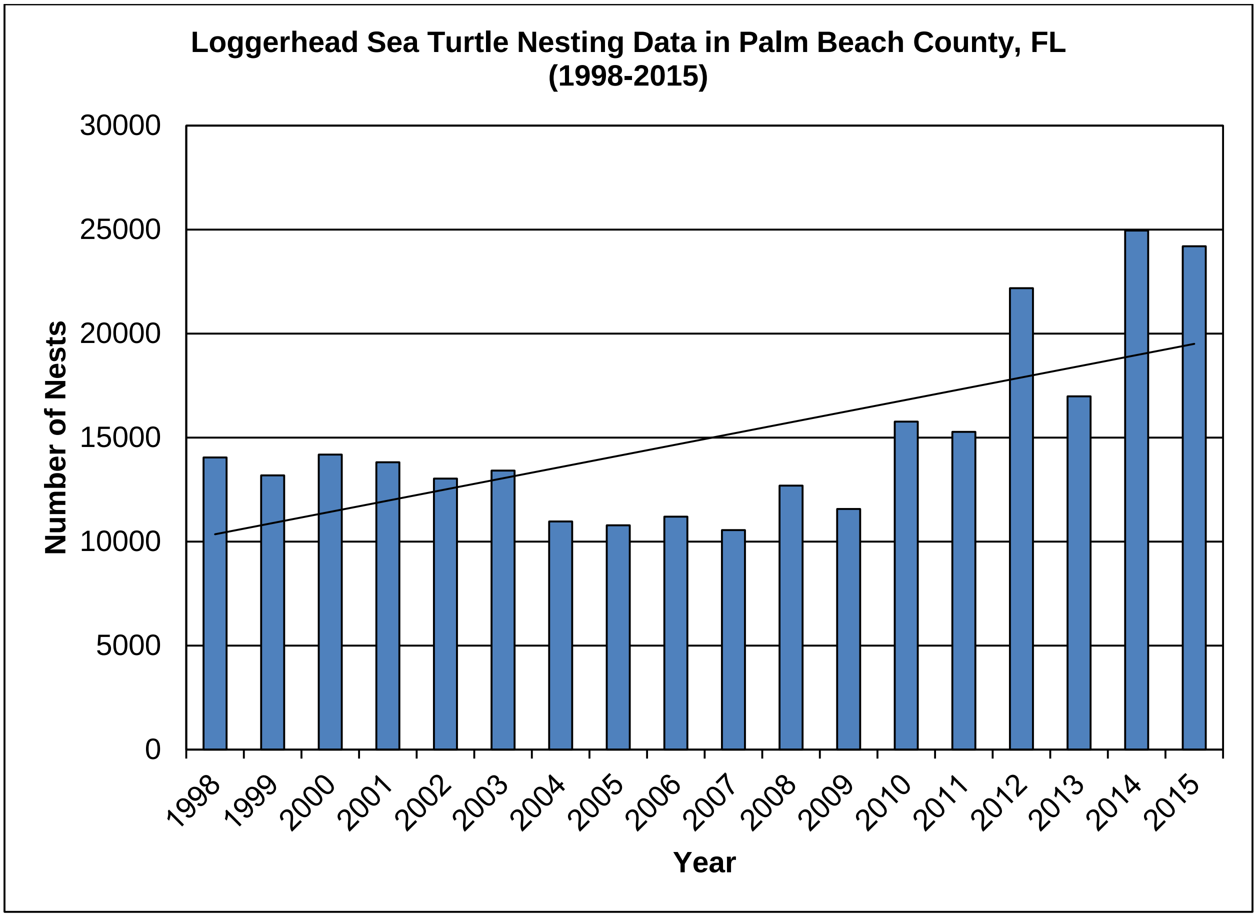


Figure 3-8. Loggerhead sea turtle nesting data for Palm Beach County (1998-2015); the black line represents a slightly increasing linear trend in the number of nests per year (PBC-ERM, 2015).

3.4.1.2.2. Green Sea Turtles

Green sea turtle nesting occurs in over 80 countries. The two largest nesting populations are found at Tortuguero, on the Caribbean coast of Costa Rica and Raine Island on the Great Barrier Reef in Australia (NMFS, 2013a). Major green turtle nesting colonies in the western Atlantic/Caribbean occur on the Yucatán Peninsula (Mexico), Tortuguero (Costa Rica), Aves Island (Venezuela), Galibi Reserve (Suriname) and Isla Trinidade (Brazil)

(NMFS and USFWS, 2007b). In the U.S., green turtles nest primarily along the central and southeast coast of Florida. Present annual estimates from within this area range from 200 to 1,100 nesting females (NMFS, 2013a). Scientists estimate that green turtles reach sexual maturity anywhere between 20 and 50 years of age. At that time, females begin returning to their natal beaches every 2-4 years to lay eggs. In the southeastern U.S., females generally nest between June and September while peak nesting occurs in June and July. Females nest at approximately two week intervals laying an average of five clutches in one nesting season. In Florida, green turtle nests contain an average of 135 eggs which incubate for approximately 2 months before hatching (NMFS, 2013a).

Green turtles deposited 9,554 nests in the County in 2015 which was the highest count recorded from 1998-2015. There is an overall upward trend in yearly number of green sea turtle nests since 1998. The 2015 nesting data were above the previous 18-year average of 2,639 (± 2,555) by approximately 7,000 nests (Figure 3-9). According to FWC (2016a), green sea turtle nesting data typically has large year-to-year fluctuations due to their two-year reproductive cycle.

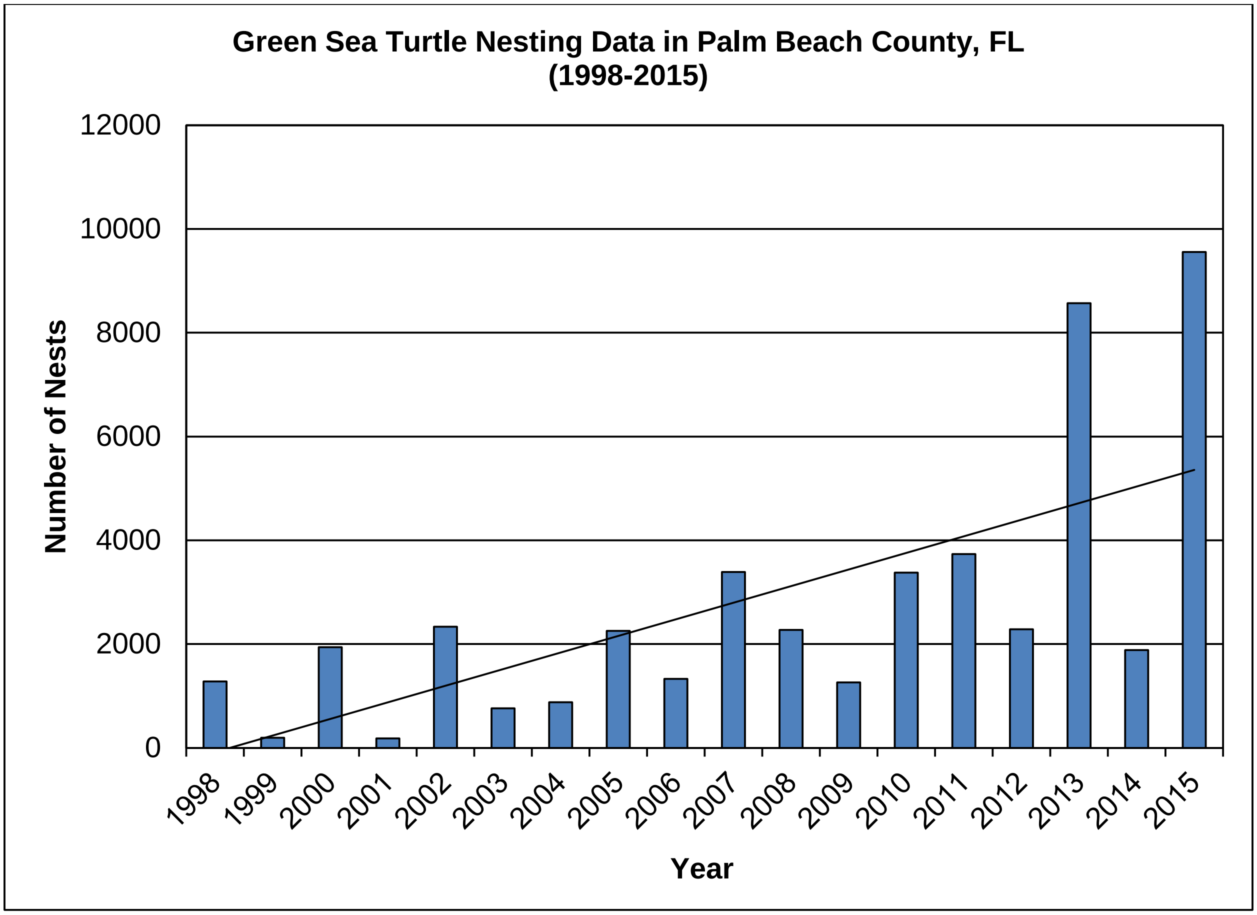


Figure 3-9. Green sea turtle nesting data for Palm Beach County (1998-2015); the black line represents an increasing linear trend in the number of nests per year (PBC-ERM, 2015).

3.4.1.2.3. Leatherback Sea Turtles

Nesting grounds for the leatherback sea turtle are distributed worldwide. The largest nesting populations in the Atlantic are located in Suriname and French Guiana (5,000-20,000 females nesting/year) and Gabon (15,730-41,373 females nesting/year). In the western Pacific, the largest nesting populations are in Papua, Solomon Islands, Papua New Guinea, Vanuatu, and Indonesia (2,700-4,500 females nesting/year). In the United States, small nesting populations occur in Florida (63-754 nests/year), Sandy Point, U.S. Virgin Islands (143-1,008 nests/year), and Puerto Rico (including Culebra) (32-395 nests/year) and mainland (131-1,291 nests/year) (NMFS, 2013b). The U.S. Caribbean (primarily Puerto Rico and the U.S. Virgin Islands) and southeast Florida support minor nesting colonies but represent the most significant nesting activity within the U.S. Adult leatherbacks are capable of tolerating a wide range of water temperatures and have been sighted along the entire continental east coast of the United States as far north as the Gulf of Maine and south to Puerto Rico, the U.S. Virgin Islands, and into the Gulf of Mexico (NMFS and USFWS, 2007c; NMFS, 2013b). Females nest several times during a nesting season with each nest containing approximately 100 eggs. The incubation period for leatherback sea turtles ranges from approximately 55 to 75 days (NMFS, 2013b).

Leatherback turtles are not found foraging in the nearshore areas of the County; however, they have been recorded to nest within the Study Area. Leatherbacks deposited 463 nests in the County in 2015 which was higher than the previous 18-year average of 342 (± 157) nests by approximately 100 nests. There has been an overall upward trend in yearly number of leatherback sea turtle nests since 1998 (Figure 3-10).

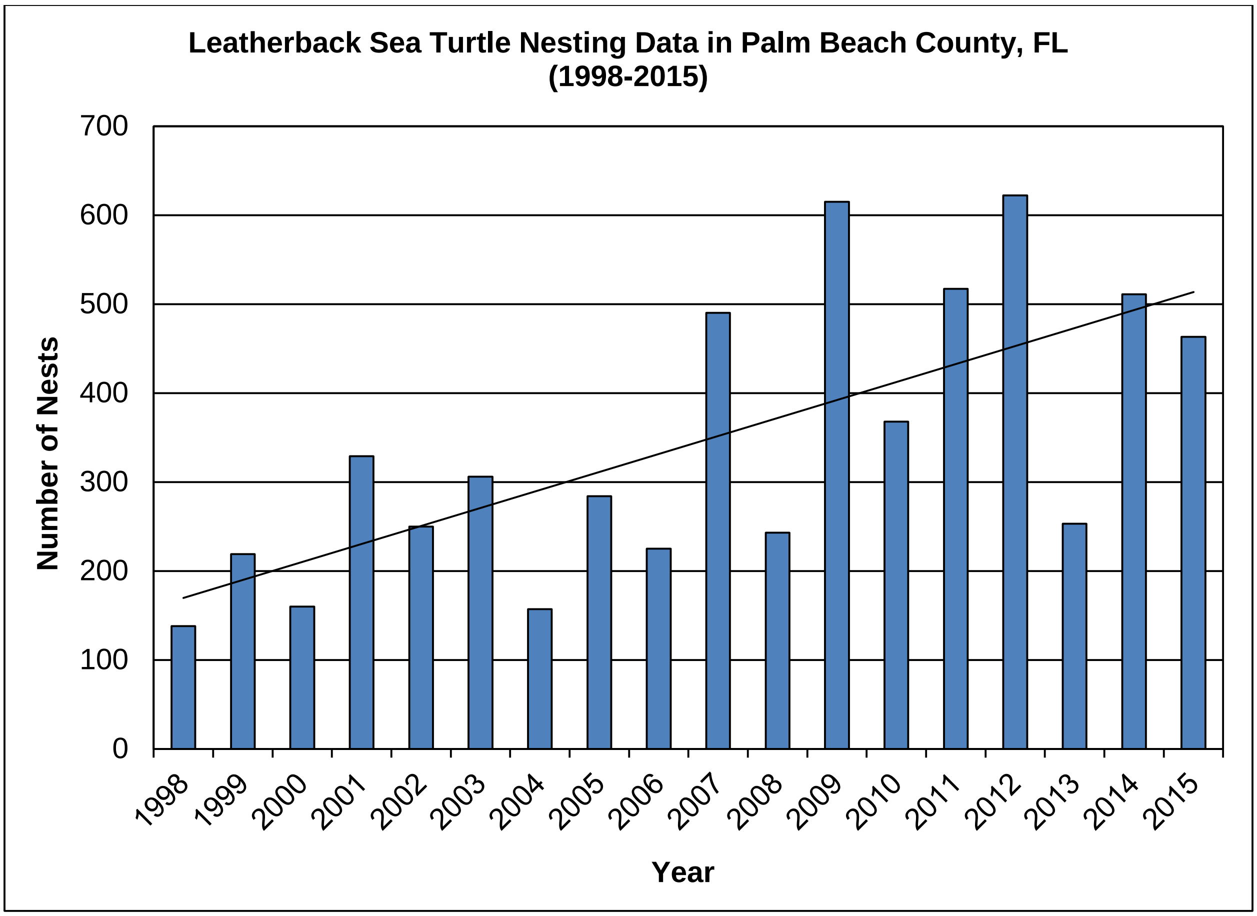


Figure 3-10. Leatherback sea turtle nesting data for Palm Beach County (1998-2015); the black line represents an increasing linear trend in the number of nests per year (PBC-ERM, 2015).

3.4.1.2.4. Hawksbill Sea Turtles

Hawksbills are solitary nesters; thus, determining population trends or estimates on nesting beaches is difficult. The largest populations of hawksbills are found in the Caribbean, the Republic of Seychelles, Indonesia, and Australia. The largest nesting population of hawksbills occurs in Australia. The most significant nesting within the U.S. occurs in Puerto Rico and the U.S. Virgin Islands, specifically on Mona Island and Buck Island, respectively. Nesting also occurs on beaches in St. Croix, St. John, St. Thomas, Culebra Island, Vieques Island and mainland Puerto Rico. In addition, hawksbills nest at numerous other sites throughout the Caribbean with the majority of nesting occurring in Mexico and Cuba (NMFS and USFWS, 1993; NMFS, 2013c). Within the continental U.S., nesting is rare and restricted to the southeast coast of Florida and the Florida Keys. No nesting occurs on the west coast of the U.S. mainland. In the U.S. Pacific, hawksbills nest only on main island beaches in Hawaii as well as American Samoa and Guam. Female hawksbills return to their natal beaches every 2-3 years generally laying 3-5 nests per season with an average clutch size of approximately 130 eggs. Hawksbill turtles usually nest high up on the beach under or in the beach/dune vegetation. They are also commonly observed nesting on pocket beaches with little or no sand. The incubation period for hawksbill sea turtles is approximately 60 days (NMFS and USFWS, 1993; NMFS, 2013c).

Although they are common inhabitants of the shallow nearshore waters of southern Florida, hawksbill sea turtles nest infrequently along the County shorelines. Within the past 20 years, only 5 nests have been documented in the County and none of those nests were documented within the proposed Project Area.

3.4.1.2.5. Kemp’s Ridley Sea Turtles

Nesting aggregations of Kemp’s ridley turtles occur at Rancho Nuevo in Tamaulipas, Mexico, where 95% of worldwide nesting occurs for this species. These nesting aggregations (known as “arribadas”) are synchronized events unique to the *Lepidochelys* genus. Nesting also occurs in Veracruz, Mexico, and Texas, U.S., but on a much smaller scale. Nesting occurs from May to July. Females lay two to three clutches of approximately 100 eggs per season which incubate for 50 to 60 days (NMFS, 2013d). After leaving the nesting beach, hatchlings are believed to become entrained in eddies within the Gulf of Mexico, where they are dispersed within the Gulf and Atlantic by oceanic surface currents until they reach about 20 cm (8 in) in length. At this size they enter coastal shallow water habitats. As juveniles, Kemp's ridley turtles feed primarily upon crabs, clams, mussels and shrimp and are most commonly found in productive coastal and estuarine areas. Adults primarily prey upon swimming crabs, but may also eat fish, jellyfish, and mollusks (NMFS, 2013d).

Kemp's ridley sea turtles nests have never been documented in the County, and therefore are unlikely to occur in Project Area.

3.4.1.3. NEARSHORE MARINE HABITAT

The complex life history of sea turtles requires the use of a variety of different habitats throughout the course of their life. Following the early stages of sea turtle development, known as the "lost years" which occur in the pelagic, open ocean, juvenile sea turtles return to more inshore, developmental habitat to grow and forage. This inshore habitat, namely the inner continental shelf, is considered to be the waters and seabed, including both softbottom and hardbottom habitat, extending from the shoreline to the 20 m isobath. The proposed Project and alternatives are not expected to extend over the inner continental shelf, but temporary impacts may occur out to approximately 350 m (1150 ft) offshore in less than 5 m (15 ft) water depth.

3.4.1.3.1. Loggerhead Sea Turtles

The loggerhead sea turtle occupies three different habitats throughout its lifecycle: the beach, open ocean (pelagic), and neritic (coastal zone). Movement among these habitats is influenced by the change in dietary needs. In the early juvenile stage, loggerheads drift and feed in large patches of *Sargassum* sp. algae within the open ocean. However, at later stages, they move inshore to forage on benthic communities of the hard and softbottom substrates. Here, their diet mainly consists of invertebrates and occasional jellyfish or algae (Bjorndal, 1997). The loggerhead sea turtle is found year-round in Florida waters with a peak during spring and fall migrations (USACE, 2012). Loggerheads depend on the inner continental shelf habitat for foraging, inter-nesting habitat, and migration (NMFS, 2013e).

3.4.1.3.2. Green Sea Turtles

The green sea turtle distribution extends worldwide in tropical and subtropical waters. Green sea turtles are thought to inhabit coastal areas of more than 140 countries. In the U.S. Atlantic and Gulf of Mexico waters, green sea turtles are found in inshore and nearshore waters from Texas to Massachusetts, the U.S. Virgin Islands, and Puerto Rico. Green sea turtles can be found in the fairly shallow waters of the inner continental shelf, primarily around coral reefs, seabeds, and mangroves. While juveniles are known to primarily prey upon invertebrates, adult green sea turtles are primarily herbivores and depend on seagrass and algae within this zone (NMFS, 2013a).

3.4.1.3.3. Leatherback Sea Turtles

Leatherbacks have the widest global distribution of any reptile and are the most pelagic of any sea turtle (NMFS, 2013b). Adult leatherbacks are capable of tolerating a wide range of water temperatures, and have been sighted along the entire continental east coast of the United States as far north as the Gulf of Maine and south to Puerto Rico, the U.S. Virgin Islands, and into the Gulf of Mexico (NMFS and USFWS, 2007c; NMFS, 2013b). They are found in the mid/inner shelf where thermal fronts accumulate food, particularly gelatinous prey items such as jellyfish and salps (NMFS and USFWS, 2007c; NMFS, 2013b).

3.4.1.3.4. Hawksbill Sea Turtles

Hawksbills are found worldwide in tropical and subtropical seas where they inhabit shallow coastal areas, lagoons, and coral reefs. Being omnivores, hawksbills feed primarily on sponges, benthic crustaceans, tunicates, bryozoans, algae, and mollusks (Bjorndal, 1997). Smaller populations of foraging hawksbills reside along the hardbottom habitats of the Florida Keys and other small islands in Puerto Rico and the U.S. Virgin Islands (NMFS and USFWS, 1993).

3.4.1.3.5. Kemp's Ridley Sea Turtles

Adults of this species are usually confined to the Gulf of Mexico, although adult-sized individuals are occasionally found on the east coast of the United States (NMFS, 2013d). Immature Kemp’s ridleys have been found along the eastern seaboard of the United States and in the Gulf of Mexico. In the continental U.S., Kemp ridleys frequent warm temperate to subtropical sounds, bays, estuaries, tidal passes, shipping channels, and nearshore waters. These ecosystems overlap with the distribution of the turtle’s preferred food source: the blue crab (*Callinectes sapidus*) (Landry and Costa, 1999). The movements of Kemp’s ridleys within and among developmental habitats have been documented along both the Atlantic and Gulf coasts (Henwood, 1987). In the Atlantic, immature turtles travel northward seasonally as the water temperature increases to feed in the productive, coastal offshore waters from Georgia to New England. They then migrate southward with the onset of winter as water temperatures drop (Lutcavage and Musick, 1985; Henwood, 1987). Studies have shown the post-hatchling pelagic stage varies from one to four or more years, and the immature stage lasts seven to nine years (Renaud, 1995). The Turtle Expert Working Group (TEWG) (2000) estimates age to maturity to occur between seven to fifteen years.

3.4.2. FLORIDA MANATEE

The West Indian manatee includes two distinct subspecies, the Florida manatee (*Trichechus manatus latirostris*) and the Antillean manatee (*Trichechus manatus manatus*). The Florida manatee was first listed as endangered under the Federal Endangered Species Preservation Act of 1966 (32 FR 4001), later superseded by the 1969 Endangered Species Conservation Act. Previously, however, Florida prohibited the killing of manatees in 1893, making it one of the first wildlife species in the U.S. to receive protection. In 1973, manatees were listed under the ESA. They are also protected under the Marine Mammal Protection Act (MMPA) of 1972. The USFWS published a five-year review of the Florida manatee population in 2007, which stated that the best available science shows the overall population of the Florida manatee has increased and the Antillean manatee levels are stable, and neither subspecies is currently in danger of becoming extinct within all or a significant portion of their range. The USFWS concluded that the West Indian manatee species' status better fits the ESA definition of threatened and as such has recommended reclassification (USFWS, 2007a). On January 8, 2016 the USFWS published (81 FR 1000) a 12-month finding on a petition to downlist the West Indian manatee and a proposed rule to reclassify the West Indian manatee as threatened; however, this species is currently still listed as endangered.

Manatees are round, slow-moving aquatic mammals with bodies that taper to a flat, paddle-shaped tail. They have two forelimbs, called flippers, with three to four nails. Their small head has a square snout with fleshy mobile lips, numerous whiskers, and two semi-circular nostrils at the front. The body is gray to brown, and is covered with fine hairs (Jefferson et al., 1993).

The Florida manatee is found in subtropical and tropical waters from the western North Atlantic to the southeastern U.S. in freshwater, brackish, and marine environments. Typical coastal and inland habitats include coastal tidal rivers and streams, mangrove swamps, salt marshes, freshwater springs, and vegetated bottoms. Manatee diets include submerged, emergent, and floating vegetation. Shallow grass beds, with ready access to deep channels, are generally preferred feeding areas in coastal and riverine habitats. In coastal Georgia and northeastern Florida, manatees feed in salt marshes on smooth cordgrass (*Spartina alterniflora*) by timing feeding periods with high tide. Manatees use springs and freshwater runoff sites for drinking water; secluded canals, creeks, embayments, and lagoons for resting, cavorting, mating, calving and nurturing their young; and open waterways and channels as travel corridors (USFWS, 2001; 2007a).

Florida manatees occupy different habitats during various times of the year. During the winter, cold temperatures keep the population concentrated in peninsular Florida and many manatees rely on the warm water from natural springs and power plant outfalls. During the summer they expand their range and, on rare occasions, are seen as far north as Rhode Island on the Atlantic coast and as far west as Texas on the Gulf coast (USFWS, 2001; 2007a). The Florida manatee population appears to be divided into at least two somewhat isolated areas, one on the Atlantic coast and the other on the Gulf coast of Florida; the populations are broken down further into regional groups, with the Northwest and Southwest groups on the Gulf Coast and Atlantic and Upper St. Johns River groups on the Atlantic coast (USFWS, 2001). Each of these “subpopulations” is composed of individual manatees that tend to return to the same warm-water sites each winter and have similar non-winter distribution patterns. Exchange of individuals between these subpopulations is considered to be limited during winter months, based on telemetry data (USFWS, 2007a).

The most significant threat to Florida manatees is death or injury from boat strikes (USFWS, 2001). In the Northwest Region, which includes Alabama waters, adult mortality is almost equally divided between human-related and natural causes with watercraft collision (direct impact and/or propeller) being the primary cause of human-induced mortality. For non-adults, perinatal mortality is the most common cause of death with watercraft collisions ranked second (USFWS, 2007a). Other human-related threats include entrapment and/or crushing in water control structures (e.g. gates, locks) and entanglement in fishing lines and crab pot lines. Natural threats include exposure to cold and red tide which can result in mortality through cold stress syndrome and brevitoxicosis, respectively (USFWS, 2007a). In Florida, many manatees depend on warm-water refuges, however, the long-term availability of these refuges is uncertain if minimum flows and levels are not established for natural springs and as deregulation of the power industry in Florida occurs (USFWS, 2001).

The current available estimate of the Florida manatee population is 6,250 individuals, based on synoptic aerial surveys of warm-water sites on the east and west coasts of Florida conducted on February 11, 12, and 13, 2016 (FWC, 2016b). This was the highest count recorded during synoptic surveys since 1991. The annual statewide manatee synoptic surveys were not performed in winter of 2008, 2012 or 2013 because the warmer than average weather created unfavorable survey conditions that did not meet minimum criteria established by FWC.

In the County, manatees are common year-round residents in canals and waterways. Collection of data from past surveys suggests that in the County the most abundant populations occur during the winter season. The north section of Lake Worth Lagoon (LWL) is an area of particular importance for manatee habitat. Extensive seagrass beds occur in this area serving as an attractant to manatee populations (CUESFAU and EAI, 2007). Since 1974, FWC has documented mortality statistics of the Florida manatee including the number of deaths and their cause. Data from 2015 (not yet finalized) show a total of ten manatee mortalities in the County categorized by perinatal, cold stress, undetermined causes, and unrecovered. This represents approximately 2.5% of the total 405 manatee mortalities documented within Florida. Of the 405 total mortalities, 15 were red-tide related deaths in 2015. Preliminary data from 2016 ending on January 31, 2016 show a total of three manatee mortalities in the County, or 7% of the total 43 manatee mortalities documented within Florida to date (FWC, 2016c).

Palm Beach County's Department of Environmental Resources Management (PBC-ERM) developed an FWC-approved Manatee Protection Plan (MPP) in 2006. The main goals of the MPP are: to reduce the risks to manatees while ensuring adequate public access to waterways; to protect manatee habitat, to promote boating safety; and to increase public awareness of the need to protect manatees and their environment. Specifically, the MPP includes the following components: 1) a Boat Facility Siting Plan, which inventories existing boat facilities and natural resources; 2) an evaluation of boat use and traffic patterns; 3) criteria on which proposed sites will be evaluated; 4) lists and maps of locations of potential marina facilities; 5) dock densities; 6) policies for the expansion of existing boat facilities; 7) boating speed zones; 8) provisions to protect water quality and submerged aquatic vegetation; and 9) a local education and awareness element, as well as enforcement (CUESFAU and EAI, 2007).

Critical habitat was designated in 1976 for the Florida manatee (50 CFR Part 17.95[a]). This was one of the first ESA designations of critical habitat for an endangered species and the first for an endangered marine mammal (USFWS, 2001). On March 16, 2012, the USFWS established a manatee refuge in the waters of Kings Bay, its tributaries and connected waters in Citrus County, Florida (77 FR 15617). There is no critical habitat for the Florida manatee within the Study Area. Manatees may be found passing through the nearshore habitat of the Study Area.

3.4.3 FLORIDA PANTHER

The Florida panther (*Puma concolor coryi)* was listed as endangered under the ESA on March 3, 1967 (32 FR 4001). It is one of the smaller cougar species in the western hemisphere. Adult males can reach a length of 2.1 m (7 ft) with a shoulder height between 60-70 cm (24-28 in), and an average weight of 52.6 kg (116 lbs). Females are smaller, as they only reach a length of up to 1.8 m (6 ft) and a weight of 34 kg (75 lbs). Adult Florida panthers have a reddish-brown back, dark tan sides, and a pale gray belly. Kittens have a gray colored body, with black or brown spots, and five stripes that go around the tail. Panthers are never black in coloration (USFWS, 2008).

Florida panthers are carnivores and their diet consists primarily of deer, raccoons, wild hogs, armadillos, and rabbits. Florida panther home ranges average 194 and 388 km^2 (75 and 150 mi^2) for females and males, respectively. There is some overlap amongst home ranges, particularly for females, but males are typically intolerant of other males.

Florida panthers are solitary in nature, except for females with kittens, and they do not form pair bonds with mates. The total gestation time is 92-96 days with one to four kittens per litter. Births occur throughout the year, but mainly occur in late spring. Dens are usually created in a palmetto thicket. Females do not breed again until their young are 1.5-2 years old. Females reach sexual maturity at 1.5-2.5 years old, while males reach sexual maturity around 3 years old.

Female panthers have a higher survival rate and therefore tend to live longer than male panthers. Ages at death average 7.5 years for females and just over 5 years for males. The oldest known wild panthers were 20 and 14 years old at death for a female and male panther, respectively.

Florida panthers inhabit large forested communities and wetlands (FNAI, 2001). They can be found in south Florida and parts of central Florida, although male panthers have been documented as far north as central Georgia. Collier, Glades, and Lee counties are the stronghold for the Florida panther, but Miami-Dade and Monroe counties are also important. Currently, FWC estimates there are between 100 and 160 adult panthers in south Florida (FWC, 2014b). The USFWS panther subteam of Multi-Species/Ecosystem Recovery Implementation Team (MERIT) developed three panther habitat zones to identify important areas for the long-term survival of the species (Figure 3-11). The Primary Zone encompasses “all lands essential for the survival of the Florida panther in the wild.” The Secondary Zone includes “lands contiguous with the Primary Zone, and areas which panthers may currently use, and where expansion of the Florida panther population is likely to occur.” The Dispersal Zone is an “area needed for panthers to disperse north of the Caloosahatchee River.” There are Primary, Secondary, and Dispersal Zones within Collier and Glades County, which are where potential upland mines are located, therefore the Florida panther may potentially occur in the vicinity of truck routes from upland mines.

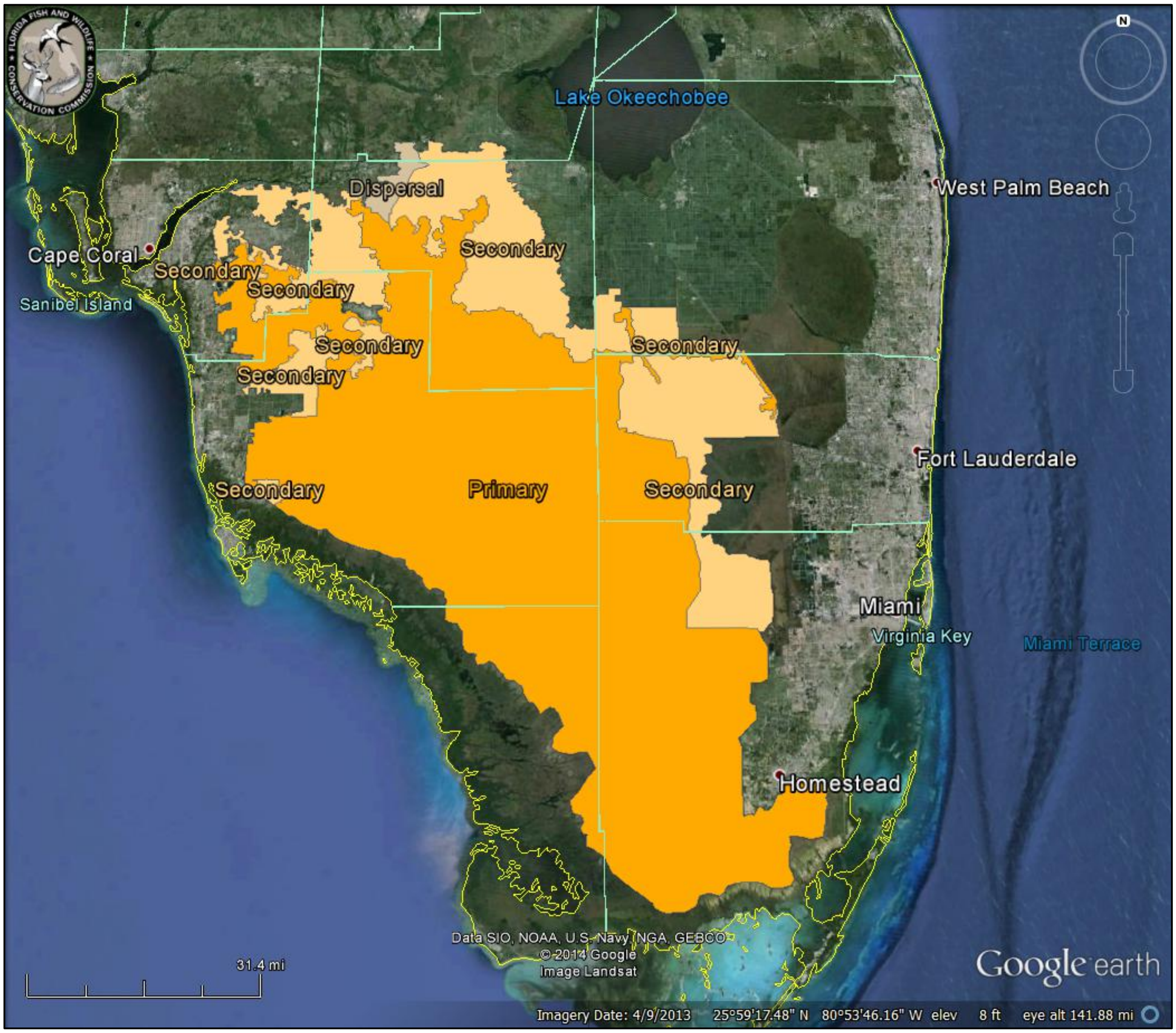


Figure 3-11. Florida panther habitat zones (FWC, 2012).

Habitat loss and hunting have led to the panther's near extinction. Low wild population numbers led to decreased genetic diversity and inbreeding. A plan to restore the genetic health of Florida panthers was implemented in 1995. Genetic restoration involved the release of eight female pumas (*Puma concolor stanleyana*) from Texas in 1995 into available panther habitat in south Florida. The Texas subspecies was selected for this Project because they represented the closest puma population to Florida, and historically, the Florida panther subspecies bordered the Texas population and interbreeding occurred naturally between them. Five of the eight Texas females reproduced successfully, resulting in a minimum of 20 kittens. By 2003, the last three surviving Texas females were removed from the wild Florida population; no Texas pumas remain in the wild in Florida today. Habitat loss and fragmentation continue to be major threats to the Florida panther, along with inbreeding, insufficient large prey, disease and environmental contaminants (FWC, 2014b; PantherNet, 2014).

3.4.4. SMALLTOOTH SAWFISH

The smalltooth sawfish (*Pristis pectinata*) is a tropical marine and estuarine elasmobranch that inhabits the waters of the eastern United States, the northwestern terminus of their Atlantic range. On April 1, 2003, NMFS published a final rule to list the U.S. distinct population segment as an endangered species under the ESA (68 FR 15674). The smalltooth sawfish commonly reaches 5.5 m (18 ft) in length and may grow to 7 m (25 ft) (NMFS, 2013f). Little is known about the life history of these animals, however research has suggested that they may live up to 25-30 years, maturing after approximately 10 years. Like many elasmobranchs, smalltooth sawfish are ovoviviparous, meaning the mother hatches the eggs inside of her until the young are ready to be born, usually in litters of 15 to 20 pups.

Sawfish species inhabit shallow coastal waters of tropical seas and estuaries throughout the world. Specifically, they are usually found in shallow waters very close to shore over muddy and sandy bottoms within sheltered bays, on shallow banks, and in estuaries or river mouths (NMFS, 2013f). Juvenile sawfish use shallow, well-vegetated habitats, such as mangrove forests, as nursery areas. Smalltooth sawfish have been reported in the Pacific and Atlantic Oceans and Gulf of Mexico; however, the U.S. population is found only in the Atlantic Ocean and Gulf of Mexico. Historically, the U.S. population was common throughout the Gulf of Mexico from Texas to Florida and along the east coast from Florida to Cape Hatteras. Now, however, this species is most commonly found within the Everglades region of southern Florida (NMFS, 2013f). Sawfish encounters have also been recorded within Florida Bay and the Florida Keys in depths ranging from less than 3 m (10 ft) to greater than 21 m (70 ft) within a variety of habitats including mud, sand, seagrass, limestone hardbottom, rock, coral reef, and sponge bottom. Some individuals were also seen associated with a culvert pipe, sea fans, artificial reefs, a freshwater spring, and an oil rig (Poulakis and Seitz, 2004). Although sawfish were once a common sight off Florida's coastline, they have become less common during the last century due to overfishing. Although not always targeted as a commercial fisheries species, their long rostra, commonly known as "saws", were easily entangled in any kind of fishing gear. Sawfish rostrums have also been popular trophy items. Since these fish produce few young, it has been a challenge for their population to recover after being depleted (FWC, 2013d). Many of the habitats that serve as nursery areas for juveniles have been modified or lost due to development of the waterfront in Florida and other southeastern states, likely contributing to the decline of this species (NMFS, 2013f). Population data are few for this species, therefore reliable estimates of the current population size are not available (NMFS 2009a; 2013f). However, historic records, including museum records and anecdotal fishermen observations indicate that the smalltooth sawfish was once abundant throughout its range. Available data suggest that the distribution has been reduced by about 90%, and that the population has declined by 95% or more (NMFS, 2013f). Based on the contraction in range and anecdotal data, it is likely that the population is currently at a level less than 5% of its size at the time of European settlement (NMFS, 2009a).

According the International Sawfish Encounter Database, there have been 55 sightings of *P. pectinata* in Palm Beach County between 2003 and 2015 (Figure 3-12). Two sightings were in South Lake Worth Inlet and the remaining 53 were sighted in the Atlantic Ocean. Within the same time frame, five smalltooth sawfish were sighted within roughly 4 km (2.5 mi) of the Town of Palm Beach. Since April 2011, there have been three smalltooth sawfish sightings in the Atlantic Ocean offshore the Town of Palm Beach (Frick, pers. comm., 2013). On May 25, 2014, a smalltooth sawfish was caught with hook and line in the County near the Boynton Beach (Landau, 2014).

Critical habitat was designated for the smalltooth sawfish on September 2, 2009, and includes two units: the Charlotte Harbor Estuary Unit and the Ten Thousand Islands/Everglades Unit. These two units are located along the southwestern coast of Florida between Charlotte Harbor and Florida Bay (73 FR 45353). There is no smalltooth sawfish critical habitat in the vicinity of the Project Area.

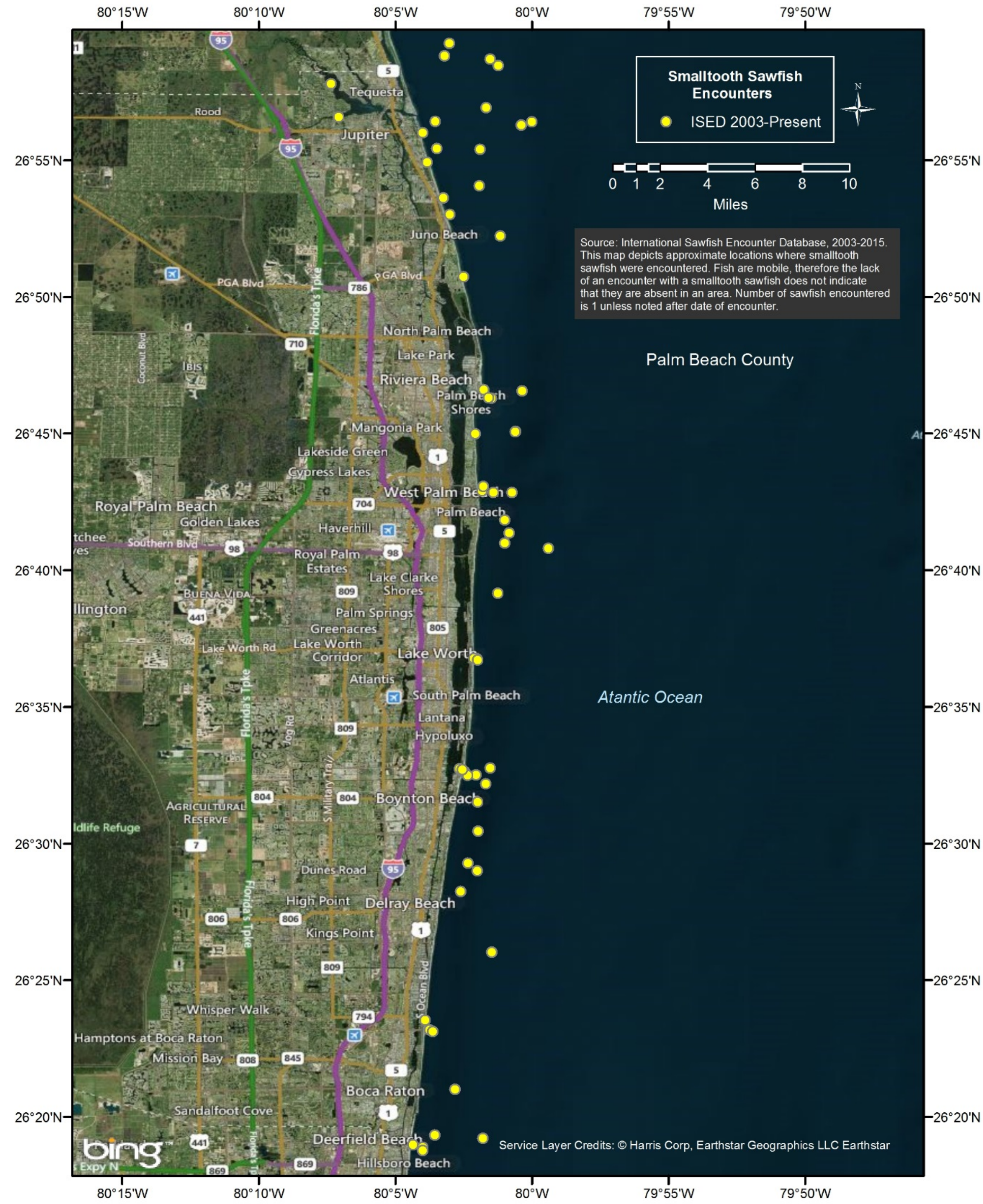


Figure 3-12. Smalltooth sawfish encounters in Palm Beach County, FL from 2003-2015 (Frick, pers. comm., 2015).

3.4.5 PIPING PLOVER

Piping plovers (*Charadrius melodus*) are small, migratory shorebirds that breed in only three geographic regions of North America: on sandy beaches along the Atlantic Ocean, on sandy shorelines throughout the Great Lakes region, and on the river-bank systems and prairie wetlands of the Northern Great Plains. Piping plover breeding populations were federally listed as threatened and endangered in 1986. The Northern Great Plains and Atlantic Coast breeding populations are threatened, and the Great Lakes population is endangered. Piping plovers from all three breeding populations winter along South Atlantic, Gulf Coast, and Caribbean beaches and barrier islands, primarily on intertidal beaches with sand and/or mud flats with no or very sparse vegetation. Piping plovers are considered threatened throughout their wintering range (USFWS, 2009).

Piping plovers are approximately 18 cm (7 in) in length with pale gray to sandy-brown plumage on their backs and crown and white plumage on their underparts. Breeding birds have a single black breastband, a black bar across the forehead, bright orange legs and bill, and a black tip on the bill. During winter, the black bands disappear, the legs fade to pale yellow, and the bill becomes mostly black (USFWS, 2013b). Plovers arrive on the breeding grounds during mid-March through mid-May where they typically remain for three to four months each year. They nest above the high tide line on coastal beaches, sandflats at the ends of sandspits and barrier islands, gently sloping foredunes, blowout areas behind primary dunes, sparsely vegetated dunes, and washover areas cut into or between dunes. They lay three to four eggs in shallow scraped depressions lined with light colored pebbles and shell fragments. The incubation period for piping plovers is typically 30 days. Plovers depart for the wintering grounds between mid-July through late October. Breeding and wintering plovers feed on exposed wet sand in wash zones; intertidal ocean beach; wrack lines; washover areas; mud-, sand-, and algal flats, and shorelines of streams, ephemeral ponds, lagoons, and salt marshes by probing for invertebrates at or just below the surface. They use beaches adjacent to foraging areas for roosting and preening. Small sand dunes, debris, and sparse vegetation within adjacent beaches provide shelter from wind and extreme temperatures (USFWS, 1996; 2013b).

The initial decline of the piping plover population in the nineteenth century was due primarily to hunting for the millinery trade; however, shooting of the piping plover and other migratory birds has been prohibited since passage of the Migratory Bird Treaty Act of 1918 (MBTA). Major threats to the species are now loss and degradation of breeding and foraging habitat attributed to development and shoreline stabilization. Disturbance by human activity and pets causes direct and indirect mortality of eggs and chicks. Predation is also a major threat to piping plover reproductive success (USFWS, 2013b; 2009). The listing of all three breeding populations is evidence of the drastic declines observed in piping plovers in recent decades.

Critical habitat was designated for the Great Lakes breeding population in 2001 (66 FR 22938), and for the Northern Great Plains breeding population in 2002 (67 FR 57638). Critical habitat for wintering piping plovers, including individuals from the Great Lakes, Northern Great Plains, and Atlantic Coast breeding populations, was designated along the coasts of North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, and Texas in July 2001 (66 FR 36038). The closest critical habitat unit to the Project Area is critical habitat Unit FL-33. This unit is located within St. Lucie Inlet in Martin County, more than 56 km (35 mi) north of the Project Area, and encompasses 282 ac (Figure 3-13).

Data from the USGS 2011 International Piping Plover Census indicated that the total number of wintering Piping Plovers observed along south Florida’s Atlantic coast (58) was higher than the 1991 (46), 1996 (46), and 2006 (44) census results, and lower than the 2001 results (647). The 2011 census had the first recorded observations along the Indian River County beaches approximately 90 miles north of the Study Area. Data from the 2006 census reported no piping plover observations for Palm Beach County (Elliott-Smith et al., 2009). According to e-Bird, a database launched by the Cornell Lab of Ornithology and National Audubon Society, there have been 207 piping plover sightings in the County since 2013. Two sightings occurred near Lake Worth Pier, one in 2010 and one in 2012 (e-Bird, 2015a).

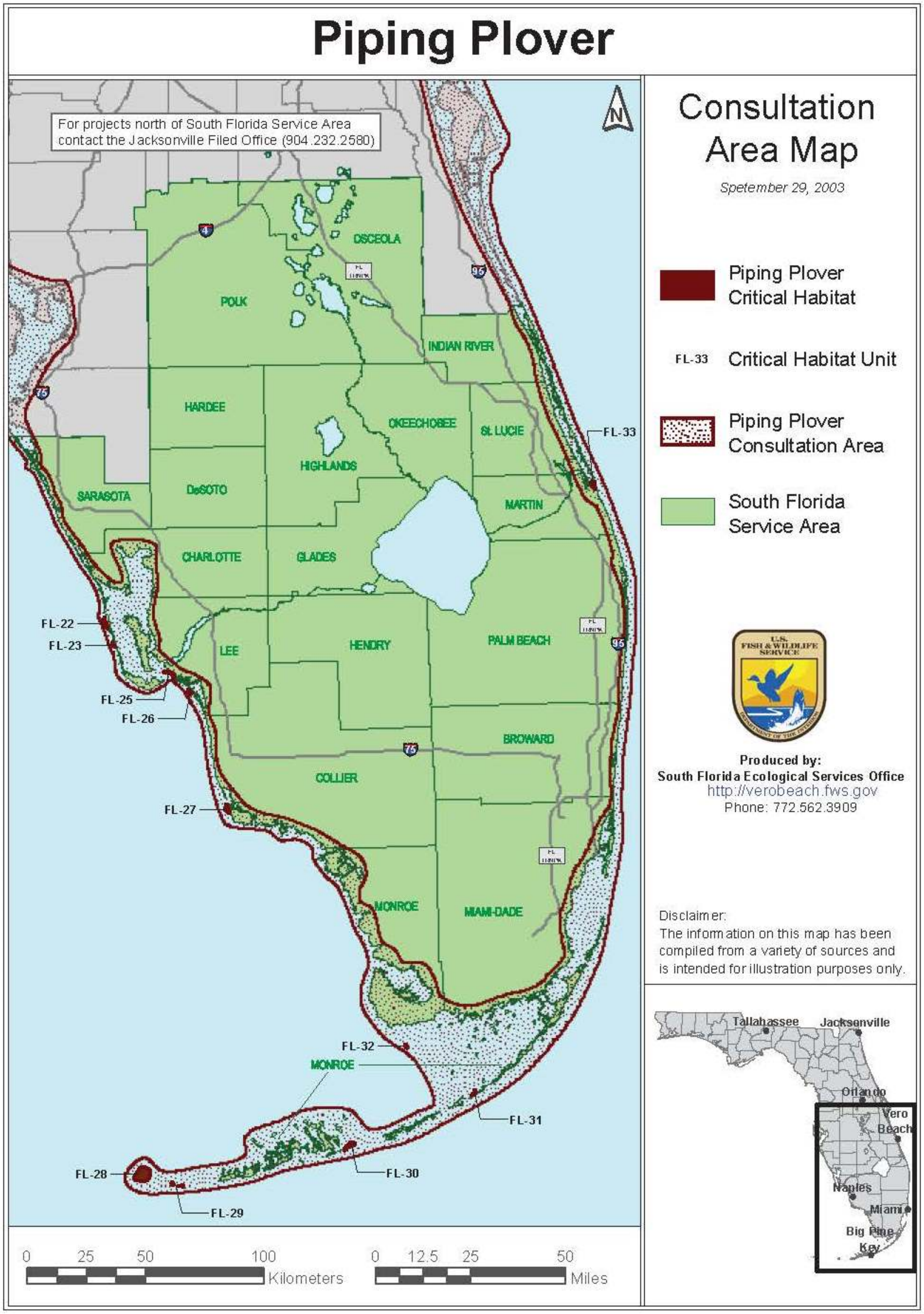


Figure 3-13. Piping plover consultation area map including critical habitat (USFWS, 2003).

3.4.6. RUFA RED KNOT

The red knot (*Calidris canutus*) was added to the list of Federal ESA candidate species in 2006. On December 11, 2014, USFWS determined threatened species status for the rufa subspecies (*Calidris canutus rufa*) under the ESA (79 FR 73706) and the rule became effective on January 12, 2015. Rufa red knots are also federally protected under the Migratory Bird Treaty Act (MBTA).

At nine to ten inches long, the rufa red knot is a large, bulky sandpiper with a short, straight, black bill (Audubon, 2013). During the breeding season, the legs are dark brown to black, and the breast and belly are a characteristic russet color that ranges from salmon-red to brick-red. Males are typically brighter shades of red, with a more distinct line through the eye. When not breeding, the two sexes look similar with plain gray above and dirty white below with faint, dark streaking. As with most shorebirds, the long-winged, strong-flying knots fly in groups, occasionally with other species. Rufa red knots feed on invertebrates, especially bivalves, small snails, crustaceans, horseshoe crab eggs and, on breeding grounds, terrestrial invertebrates (USFWS, 2013c).

The primary wintering areas for the rufa red knot include the southern tip of South America, northern Brazil, the Caribbean, and the southeastern and Gulf coasts of the U.S. The rufa red knot breeds in the tundra of the central Canadian Arctic. Some of these shorebirds fly more than 15,000 km (9,300 mi) from south to north every spring and reverse the trip every autumn, making the rufa red knot one of the longest-distance migrating animals. Migrating rufa red knots can complete non-stop flights of 2,400 km (1,500 mi) or more, converging on critical stopover areas to rest and refuel along the way. Large flocks of rufa red knots arrive at stopover areas along the Delaware Bay and New Jersey's Atlantic coast each spring, with many of the birds having flown directly from northern Brazil. The spring migration is timed to coincide with the spawning season for the horseshoe crab (*Limulus polyphemus*). Horseshoe crab eggs provide a rich, easily digestible food source which allows the rufa red knots to lay down fat and protein reserves both to fuel the 3,000 km (1864 mi) flight to the arctic breeding grounds and ensure their survival after they arrive at a time when food availability is often low. Mussel beds on New

Jersey's southern Atlantic coast are also an important food source for migrating knots. Birds arrive at stopover areas with depleted energy reserves and must quickly rebuild their body fat to complete their migration to Arctic breeding areas. During their brief 10 to 14-day spring stay in the mid-Atlantic, rufa red knots can nearly double their body weight (Niles et. al, 2008; USFWS, 2013c).

The declining population of the rufa red knot is directly related to the increased harvest of horseshoe crabs as bait for the conch and eel fisheries in the mid-Atlantic (Niles et. al, 2008). Threats to the rufa red knot also include sea level rise; coastal development; shoreline stabilization; dredging; reduced food availability at stopover areas; disturbance by vehicles, human activity, dogs, aircrafts, boats, and climate change (USFWS, 2013c).

Florida is known as an overwintering habitat for the rufa red knot, and wintering rufa red knots are most commonly recorded on the west coast where the population was estimated at around 10,000 in the 1980s (Niles et. al, 2006). A September 2006 shorebird survey conducted along the shoreline between R-134 and R-141 did not document any rufa red knots (CPE, 2007). However, according to e-Bird, there have been 60 rufa red knot sightings in Palm Beach County since 2013. Closest to the Study Area for the proposed Project, three rufa red knots were observed at Boynton Inlet Park (near R-152), just south of South Lake Worth Inlet, in 2005, and one was observed around Ocean Ridge in 2004 (near R-162) (e-Bird, 2015b). While no rufa red knot observations have been recorded within the Study Area, based on documented sightings along the shoreline elsewhere in the County, it may be expected that overwintering rufa red knots may occur within the Study Area.

3.4.7. BEACH JACQUEMONTIA

There are approximately 100 species in the genus *Jacquemontia*, most of which are found in tropical and subtropical America. Beach jacquemontia (*Jacquemontia reclinata*) is the only species found along the beaches of southeastern Florida and is endemic to the coastal barrier islands in southeast Florida from Palm Beach to Miami-Dade Counties. It is commonly known as beach jacquemontia or beach clustervine. This species is a perennial vine with a woody base and non-woody, twining stems up to 2 m (6 ft) long.

Leaves are alternate, estipulate, spirally arranged, and almost always petiolate, reaching 1-3 cm (0.4-1.2 in) in length and 0.5-2.5 cm (0.2-1 in) in breadth and characterized as fleshy and rounded with blunted or indented tips. The flowers are white or pinkish, approximately 2.5 cm (1 in) across, and deeply five-lobed with a short tube. *Jacquemontia reclinata* requires open areas that are typically found on the crest and lee sides of stable dunes but may also invade and restabilize maritime hammock or costal strand communities that have been disturbed by tropical storms, hurricanes and possibly fire (USFWS, 1998; 1999).

Jacquemontia reclinata was once found at several sites on Jupiter Island and Palm Beach Island, but is no longer found north of Jupiter Inlet due to habitat destruction associated with residential construction. It has been documented to the south at Crandon Park in Miami-Dade County and at Hugh Taylor Birch State Recreational Area in Broward County. A dune restoration project in Delray Beach, Palm Beach County, has successfully reintroduced *J. reclinata* to the site and is testing whether breeding history of plants will influence survival, reproduction and population growth (Barron, 2013). A small population of *J. reclinata* is also present in Loggerhead Park (Juno Beach, FL). Several locations in Juno Beach were identified as acceptable sites at which to plant this endangered species in order to increase the size of the population in the County. As of July 2011, 38% of the individuals planted in 2007 had survived (PBC-ERM, 2011).

Jacquemontia reclinata was listed as federally endangered (58 FR 62050) in 1993 and is also state-listed as endangered (USFWS, 2013d). The majority of its preferred coastal beach strand habitat has been destroyed or lost due to residential and commercial construction, development of recreational areas and beach erosion. This species is further threatened by invasion of exotic plant species including Australian pine, carrotwood, Brazilian pepper and turf grass. All but one of the wild populations exist on public lands in parks or conservation areas. The most recent surveys indicate that studied populations were declining in total number of individuals, total area occupied and stem density. There has been a 13% decline in total wild populations since 2000 (USFWS, 2007b). Protection and management of this species involves removal of exotics, protecting coastal habitats from development by conservation purchases or easements, and establishing new populations of this species in protected areas. Reintroductions of *J. reclinata* have increased the number of plants in the wild, although survival after transplant is quite variable (2-97%), due to mortality caused by human and natural factors (USFWS, 2007b).

CB&I biologists conducted a dune vegetation survey within the Study Area of the Southern Palm Beach Island Comprehensive Shoreline Stabilization Project in November 2013. Following an examination of aerial photography to determine specific areas of interest along the Study Area which may support dune vegetation, biologists ground-truthed the extent of vegetation using DGPS on November 15, 2013. Dominant species were identified and photographs were collected throughout the survey area. Particular effort was made to identify and document the presence of the endangered plant species beach jacquemontia; however, no beach jacquemontia was observed within the survey area (CB&I, 2014). The 2013 Habitat Characterization Report is provided as Appendix D.

3.4.8. SCLERACTINIAN CORALS

Scleractinian is an order of corals often referred to as stony or hard corals. On October 20, 2009, the Center for Biological Diversity petitioned NMFS to list 83 coral species as threatened or endangered under the U.S. Endangered Species Act (ESA). NMFS identified 82 of the corals as candidate species and established a Biological Review Team (BRT) to prepare a Status Review Report to examine those 82 candidate coral species and evaluate extinction risks for each of them. Of those 82 species, NMFS proposed listing for 66 coral species: 59 in the Pacific (7 as endangered, 52 as threatened) and 7 in the Caribbean (5 as endangered, 2 as threatened). On September 10, 2014 NMFS published the final rule (79 FR 53851) to implement the final determination to list 20 coral species as threatened – 15 in the Indo-Pacific and 5 in the Caribbean. The five Caribbean coral species are *Dendrogyra cylindrus*, *Orbicella* complex (*O. annularis, O. faveolata*, and *O*. *franksi*), and *Mycetophyllia ferox*. *Acropora cervicornis* and *A. palmata* were not reclassified to endangered; thereby they both remain classified as threatened under the ESA.

3.4.8.1. *ACROPORA* SPP. CORALS

In 2006, staghorn coral (*Acropora cervicornis*) and elkhorn coral (*A. palmata)* were listed as threatened under the ESA (71 FR 26852, May 9, 2006). In 2008, NMFS designated critical habitat for these two species (73 FR 72210, November 26, 2008), which includes the hardbottom and reef resources south of the South Lake Worth Inlet, located approximately 4 km (2.5 mi) south of the proposed Project Area.

These species have played crucial roles on Caribbean reefs as habitat providers and historically as reef-building organisms. Staghorn and elkhorn coral were once the most abundant species on Caribbean and Florida Keys coral reefs in terms of accretion and reef structure. Rapid growth rates and reproductive strategies exhibited by both species were critical in allowing reefs to keep pace with environmental changes. Staghorn coral, one of the fastest growing corals in the western Atlantic, may exhibit growth rates from 10-20 cm (4-8 in) per year. The primary method of reproduction of this species is asexual fragmentation, in which new colonies form when branches are broken off and reattach to the substrate. Elkhorn coral may grow as much as 5-10 cm (2-4 in) per year. Similarly, the primary reproductive mode for this species is asexual fragmentation. In both species, sexual reproduction also occurs once a year via mass broadcast spawning of gametes into the water column between August and September. Colonies are simultaneous hermaphrodites and release millions of gametes during the spawning season (NMFS, 2008a).

Environmental influences have driven the morphological differences between the two species. Staghorn coral occurs in back reef and fore reef environments in depths from 0-30 m (0-100 ft), limited by wave activity (upper limit), suspended sediments and light availability (lower limit). Prior to the mid-1980s, fore reef zones at depths of 5-25 m (15-18 ft) were dominated by extensive stands of staghorn coral. This species characteristically grows in antler-like colonies with cylindrical, fragile branches of 1-4 cm (0.4-1.6 in) diameter that can reach over 2 m (6.5 ft) in length. By contrast, elkhorn coral typically occurs in reef crest and fore reef environments exposed to heavy surf in depths less than 6 m (20 ft). Colonies grow in robust, antler-like formations with thick, sturdy branches that can reach 2-10 cm (0.8-3.9 in) in thickness and grow over 2 m (6.5 ft) in length (NMFS, 2008a).

In general, the two species have the same geographic range with a few exceptions. Both are found throughout south Florida, the Florida Keys, the Bahamas, and the Caribbean islands, as well as the eastern coasts of Mexico, Belize, Honduras, Nicaragua, Costa Rica, Panama, and Venezuela. In southeast Florida, staghorn coral has been documented as far north as Palm Beach County in water depths of at least (17 m [56 ft]) (CEG, 2009) and is distributed south and west throughout the coral and hardbottom habitats of the Florida Keys to the Tortugas Bank. Elkhorn coral has been reported as far north as Fort Lauderdale and Lauderdale By the Sea in Broward County Segment II (Gilliam et al., 2012; Precht and Aronson, 2004) and distributed discontinuously southward to Venezuela.

Since the 1980s, population declines have been drastic, and it has been estimated that 90-95% of these corals have been lost (EOL, 2013). Major threats to elkhorn and staghorn coral include disease, coral bleaching, predation, climate change, storm damage, and human activity. All of these factors have created a synergistic effect that greatly diminishes the survival and reproductive success of these corals (Precht and Aronson, 2004). Natural recovery of coral is a slow process and may never occur with this species because there are so many inhibitors to its survival.

The predominance of asexual methods of reproduction in these species combined with limited larval dispersal has led to the development of populations with low genetic diversity and potentially increased susceptibility toward disease (Vollmer and Palumbi, 2007). Diseases that affect elkhorn coral include white pox disease, white band disease, and black band disease. White pox disease only affects elkhorn coral and is caused by a fecal enterobacterium, *Serratia marcescens* (Patterson et al., 2002). The disease is very contagious and commonly moves from one colony to its nearest neighbor. White pox creates white lesions on the coral skeleton and results in an average tissue loss of 2.5 cm^2 (0.39 in^2) per day but can cause as much tissue loss as 10.5 cm^2 (1.63 in^2) per day (Patterson et al., 2002). White band disease and black band disease have also greatly reduced the abundance of elkhorn coral by causing catastrophic tissue losses (Reefball, 2013). A rapidly progressing condition referred to as rapid tissue loss has been observed over large areas in the Florida Keys (Williams and Miller, 2005) and southeast Florida (Smith and Thomas, 2008). This condition is characterized by a sloughing off of tissue that progresses rapidly (on average 4 cm [1.6 in] branch length per day) throughout the colony (Williams and Miller, 2005).

Predators of elkhorn and staghorn coral include coralivorous snails (*Coralliophila abbreviata*), polychaetes (such as the bearded fireworm), and damselfish. Predation by these organisms reduces the growth and reproductive abilities of the coral. Predation can eventually lead to the death of the coral colony.

Critical habitat for threatened elkhorn and staghorn coral was designated on November 26, 2008 in four areas: Florida, Puerto Rico, St. John/St. Thomas and St. Croix. In Florida, critical habitat is divided into three sub-areas that stretch from South Lake Worth Inlet in Palm Beach County to the Dry Tortugas (Figure 3-14). Sub-area A is closest, located about 4 km (2.5 mi) south of the Project Area, and extends from South Lake Worth Inlet to Government Cut in Miami-Dade County. The inshore boundary begins at the 1.8 m (6 ft) contour and extends out to the shoreward boundary at the 30 m (98 ft) contour. There is no critical habitat and no known individual colonies located within the Study Area.

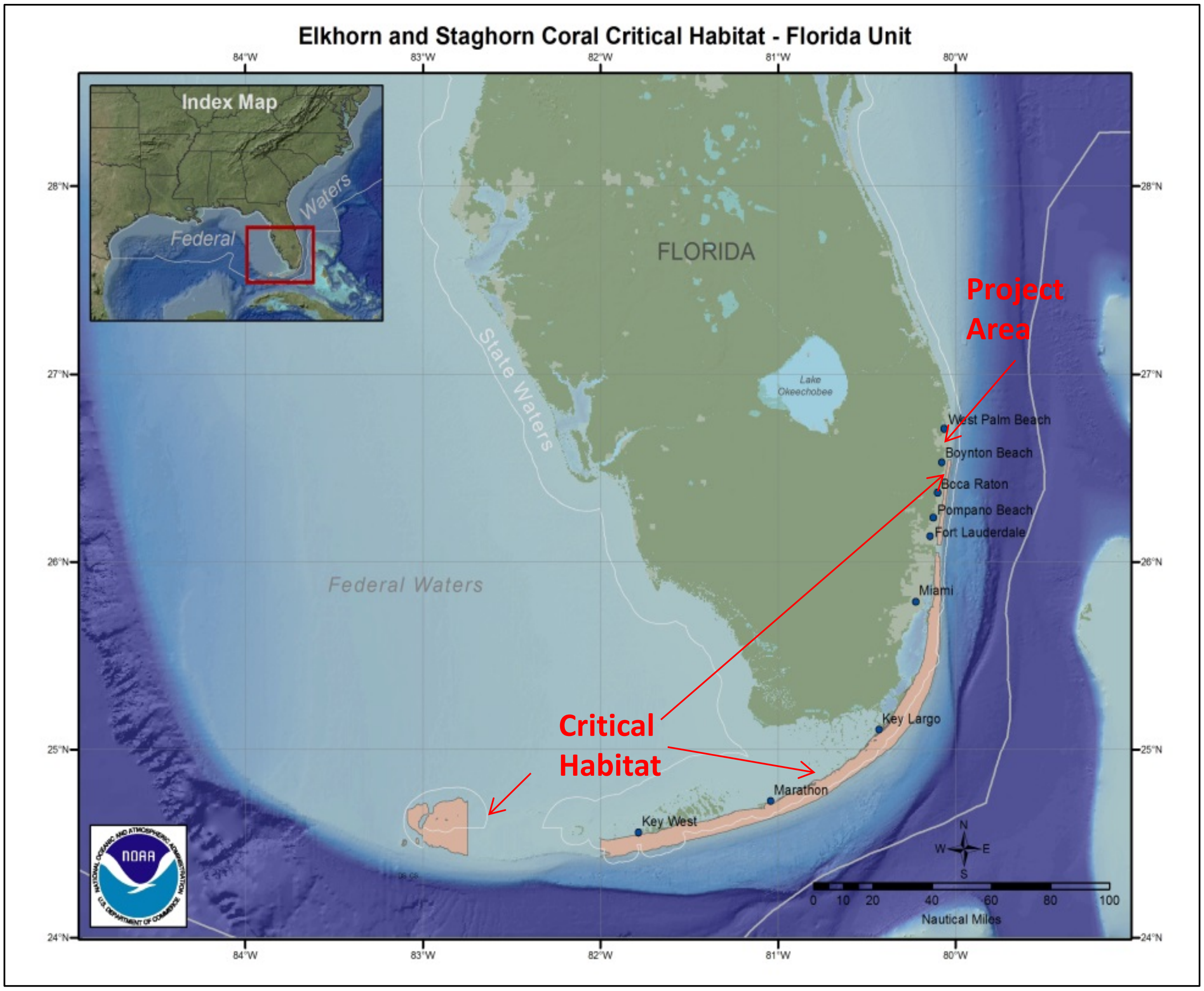


Figure 3-14. *Acropora* spp. critical habitat (NMFS, 2008b).

On January 6, 2009, NMFS received a petition from Palm Beach County Reef Rescue to revise the Florida critical habitat area for elkhorn and staghorn corals. The petition provided information on the location of *A. cervicornis* colonies on an offshore reef locally known as Bath and Tennis Reef, located approximately 13 km (8 mi) north of South Lake Worth Inlet and approximately 6.1 km (3.8 mi) north of the proposed Project Area. Based upon these reports, the Town of Palm Beach commissioned the verification, mapping and characterization study of the subject area by Coastal Eco-Group, Inc. Mapping and assessment activities were conducted for *A. cervicornis* in October 2009. During the investigation a total of 157 stony coral colonies ≥ 5 cm (2 in) in diameter consisting of 11 species were identified within the 70 m^2 (754 ft^2) sampling area. Overall, stony coral density of colonies ≥ 5 cm (2 in) (including all *A. cervicornis* colonies, attached and fragments) was 2.24±0.31 colonies m^{-2}. When *A. cervicornis* colonies were excluded, stony coral density was 1.51±0.15 colonies m^{-2}. In comparison to the thickets in Broward County, where *A. cervicornis* accounted for 87-97% of all stony corals (Vargas-Ángel et al., 2003), *A. cervicornis* accounted for 32% of all stony corals within the 70 m^2 (754 ft^2) sample area (CEG, 2009).

After reviewing all the available data, NMFS announced their final determination on January 22, 2010 (75 FR 3711) stating they would deny the petition and not extend the northern boundary of the critical habitat area to the Lake Worth Inlet. This conclusion was “based on the adequacy of the existing, recent designation to meet the corals' conservation needs, the relatively low benefit the requested revision would provide, the protections afforded to the species from the recent ESA section 4(d) regulations, and our need to complete higher priority conservation activities for these and other coral species.”

Palm Beach County divers conducted an *Acropora* spp. survey in October 2013 on nearshore hardbottom within the Study Area between R-130 to R-141 (there was no exposed hardbottom between R-127 and R-130). No *Acropora* colonies were observed, and no proposed coral species (described in Section 3.4.6.2) were documented in the investigation area (PBC-ERM, 2013b). A copy of the 2013 *Acropora* Survey Report (PBC-ERM, 2013b) is provided as Appendix C. Nearshore hardbottom investigations were also conducted in October 2013. These surveys assessed the benthic communities between R-130 and R-141, from the intertidal zone out to approximately 150 m offshore. No *Acropora* colonies were observed during these investigations; a copy of the 2013 Characterization Report (CB&I, 2014) is provided as Appendix D.

3.4.8.2. *ORBICELLA ANNULARIS* COMPLEX (*O. ANNULARIS, O. FAVEOLATA,* AND *O. FRANKSI*), *DENDROGYRA CYLINDRUS*, AND *MYCETOPHYLLIA FEROX*

Nearshore hardbottom investigations were conducted in October 2013 to assess the benthic communities in the Study Area between R-130 and R-141 (there was no exposed hardbottom between R-127 and R-130), from the intertidal zone out to approximately 150 m offshore. None of the coral species listed under the ESA were observed during these investigations (CB&I, 2014). The 2013 Characterization Report is provided as Appendix

D. As described in section 3.4.6.1., Palm Beach County divers conducted an *Acropora* survey in October 2013 on nearshore hardbottom within the Study Area between R-130 to R-141. None of the recently listed coral were documented during this survey; the 2013 *Acropora* Survey Report (PBC-ERM, 2013b) is provided as Appendix C.

The following information on the species biology of the five Caribbean coral species recently listed under the ESA was gathered from the NOAA-NMFS Coral Status Review Report of 82 Candidate Coral Species Petitioned under the U.S. Endangered Species Act (Brainard et al., 2011) unless otherwise cited.

3.4.8.2.1. *Orbicella annularis* complex

Species within the *Orbicella annularis* complex were previously classified under the *Montastrea* genus; however, a recent study by Budd et al. (2012) reclassified the genus as *Orbicella* based on molecular and morphological data. *Orbicella annularis* has historically been one of the primary reef framework builders of the western Atlantic and Caribbean. Its depth range is from 1 m (3.3 ft) to over 30 m (100 ft) and this species has multiple growth forms ranging from columnar to massive to plating. These growth forms were partitioned into three separate species in the early 1990s based on their morphology, depth range, ecology and behavior with subsequent support from reproductive and genetic studies: *O. annularis, O. faveolata* and *O. franksi.*

The *Orbicella annularis* complex characterize the “buttress zone” and “annularis zone” in the classical descriptions of Caribbean reefs and have been described as very abundant in these zones. Declines became obvious in the 1990s and 2000s and were most often associated with combined disease and bleaching events. They exhibit dramatically low productivity (low growth and extremely low recruitment), which puts them at high extinction risk due to any substantial declines in adult populations.

In Florida, several studies spanning nearly 30 years imply extreme declines of this complex in the Florida Keys (80%-90%) between the late 1970s and 2003. Parameters measured revealed declines in absolute cover, colony shrinkage, and virtually no recruitment. Additionally, further dramatic losses occurred in this region during the cold weather event in January 2010. Similar declines have been documented in the U.S. Virgin Islands, Belize, and Colombia as well as on relatively remote Caribbean reefs such as Navassa Island National Wildlife Refuge and offshore islands in Puerto Rico.

All three species are hermaphroditic broadcast spawners. Reproduction is characterized by small eggs and larvae and very slow post-settlement growth rates, which may contribute to extremely low post-settlement survivorship. Of this complex of coral species, it is thought that only *O. annularis* is capable of some degree of fragmentation/fission and clonal reproduction.

The *Orbicella annularis* complex has been shown to be highly-to-moderately susceptible to bleaching, which was highlighted during the well-documented mortalities in these species following severe mass-bleaching in 2005 due to thermal stress. Disease outbreaks of white-plague and yellow-band have also resulted in population declines to these species. Degraded water quality (increased nutrients and/or toxins) and increased turbidity and sedimentation associated with land-based sources of pollution has resulted in decreased growth rates and increase susceptibility to bleaching and disease.

Orbicella annularis. Boulder star coral (*O. annularis*) is restricted to the western Atlantic and occurs throughout the Caribbean, Florida, the Bahamas, Flower Garden Banks and Bermuda; however the species abundance is considered rare in Bermuda. It has been reported in water depths ranging from 0.5-20 m (1.6-66 ft) and is generally described with a shallower distribution.

Orbicella annularis colonies grow in columns that exhibit rapid and regular upward growth. Based on the Status Review, very low productivity (growth and recruitment), dramatic recent declines and its restriction to the highly disturbed/degraded wider Caribbean region and its preference for shallow habitats (yielding greater exposure to surface-based threats) are the main factors that increase the extinction risk for *O. annularis.*

Orbicella faveolata. Mountainous star coral (*O. faveolata*) is restricted to the western Atlantic and occurs throughout the Caribbean, Florida, the Bahamas, Flower Garden Banks and the entire Caribbean coastline. It is documented on most reef habitats ranging in water depths from 0.5-40 m (1.6-131 ft). It has been reported as the most abundant coral in fore reef environments between 10-20 m (33-66 ft).

Of the many life history characteristics, including growth rates, tissue regeneration, and egg size, *O. faveolata* is considered to be intermediate between its two sister species. Based on the Status Review, extremely low productivity (growth and recruitment), dramatic recent declines and its restriction to the highly disturbed/degraded wider Caribbean region are the main factors that increase the extinction risk for *O. faveolata.*

Orbicella franksi. Star coral (*O. franksi*) is restricted to the western Atlantic and found throughout the Caribbean, Florida, the Bahamas, Bermuda, Flower Garden Banks and the entire Caribbean coastline. It has been reported in water depths from 5-50 m (16-164 ft) and is often a dominant component of Caribbean mesophotic reefs. *Orbicella franksi* tends to have a deeper distribution that its two sister species.

Based on the Status Review, extremely low productivity (growth and recruitment), dramatic recent declines and its restriction to the highly disturbed/degraded wider Caribbean region are the main factors that increase the extinction risk for *O. franksi.*

3.4.8.2.2. *Dendrogyra cylindrus*

Pillar coral (*D*. *cylindrus*) is restricted to the western Atlantic and is present throughout the greater Caribbean and Florida, however, is one of the Caribbean genera absent from the southwest Gulf of Mexico. A single colony (in poor condition) has been observed in Bermuda. It is reported in most reef environments but is more common on fore reef spur-and-groove habitats in the Florida Keys rather than in nearshore hardbottom and reef habitats. It has been documented in water depths between 2-25 m (7-82 ft).

Dendrogyra cylindrus is reported as uncommon but conspicuous with isolated colonies scattered across a range of habitat types. In Florida, the overall density is estimated at approximately 0.6 colonies per 10 m^2. They are described as having gonochoric spawning but their low density does not support successful reproduction; however, they are effective in propagation through fragmentation. Annual growth rates range from 1.2-2.0

mm (0.5-0.8 in) in the Florida Keys but only 0.8 cm per year (0.3 in/yr) elsewhere in the Caribbean.

Conflicting reports and low density make understanding the susceptibility of *D. cylindrus* to elevated temperatures difficult; however, it is known to be sensitive to cold shock. Based on the Status Review, the overall low population density and low population size combined with a gonochoric spawning mode, corresponding lack of observed sexual recruitment, and susceptibility to observed disease mortality are the main factors that increase the extinction risk for *D. cylindrus.*

3.4.8.2.3. *Mycetophyllia ferox*

Rough cactus coral (*M. ferox*) is restricted to the western Atlantic with reports throughout most of the Caribbean and Florida. Unlike several of the other species described above, it has not been documented in the Flower Garden Banks or in Bermuda. It has been reported to occur in shallow reef habitats ranging from 5-30 m (16-100 ft) water depths.

The species is described as uncommon or rare contributing less than 0.1% species contribution and occurs at densities less than 0.8 colonies per 10 m^2 in Florida. Studies conducted in the Florida Keys show a dramatic decline since the mid-1990s and it has been suggested that *M. ferox* was much more abundant in the upper Florida Keys in the early mid-1970s compared to current observations as it was highly affected by disease.

Mycetophyllia ferox has been reported as susceptible to acute and sub-acute white plague disease, and the rate of progression was positively correlated with water temperature. Based on the Status Review, disease, rare abundance, and observed declines in abundance are the main factors that increase the extinction risk for *M. ferox.*

3.4.9. EASTERN INDIGO SNAKE

The eastern indigo snake (*Drymarchon corais couperi*) is a large, black non-venomous snake. Its color is uniformly lustrous-black, dorsally and ventrally, except for a red or cream-colored suffusion of the chin, throat, and sometimes cheeks. It is the longest snake in the United States, reaching length up to 265 cm. Its scales are large and smooth in 17 scale rows at midbody.

In north Florida breeding occurs between November and April, and females deposit four to 12 eggs during May or June (Moler, 1992). Speake et al. (1987) reported an average clutch size of 9.4 for 20 captive bred females. Eggs are laid from late May through August, and young hatch in approximately 3 months. Peak hatching activity occurs between August and September, and yearling activity peaks in April and May (Groves, 1960; Smith, 1987). Limited information on the reproductive cycle in south-central Florida suggests that the breeding and egg laying season may be extended. In this region, breeding extends from June to January, laying occurs from April to July, and hatching occurs during mid-summer to early fall (Layne and Steiner, 1996).

The eastern indigo snake is an active terrestrial and fossorial predator that will eat any vertebrate small enough to be overpowered. An adult eastern indigo snake's diet may include fish, frogs, toads, snakes (venomous as well as nonvenomous), lizards, turtles, turtle eggs, juvenile gopher tortoises, small alligators, birds, and small mammals (Keegan, 1944, Babis, 1949, Kochman, 1978, Steiner et al., 1983). Juvenile eastern indigo snakes eat mostly invertebrates (Layne and Steiner, 1996).

Layne and Steiner (1996) determined in south-central Florida, adult male home ranges average about 74 ha (max. 199.2 ha), whereas adult female home ranges average about 19 ha (max. 48.6 ha). Eastern indigo snakes require a sheltered refuge from winter cold and dry conditions. Wherever the eastern indigo snake occurs in xeric habitats (Georgia, Alabama, and the panhandle area of Florida), it is closely associated with the gopher tortoise, the burrows of which provide shelter from winter cold and the desiccating sandhill environment (Bogert and Cowles 1947, Speake et al. 1978). In more mesic habitats that lack gopher tortoises, eastern indigo snakes may take shelter in hollowed root channels, rodent burrows, armadillo burrows, hollow logs, or crab burrows (Lawler 1977, Moler 1985b).

Eastern indigo snakes need a mosaic of habitats to complete their annual cycle. Over most of its range, the eastern indigo snake frequents several habitat types, including pine flatwoods, scrubby flatwoods, high pine, dry prairie, tropical hardwood hammocks, edges of freshwater marshes, agricultural fields, coastal dunes, and human-altered habitats. In the milder climates of central and southern Florida, eastern indigo snakes exist in a more stable thermal environment, where availability of thermal refugia may not be as critical to the snake's survival. Throughout peninsular Florida, this species may be found in all terrestrial habitats which have not suffered high density urban development. They are especially common in the hydric hammocks throughout this region (Moler 1985a). In central and coastal Florida, eastern indigos are mainly found within many of the State's high, sandy ridges. In extreme South Florida, these snakes are typically found in pine flatwoods, pine rocklands, tropical hardwood hammocks, and in most other undeveloped areas (Kuntz 1977). Eastern indigo snakes also use some agricultural lands (e.g., citrus) and various types of wetlands (Layne and Steiner 1996).

The eastern indigo snake was listed as a threatened species on January 1, 1978 (43 FR 4026) as a result of dramatic population declines caused by over-collecting for the domestic and international pet trade as well as mortalities caused by rattlesnake collectors who gassed gopher tortoise burrows to collect snakes. Since its listing, habitat loss and fragmentation by residential and commercial expansion have become much more significant threats to the eastern indigo snake. The above information can be found in the South Florida Multi-Species Recovery Plan (USFWS, 1999). This species would also have been considered during the authorization of any upland mine approved by the State of Florida or by the USACE.

3.5. CORAL REEF AND HARDBOTTOM RESOURCES

Along most of the east coast of Florida, the Pleistocene Anastasia Formation forms the main coastal bedrock outcrop (Finkl, 1993; Esteves and Finkl, 1999) (see Section 3.2.8. Geology/Sediment Characteristics for additional information). Sporadic outcrops occur along the Florida Atlantic shore from St. Augustine to central Broward County (Esteves and Finkl, 1999). Formations that are exposed in the surf zone tend to have smooth surfaces that have been abraded by wave and current action. In Palm Beach County, shoreline occurrences of the Anastasia Formation can be found between the Lake Worth

Inlet and the South Lake Worth Inlet and occur in a range of morphological expressions of coquina including inshore and offshore rock reefs (Finkl and Warner, 2005). These rock exposures are quite often ephemeral, exhibiting periodic burial and exposure (see Section 3.2.2.4 for data on ephemeral nature of nearshore hardbottom in Study Area). The dynamics are largely storm driven with periodicities related to occurrences of high-energy events such as tropical storms and hurricanes.

There are no hardbottom resources within the proposed borrow areas or within 500-feet of the borrow areas. The construction of mitigation reefs for unavoidable impacts associated with the build alternatives is proposed to be located in the nearshore habitat on unconsolidated sandy substrate in the vicinity of the nearshore hardbottom resources while maintaining a protective buffer to avoid potential impacts to natural hardbottom during construction.

Nearshore hardbottom features within the Study Area are comprised of 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, extend 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. The majority of hardbottom observed in the Study Area includes partially exposed rock with sand veneers of varying depths.

These resources are defined by two shore-parallel ridges that are considered ephemeral. Aerial delineations have been conducted for the Beach Management Agreement (FDEP, 2013) and are available on FDEP’s website as shapefiles. The 2003-2012 and 2014 shapefiles were downloaded from FDEP’s website and the 2013 aerial delineation was conducted by CB&I for this EIS at the same time that an *in situ* assessment of the benthic habitat was performed. These delineations between 2003 and 2014 show that both, one or neither of these ridges may be exposed at any given time (Figure 3-2). Due to the dynamic nature of sand movement in this area, the hardbottom is constantly exposed to burial and scouring resulting in an opportunistic benthic community dominated by turf and macroalgae and supporting small coral colonies. A November 2013 investigation found the hardbottom to be generally low relief (< 0.3 m [1 ft]) and in water depths generally 0-4 m (6-13 ft). Twelve transects were sampled across the intertidal and subtidal hardbottom. These transects commenced at the westernmost (inshore) hardbottom edge and extended east to the seaward extent of hardbottom or 150 m (492 ft), whichever came first. Table 3-9 lists and quantifies the benthic flora and fauna observed during the investigation (CB&I, 2014). The 2013 Habitat Characterization Report is provided as Appendix D.

Table 3-9. Benthic composition of the nearshore hardbottom habitat in the Study Area (CB&I, 2014).

Functional Groups and Macroalgae Average Percent Cover			
Functional Group	**Average Percent Cover**	**Macroalgae Genus**	**Average Percent Cover**
Sediment	21.9 ± 29.5	*Bryothamnion*	0.02 ± 0.06
Macroalgae	10.4 ± 12.8	*Caulerpa*	0.11 ± 0.25
Turf Algae	60.9 ± 28.6	*Cymopolia*	0.02 ± 0.05
Encrusting Red Algae	2.3 ± 7.2	*Dasya*	0.07 ± 0.24
Sponge	0.2 ± 0.5	*Dasycladus*	0.93 ± 1.43
Hydroid	1.1 ± 2.0	*Dictyopteris*	0.03 ± 0.11
Octocoral	0.5 ± 1.2	*Dictyota*	5.36 ± 5.08
Stony Coral	0.1 ± 0.4	*Gelidiella*	1.62 ± 2.54
Tunicate	0.6 ± 7.0	*Gelidium*	0.18 ± 0.50
Bare Hard Substrate	1.1 ± 3.7	*Halimeda*	0.02 ± 0.08
Bryozoan	0.6 ± 2.2	*Jania*	0.19 ± 0.27
Sessile Worm	0.3 ± 0.4	*Laurencia*	0.02 ± 0.05
Wormrock	0.1 ± 0.7	*Padina*	0.34 ± 0.55
Other	0.1 ± 0.1	*Wrangelia*	0.01 ± 0.05

Coral Community		
Coral	**Density (colonies m^{-2})**	**Average Size (cm)**
Stony corals	0.5 ± 0.7	2.6 ± 1.4
Octocorals	6.1 ± 11.9	5.3 ± 1.8

*Other includes functional groups < than 0.1%.

The sabellariid tubeworm *Phragmatopoma caudata,* also known as wormrock, colonizes nearshore hardbottom in portions of the Study Area. This colonial species settles in intertidal and subtidal hardbottom areas and uses sand particles together with a mucoprotenaceous cement to construct dwelling tubes resulting in the construction of reef-like structures (Gore et al., 1978; Nelson and Demetriades, 1992; Reuter et al., 2010; Drake et al., 2007). Wormrock is somewhat ephemeral as storm waves and burial by sediments may destroy the structures (CSA, 2009). In addition, the species typically constructs the wormrock structure only from early summer through fall. Although *P. caudata* is capable of spawning year-round (Eckelbarger, 1976), 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. caudata* is quite resilient to turbidity (Main and Nelson, 1988), studies evaluating sediment burial tolerance of *P. caudata* 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).

Off the east coast of Florida, the structure provided by nearshore hardbottom and associated wormrock supports locally moderate to high diversities and abundances of algae, fishes, and invertebrate groups including sponges, hydroids, mollusks, crustaceans, bryozoans, ascidians, and cnidarians (Gore et al., 1978; Lindeman and Snyder, 1999; Delaney et al., 2006). Considered important nursery habitat for juvenile fishes (Sloan and Irlandi, 2008), nearshore hardbottom also provides shelter and/or foraging grounds for sea turtles (Wershoven and Wershoven, 1989; CSA, 2009). Substantial geological evidence suggests that nearshore hardbottom and/or wormrock 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 wormrock habitat (Gram, 1965; Multer and Milliman, 1967; Kirtley and Tanner, 1968).

On several occasions (February 2005, March 2005, May 2006, July 2006, May 2007, May 2008), field investigations of the intertidal and subtidal hardbottom within and adjacent to the Study Area have been conducted in association with various projects. These investigations have documented intertidal hardbottom that is scoured and supports little or no biota with variable relief generally less than 1.0 m (3.3 ft). Biota that has been observed is generally dominated by turf and macroalgae with small stony and octocoral colonies.

Biological assessments have been conducted in the nearshore marine habitat in the Study Area within the past several years. Within the Town of Palm Beach, the FDEP Hurricane Recovery Dune Restoration Project was constructed in April and May of 2006 in response to erosion caused by the hurricanes during 2004 and 2005. The project spanned Reaches 7 and 8 in the Town of Palm Beach and was constructed using offshore sand truck-hauled from the Reach 7 Phipps Ocean Park Beach Restoration Project. The biological monitoring program for the 2006 project included shore-perpendicular transects that spanned the width of the nearshore hardbottom resources between R-128 and R-

134 (conducted in May 2006). South of the dune project, quantitative assessments were conducted in July 2006 along shore-perpendicular transects between R-134 and R-142 in association with the South Palm Beach/Lantana Erosion Control Study. Within the same project area (R-134 to R-142) and timeframe (September 2006) a dune vegetation survey was conducted to map species coverage and document species location. A survey was also conducted in April 2009 and April 2010 to collect hardbottom relief data in support of the South Palm Beach/Lantana Segmented Breakwater Project. The 2013 Habitat Characterization Report (CB&I, 2014, provided as Appendix D) compares the dune and nearshore hardbottom data to previous data collected during 2006 surveys within the Study Area.

Biologists from NMFS Habitat Conservation Division and the U.S. Environmental Protection Agency (EPA) have visited the Reach 8 site on several occasions, most recently on February 24, 2011 during low tide. Consistent with previous 2004 and 2005 findings, exposed hardbottom was clearly visible from the shoreline throughout much of Reach 8 during this assessment (CPE, 2005a; CPE 2005b; CPE and FDEP, 2008). Hardbottom was noted in two distinct areas in the southern portion of Reach 8. The southern area of hardbottom started approximately 91 m (300 ft) north of R-134 and continued south beyond the southern boundary of Reach 8 (USACE, 2011b).

Analysis of aerial imagery over the past decade has demonstrated the ephemeral nature of this hardbottom habitat (see Section 3.2.2.4 and Figure 3-2). The most recent benthic survey was conducted in October 2013. In general, observations show that nearshore hardbottom relief is low, averaging 15 cm (4.9 in) or less, with habitat relief sometimes greater on intertidal hardbottom than on subtidal areas (CPE 2007; 2010; CB&I, 2014). Surveys of the benthic community have shown high cover of turf algae and sediment along transects, followed by bare hard substrate, wormrock (*Phragmatopoma caudata*), and macroalgae; common macroalgae genera include *Padina, Dictyota, Hypnea, Dasycladus, Laurencia*, and *Halimeda*. Also observed on the nearshore hardbottom, but typically with less than 1% cover, were tunicates, sponges, zoanthids, bryozoans, scleractinian (stony) corals and octocorals. The scleractinian species most frequently observed on the intertidal and subtidal hardbottom were *Siderastrea* spp. and

Solenastrea bournoni. The most common genus of octocorals observed was *Pseudopterogorgia*, followed by *Pterogorgia, Muricea*, and *Eunicea* (CPE, 2005, 2007; CB&I, 2014; CPE and CSI, 2011a; Delaney et al., 2006).

3.6. FISH AND WILDLIFE RESOURCES

3.6.1. SOFTBOTTOM COMMUNITIES

A portion of the nearshore marine habitat within the Study Area is composed of unconsolidated softbottom habitat. Unvegetated softbottom intertidal and subtidal areas are important habitats for benthic organisms living on (epibenthos) or within (infauna) the sediment. This faunal community is an important element in the food web, providing prey for wading birds, shorebirds and fish. Shallow subtidal softbottom environments may be highly impacted by water turbulence, suspended sediments, and unstable substrate resulting in low species diversity and faunal abundance (Wanless and Maier, 2007; Jordan et al., 2010; Manning et al., 2014). Shallow subtidal softbottom habitat is dominated by a mix of polychaetes (primarily spionids), gastropods (*Oliva* sp., *Terebra* sp.), portunid crabs (*Arenus* sp., *Callinectes* sp., and *Ovalipes* sp.) and burrowing shrimp (*Callianassa* sp.). In slightly deeper water [1-3 m (3-10 ft) depth], the dominant fauna are polychaetes, haustoriid, and other amphipod groups, and the bivalves *Donax* sp. and *Tellina* sp. (Marsh et al*.,* 1980; Goldberg et al*.,* 1985; Gorzelany and Nelson, 1987; Nelson, 1985).

Softbottom macrobenthic and infaunal communities located within the nearshore portion of the Project Area experience dynamic conditions due to the high energy wave action in the intertidal surf zone. Portions of this nearshore environment consists of medium to coarse quartz sand and shell hash and coarse carbonate/quartz sand with the associated assemblages of plants and animals that use these softbottom habitats. In tropical and subtropical areas, the ghost crab (genus *Ocypode*) is a dominant faunal feature of the upper beach area. Mole crabs (*Emerita*), haustoriid amphipods, and bivalves (*Donax*) are numerical dominants in the intertidal area while polychaetes, other amphipod species, and bivalves are increasingly abundant in the subtidal nearshore areas (Pearse et al., 1942; Dahl, 1952; Spring, 1981).

3.6.2. NEARSHORE HARDBOTTOM FISH ASSEMBLAGES

The biological abundance and diversity of fish assemblages within the nearshore hardbottom habitat vary seasonally. Although the abundance and diversity are typically highest in the summer and lowest in the winter, fish species within the nearshore waters of Palm Beach Island are plentiful. Over 250 species of fish utilize the nearshore hardbottom areas as habitat (FDEP, 2010).

The nearshore subtidal zone provides habitat for a wide range of species including various shellfish, foraging fish, predatory fish, and occasional offshore migratory predators. The FDEP has grouped the fish present within the area into four specific categories (FDEP, 2010). The first category is labeled “demersal carnivores”, which includes about 110 fish species such as grunts, drums and wrasses. The next category is known as the “cryptic hardbottom residents,” with approximately 30 species including of gobies, blennies and eels. The final two categories are “coastal pelagics,” consisting of approximately 25 species (including herring, jacks, and mackerels) and “herbivores,” consisting of approximately 20 species (including damselfish, chub, parrotfish, and sturgeon). Juvenile fish dominate the nearshore subtidal zone and depend on this habitat for foraging and shelter (CSA, 2009).

An investigation conducted by CSA International during 2009 documented the fish assemblages associated with the nearshore hardbottom in the vicinity of the Project Area. The extant assemblage comprised primarily of reef-associated species generally expected for the region (Gilmore et al., 1981; CSA, 2009). The results of the investigation revealed 70 species dominated by black margate (*Anisotremus surinamensis*), silver porgy (*Diplodus argenteus*), newly settled grunts (*Haemulon* spp.), sailors choice (*H. parra*), hairy blenny (*Labrisomus nuchipinnis*), and porkfish (*A. virginicus*). The nine taxa of grunts (Haemulidae) were the taxonomically dominant family observed.

CSA International identified 24 federally managed species during their 2009 surveys of the nearshore hardbottom. Many of these managed species occurred as newly settled or juvenile stage individuals indicating that the area serves as effective juvenile habitat for managed species. The South Atlantic Fishery Management Council (SAFMC) includes most of these species as members of the snapper-grouper complex (SAFMC, 1998). In addition to these species, the CSA survey also reported two other managed species: a coastal pelagic species (Spanish mackerel, *Scomberomorus maculatus*) and a coastal shark (nurse shark, *Ginglymostoma cirratum*). Other economically important or notable species anecdotally observed near or over hardbottom (not formally recorded during timed swims or in strip transects during the survey) included snook (*Centropomus undecimalis*), bonnethead shark (*Sphyrna tiburo*), tarpon (*Megalops atlanticus*), cobia (*Rachycentron canadum*), king mackerel (*Scomberomorus cavalla*), and Florida pompano (*Trachinotus carolinus*). Although not a federally managed fishery species, the striped croaker (*Bairdiella sanctaeluciae*) was observed and is a federally designated SSC.

3.6.3. COASTAL PELAGIC FISH

The major coastal pelagic families occurring in inshore coastal waters within the Study Area include ladyfish, anchovies, herrings, mackerels, jacks, mullets, bluefish, and cobia. Coastal pelagic species migrate over the region's shelf waters throughout the year. Some species form large schools (e.g., Spanish mackerel), 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). Concentrations of anchovies, herrings, and mullets in nearshore areas may attract larger predatory species (particularly bluefish, sharks, and mackerels). The presence and density of most coastal pelagic fish species depend on water temperature and quality, which vary spatially and seasonally.

3.6.4 STATE LISTED SPECIES

The Florida Endangered and Threatened Species List (68A-27.003, F.A.C.) and Species of Special Concern (SSC) List (68A-27.005, F.A.C) are maintained by the Florida Fish and Wildlife Conservation Commission (FWC) and are authorized under the Florida Endangered and Threatened Species Act (379.2291, F.S.). In addition, all Florida species that are listed under the ESA by the USFWS or NMFS are included (Table 3-7) on the Florida Endangered and Threatened Species List as Federally-designated Endangered

(E), Federally-designated Threatened (T), Federally-designated Threatened Due to Similarity of Appearance [FT(S/A)], or Federally-designated Nonessential Experimental species (FXN). Florida's SSC are defined as a species facing a moderate risk of extinction or extirpation from Florida. State-designated Threatened (T) species are those native to Florida that have experienced severe reductions in population size or geographic range, or quantitative analysis has shown the probability of extinction in the wild to be at least 10% within 100 years (FWC, 2013a). The list of Florida's Federally-listed plant species is maintained by the Florida Statewide Endangered and Threatened Plant Conservation Program run by the Florida Department of Agriculture and Consumer Services (FDACS). A list of the state protected species that may occur in the vicinity of the Project Area or along the truck-haul routes from upland mines and/or the stockpile area to the Project Area is provided in Table 3-7.

In regards to state-listed species, Biological Status Reviews conducted in 2011 have determined that several species currently state-listed as SSC should either be removed from the Florida Endangered and Threatened Species List or upgraded to Threatened. As part of this process, Species Action Plans (SAPs) were completed for each species and are now awaiting the approval by the FWC, which is expected to occur in 2016. The species to be removed from the Florida Endangered and Threatened Species List include the Florida mouse (*Podomys floridanus*), limpkin (*Aramus guarauna*), snowy egret (*Egretta thula*), white ibis (*Eudocimus albus*), and gopher frog (*Lithobates capito*). The species to be classified as threatened are the black skimmer (*Rynchops niger*), burrowing owl (*Athene cunicularia floridana*), and several wading birds including the little blue heron (*Egretta caerulea)*, tricolored heron (*Egretta tricolor*), reddish egret (*Egretta rufescens*), and roseate spoonbill (*Platalea ajaja*). Taking these recommendations into account, the Florida mouse, gopher frog, limpkin, snowy egret, and white ibis will not be evaluated further in this document. In addition, the gopher tortoise, black skimmer, burrowing owl, and whooping crane are unlikely to occur in the vicinity of the Project Area and so will also be eliminated from further discussion. The gopher tortoise prefers a xeric upland habitat, especially sandhills, which do not occur in the vicinity of the Project Area or along the truck-haul route (FWC, 2007). The black skimmer nesting habitat is historically north of Brevard County and nesting is currently rare along the entire east coast (FWC, 2013b).

The burrowing owl requires open-type habitats, which in the past were predominately dry prairies; however, due to human development their habitat now consists of pastures, agricultural fields, golf courses, airports, schools, and vacant lots, none of which are likely to occur in the Project Area or along the potential truck-haul route (FWC, 2013c). The whooping crane population in Florida is found primarily on the Kissimmee Prairie and surrounding areas. Due to the fact that these state-listed species are unlikely to be found in the vicinity of the Project Area or along the truck-haul route, it has been determined that the Proposed Action will have “no effect” on the gopher tortoise, black skimmer, burrowing owl, and whooping crane. Therefore these species will not be evaluated further in this document.

3.6.4.1. FLORIDA SANDHILL CRANE

The Florida sandhill crane (*Grus canadensis pratensis*) is a state-designated threatened species and is protected by the U.S. MBTA. It can reach a height of 120 cm (47.2 in) with a wingspan around 200 cm (78.7 in) (Tacha et al., 1992). This species is gray with a long neck and legs, and a bald spot of red skin on the top of its head. The sandhill crane is unique in flight as it can be seen flying with its neck stretched out completely.

The diet of the Florida sandhill crane primarily consists of grain, berries, seeds, insects, worms, mice, small birds, snakes, lizards, and frogs. Florida sandhill cranes are a non-migratory species that nests in freshwater ponds and marshes. This species is monogamous (breeds with one mate). Courtship consists of dancing, which features jumping, running, and wing flapping (International Crane Foundation, 2014). Sandhill crane nests are built by both mates with grass, moss, and sticks. Females lay two eggs that incubate for 32 days. Both male and female participate in incubating the eggs (Tacha et al., 1992). The offspring will begin traveling from the nest with their parents just 24 hours after hatching. At ten months old, juveniles are able to leave their parents (Tacha et al., 1992). Bonding between pairs begins at two years old.

Florida sandhill cranes inhabit freshwater marshes, prairies, and pastures (FNAI, 2001). They occur throughout peninsular Florida to the Okefenokee Swamp in southern Georgia; however, they are less common at the northernmost and southernmost portions of this range. Florida's Kissimmee and Desoto prairie regions are home to the state's most abundant populations (Meine and Archibald, 1996).

Degradation or direct loss of habitat due to wetland drainage or conversion of prairie for development or agricultural use are the primary threats facing Florida sandhill cranes. The range of the Florida sandhill crane diminished in the southeastern United States during the 20th century, with breeding populations disappearing from coastal Texas, Alabama, and southern Louisiana due to degradation, habitat loss, and overhunting (Meine and Archibald, 1996).

In 2015, there were 1,238 Florida sandhill cranes recorded in Palm Beach County, which includes more observation than 2013 and 2014 combined. The closest observation to the Study Area was in John Prince Park, which is located inland (approximately three miles west of the Project Area) on the shore of Lake Osborne in Lake Worth. All other observations were further inland, potentially in the vicinity of truck routes from upland mines (e-bird, 2015c).

3.6.4.2. WADING BIRDS

The little blue heron (*Egretta caerulea*), reddish egret (*Egretta rufescens*), roseate spoonbill (*Platalea ajaja*) and tricolored heron *(Egretta tricolor*) are listed by the FWC as SSC, however in light of the 2011 Biological Status Reviews, it was determined that these species met the criteria for being listed as threatened. A Species Action Plan (SAP) has been completed for the four wading birds and is awaiting approval by the FWC to officially change the status. The birds are also protected by the U.S. MBTA.

3.6.4.2.1. Little Blue Heron

The little blue heron (*Egretta caerulea*) is a smaller-sized heron, dark overall with yellow-green legs, and a blue bill with a black tip. The head and neck color changes between breeding and non-breeding periods from dark red to purplish (Rodgers, Jr. and Smith, 2012). The little blue heron inhabits both freshwater and saltwater habitats such as swamps, estuaries, ponds, lakes, and rivers but prefers freshwater environments. The little blue heron is widely distributed throughout the state with breeding populations concentrated in central and southern Florida. Breeding occurs from April through September in Florida and the little blue heron typically nests with other long-legged wading birds in multi-species colonies. The nests are located in a variety of woody vegetation including cypress, willow, maple, black mangrove, and cabbage palm (FNAI, 2001). Average clutch size is 3-5 blue-green eggs that hatch in 20-24 days and the young fledge in approximately 28 days. Little blue herons are solitary forages whose diet consists of fish, insects, shrimp, and amphibians (FWC, 2003).

According to e-bird (2015d) there were 8,091 little blue herons observed in Palm Beach County in 2015. Recently, the closest observations were in the Town of Palm Beach and South Palm Beach. Little blue herons were also recorded at other coastal and inland areas within the County.

3.6.4.2.2. Reddish Egret

Reddish egrets (*Egretta rufescens*) have two color morphs: white and dark. Dark morphs have gray bodies with reddish heads and white morphs have entirely white plumage; both morphs have blue legs and pink bills with black tips (Lowther and Paul 2002). The reddish egret is the rarest egret species in Florida and is entirely restricted to the Florida coast with two-thirds of the state's breeding population concentrated in Florida Bay and the Keys. In Florida Bay and the Keys, nesting season is from November through May, while in the mainland nesting season occurs between February and June. Reddish egrets typically nest in multi-species colonies or in small groups and rarely as isolated pairs. Typically nests are constructed on coastal islands in mangroves (red and black) or Brazilian pepper and on spoil islands (Lowther and Paul, 2002). On average, clutch size is 3-4 bluish-green eggs and the incubation period is approximately 26 days. Both parents share incubation responsibilities and the young leave the colony at about 9 weeks old, yet are capable of flight at about 45 days. The reddish egret forages on shallow flats and sandbars for small fish species, including killifish, sheepshead minnow, and sailfin molly. This species is known for using aerial techniques, such as jumping with wings spread, to capture prey (FWC, 2003).

In 2015, there were 109 reddish egrets recorded in Palm Beach County which included observations at the Snook Islands Natural Area, located in the LWL, which is approximately half a mile west of the northern end of the Study Area. Sightings were also recorded in other coastal areas and inland areas which may be within the vicinity of potential truck routes from upland mines (e-bird, 2015e).

3.6.4.2.3. Roseate Spoonbill

Roseate spoonbills (*Platalea ajaja*) have a pink body with a white neck and breast, pink wings with highlights of red and long reddish legs. Spoonbills have an unfeathered head which can be yellow or green. Roseate spoonbills are large wading birds, weighing about 1.4 kg (3.0 lbs) and have a 127 cm (50 in) wingspan. Characteristic to the species is a long, spatulate bill. The spoonbill feeds by wading through shallow water, head down, probing the bottom by sweeping its long, spoon-shaped bill back and forth in the water. When prey is detected by touch, the bill snaps shut; small fish, crustaceans, and insects make up the bulk of the diet (Dumas, 2000). In Florida Bay nesting occurs between November 1 and December 15 and from February through June at Tampa Bay and Merritt Island. Spoonbills prefer mangrove and spoil islands as nesting habitat. Females usually lay three eggs and eggs are incubated for approximately 21 days. After the young spoonbills hatch, chicks require a continuous supply of food for 42 days. Foraging adult spoonbills require water levels at or below 13 cm (5.1 in) within the coastal wetlands to forage efficiently and feed young (Lorenz, 2014). Nestlings fledge in approximately four weeks (FWC, 2003).

According to e-bird (2015f), there were 7,376 roseate spoonbill observations in Palm Beach County in 2013. The roseate spoonbill was recorded at the Snook Islands Natural Area, which is the closest recorded observation to the Study Area, as well as other coastal and non-coastal areas in the County.

3.6.4.2.4. Tricolored Heron

The tricolored heron *(Egretta tricolor*) is ornately colored; it is slate-blue on its head and upper body and has a purplish chest with white under parts and fore-neck (FWC, 2003).

The tricolored heron occupies freshwater and saltwater environments, such as marshes, estuaries, mangrove swamps, lagoons, and river deltas in central and southern Florida. Nests are found in trees or shrubs on salt marsh islands or standing water. The breeding period is from February through August and occurs along the coast and inland, most commonly in southern Florida (FWC, 2003). Tricolored herons nest in colonies with ibis and other heron species. Average clutch is size is 3-4 blue-green eggs and the incubation period is about 22 days. After 12-21 days the young are able to fly. The diet of the tricolored heron is mainly small fish (FWC, 2003).

In 2015, there were 14,378 tricolored herons recorded in Palm Beach County. Recently, sightings were documented in the Town of Palm Beach and South Palm Beach. Tricolored herons were also recorded at other coastal and inland areas within the County (e-bird, 2015g).

3.6.4.2.5. Threats to Wading Birds

Key threats to the little blue heron (*Egretta caerulea*), reddish egret (*Egretta rufescens*), roseate spoonbill (*Platalea ajaja*) and tricolored heron *(Egretta tricolor*) include loss of suitable foraging and breeding areas due to human disturbance of nesting colonies; increased populations of native and exotic predators that cause nest failure; and habitat degradation, including altered hydrological regimes, lower water tables, nutrient enrichment of waters, and exposure to environmental contaminants (FWC, 2013e).

3.6.5. SEABIRDS AND SHOREBIRDS

Common Florida seabirds such as the least tern (*Sternula antillarum*), black skimmer (*Rynchops nige*r), royal tern (*Thalasseus maxima*) and sandwich tern (*Thalasseus sandvicensis*) nest on open beach areas. Florida shorebirds, such as the American oystercatcher (*Haematopus palliatus*), snowy plover (*Charadrius alexandrines*), Wilson's plover (*Charadrius wilsonia*) and willet (*Trina semipalmata*) nest within the wrack line, on open beach, within dune vegetation or even in marsh grasses (FWC, 2010; FWC, 2013f).

3.6.6. MIGRATORY BIRDS

The Study Area supports migratory birds. Migratory birds are of great ecological and economic value to this country and to other countries, contributing to biological diversity and providing educational and recreational opportunities to people who study, watch, or hunt these birds throughout the world. The United States has recognized the critical importance of this shared resource by ratifying international, bilateral conventions for the conservation of migratory birds. These migratory bird conventions impose substantive obligations on the United States for the conservation of migratory birds and their habitats, and through the Migratory Bird Treaty Act (MBTA) the U.S. has implemented these migratory bird conventions.

Executive Order 13186 of January 10, 2001 directs executive departments and agencies to take certain actions to further implement the MBTA. Under Section 3.(e) of Executive Order 13186, each agency shall, pursuant to its Memorandum of Understanding with the USFWS and to the extent permitted by law and subject to the availability of appropriations and within budgetary limits, and in harmony with agency missions: (1) support the conservation intent of the migratory bird conventions by in part, avoiding or minimizing impacts on migratory bird resources; (2) restore and enhance the habitat of migratory birds, as practicable; (3) prevent or abate the pollution or detrimental alteration of the environment for the benefit of migratory birds, as practicable; (4) design migratory bird habitat and population conservation principles, measures, and practices into agency plans and planning processes as practicable and coordinate with other agencies and nonfederal partners; (5) ensure that agency plans and actions promote programs of comprehensive migratory bird planning efforts; (6) ensure environmental analysis of Federal Actions required by NEPA evaluate the effects of actions on migratory birds with emphasis on SSC; (7) provide notice to the USFWS in advance of conducting an action that is intended to take migratory birds; (8) minimize the intentional take of species of concern; and (9) identify where unintentional take reasonably attributable to agency actions is having or is likely to have a measurable negative effect on migratory bird populations. For a complete list of the requirements in Executive Order 13186, please refer to the Presidential Documents, Federal Register, Volume 66, Number 11 dated January 10, 2001 *Responsibilities of Federal Agencies to Protect Migratory Birds.*

3.7. ESSENTIAL FISH HABITAT

The Magnuson Fishery Conservation and Management Act of 1976, amended Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act, MSFCMA) by the Sustainable Fisheries Act of 1996, set forth a mandate to identify and protect important marine and estuarine fish and their habitat. The U.S. Congress enacted the Magnuson-Stevens Act to support the government's goal of sustainable fisheries. Crucial to achieving this goal is the maintenance of suitable marine fishery habitat quality and quantity. This goal is achieved through identifying and describing Essential Fish Habitat (EFH), describing non-fishing and fishing threats, and suggesting measures to conserve and enhance EFH. The Magnuson-Stevens Act defines EFH as "...those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (16. U.S.C. 1802 (10))."

The Project Area falls under the jurisdiction of the 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. Table 3-10 lists the important habitats within estuarine and marine areas of the South Atlantic region as designated by the comprehensive EFH amendment (SAFMC, 1998) and Fishery Ecosystem Plan (SAFMC, 2008). Although unconsolidated (soft) bottom is not defined as an EFH category in FMP Amendments by the SAFMC, it has been listed as EFH for certain life stages of snapper grouper, spiny lobster and shrimp FMPs (SAFMC, 2014), and is therefore also included in Table 3-10. The Project Area encompasses only marine areas, specifically nearshore hardbottom and coral habitat, water column, and unconsolidated (soft) bottom.

Table 3-10. South Atlantic Fisheries Management Council (SAFMC) designated Essential Fish Habitat (EFH) (SAFMC, 1998).

ESTUARINE AREAS	MARINE AREAS
Estuarine Emergent Wetlands	Live / Hardbottom
Estuarine Scrub/Shrub Mangroves	Coral & Coral reefs
Submerged Aquatic Vegetation	Artificial / Manmade reefs
Oyster Reefs & Shell Banks	Sargassum
Intertidal Flats	Water Column
Palustrine Emergent & Forested Wetlands	Unconsolidated bottom (soft sediments)
Aquatic Beds	
Estuarine Water Column	

3.7.1. EFH IN THE PROJECT AREA

Of the EFH areas designated by the SAFMC, the Southern Palm Beach Island Comprehensive Shoreline Stabilization Project Area (R-129-210 to R-138+551) encompasses only marine areas, specifically nearshore coral/live hardbottom, water column, and unconsolidated (soft) bottom. The following sections address the EFH in and near the Project Area; however, Appendix F provides the full EFH Assessment. This EFH assessment includes analysis of potential direct and indirect impacts to EFH and managed species from sand placement and groin construction; this assessment discusses but does not include a detailed effects analysis of dredging offshore borrow areas or the activities associated with stockpiling the dredged material since EFH consultation has occurred separately for these activities under the permitting processes for the Phipps and/or Mid-Town projects. Similarly, this consultation will occur for any future Phipps and Mid-Town projects.

3.7.1.1. CORAL/LIVE HARDBOTTOM

The SAFMC classifies coral and live/hardbottom habitats as EFH. The Fishery Management Plan for Coral, Coral Reefs and Live/Hard Bottom Habitat of the South Atlantic Region (Coral FMP) defines coral reefs as nearshore hardbottoms, deepwater hardbottoms (including deepwater banks), patch reefs, and outer bank reefs. SAFMC has determined that the nearshore hardbottom resources from Cape Canaveral to Broward County, Florida, including the resources located adjacent to the Project Area, meet the criteria as Habitat Areas of Particular Concern (HAPC) for coral, coral reefs and live/hardbottom (SAFMC, 2009; 2011). According to the SAFMC Final Habitat Plan for the South Atlantic Region (1998), hardbottom habitats in this area are generally low relief areas on continental shelves. They constitute a group of communities characterized by a thin veneer of corals and other biota overlying assorted sediment types.

Field investigations have determined that natural intertidal hardbottom formations located in the Study Area fluctuate with seasonal variations and storm events (CPE, 2007). These formations are ephemeral in nature and the quantity and quality of intertidal hardbottom changes drastically over short time periods (i.e. six months to one year, or less). Sampling revealed these formations support a variety of turf and macroalgae species, some octocoral and stony coral species, and other benthic sessile or encrusting life forms, such as species of annelid worms (including *Phragmatopoma* sp.) and bryozoans (CPE, 2007; CB&I, 2014). *In situ* hardbottom biological monitoring has been conducted on the nearshore intertidal and subtidal hardbottom formations in association with several beach nourishment projects on Palm Beach Island, and the most recent survey was conducted in October 2013 in order to provide updated data for planning and permitting of the proposed Project (CB&I, 2014) (See Section 3.5. for more details).

Managed species that may utilize this habitat include species of the snapper-grouper complex, coastal inshore shark species, spiny lobster, and coral. Additional fish species are present offshore year round and may utilize the ephemeral hardbottom in nearshore waters at different life stages (Lindeman and Snyder, 1999). Fish reported utilizing this habitat in the nearshore waters of the Project Area are included in Table 3-2 of the EFH Assessment (Appendix F) (CPE, 2005; CPE and CSI, 2011a; CB&I, 2014).

3.7.1.2. SOFTBOTTOM

Though not designated as an EFH category in FMP Amendments by the SAFMC, unconsolidated (soft) bottom has been listed as EFH for certain life stages of snapper grouper, spiny lobster and shrimp FMPs (SAFMC, 2014). Softbottom is also used to some extent by many coastal fish species. However, certain species are better adapted to or dependent on shallow unvegetated bottom. Flatfish, rays, and skates are well suited for utilization of softbottom. Juvenile and adult fish species that forage on the rich abundance of microalgae, detritus, and small invertebrates are highly dependent on the condition of softbottom (SAFMC, 2009).

Along the proposed Project Area, softbottom occurs continuously between the nearshore reef tracts. The direct placement and equilibration (offshore spreading) of sand from the Proposed Action will permanently bury and/or asphyxiate most infaunal and epifaunal softbottom organisms. The quality of the material which will be obtained from upland or offshore sources for use in the Project will be similar to that of the beaches in the Project Area, and therefore, similar to the subtidal marine environment. The similarity of the sand material to the native sediment will aid in the recovery of the benthic communities impacted by the placement of the fill material.

3.7.1.3. MARINE WATER COLUMN

The SAFMC designates marine water column as EFH. It is the “medium of transport for nutrients and migrating organisms between river systems and the open ocean” (SAFMC, 1998). The water column from Dry Tortugas to Cape Hatteras serves as habitat for many marine fish and shellfish. Most marine fish and shellfish broadcast-spawn pelagic eggs and, thus utilize the water column during a portion of their early life history (e.g. egg, larval, and juvenile stages). In general, larvae of shrimp, lobsters, crabs as well as reef, demersal and pelagic fishes are found in the water column (SAFMC, 1998). Important attributes of the water column include hydrodynamics, temperature, salinity, and dissolved oxygen.

3.7.2. MANAGED SPECIES

Of the fisheries managed by SAFMC and NMFS, the following may occur within the Project Area:

- Coral/ Live hardbottom
- Penaeid shrimp
- Snapper grouper complex
- Spiny lobster
- Coastal migratory pelagic species (including dolphin and wahoo)
- Highly migratory species

Members of these groups occur in the Project Area for at least a portion of their life history. The following sections briefly summarize the EFH for these species and their respective life stages, as described in the relevant FMPs. Species-specific details can be found in the EFH Assessment (Appendix F).

3.7.2.1. CORAL/LIVE HARDBOTTOM

The Fishery Management Plan for Coral, Coral Reefs and Live/Hard Bottom Habitat of the South Atlantic Region (Coral FMP) defines coral reefs as nearshore hardbottoms, deepwater hardbottoms, patch reefs, and outer bank reefs. The Coral FMP includes hundreds of species found within coral reef and hardbottom communities. SAFMC has determined that the nearshore hardbottom resources from Cape Canaveral to Broward County, Florida, including the resources located adjacent to the Project Area, meet the criteria as HAPC for coral, coral reefs, and live/hardbottom (SAFMC, 2009; 2011). Section 3.5 details the coral/live hardbottom habitat found adjacent to the proposed Project Area, and the species of scleractinian corals, octocorals and fish which have been documented within this habitat.

3.7.2.2. PENAEID SHRIMP

The shrimp fishery in the South Atlantic includes five species: brown shrimp (*Farfantepeneaus aztecus*), pink shrimp (*Farfantepenaeus duorarum*), white shrimp (*Litopenaeus setiferus*), rock shrimp (*Sicyonia brevirostris*), and royal red shrimp (*Pleoticus robustus*) (SAFMC, 1998; NMFS, 1999). The shrimp species of the southeastern U.S. occupy similar habitats with the greatest differences being in optimal substrate and salinity. In general, EFH is designated as varied inshore, pelagic, and benthic habitats from the Virginia/North Carolina border to southern Florida. Of these six managed species, pink shrimp are expected to occur within the Project Area as they are the only penaied species whose range includes south Florida (SAFMC, 1998).

3.7.2.3. SNAPPER GROUPER COMPLEX

EFH for snapper-grouper species includes coral reefs, live/hardbottom, submerged aquatic vegetation, artificial reefs, and medium to high profile outcroppings on and around the shelf break zone from shore to at least 183 m (600 ft) and at least 610 m (2000 ft) for wreckfish. The annual water temperature range in this area is sufficiently warm to maintain adult populations of members of this largely tropical complex (SAFMC, 2013).

Of the species managed by the SAFMC, 60 are included in the snapper-grouper complex (SAFMC, 2013). Because of its mixed-species nature, this fishery is challenging to manage. Through the original FMP and subsequent amendments, the SAFMC has addressed overcapitalization, implemented measures to rebuild overfished species, and is moving forward with the use of Marine Protected Areas (MPA) as a management tool for deepwater species.

The SAFMC's FMP for the snapper grouper resource was first implemented in 1983. Strict management measures, including prohibition of harvest in some cases, have been implemented to rebuild overfished species in the snapper grouper complex. In addition, the SAFMC has used traditional management tools such as bag limits, size limits, trip limits, commercial quotas, and spawning season closures to help rebuild stocks. The SAFMC also approved Amendment 14 to create a system of eight deepwater marine protected areas to help further protect deepwater snapper-grouper species and their associated habitat (SAFMC, 2009). More recently, the SAFMC has explored the use of Limited Access Privilege (LAP) Programs for the snapper grouper fishery, including a program specific for the golden tilefish commercial fishery. There are no MPAs or LAPs in the Project Area.

3.7.2.4. SPINY LOBSTER

EFH for spiny lobster includes nearshore shelf/oceanic waters; shallow subtidal bottom; seagrass habitat; unconsolidated bottom (soft sediments); coral and live/hard bottom habitat; sponges; algal communities (*Laurencia*); and mangrove habitat (prop roots). In addition, the Gulf Stream is EFH because it provides a mechanism to disperse spiny lobster larvae (SAFMC, 1998). HAPCs for spiny lobster include Florida Bay, Biscayne Bay, Card Sound, and coral/hard bottom habitat from Jupiter Inlet, Florida through the Dry Tortugas, Florida.

3.7.2.5. COASTAL MIGRATORY PELAGIC SPECIES INCLUDING DOLPHIN AND WAHOO

Coastal migratory pelagic (CMP) species managed under the SAMFC, such as king mackerel, Spanish mackerel, cobia, common dolphinfish, and wahoo, utilize the marine water column. EFH for these species includes sandy shoals of capes and offshore bars, high profile rocky bottom and barrier island ocean-side waters, from the surf to the shelf break zone. In addition, all coastal inlets, all state-designated nursery habitats of particular importance to CMPs are considered EFH (SAFMC, 1998). The Gulf Stream is also considered EFH because it provides a mechanism to disperse CMP larvae. Within the spawning area, eggs and larvae are concentrated in the surface waters.

EFH for dolphin and wahoo is the Gulf Stream, Charleston Gyre, Florida Current, and pelagic *Sargassum* (SAFMC, 2003). EFH-HAPC for dolphin and wahoo in the Atlantic include: The Point, The Ten-Fathom Ledge and Big Rock (North Carolina); The Charleston Bump and The Georgetown Hole (South Carolina); The Point off Jupiter Inlet (Florida); The Hump off Islamorada (Florida), The Marathon Hump off Marathon (Florida); The “Wall” off the Florida Keys, and Pelagic *Sargassum* (SAFMC, 2003).

3.7.2.6. COASTAL HIGHLY MIGRATORY SPECIES

Highly migratory species (HMS), such as Atlantic tunas, swordfish, sharks and billfish are found throughout the Atlantic Ocean and need to be managed on domestic and international levels. To address this issue the Fishery Conservation Amendments of 1990 were signed into law on November 29, 1990. This effectively transferred the management authority of HMS from the fishery management councils (FMC) to the Secretary of Commerce who in turn delegated the authority to NMFS (Pub. L. 101-627) (NMFS, 2010). The HMS Management Division was created by NMFS to manage and regulate HMS fisheries which include both coastal and pelagic highly migratory species. Coastal HMS, such as tuna and coastal sharks, may utilize the marine water column in or near the Project Area. Several pelagic HMS species may occur in the waters extending out to the western edge of the Gulf Stream, but are more commonly found in water depths greater than 100 m.

Table 3-11 lists coastal HMS species with the potential to occur within or adjacent to the Project Area. Pelagic HMS are not listed, as they generally occur in waters at least 25 m (82 ft) in depth, which is outside of Project influence.

According to NMFS, identifying EFH for tuna, swordfish, and many pelagic shark species is challenging because, although some HMS may frequent the neritic waters of the continental shelf as well as inshore areas, they are primarily blue-water (i.e., open-ocean) species. Most of these species frequent coastal and estuarine habitats during various life stages and travel over great horizontal distances, commonly migrating vertically within the water column (NMFS, 1999).

Due to the variety of habitats utilized by most HMS during various life stages, most HMS have the potential to occur somewhere in the Project Area. EFH for HMS was updated in the Final Amendment 1 to the Consolidated Atlantic Highly Migratory Species Fishery Management Plan (NMFS, 2009c). Table 3-11 lists coastal HMS which have life stages with designated EFH located in the Project Area.

Table 3-11. Coastal highly migratory species (HMS) that have the potential to occur in the Study Area (J=juvenile; A=adult) (NMFS, 1999). Measurements (m) represent isobath.

Common Name	Scientific Name	EFH
Coastal HMS		
Atlantic bluefin tuna	*Thunnus thynnus*	J, A = coastal waters to EEZ boundary
Great hammerhead	*Sphyrna mokarran*	J, A = coastal waters to 100 m
Nurse shark	*Ginglymostoma cirratum*	J, A = shoreline to 25 m
Bull shark	*Carcharhinus leucas*	J = inlets, estuaries, < 25 m
Lemon shark	*Negaprion brevirostris*	A = inlets, estuaries, < 25 m
Scalloped hammerhead	*Sphyrna lewini*	J = shoreline to 200 m
Dusky shark	*Carcharhinus obscurus*	J = shallow coastal waters, inlets, estuaries to the 500 m
Spinner shark	*Carcharhinus brevipinna*	Early J = coastal waters to 25 m
Tiger shark	*Galeocerdo cuvieri*	A = coastal to Gulf Stream
Bonnethead shark	*Sphyrna tiburo*	J = shallow coastal waters, inlets, estuaries, < 25 m

3.8. OFFSHORE BORROW AREA RESOURCES

None of the alternatives being considered includes dredging directly from an offshore borrow area; however, the Town of Palm Beach proposes to utilize a stockpile of dredged material from the Phipps Project and/or the Mid-Town Project for the Project Area within the Town of Palm Beach limits. This material will be dredged under authorization by USACE Permit No. SAJ-2000-00380 for Phipps and USACE Permit No. SAJ-1995-03779 for Mid-Town, and both projects will be authorized by FDEP under the Palm Beach Island Beach Management Agreement (BMA) (FDEP, 2013). These projects may dredge sand from North Borrow Area 1 (NBA1), South Borrow Area 2 (SBA2), South Borrow Area 3 (SBA3) (see Figure 2-3) or any offshore sand source that is consistent with the BMA cell-wide sediment quality specifications (see Table 2-1). The stockpiled sand will be located within the permitted Phipps and Mid-Town templates (alternating between the two projects) and will be considered an active stockpile so that sand is removed for transport to the Project Area soon after it is piled. The total proposed volume for placement for the Town of Palm Beach's Preferred Alternative is approximately 65,200 cy, 3,400 cy of which will be placed below MHW. If timing of the Phipps and Mid-Town projects does not allow for use of dredged sand for this Project, the Town of Palm Beach would consider using sand from an upland source. The County proposes to use only sand from an upland source for placement in the County project within the Towns of South Palm Beach, Lantana and Manalapan.

3.9. COASTAL BARRIER RESOURCES

Congress passed the Coastal Barrier Resources Act (CBRA) in 1982 and the Coastal Barrier Improvement Act (CBIA) of 1990 to address problems caused by coastal barrier development. These Acts defined a list of undeveloped coastal barriers along the Atlantic and Gulf coasts and were passed to limit federally-subsidized development within a defined Coastal Barrier Resources System (Unit). There are no CBRA Units in or in proximity to the Project Area. The nearest unit, John H. Chafee Coastal Barrier Resources System Unit FL-18P in MacArthur Beach, is located approximately 24 km (15 mi) north of the Project Area.

3.10. WATER QUALITY

Eastern Palm Beach County is one of the more heavily urbanized areas within the State of Florida. The rapid population growth is a suspected contributor to the noticeable environmental degradation of water quality along this area. These declines in water quality have been brought about mainly through the discharge of nutrient-laden sewage and storm water runoff into canals (FDEP, Division of Water Resource Management, 2003). Three major drainage canals of eastern Palm Beach County discharge into LWL. From LWL and the AICW, two maintained inlets (Lake Worth Inlet and South Lake Worth Inlet) provide access to the Atlantic Ocean; therefore, discharges and inflows eventually reach coastal waters. According to the FDEP, Division of Water Resource Management (2003), this runoff may carry bacteria, viruses, oil and grease, toxic metals, and pesticides into urban canals and eventually coastal waters.

Both Lake Worth Inlet and South Lake Worth Inlet provide a mechanism for natural flushing and exchange between LWL and the Class III oceanic waters off the coast of Palm Beach County. Class III waters are defined as areas suitable for recreation and the propagation and maintenance of a healthy, well-balanced population of fish and wildlife (FDEP, Division of Water Resource Management, 2003). One of the major impediments to coastal water quality within the County is high turbidity. Turbidity, measured in Nephelometric Turbidity Units (NTU), is a measure of the loss in water clarity due to the presence if suspended particulates. The turbidity within this region is generally lowest in the summer months and highest in the winter months in relation to the frequency of storm events. This storm-induced high turbidity is caused by the re-suspension of organic matter and sediments by wave action during these storm events. High turbidity events are temporary in nature and return to lower levels within several days to several weeks following a storm, depending on the duration of the storm event.

3.11. AIR QUALITY

Air pollutants are classified as either primary or secondary depending on how they are formed. Primary pollutants are generated daily and emitted directly from a source into the atmosphere. Primary pollutants include carbon monoxide (CO), nitrogen dioxide (NO_2), nitric oxide (NO), sulfur dioxide (SO_2), particulates (PM-10 and PM-2.5), and hydrocarbons (HC). Hydrocarbons are also known as volatile organic compounds (VOC).

Secondary pollutants are created over time as a result of chemical and photochemical reactions in the atmosphere. Ozone (O_3) is a secondary pollutant, formed when NO_2 reacts with HC in the presence of sunlight.

The U.S. EPA has established national ambient air quality standards for six “criteria air pollutants.” The State of Florida has adopted the same six criteria pollutants and related standards. The ambient air quality standards for criteria pollutants are shown in Table 3-12. The Southeast Florida Intrastate Air Quality Control Region, which includes Palm Beach County, is classified as a Federal attainment area (an area designated by EPA as having attained the relevant national ambient air quality standard for a given pollutant).

Table 3-12. Ambient air quality standards.

Air Pollutant	National Standard	
	Primary	Secondary
Ozone (O_3)	0.12 ppm, 1-hr. average	0.12 ppm, 1-hr average
Monoxide (CO)	9.0 ppm, 8-hr. average	
	35 ppm, 1-hr. average	
Nitrogen Dioxide (NO2)	0.053 ppm, AAM	0.053 ppm, AAM
Sulfur Dioxide (SO_2)	0.03 ppm, AAM	0.50 ppm, 3-hr. average
	0.14 ppm, 24-hr. average	
Suspended Particulate Matter (PM10)	150 μg/m^3, 24-hr. average	150 μg/m^3, 24-hr.
	50 μg/m^3 AAM	50 μg/m^3 AAM
Lead (Pb)	1.5 μg/m^3, calendar quarter	1.5 μg/m^3

Source: EPA Office of Air Quality Planning and Standards, 2013
Notes: ppm = parts per million by volume, AAM = annual arithmetic mean, μg/m^3 = micrograms per cubic meter

The Project is exempt from the Clean Air Act (CAA) conformity requirements because it is located in a Federal attainment area (EPA, 1973). In July 1, 2000, the State of Florida eliminated the auto emissions test requirement for all vehicles throughout the state (FL DMV, 2013). The typical sea breezes along the Palm Beach coastline readily disperse airborne pollutants. This Project, regardless of the alternative implemented, would not require air quality permits.

3.12. AESTHETIC RESOURCES

The Study Area is composed of lands that are used by the public for tourism and beach recreation, such as swimming, picnicking, sporting activities, and exercising. The visual landscape of the area includes vistas of the Atlantic Ocean, natural beach and dune areas. The shoreline along proposed Study Area is characterized by residential and commercial development and public recreational lands. Exposed and buried seawalls are intermittently spaced along the shoreline from R-129 to just south of R-133. Dune vegetation exists on the seaward side of buried seawalls in this area. The shoreline includes exposed seawalls south of R-133 to R-141 (Figure 3-2). Public beach access is available at Lake Worth Municipal Beach and Lantana Public Beach. The Lake Worth Fishing Pier (located between R-128 and R-129) also provides visitors with fishing access.

3.13. RECREATION RESOURCES

The County's coast provides a variety of recreational activities for the public. Water and air temperatures are comfortable year-round, averaging 24°C (75°F) and 25°C (78°F) respectively, and provide ideal conditions for water sports and other outdoor recreational activities. Popular activities within the Study Area and adjacent waters of the Atlantic Ocean include fishing, boating, snorkeling, SCUBA diving, and surfing.

There are two primary locations within the Study Area which are used by surfers when conditions permit. The first is located just before the guarded area on the south side of Lake Worth Pier. A sandbar extends toward the south in front of an old seawall called "Blackwall". When a north or northeast swell is present, fast, hollow waves reel along this bar earning it the nickname, "Banzai" (Surfline, 2013). The second surf location is located at the Lantana Public Beach. Waves break at this location on almost all conditions. While groundswells often cause the wave to close out, wind-driven swells deliver powerful peaks over the inside sandbars (Surfline, 2013).

The Lake Worth Municipal Beach provides public access to the Lake Worth Fishing Pier. The 396 m (1,300 ft) pier is located at the northern end of the Study Area between FDEP survey R-monuments R-128 and R-129. The beach in this area features picnic areas, grills, park benches, a pool with lifeguards, a gift shop, a restaurant on the beach side of the pier, and metered parking (Palm Beach County Convention and Visitors Bureau, 2013).

3.14. NAVIGATION

The Study Area is located between two Palm Beach County inlets: the Lake Worth Inlet and South Lake Worth Inlet (Boynton Inlet) serve as access points for recreational and commercial vessels year round. Lake Worth Inlet is located between FDEP R-monuments R-75 and R-76 approximately 16 km (10 mi) north of the Project Area. The South Lake Worth Inlet is located between FDEP R-monuments R-151 and R-152, approximately 4 km (2.5 mi) south of the Project Area.

Lake Worth Inlet is approximately 244 m (800 ft) wide with a navigation depth of approximately 11 m (35 ft) and serves as a navigation channel that is maintained periodically by dredging. The north and south jetties stabilize the navigation channel alignment. A sand bypassing plant at the north jetty transfers sand from the updrift fillet and discharges the material approximately 31 m (100 ft) downdrift of the south jetty. The bypassing plant was constructed by the Town of Palm Beach in 1958 and is presently operated by the County (FDEP, 2008). The South Lake Worth Inlet is 40 m (130 ft) wide with a depth ranging from 1.8-3.7 m (6.0-12.0 ft) (FDEP, 2008). Small commercial and recreational boaters use this inlet as an access to the Atlantic Ocean. Recreational boat traffic through the inlets increases during the winter season due to an influx of seasonal residents to the area population.

3.15. CULTURAL RESOURCES AND HISTORIC PROPERTIES

The Code of Federal Regulations (CFR) Title 36, Chapter VIII, Part 800 (36 CFR 800) contains the guidelines for fulfilling the provisions of Section 106 of the National Historic Preservation Act of 1966 (NHPA). Cultural resources include archaeological, architectural, and historical sites and objects. Similarly, Section 267 of the Florida Statutes which addresses Historical Resources requires that “each state agency of the executive branch having direct or indirect jurisdiction over a proposed state or state-assisted undertaking shall, in accordance with state policy and prior to the approval of expenditure of any state funds on the undertaking, consider the effect of the undertaking on any historic property that is included in, or eligible for inclusion in, the National Register of Historic Places” (Section 267.061(2)(a), F.S.).

A comprehensive literature review included historic and recent documentation of beach nourishment projects and cultural resource investigations within the Town of Palm Beach. Data identified during the literature review was compiled into an ArcGIS map to illustrate the location of the cultural resources with respect to the Project Area (Figure 3-15). The literature review revealed four potential cultural resources within the Project Area. Three have been previously identified; one is located on the northeastern boundary of the Project Area and would require further investigation to confirm the nature of the resource.

In 1988, a magnetometer remote sensing survey was conducted within two potential borrow areas offshore of the Town of Palm Beach (Baer, 2000). The survey location was several miles south of the Lake Worth Inlet which is north of the proposed Project Area. The survey identified 29 magnetic anomalies that were all related to modern debris, pipelines, and cables. None of these anomalies were recommended for further investigation as possible archaeological material.

In 1989, a magnetometer remote sensing survey of a potential borrow area located immediately south of the Lake Worth Inlet, north of the proposed Project Area (Baer, 2000) was conducted. A total of 38 magnetic anomalies were identified. None of these anomalies were associated with archaeological material or recommended for avoidance.

In 2000, a remote sensing survey of three potential borrow areas near the Lake Worth Inlet, north of the current Project Area (Baer, 2000) was conducted. A total of 110 magnetic anomalies were identified. Nine clusters of anomalies had characteristics indicative of potentially significant submerged cultural resources. It was recommended that each cluster of anomalies be avoided by placing a 200-ft diameter buffer around the center of each anomaly.

In May of 2006, a team of marine biologists from CPE observed an anchor during a biological investigation of the nearshore benthic community within Reach 8. Photographs and recorded observations were sent to Dr. Gordon Watts of Tidewater Atlantic Research, Inc. (TAR) for review. Dr. Watts concluded the anchor was likely a mid or late 19th Century piece that possibly served as a mooring anchor. The Florida Department of State Division of Historical Resources (DHR) recommended a 500-ft radius buffer be placed around the anchor site (8PB10358) due to the lack of information regarding the extent of the site (Gaske, 2006). The DHR also recommended a 500-ft radius buffer for two other possible historic shipwrecks (8PB10356 & 8PB10359) within the southernmost extent of the Project Area and these are indicated as the “2006 DHR 500’ Cultural Resource Buffers” in Figure 3-15 (Gaske, 2006).

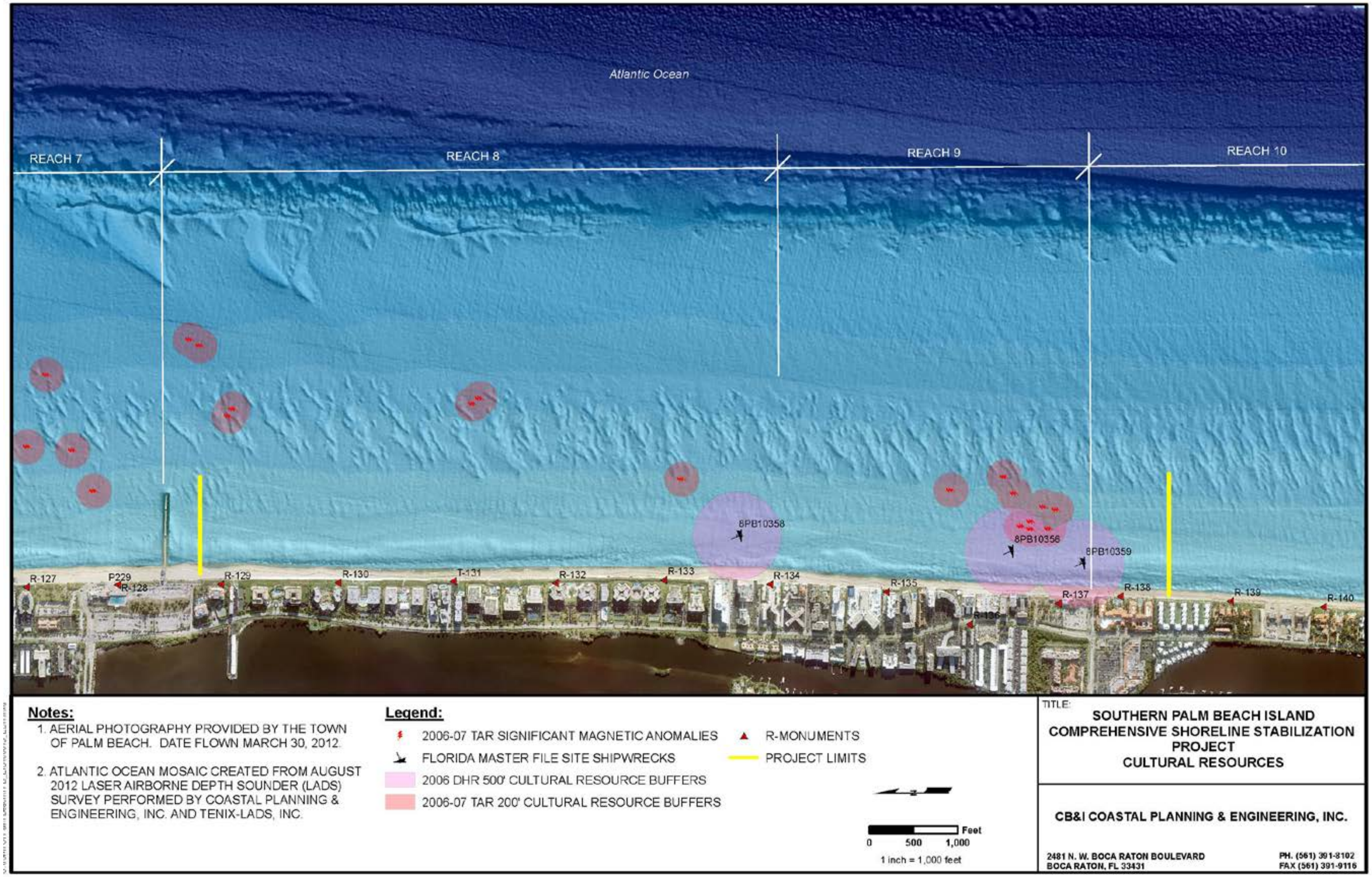


Figure 3-15. Potential cultural resources within the vicinity of the Project Area.

The most recent remote sensing survey within the Project Area was conducted during November 2006 and April 2007. TAR was contracted by CPE to conduct a cultural resource survey of four potential borrow areas for a beach nourishment project at Reaches 5 and 8 in the County (TAR, 2007). The survey was designed to identify potentially significant cultural resources within the project limits and to provide recommendations for avoidance and/or additional investigation for discovered magnetic anomalies.

The 2006-07 cultural resources survey consisted of background research and field investigations of four survey areas (South, Middle South, Middle North, and North) using a cesium magnetometer, sidescan sonar and sub-bottom along parallel lines spaced at 100-foot intervals. The field investigations identified a total of 47 magnetic and/or acoustic anomalies (TAR, 2007). Of the 47 anomalies, 18 were determined to be material associated with potentially significant cultural resources. Of these 18 potentially significant anomalies, 13 were located adjacent to Reaches 7 through 10. One anomaly was located in the Middle South Survey Area and four in the North Survey Area. In the South Survey Area, which covers the current Project Area, a cluster of 8 potentially significant anomalies outside of the Area of Potential Effect (APE) were recorded near a possible nineteenth century wreck site listed in the Florida site files (8PB10356) (TAR, 2007). TAR recommended that anomalies associated with potentially significant cultural resources located within the APE and proposed sand borrow areas be avoided with 200-ft radius buffers and anomalies outside the proposed borrow sites be also buffered with a 200-ft radius or investigated further if those areas become part of the APE. These buffers are denoted as the '2006-07 TAR 200' Cultural Resource Buffers' in Figure 3-15. The remaining 29 anomalies were associated with modern debris and were not recommended for avoidance. In addition, analysis of the seismic records did not indicate the location of buried channels or other relict landforms associated with the location of submerged prehistoric archaeological sites within the proposed borrow areas. The DHR concurred with the initial report findings and recommendations of 200-ft radius buffers for anomalies possibly associated with a historic shipwreck (Gaske, 2007). However, as previously stated, in 2006 the DHR recommended that the three recorded shipwrecks within the Project limits (8PB10356, 8PB10358, 8PB10359) be avoided with 500-ft radius buffers (Gaske, 2006).

In letters dated February 3, 2015, the Division of Historical Resources and State Historic Preservation Officer stated that the proposed project will have no effect on historic properties as long as the following conditions are met (letters included in Appendix K):

- Sand is placed on the beach in such a manner that no ground disturbance (such as trenching) is undertaken
- No historic structures on the beach, or uplands are impacted
- The buffers outlined in Figure 3-15 are observed during project activities; 500 ft buffers for known shipwrecks and 200 ft buffers for offshore anomaly clusters.

3.16. SOCIOECONOMICS

The Southeast Florida coastal region consists of the eight counties in the southeast corner of the state ranging southwards through Brevard, Indian River, St. Lucie, Martin, Palm Beach, Broward, Miami-Dade and Monroe Counties. The proposed Project includes the following municipalities: Town of Palm Beach, Town of South Palm Beach, Town of Lantana, and the Town of Manalapan. The 2010 population census for The Town of Palm Beach reported 8,348 residents, 9,091 housing units, a median age of 67.4, and a median household income of $109,167 (U.S. Census Bureau, 2010). The 2010 population census for The Town of South Palm Beach reported 1,171 residents, 1,492 housing units, a median age of 68.9, and a median household income of $62,589 (U.S. Census Bureau, 2010). The 2010 population census for The Town of Lantana reported 10,423 residents, 5,186 housing units, a median age of 40.3, and a median household income of $42,731 (U.S. Census Bureau, 2010). The 2010 population census for The Town of Manalapan reported 406 residents, 339 housing units, a median age of 61.2, and a median household income of $235,625 (U.S. Census Bureau, 2010).

The coastal properties within the Southeast Florida coastal region had a value of $15.9 billion, with 29% in Palm Beach County in 2007 (Kildow, 2008). Second to Martin County, Palm Beach County had an average value of coastal properties of $981,610 in 2007

(Kildow, 2008). Property tax revenues received by taxing authorities from coastal real estate in the Southeast region were highest in Palm Beach County ($308.3 million). One reason for this was the relatively higher assessment of taxable value on the beachfront homes within Palm Beach County (Kildow, 2008).

The value of tourist-oriented properties, which include accommodations, restaurants, groceries, retail stores, shopping centers, and entertainment and recreational facilities, in Southeast Florida amounted to $4.9 billion in 2007. Most of this value was concentrated in the four southern counties in the region: Miami-Dade (38%), Broward (25%), Monroe (17%) and Palm Beach (15%) (Kildow, 2008).

During 1997-98, there were an estimated 783,386 visits made to the beaches on Palm Beach Island. The vast majority of these visits were made by non-residents of the island (93.7%). More than 60% of visits were made by residents from elsewhere in Palm Beach County (60.1%), 6.4% of visits were made by Florida in-state tourists, and 27% were made by out-of-state tourists (Kildow, 2008).

3.17. ENVIRONMENTAL JUSTICE

Under Executive Order 12898, Federal agencies are responsible for identifying and addressing potential disproportionately high and adverse human health and environmental effects on minority and low-income populations. Minority persons are those who identify themselves as Hispanic or Latino, Asian, Black or African American, American Indian or Alaska Native, Native Hawaiian or Other Pacific Islander, or multiracial (with at least one race designated as a minority race under CEQ guidelines) (CEQ, 1997). Persons whose income is below the federal poverty threshold are designated as low income.

Disproportionately high and adverse human health effects occur when the risk or rate of exposure to an environmental hazard for a minority or low-income population is significant (as defined by NEPA) and appreciably exceeds the risk or exposure rate for the general population or for another appropriate comparison group (CEQ, 1997). Such effects may include ecological, cultural, human health, economic, or social impacts. An adverse environmental impact is an impact that is determined to be both harmful and significant (as defined by NEPA).

For the environmental justice analysis for this EIS, the Study Area was examined, including the coastal beach owned by the state, up to the high tide line. The Project is not anticipated to disproportionately affect any community.

3.18 SURFABILITY

Concern regarding potential impacts to surfing was expressed in the public scoping meeting for the proposed Project. The surfability was evaluated at two popular southern Palm Beach surf spots, Lantana Park and the Lake Worth Pier. Three wave conditions: (i) southeast, (ii) cold front and (iii) hurricane (pre-landfall), were used to replicate the range of surfing conditions experienced at the two locations. The significant wave height for the No Action Alternative was analyzed as well as the relative differences (%) between the No Action Alternative and the build alternatives. In addition, the main parameters to assess surfability (Iribarren number ξ_b, peel angle, velocity of wave, peel rate and velocity of surfer) were compared to evaluate the quality of wave for surfing. The results from this analysis are provided in Section 4.1.5.3 and Appendix G.

3.19. ADJACENT PROPERTIES

Two condominium communities and single family homes, all of which are lined with seawalls, are located immediately south of the southern Project boundary. Immediately north of the northern Project boundary is City of Lake Worth Property, including Lake Worth Pier, which is lined with vegetated dunes.

3.20. DRINKING WATER

No municipal or private water supplies are located in or near the Project site

3.21. PUBLIC SAFETY

The Project Area is characterized by a shoreline with a mixture of hotel and residential development, with limited public access to the beach. Many opportunities for recreation exist within the area. However, the beach in this area has been narrowed as a result of past hurricanes and tropical storms.

CHAPTER 4

ENVIRONMENTAL CONSEQUENCES

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4.0 ENVIRONMENTAL CONSEQUENCES

4.1. INTRODUCTION

This chapter provides a discussion of the potential environmental effects, which can be either positive or negative, that could result from implementation of the Alternatives including the proposed mitigation artificial reef described in Chapter 2. The evaluation of the effects was based on results of modeling simulations (as described in Section 4.1.5), current information including scientific literature, direct observation, project design reports, reasonable scientific judgment, the scoping process, and other Environmental Impact Statement (EIS) documents for similar projects. Impacts were assessed based on the volume of sand required.

The total volume of sand needed to construct each alternative will be dependent on the results from surveys conducted immediately prior to construction. The volumes of sand presented in this EIS are based on the 2014 conditions. The actual volume of sand needed to construct the project will be dependent on the project template and the condition of the beach (based on results of a physical survey) immediately prior to construction.

This chapter considers direct, indirect, and cumulative impacts to resources from each of the seven alternatives, including potential impacts from the proposed mitigation (construction of artificial reefs), unavoidable adverse impacts (permanent and temporary), effects to the resources that cannot or would not be reversed in a foreseeable amount of time (irreversible and irretrievable commitment of resources), any conflicts and controversy associated with this Project, and environmental commitments.

This chapter includes a discussion of how the proposed Project will affect threatened and endangered species and any critical habitats that occur in the Project Area. The Endangered Species Act (ESA) requires that all effects be considered when determining if an action may affect listed species. Therefore, direct, indirect, and cumulative effects, as well as interrelated or interdependent actions, are all considered. Sections 4.2 through

4.29 describe the direct and indirect effects while the cumulative effects are described in Section 4.30 and Appendix J.

The Applicants are proposing the same mitigation regardless of the alternative; therefore, the evaluation of direct, indirect, and cumulative effects of the proposed mitigation is discussed as a subset in each effect section. In other words, the effects of the mitigation are described in each section (e.g. 4.2, 4.3, 4.4, etc.) after Alternative 7b. This chapter also analyzes anticipated impacts to resource related issues such as benthic communities, fish and wildlife resources, water quality, essential fish habitat (EFH), benthic communities, wave modification, cultural and socioeconomic resources, vegetation, air quality, aesthetics and recreation. Therefore, the USACE's decision of whether to issue, issue with modifications, or deny the Town of Palm Beach's and County's DA permit applications can be made based on this evaluation.

4.1.1. SCOPE OF THE ANALYSIS

The Scope of Analysis includes the direct, indirect, and cumulative impacts of the Proposed Action and its alternatives.

The spatial and temporal limits are defined on a case-by-case basis based on the characteristics of the resources affected, the magnitude and scale of the Project's impacts, and the environmental setting.

The USACE Scope of Analysis is identified in Section 1.7.1 in Chapter 1.

4.1.1.1. GEOGRAPHIC SCOPE

The direct and indirect effects associated with some of the alternatives are expected to extend beyond the Project construction limits (R-129-210 to R-138+551) due to potential updrift and downdrift impacts to the shoreline from the groins and the addition of sand to the littoral system. The updrift and downdrift impacts are included in the impact analysis and are also included as part of the Study Area (R-127 to R-141+586). For those aspects of the affected environment which can be assessed in an area-specific context (i.e., sea turtle nesting habitat, dune vegetation, nearshore hardbottom), the geographic scope of direct and indirect effects analysis includes the Project Area as well as adjacent areas to the north and south and the nearshore marine environment which may be impacted by the evaluated alternatives. The resource and anticipated effect is specifically identified in the sections below.

For a project-specific analysis, it is often sufficient to analyze effects within the immediate area of the proposed action. When analyzing the contribution of this proposed action to cumulative effects, the geographic boundaries of the analysis almost always should be expanded (CEQ, 1997). In order to assess the cumulative effects of the proposed Project, the geographic scope of this analysis includes the areas between South Lake Worth Inlet (Boynton Beach Inlet) and just north of the Lake Worth Inlet (Port of Palm Beach Inlet) and includes: (1) the northern limit of North Borrow Area 1 (NBA1), approximately 2 miles north of Lake Worth Inlet; (2) the offshore extent is located at the eastern edge of NBA1, within water depths between 40 and 60 feet approximately 2,500 feet offshore of Singer Island; (3) the southern extent is located at South Lake Worth Inlet (R-151;); and (4) the inland (western) extent includes the routes from potential upland mines to the Project Area (see Figures 2-7 and 3-1).

4.1.1.2. TEMPORAL SCOPE

Temporal scope of a direct or indirect impact includes the period of time that the impact will persist, including recovery time of resources negatively affected as well as the longevity of the resources that are enhanced. Short-term effects are defined as those lasting less than one year. Long-term effects are those lasting longer than one year, and may continue perpetually, in which case they would be considered permanent. The temporal scope of analysis for direct and indirect impacts will vary by resource and will be identified more specifically in that resource section.

Planning for the Project was formulated to include a 50-year horizon considering sand resource utilization and project life-spans (i.e. each individual nourishment/renourishment event) of approximately 3-4 years. The USACE is considering authorizing the proposed projects under a 10-year permit to allow for initial project construction and maintenance (renourishment) for up to three (3) renourishments events. Assessment of the mitigation requirements for impacts to nearshore hardbottom was computed over an indefinite (perpetual) horizon, i.e., presuming perpetual impacts to resources. If the projects were constructed on a regular basis, the anticipated impacts assume that the actions presented will be repeated for a period of at least 50 years. The USACE is evaluating a request for a 10-year permit to include initial construction plus no more than three (3) renourishment events. If a 10-year permit is issued, any future proposed work in jurisdictional waters would require separate USACE authorization.

4.1.2. DIRECT VERSUS INDIRECT EFFECTS

Environmental impacts include both direct and indirect effects. Under the Council on Environmental Quality (CEQ) regulations, direct effects are "caused by the action and occur at the same time and place," while indirect effects are "caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate, and related effects on air and water and other natural systems, including ecosystems" (40 CFR 1508.8). This chapter considers both direct and indirect impacts to resources resulting from the Project alternatives. Within the NEPA process, effects may be beneficial or adverse, and may apply to ecological resources, aesthetics, historical materials, culture, the economy, society, and human health. The direct and indirect effects are described in Sections 4.2 through 4.29. Most of the alternative separated into direct impacts from sand placement, direct impacts from groin construction, indirect impacts from sand placement, and indirect impacts from groin construction. The only variable in Alternatives 2 through 7b regarding sand placement is the volume of sand. Since effects from sand placement in one alternative will be similar to effects of sand placement in another alternative, the effects the section will just refer back to the alternative where the effect was analyzed first in the document, instead of repeating the text throughout the document. The primary difference between the alternatives is the volume of sand placed on the beach and the presence and type of groin. As a result most of the alternatives will be referenced to the analysis completed in Alternative 2 since that was the first action alternative that included both sand placement and groins.

This chapter includes a discussion of both the direct effects and their significance, and the indirect effects and their significance. When possible, the effects are quantified to assist in evaluating the alternatives.

4.1.3. CUMULATIVE EFFECTS

The CEQ Regulations define a cumulative impact as the “impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time” (40 CFR 1508.7). Recognizing that the Applicants intend to maintain the Project approximately every three to four years, the USACE is considering authorization under a 10-year permit that would allow for initial project construction and maintenance (renourishment) for up to three renourishment events. Therefore, although future renourishments at the Project Area would require additional authorization by the USACE, renourishments at least every four years are considered a reasonably foreseeable action included within the Cumulative Impacts Analysis (CIA) (Section 4.30 and Appendix J). The CIA provides an evaluation of the anticipated cumulative impacts to resources resulting from past, present and reasonably foreseeable future actions.

4.1.4. DETAIL OF ANALYSIS

The level to which each resource category is analyzed is consistent with the severity, nature, and extent of the effect on the resource category, as well as the potential for controversy. As stated in the CEQ regulations (40 CFR 1501.1);

> “…following scoping, the preparing agency should:
>
> Determine the scope (Sec. 1508.25) and the significant issues to be analyzed in depth in the environmental effect statement. Identify and eliminate from detailed study the issues which are not significant or which have been covered by prior environmental review (Sec. 1506.3), narrowing the discussion of these issues in

the statement to a brief presentation of why they will not have a significant effect on the human environment or providing a reference to their coverage elsewhere."

As described in the Executive Summary, following scoping, issues that were not believed to be significant were eliminated from detailed study. These topics include Noise Pollution, Transportation, Water Supply and Drinking Water and Hazardous, Toxic and Radioactive Waste.

4.1.5. MODELING EFFORTS

The Project Area is characterized by a narrow beach with seawalls and dunes along its landward boundary and by ephemeral hardbottom formations in the nearshore. The following modeling was performed to assess the potential benefits to upland property in terms of storm protection, impacts to hardbottom in terms of burial of the resource, and variations in recreational surfing. The modeling analysis and results are detailed in Appendix G.

- Storm Protection: The Storm Induced Beach Change (SBEACH) model was utilized to analyze the level of storm protection. The IH2VOF model was utilized to evaluate the amount of dune/seawall overtopping during storm events.

- Potential Hardbottom Impacts: The DELFT3D model was utilized to simulate the movement of sand within the littoral system in the vicinity of ephemeral hardbottom. The equilibrium toe of fill (ETOF) due to cross-shore spreading was evaluated based on analytic engineering analysis.

- Surfability: The BOUSS2D model was utilized to assess wave breaking and associated surfing conditions within and adjacent to the Project Area.

4.1.5.1. STORM PROTECTION

The coastline within the Project Area provides storm protection to upland property. The width and elevation of the beach and dune system and the presence of seawalls are factors that contribute to the storm protection afforded by the coastline.

The level of storm protection during the 5, 15, 25, 50, and 100 year return period storm events was analyzed using the SBEACH (Larson and Kraus, 1989). The objectives of analysis were as follows:

- To verify the need for a project along all sections of the Project Area
- Determine the level of storm protection provided by the existing conditions
- Evaluate the range of storm protection associated with proposed fill alternatives

While erosion of the beach profile during these storm events is anticipated, the elevated water levels and large waves can cause additional damage if the dune and seawalls are overtopped. Overtopping water can cause flooding, erosion on landward (back) slopes, and seawall failure. The IH2VOF model was used to evaluate the amount of overtopping during the 15, 25, and 50 year return period storm events. The 5- year storm event was not evaluated for overtopping since overtopping of seawalls is not expected during the 5 year storm event.

4.1.5.2. POTENTIAL HARDBOTTOM IMPACTS

The SBEACH and IH2VOF modeling analyzed the level of protection and evaluated the overtopping during storm events in order to identify the anticipated benefits of the additional fill volumes associated with the alternatives. The additional fill introduced into the littoral system will be transported offshore and alongshore over time as the sand is reworked by wave action. While the additional sand will create a wider beach increasing storm protection and benefiting nesting marine sea turtles, the reworked sand may be deposited offshore causing adverse impacts to ephemeral, nearshore hardbottom.

As part of a previous study conducted for the County, a Delft3D numerical model (CPE, 2013) was developed, calibrated and applied to evaluate project alternatives along the shoreline of South Palm Beach, Lantana and Manalapan. This setup was focused on the County project area and was expanded in order to evaluate the combined project area, with the Town of Palm Beach. The existing model was updated and recalibrated for use in evaluating the proposed actions and alternatives and estimating potential hardbottom coverage.

After fill placement, it is anticipated that the constructed profile would equilibrate due to natural coastal processes adjusting back to the shape of the pre-construction profile. However, the cross-shore extent of this equilibration process is limited by the low density fill placement and strong alongshore current that exists in the Project Area. An analytical ETOF was estimated by translating the beach profile to conserve the fill volume while accounting for the insignificant changes in the offshore portion of the profile.

It is noted that cross-shore fill equilibration is not instantaneous, as the equilibrium profile theory suggests, because sand migrates alongshore due to background erosion and littoral transport. Therefore, the reasonably anticipated extent of hardbottom impacts is accounted for in the analytical estimation of the ETOF and the Delft3D model results.

4.1.5.3. SURFABILITY

In order to evaluate project-related effects on surfing, the BOUSS-2D model was used to simulate breaking waves within the Study Area. Surfability was evaluated at two popular southern Palm Beach surf spots, Lantana Park and the Lake Worth Pier. Three wave conditions: (i) southeast, (ii) cold front and (iii) hurricane (pre-landfall), were used to replicate the range of surfing conditions experienced at the two locations. Main conclusions of this modelling study are provided in Section 4.19, however a detailed report is provided in Appendix G.

4.2. VEGETATION

The analysis of potential direct and indirect impacts on vegetation focuses primarily on the beach and dune plant communities within the Study Area (R-127 to R-141+586). Section 3.3 provides information concerning the species composition and geographical extent of the existing vegetation within this area. During construction, two access points have been identified along the Project Area shoreline, including one within the Town of Palm Beach project area and one within the County project area. Since 2005, the Town of Palm Beach has utilized a truck-haul method for placement of sand and equipment on the beach in Reach 8 from the 3200 Condominium property (3200 S. Ocean Blvd.) for renourishment efforts, this Project will continue to use this location, in addition to the

Lantana Public Beach which will act as a staging area for the County project, with access via Dorothy Rissler Road.

4.2.1. ALTERNATIVE 1 – NO ACTION ALTERNATIVE

The No Action Alternative does not result in fill placed within the USACE's jurisdiction, seaward of the high tide line, or structures in navigable waters. The alternative evaluated for the No Action is the current condition of fill placed on the dunes above the high tide line.

Direct Effects from Sand Placement

It is anticipated that the dunes would continue to be restored periodically through placement of small volumes of sand in portions of the Project Area landward of the high tide line outside of the USACE jurisdiction. The typical segments of the Study Area were either vegetated dune systems or unvegetated or sparsely vegetated areas of beach seaward of seawalls and dunes. The vegetation seaward of the seawalls is likely to be completely eroded under the Dune Fill Only No Action Alternative. However, the amount of vegetation seaward of the dunes and seawalls is minimal so this effect will not be significant. The vegetation on the dune will be completely impacted as a result of fill placement on the dunes and by removal of the vegetation at the construction access points. However, the Applicants will replant their respective dunes after construction. The Applicants will monitor the plantings and ensure 80 percent survivorship; therefore, the impacts to dune vegetation will be temporary and moderate. Because the vegetation will be impacted as a result of the dune fill, the effect will be negative; however, since the vegetation will be restored the effect is minimal.

Indirect Effects from Sand Placement

The Dune Fill Only No Action Alternative will have a beneficial minimal indirect effect on vegetation. Maintenance of the dune will stabilize the dune and maintain or expand existing habitat for vegetation.

4.2.2. ALTERNATIVE 2 – THE APPLICANTS' PREFERRED PROJECT: BEACH AND DUNE FILL WITH SHORELINE PROTECTION STRUCTURES

Direct Effects from Sand Placement

Alternative 2 includes sand placed above and below mean high water (MHW). The sand placed above MHW would have a negative direct impact on vegetation because some of the sand will be placed in the dunes over existing vegetation. However, this impact will be temporary because the Applicants will replant the dune with appropriate native vegetation and will monitor the planted vegetation for success. Trucks used for sand placement will enter and exit at designated access points. Vegetation at these access points will be removed but replanted once construction is complete; therefore the vegetation will be directly impacted but the impact will be temporary and minimal.

Direct Effects from Groin Construction

The inclusion or exclusion of shoreline protection structures is not anticipated to directly affect vegetation because they will be constructed in areas void of vegetation. Trucks used for groin construction will enter and exit at designated access points. Vegetation at these access points will be removed but replanted once construction is complete; therefore the vegetation will be directly impacted but the impact will be temporary and minimal.

Indirect Effects from Sand Placement

The Applicants' Preferred Alternative would indirectly benefit beach and dune vegetation communities within the Study Area. The preferred alternative would result in a wider beach in those areas proposed to receive beach sand, which would help to stabilize and protect existent beach and dune vegetation from storm surge and erosion. Furthermore, the addition of sand to the overall system could further enhance dune development. The Applicants' Preferred Alternative also includes placement of sand as dune fill in three sections within the Town of Palm Beach, thereby providing additional habitat which would have a minimal beneficial indirect effect on dune plant species.

Indirect Effects from Groin Construction

The construction of groins would enhance the beach, which would thus support a more stable dune habitat. This action would have a minimal beneficial indirect effect.

4.2.3. ALTERNATIVE 3 – THE APPLICANTS' PREFERRED PROJECT WITHOUT SHORELINE PROTECTION STRUCTURES

Direct Effects from Sand Placement

Alternative 3 includes sand placed above and below MHW. The sand placed above MHW would have a negative direct impact on vegetation because some of the sand will be placed in the dunes over existing vegetation. However, this impact will be temporary because the Applicants will replant the dune with appropriate native vegetation and will monitor the planted vegetation for success. Trucks used for sand placement will enter and exit at designated access points. Vegetation at these access points will be removed but replanted once construction is complete; therefore the vegetation will be directly impacted but the impact will be temporary and minimal.

Indirect Effects from Sand Placement

This alternative would indirectly benefit beach and dune vegetation communities within the Study Area. This alternative would result in a wider beach in those areas proposed to receive beach sand, which would help to stabilize and protect existent beach and dune vegetation from storm surge and erosion. Furthermore, the addition of sand to the overall system could further enhance dune development. This alternative also includes placement of sand as dune fill in three (3) sections within the Town of Palm Beach, thereby providing additional habitat which would directly benefit dune plant species. This action will have a beneficial minimal indirect effect on vegetation.

4.2.4. ALTERNATIVE 4 – THE TOWN OF PALM BEACH PREFERRED PROJECT AND COUNTY INCREASED SAND VOLUME WITHOUT SHORELINE PROTECTION STRUCTURES

Direct Effects from Sand Placement

Alternative 4 includes sand placed above and below MHW. The sand placed above MHW would have a negative direct impact on vegetation because some of the sand will be placed in the dunes over existing vegetation. However, this impact will be temporary because the Applicants will replant the dune with appropriate native vegetation and will monitor the planted vegetation for success. Trucks used for sand placement will enter and exit at designated access points. Vegetation at these access points will be removed but replanted once construction is complete; therefore the vegetation will be directly impacted but the impact will be temporary and minimal.

Indirect Effects from Sand Placement

This alternative would indirectly benefit beach and dune vegetation communities within the Study Area. This alternative would result in a wider beach in those areas proposed to receive beach sand, which would help to stabilize and protect existent beach and dune vegetation from storm surge and erosion. Furthermore, the addition of sand to the overall system could further enhance dune development. This alternative also includes placement of sand as dune fill in three sections within the Town of Palm Beach, placed in areas void of vegetation, thereby providing additional habitat which would directly benefit dune plant species. This alternative also includes 160,000 cy of sand for the County portion of the Project. This additional volume of sand would mean the positive effects of stabilization and protection of the beach and dune vegetation would be enhanced along the Towns of South Palm Beach, Lantana and Manalapan. This action will have a beneficial minimal indirect effect on vegetation.

4.2.5. ALTERNATIVE 5 – THE TOWN OF PALM BEACH INCREASED SAND VOLUME PROJECT AND COUNTY PREFERRED PROJECT

Direct Effects from Sand Placement

Alternative 5 includes sand placed above and below MHW. The sand placed above MHW would have a negative direct impact on vegetation because some of the sand will be placed in the dunes over existing vegetation. However, this impact will be temporary because the Applicants will replant the dune with appropriate native vegetation and will monitor the planted vegetation for success. Trucks used for sand placement will enter and exit at designated access points. Vegetation at these access points will be removed but replanted once construction is complete; therefore the vegetation will be directly impacted but the impact will be temporary and minimal.

Direct Effects from Groin Construction

The inclusion or exclusion of shoreline protection structures is not anticipated to directly affect vegetation because they will be constructed in areas void of vegetation. Trucks used for groin construction will enter and exit at designated access points. Vegetation at these access points will be removed but replanted once construction is complete; therefore the vegetation will be directly impacted but the impact will be temporary and minimal.

Indirect Effects from Sand Placement

This alternative would indirectly benefit beach and dune vegetation communities within the Study Area. This alternative would result in a wider beach in those areas proposed to receive beach sand, which would help to stabilize and protect existent beach and dune vegetation from storm surge and erosion. Furthermore, the addition of sand to the overall system could further enhance dune development. This alternative also includes placement of sand as dune fill in three sections within the Town of Palm Beach, thereby providing additional habitat which would directly benefit dune plant species. This alternative includes 96,000 cy of sand for the Town of Palm Beach portion of the project. This added volume of sand increases the positive effects of stabilization and protection of the beach and dune vegetation and further enhances Town of Palm Beach shoreline. This action will have a beneficial minimal indirect effect on vegetation.

Indirect Effects from Groin Construction

The construction of groins would enhance the beach, which would thus support a more stable dune habitat. This action will have a beneficial minimal indirect effect on vegetation.

4.2.6. ALTERNATIVE 6 – THE TOWN OF PALM BEACH INCREASED SAND VOLUME PROJECT AND COUNTY INCREASED SAND VOLUME PROJECT WITHOUT SHORELINE PROTECTION STRUCTURES

Direct Effects from Sand Placement

Alternative 6 includes sand placed above and below MHW. The sand placed above MHW would have a negative direct impact on vegetation because some of the sand will be placed in the dunes over existing vegetation. However, this impact will be temporary because the Applicants will replant the dune with appropriate native vegetation and will monitor the planted vegetation for success. Trucks used for sand placement will enter and exit at designated access points. Vegetation at these access points will be removed but replanted once construction is complete; therefore the vegetation will be directly impacted but the impact will be temporary and minimal.

Indirect Effects from Sand Placement

This alternative would indirectly benefit beach and dune vegetation communities within the Study Area. This alternative would result in a wider beach in those areas proposed to receive beach sand, which would help to stabilize and protect existent beach and dune vegetation from storm surge and erosion. Furthermore, the addition of sand to the overall system could further enhance dune development. This alternative also includes placement of sand as dune fill in three sections within the Town of Palm Beach, in areas void of vegetation, thereby providing additional habitat and direct benefit for dune plant species. The sand volume along the Town of Palm Beach shoreline would increase from 65,200 cy to 121,700 cy and the sand volume along the County shoreline would increase from 77,600 cy to 187,800 cy. Therefore, the positive effects of stabilization and protection of the beach and dune vegetation would be enhanced along both the Town of Palm Beach shoreline and the County project shorelines. This action will have a beneficial minimal indirect effect on vegetation.

4.2.7. ALTERNATIVE 7b – THE TOWN OF PALM BEACH INCREASED SAND VOLUME WITH TWO SHORELINE PROTECTION STRUCTURES (THE

COALITION TO SAVE OUR SHORELINE, INC. (SOS) ALTERNATIVE) AND THE COUNTY PREFERRED PROJECT

Direct Effects from Sand Placement

Alternative 5 includes sand placed above and below MHW. The sand placed above MHW would have a negative direct impact on vegetation because some of the sand will be placed in the dunes over existing vegetation. However, this impact will be temporary because the Applicants will replant the dune with appropriate native vegetation and will monitor the planted vegetation for success. Trucks used for sand placement will enter and exit at designated access points. Vegetation at these access points will be removed but replanted once construction is complete; therefore the vegetation will be directly impacted but the impact will be temporary and minimal.

Direct Effects from Groin Construction

The inclusion or exclusion of shoreline protection structures is not anticipated to directly affect vegetation because they will be constructed in areas void of vegetation. Trucks used for groin construction will enter and exit at designated access points. Vegetation at these access points will be removed but replanted once construction is complete; therefore the vegetation will be directly impacted but the impact will be temporary and minimal.

Indirect Effects from Sand Placement

Based on 2014 conditions, Alternative 7b would require 175,500 cy of sand along the Town of Palm Beach shoreline and 77,600 cy along the County shoreline. Due to the increased volume of sand as compared to the Applicants' Preferred Alternative, the positive effects of stabilization and protection of the beach and dune vegetation would be enhanced along the Town of Palm Beach shoreline and remain the same along the County project shorelines.

This additional volume of sand would indirectly benefit beach and dune vegetation communities within the Study Area. This alternative would result in a wider beach in those areas proposed to receive beach sand, which would help to stabilize and protect existent beach and dune vegetation from storm surge and erosion. Furthermore, the addition of sand to the overall system could further enhance dune development. The positive effects of stabilization and protection of the beach and dune vegetation would be enhanced along both the Town of Palm Beach shoreline and the County project shorelines. This action will have a beneficial minimal indirect effect on vegetation.

Indirect Effects from Groin Construction

Alternative 7b also includes the placement of two T-head groins at the southern end of the Town's project area. The role of the T-head groins are to reduce sand losses from the south end of Reach 8 and prevent downdrift impacts to nearshore hardbottom (ECE, 2012). The construction of groins would enhance the beach, which would thus support a more stable dune habitat. This action will have a beneficial minimal indirect effect on vegetation.

4.3. THREATENED AND ENDANGERED SPECIES

This section evaluates potential effects to listed species and critical habitat that are expected to occur in the Study Area which extends from (R-127 to R-141+586), which includes the area of potential updrift and downdrift impacts. A Biological Assessment is provided in Appendix E to evaluate the potential impacts on federally listed species and designated critical habitat. The USACE will complete consultation with the U.S. Fish and Wildlife Service and National Marine Fisheries Service under Section 7 of the Endangered Species Act prior to a permit decision. Listed species and critical habitat which may occur in southeast Florida or the Atlantic waters off the Florida coast, but are not likely to occur in the Study Area, were eliminated from further consideration; a description of these species is provided in Section 3.4. The eliminated federally-listed species and critical habitat include whales, Southeastern beach mouse, and Johnson's seagrass.

The following sections evaluate potential direct and indirect effects from each of the seven project alternatives and the proposed mitigation artificial reef to listed species and critical habitat that are likely to occur in the Study Area.

4.3.1. ALTERNATIVE 1 – NO ACTION ALTERNATIVE

4.3.1.1. SEA TURTLES AND NESTING HABITAT

Direct Effects from Sand Placement

Construction of this No Action alternative, sand placement above high tide line, would directly impact sea turtle nesting habitat. The project would occur between November 1 and April 30 in order to avoid peak sea turtle nesting season and would take place during daylight hours, thereby reducing the potential for direct effects such as mechanical destruction of nests and interactions between nesting females or hatchlings and equipment on the beach during nesting activities, and effects of any artificial construction related lighting on nesting and hatchling sea turtles. This No Action Alternative will not directly impact the swimming sea turtles because no in-water work will occur. The direct effect of sand placement on sea turtles and nesting habitat will be a moderate temporary negative effect. The effect is minimized by best management practices.

Indirect Effects from Sand Placement

Sand placed landward of the high tide line has the potential to indirectly impact future nesting activities, even when constructed outside of peak sea turtle nesting season. The impacts are similar to a full-scale nourishment except on much smaller scale. The sand above the high tide line will migrate waterward over time. In the short-term, sand placed above the high tide line may hinder sea turtle nesting success due to escarpment formation, compaction, or an unfavorable sand color. These physical changes may occur if the grain size, color and moisture content of fill material do not resemble that of the natural beach. These changes in the beach environment can lead to false crawls by the nesting females by making the beach unfavorable or inaccessible for nesting (Nelson, 1988; Wood and Bjorndal, 2000). Nesting females may also deposit nests in unfavorable locations (i.e. below MHW), which can lead to nest washout. Studies have also shown that sex ratio of hatchlings in a nest is influenced by temperature. As a result, sand that is an inappropriate color may raise or lower nest temperatures, potentially altering the sex ratio of hatchlings (Nelson, 1988).

The Project proposes use of two sand sources: stockpiled material dredged from offshore borrow areas and material from upland mine sites within the state of Florida. The material utilized from both sources will meet Florida Department of Environmental Protection (FDEP) requirements for mean grain size, maximum silt content, maximum gravel content and Munsell Color Value to ensure beach sand compatibility per Section 62B-41.007(2)(j), Florida Administrative Code (F.A.C.). In addition, any sand source used for the Town of Palm Beach project must be consistent with the Beach Management Agreement (BMA) cell-wide sediment quality specifications (Table 2-1) (FDEP, 2013). The sand source used for the County project must also meet the County's technical sand specifications (Appendix B). Details regarding BMA and the County sand quality specifications are provided in Section 2.5. In addition to using high quality beach compatible sand, it is anticipated that compaction testing and/or tilling of the beach to prevent compaction and escarpment removal will be required prior to each sea turtle nesting season. In order to provide the desired storm protection, the Dune Fill Only No Action Alternative would need to be performed on an annual or biannual basis. The frequent occurrence would increase the chance of negative indirect effects.

It is anticipated that long term indirect effects of this alternative would be positive. Dune and beach restoration would ultimately increase sea turtle nesting habitat by increasing the beach width and helping to stabilize the beach. Compaction monitoring and/or beach tilling and escarpment surveys would help to minimize potential negative project impacts on turtle nesting. The indirect effect of sand placement on sea turtles and nesting habitat will be a moderate temporary negative effect. The effect is minimized by best management practices.

4.3.1.2. SEA TURTLES NEARSHORE MARINE HABITAT

This section analyzes the effects to nearshore marine habitat utilized by all sea turtles within the Study Area.

Direct Effects from Sand Placement

No direct impacts will occur to nearshore marine habitat of this No Action Alternative because no work or action will take place.

Indirect Effects from Sand Placement

There may be minor indirect effects to nearshore hardbottom as a result of this No Action Alternative. As the sand placed landward of the high tide line equilibrates small amounts may cover nearshore hardbottom. However, due to the small volume of sand it is likely to be a minor effect.

4.3.1.3. LOGGERHEAD CRITICAL HABITAT

This section analyzes the effects to nesting habitat utilized by all sea turtles within the Study Area as well as the Loggerhead Critical Habitat Terrestrial Unit. The Primary Constituent Elements (PCEs) are (1) Suitable nesting beach habitat that has (a) relatively unimpeded nearshore access from the ocean to the beach for nesting females and from the beach to the ocean for both post-nesting females and hatchlings and (b) is located above MHW to avoid being inundated frequently by high tides.(2) Sand that (a) allows for suitable nest construction, (b) is suitable for facilitating gas diffusion conducive to embryo development, and (c) is able to develop and maintain temperatures and a moisture content conducive to embryo development. (3) Suitable nesting beach habitat with sufficient darkness to ensure nesting turtles are not deterred from emerging onto the beach and hatchlings and post-nesting females orient to the sea. (4) Natural coastal processes or artificially created or maintained habitat mimicking natural conditions.

Direct Effects from Sand Placement

This No Action Alternative will have a temporary direct impact on PCE number 2 for the Terrestrial unit of Loggerhead critical habitat. As described in section 4.3.1.1., this alternative will impact sand associated with nesting habitat. However, the impacts will be reduced because the material utilized will meet FDEP requirements for mean grain size, maximum silt content, maximum gravel content and Munsell Color Value to ensure beach sand compatibility per Section 62B-41.007(2)(j), F.A.C.

Indirect Effects from Sand Placement

Dune fill only will have a minimal beneficial effect on Loggerhead critical habitat because the dune restoration will stabilize the beach and the suitable nesting habitat.

4.3.1.4. FLORIDA MANATEE

The No Action Alternative does not include any in-water work; therefore, no direct or indirect impacts to Florida manatees are anticipated.

4.3.1.5. FLORIDA PANTHER

Direct Effects

The Florida panther is not found within the Study Area; therefore, no direct impacts will occur from any of the No Action Alternatives.

Indirect Effects

Indirect effects to the panther may occur from the Sand Placement No Action Alternative. The Project Area and the preferred upland mines are not located in any of the panther habitat zones. However, one of the preferred upland mines, Ortona, may require transport of sand along the roadways from the Ortona mine may intersect with panther habitat. The increased traffic and noise disturbance may impact the Florida panther along the truck routes (FWC, 2012). Apart from potential temporary disturbances, no long-term negative effects are anticipated.

The No Action alternative will have the same effects to the panther because the sand for dune nourishment may be obtained from the same upland mines.

4.3.1.6. SMALLTOOTH SAWFISH

The No Action Alternative does not include any activity within smalltooth sawfish habitat; therefore, no direct or indirect impacts to this species is anticipated.

4.3.1.7 PIPING PLOVER

Direct Impacts from Sand Placement

Piping plovers have occasionally been observed in Palm Beach County, including two sightings near Lake Worth Pier, one in 2010 and one in 2012 (e-bird, 2015a). Heavy machinery and equipment (e.g., trucks and bulldozers operating within the Project Area) may directly adversely affect any migrating and wintering piping plovers within the Study Area by disturbance and disruption of normal activities such as roosting and feeding. During construction, birds may also be forced to expend valuable energy reserves to seek available habitat elsewhere.

Indirect Effects from Sand Placement

Sand placement above the high tide line can indirectly impact piping plovers through disruption of foraging and food habitats; however, this effect will be minor. Piping plover forage in intertidal areas. The sand will be placed above the high tide line but may migrate into the intertidal zone causing minor impacts from burial and suffocation of infaunal prey species. Beach wrack has also been recognized as important to shorebirds, including piping plovers, for camouflage and foraging. Since piping plovers spend the majority of their overwintering time in Florida foraging along the shoreline, the wrack line provides an important foraging resource for this species. Destruction of wrack, through beach nourishment eliminates this habitat.

Construction of dunes associated with the proposed Project can lead to stabilization of the shoreline which, while beneficial to beach infrastructure as well as wildlife that utilize the beach, can potentially prevent the formation of overwash areas which are an important habitat utilized by piping plovers. However, the Study Area contains and has historically contained high wide dunes which have prevented the formation of overwash areas. Therefore, because overwash areas do not exist in the Study Area, the proposed Project will not impact this type of preferred piping plover habitat. Heavy construction equipment associated with dune construction and potential planting activities may also deter piping plovers from utilizing the area on their migration routes, resulting in these birds selecting other suitable overwintering sites outside the Study Area.

Dune restoration projects can benefit piping plovers, provided the Project incorporates high-quality sand that resembles the native beach environment which can help to minimize impacts to infaunal populations (Greene, 2002). Sand from either source must meet FDEP requirements for beach sand compatibility in accordance with Section 62B-41.007(2)(j), F.A.C. In addition, any sand source used for the Town of Palm Beach project must be consistent with the BMA cell-wide sediment quality specifications (Table 2-1) (FDEP, 2013). The sand source used for the County project must also meet the County's technical sand specifications outlined in the County's Annual Dune and Wetlands Restoration contract (Appendix B). Restoration projects can also benefit piping plovers by increasing the area potentially useable for the species for foraging, roosting, and resting. These indirect effects will be minimal to moderate due to the small amount of sand and disturbance required to construct the alternative.

There is no federally designated piping plover critical habitat within or near Study Area; therefore, no impacts to piping plover critical habitat are anticipated.

4.3.1.8. RUFA RED KNOT

Direct Effects from Sand Placement

Although there have been no documented sightings of rufa red knots within the Study Area, there have been 29 sightings within Palm Beach County since 2004 (e-Bird, 2015b). It may; therefore, be expected that rufa red knots have the potential to occur within the Study Area. Direct impacts for this species will be similar to those discussed above for the piping plover, and include direct disturbance and disruption of normal activities such as roosting and feeding. During construction activities and during a short post-construction period, the abundance of preferred prey, including bivalves, small snails, and crustaceans (USFWS, 2013c), within the filled areas will likely be depleted until the area is re-colonized. However, this effect will be minimal because the sand will be placed above the high tide line. The loss of potential forage biomass within the Project's intertidal footprint could affect the rufa red knot, which arrives at stopover areas along the mid-Atlantic to restore depleted energy reserves and rebuild body mass during northerly migrations (Niles et. al, 2008; USFWS, 2013c). Restoration projects can also benefit rufa red knots by increasing the area potentially useable for the species for foraging, roosting, and resting.

Indirect Effects from Sand Placement

Construction of dunes associated with the proposed Project can lead to stabilization of the shoreline which, while beneficial to beach infrastructure as well as wildlife that utilize the beach, can potentially prevent the formation of overwash areas which are an important habitat utilized by rufa red knot. However, the Study Area contains and has historically contained high wide dunes which have prevented the formation of overwash areas. Therefore, because overwash areas do not exist in the Study Area, the proposed Project will not impact this type of preferred rufa red knot habitat. Heavy construction equipment associated with dune construction and potential planting activities may also deter rufa red knot from utilizing the area on their migration routes, resulting in these birds selecting other suitable overwintering sites outside the Study Area.

Dune restoration projects can benefit rufa red knot, provided the Project incorporates high-quality sand that resembles the native beach environment which can help to minimize impacts to infaunal populations (Greene, 2002). Sand from either source must meet FDEP requirements for beach sand compatibility in accordance with Section 62B-41.007(2)(j), F.A.C. In addition, any sand source used for the Town of Palm Beach project must be consistent with the BMA cell-wide sediment quality specifications (Table 2-1) (FDEP, 2013). The sand source used for the County project must also meet the County's technical sand specifications outlined in the County's Annual Dune and Wetlands Restoration contract (Appendix B). Restoration projects can also benefit rufa red knot by increasing the area potentially useable for the species for foraging, roosting, and resting.

4.3.1.9. BEACH JACQUEMONTIA

Direct Effects

Although within its range, no populations of beach jacquemontia have been identified within the Study Area (CB&I, 2014; provided as Appendix D); therefore, no direct impacts are expected to the species from any of the No Action Alternatives.

Indirect Effects

The No Action Alternative may result in negative indirect impacts to the dune system and associated vegetation by altering the profile and displacing vegetation. However, the No Action Alternative would result in some long-term protection of dune habitat thereby resulting in beneficial indirect effects.

4.3.1.10. SCLERACTINIAN CORALS

Recent surveys of the nearshore hardbottom habitat have not documented any colonies of listed coral species within the Study Area (PBC-ERM, 2013c – Appendix C; CB&I, 2014 – Appendix D). None of the No Action Alternatives include any activity within nearshore hardbottom habitat; therefore, no direct or indirect impacts to these resources are anticipated.

4.3.1.11. EASTERN INDIGO SNAKE

Direct Effects

No direct impacts will occur to the Eastern indigo snake as a result of the No Action Alternative because the action is limited to the Study Area and the Eastern indigo snake is not present.

Indirect Effects

Increased traffic and noise disturbance from trucks hauling sand from the stockpile or preferred upland sand mines have the potential to indirectly affect the Eastern indigo snake through vehicle strike. However, this effect is expected to be minimal because the snake will likely avoid the traffic and disturbance.

4.3.2. ALTERNATIVE 2 – THE APPLICANTS' PREFERRED PROJECT: BEACH AND DUNE FILL WITH SHORELINE PROTECTION STRUCTURES

The Applicants' Preferred Project includes beach nourishment, subsequent renourishment, dune restoration and the construction of shoreline protection structures (seven low-profile groins between R-134+135 to R-138+551).

4.3.2.1. SEA TURTLES AND NESTING HABITAT

Direct Impacts from Sand Placement

Direct affects to sea turtles as a result of this alternative include physical impacts to the species and impacts to nesting and foraging habitat. Construction of this alternative would occur between November 1 and April 30 in order to avoid peak sea turtle nesting season and would take place during daylight hours, thereby reducing the potential for direct effects such as mechanical destruction of nests and interactions between nesting females or hatchlings and equipment on the beach during nesting activities, and effects of any artificial construction related lighting on nesting and hatchling sea turtles. Because the Project proposes to utilize a truck-haul approach for beach construction, minimal or no in-water work will be required. This greatly reduces or eliminates direct interactions (e.g. vessel strike, entrainment, or entanglement) with any swimming sea turtles. The direct effect of sand placement on sea turtles and nesting habitat will be a moderate temporary negative effect. The effect is minimized by best management practices.

Direct Impacts from Groin Construction

Groin construction will occur outside of the peak sea turtle nesting season, eliminating direct effects to nesting and hatchling sea turtles during construction activities.

Indirect Impacts from Sand Placement

Beach nourishment has the potential to indirectly impact future nesting activities, even when constructed outside of peak sea turtle nesting season. Indirect effects of beach nourishment for nesting sea turtles may be beneficial or adverse, depending on the Project design and material used. In the short-term, a nourished beach may hinder sea turtle nesting success due to escarpment formation, compaction, or an unfavorable sand color. These physical changes may occur if the grain size, color and moisture content of fill material do not resemble that of the natural beach. These changes in the beach environment can lead to false crawls by the nesting females by making the beach unfavorable or inaccessible for nesting (Nelson, 1988; Wood and Bjorndal, 2000). Nesting females may also deposit nests in unfavorable locations (i.e. below mean high water (MHW)), which can lead to nest washout. Studies have also shown that sex ratio of hatchlings in a nest is influenced by temperature. As a result, sand that is an inappropriate color may raise or lower nest temperatures, potentially altering the sex ratio of hatchlings (Nelson, 1988).

The Project proposes use of two sand sources: stockpiled material dredged from offshore borrow areas and material from upland mine sites within the state of Florida. The material utilized from both sources will meet FDEP requirements for mean grain size, maximum silt content, maximum gravel content and Munsell Color Value to ensure beach sand compatibility per Section 62B-41.007(2)(j), F.A.C. In addition, any sand source used for the Town of Palm Beach project must be consistent with the BMA cell-wide sediment quality specifications (Table 2-1) (FDEP, 2013). The sand source used for the County project must also meet the County's technical sand specifications (Appendix B). Details regarding BMA and the County sand quality specifications are provided in Section 2.5. In addition to using high quality beach compatible sand, it is anticipated that compaction testing and/or tilling of the beach to prevent compaction and escarpment removal will be required prior to each sea turtle nesting season.

Studies suggest that within the first year post-nourishment, turtle nesting decreases. Montague (1993) states that beach profiles of a newly restored beach are not conducive to nesting and hatchling success. The Ocean Ridge Shore Protection Project at Ocean Ridge in Palm Beach County, Florida, just south of the South Lake Worth Inlet, provides a local example of short-term and long-term effects of coastal construction projects on sea-turtle nesting. The Project was constructed between August 1997 and April 1998 and involved the removal of 11 groins, construction of eight T-head groins and beach nourishment. A sea turtle monitoring program was implemented, which allowed for comparison of data between 1997 (pre-construction) and 2001 (four years post-construction). Monitoring showed an initial decrease in nesting, nesting success and reproductive success. However, four years post nourishment data suggested that nesting, nesting success and emergence success had returned to pre-construction levels. These results further supported other observations (at Jupiter and Martin County) that the negative effects of beach nourishment may persist for approximately two years (PBC-ERM, 2001). It is therefore anticipated that the initial nourishment action will result in temporary negative indirect impacts to sea turtles could result from the Applicants' Preferred Alternative. However, since renourishment is expected every 2 to 4 years the temporary impact is likely to occur after every sand placement activity. It is anticipated that long term indirect effects of this alternative would be positive. Dune and beach restoration would ultimately increase sea turtle nesting habitat by increasing the beach width and helping to stabilize the beach. Compaction monitoring and/or beach tilling and escarpment surveys would help to minimize potential negative project impacts on turtle nesting.

Indirect Impacts from Groin Construction

Following construction, the groins have the potential to interfere with nesting females by restricting or impeding access to the beach. Groins may also interfere with hatchlings as they commence their beach-to-ocean crawl, entrap them once they enter the water, or concentrate predatory fishes which could result in higher probabilities of hatchling predation (USFWS, 2011). It has been suggested that groins may lead to false crawls, however, there is no direct evidence to currently support this. Unlike rock groins, the groins for the proposed Project will be low profile concrete king pile and panel groins, which are designed to be level with the beach berm. This will allow the groins to blend with the beach and reduce potential interaction with nesting or hatchling sea turtles. The proposed groins will be oriented perpendicular to shore, minimizing the potential for hatchling entrapment. The groins will also be short in length and will terminate prior to reaching natural hardbottom, therefore reducing potential impediments to swimming hatchlings.

Shoreline structures, such as groins, are designed to trap or slow the bypassing of sand that would otherwise be transported by longshore currents, leading to accretion of updrift beaches while causing accelerated erosion of downdrift beaches if no pre-fill is placed (USFWS, 2011). In this way, building these structures without nourishing the beach with sand can potentially cause degradation of sea turtle nesting habitat on downdrift beaches. However, impacts may not be limited to beaches downdrift of structures. The USFWS (2011) suggests that instability from erosion as well as accretion may discourage loggerhead nesting. Modeling completed to assess the performance of the seven (7) groins for the Project has shown potential downdrift impacts from the groins will be minimal, while updrift accretion would extend to roughly R-132.5. Under an average wave climate, there would be a small downdrift impact (3,100 cy). However, since it would be spread over a long area (R-138+551 to R-144), the effect in terms of sand density (cy/foot) would be relatively small (CPE, 2013). Further, the Applicants' Preferred Alternative consists of groin construction coupled with beach nourishment. The beach nourishment adds a supply of sand to the system and the groins slow the transport of sand alongshore and extend the interval between renourishments. Under the Applicants' Preferred Alternative, sea turtles may benefit from increased availability and stability of nesting habitat. The beach and dune sand are intended to repair eroded sections of beach and will widen the dry beach to provide additional nesting habitat as well as additional protection from storms. If the nourished beach is designed and built to mimic the natural beach system, it will likely benefit nesting sea turtles more than the eroded beach it replaces would.

4.3.2.2. SEA TURTLES AND NEARSHORE MARINE HABITAT

Direct Impacts from Sand Placement

As mentioned earlier, the stockpile of dredged material may be obtained from dredged sand from offshore borrow areas associated with Phipps, federally authorized under DA Permit No. SAJ-2000-00380, and with the Mid-Town Project, authorized under DA Permit No. SAJ-1995-03779 and authorized under the Palm Beach Island Beach Management Agreement (BMA) (FDEP, 2013). Therefore, detailed analyses on the effects of dredging were conducted under the federal authorization processes for these projects. During placement of sand in nearshore waters during construction of the Project, sea turtles may be temporarily deterred from utilizing this area to avoid the noise and turbidity.

Direct Impacts from Groin Construction

Under the Applicants' Preferred Alternative, the groins may be constructed from either land or from the water, or using a combination of the two methods. Use of in-water vessels has the potential to affect swimming sea turtles either by vessel strikes, mechanized machinery injuries, or by noise and/or vibrations where they may temporarily leave or avoid the area. However, it is more likely that the groins will be installed after the beach is nourished removing negative impacts associated with in-water work including noise.

Indirect Impacts from Sand Placement

Beach nourishment may also indirectly impact sea turtles by directly or indirectly (i.e. fill placement and fill equilibration, respectively) burying nearshore foraging habitat. Several genera of macroalgae has been identified as the preferred food of juvenile green sea turtles (Makowski et al., 2006; Wershoven and Wershoven, 1989), and macroalgae in general is a major component of the nearshore hardbottom in southeastern Florida. In a 2013 characterization survey of the Study Area, five of the fourteen macroalgal genera documented on intertidal and nearshore hardbottom were identified as sea turtle preferred species, including: *Dictyota, Dictyopteris, Bryothamnion, Dasycladus,* and *Jania* (CB&I, 2014, provided as Appendix D). Based on the engineering and Delft3D modeling results, it is predicted that the Applicants' Preferred Alternative will result in permanent impacts to between 3.86 and 3.99 ac of hardbottom, and temporary impacts to between 9.53 and 9.93 ac of hardbottom (Tables 4-1 through 4-3; Figures 4-1 through 4-3). The permanent impact comprises approximately 14% of the nearshore hardbottom habitat, and the temporary impacts affect approximately 35% of the nearshore hardbottom habitat (based on an 11-year time-average – see Section 4.4 for details on the time-average methodology) within the Study Area.

Hardbottom burial associated with the proposed Project will reduce the amount of sea turtle foraging habitat within the Study Area. However, the presence of hardbottom adjacent to the Study Area, beyond project impacts, provides additional foraging opportunities for sea turtles. Also, while some areas will experience project-related sediment accumulation, other areas may scour resulting in exposed hardbottom.

Indirect Impacts from Groin Construction

Indirect effects from groin construction will be beneficial. Groins stabilize the beach and help keep the sand on the shore and away from the nearshore hardbottom.

4.3.2.3. LOGGERHEAD CRITICAL HABITAT

Direct Impacts from Sand Placement

The Study Area falls within two critical habitat units: USFWS-LOGG-T-FL-12, (which includes the nesting beach) and NMFS-LOGG-N-19, (which includes the nearshore reproductive habitat). Loggerhead Critical Habitat Primary Constituent Elements (PCEs) are detailed in section 3.4.1.1.1. This alternative will have a temporary direct impact on PCE number 2 for the Terrestrial unit of Loggerhead critical habitat. As described in section 4.4.1.1.1., this alternative will impact sand associated with nesting habitat. However, the impacts will be reduced because the material utilized will meet FDEP requirements for mean grain size, maximum silt content, maximum gravel content and Munsell Color Value to ensure beach sand compatibility per Section 62B-41.007(2)(j), F.A.C.

Direct Impacts from Groin Construction

Construction of groins have the potential to effect two of the PCEs Nearshore Reproductive Loggerhead Critical Habitat. The construction of groins have the potential to create obstructions to transit through the surf zone and outward to open water. The groins will also be short in length and will terminate prior to reaching natural hardbottom, therefore reducing potential impediments to swimming hatchlings. As the beach naturally erodes portions of the groin may be uncovered in between nourish events increasing the likelihood of impediments to hatchlings.

Indirect Impacts from Sand Placement

There will be no indirect impacts to Loggerhead Critical Habitat as a result of Alternative 2.

Indirect Impacts from Groin Construction

There will be no indirect impacts to Loggerhead Critical Habitat as a result of Alternative 2.

4.3.2.4. FLORIDA MANATEE

Direct Impacts from Sand Placement

The Florida manatee is typically found in warm freshwater, estuarine, and nearshore coastal waters; feeding areas are concentrated where shallow seagrass communities are found (USFWS, 2001). Although no seagrass exists within the Study Area, the manatee is known to utilize nearshore waters as a travel corridor, and may therefore be encountered within the Study Area. As the Applicants' Preferred Alternative would utilize a truck-haul methodology, in-water work may be limited to turbidity monitoring thus minimizing potential direct impacts to manatees due to the beach nourishment portion of the proposed Project.

Direct Impacts from Groin Construction

If the proposed groins are constructed using in-water methods, potential direct effects on the manatee include vessel strikes or mechanized machinery injuries, or indirect effects from noise and/or vibrations where they may temporarily leave or avoid the area. However, if used, all vessels will reduce the potential for manatee impacts by complying with the FWC *Standard Manatee Construction Conditions for In-Water Work* (FWC, 2011).

Indirect Impacts from Sand Placement

There would be minor indirect effects to the manatee. The manatee would likely avoid the nearshore area due to turbidity caused by the sand placement.

Indirect Impacts from Groin Construction

There will be no indirect effects to the manatee from Alternative 2.

4.3.2.5 FLORIDA PANTHER

Direct Effects

The Florida panther is not found within the Study Area; therefore, no direct impacts will occur.

Indirect Effects

The Project Area and the preferred upland mines are not located in any of the panther habitat zones. However, one of the preferred upland mines, Ortona, may require transport of sand along the roadways from the Ortona mine may intersect with panther habitat. The increased traffic and noise disturbance may impact the Florida panther along the truck routes (FWC, 2012). Apart from potential temporary disturbances, no long-term negative effects are anticipated.

4.3.2.6. SMALLTOOTH SAWFISH

Direct Impacts from Sand Placement

There have been three sightings of smalltooth sawfish offshore the Town of Palm Beach since April 2011, indicating that the Study Area is within the range of this species. The species are known to utilize a wide range of habitats including offshore deepwater reefs and tidal flats, and mud-bottom mangrove habitats. As the Applicants' Preferred Alternative would utilize a truck-haul methodology that includes upland-based construction activities, in-water work may be limited to turbidity monitoring and would not include construction activities. Therefore, the smalltooth sawfish will not likely be directly impacted by the beach nourishment portion of the proposed Project.

Direct Impacts from Groin Construction

If the proposed groins are constructed using in-water methods, potential effects on the smalltooth sawfish include vessel strikes, mechanized machinery injuries, or indirect effects from noise and/or vibrations where they may temporarily leave or avoid the area. However, if used, all vessels will comply with NMFS *Sea Turtle and Smalltooth Sawfish Construction Conditions* (NMFS, 2006) to minimize impacts to smalltooth sawfish during construction of the groins.

Indirect Impacts from Sand Placement

There will be no indirect effects to the smalltooth sawfish from Alternative 2.

Indirect Impacts from Groin Construction

There will be no indirect effects to the smalltooth sawfish from Alternative 2.

4.3.2.7. PIPING PLOVER

Direct Impacts from Sand Placement

Piping plovers have occasionally been observed in Palm Beach County, including two sightings near Lake Worth Pier, one in 2010 and one in 2012 (e-bird, 2015a). Heavy machinery and equipment (e.g., trucks and bulldozers operating within the Project Area) may directly adversely affect any migrating and wintering piping plovers within the Study Area by disturbance and disruption of normal activities such as roosting and feeding. During construction, birds may also be forced to expend valuable energy reserves to seek available habitat elsewhere.

Direct Impacts from Groin Construction

Groin construction will not affect the piping plover.

Indirect Impacts from Sand Placement

Beach nourishment can indirectly impact piping plovers through disruption of foraging and food habitats. Burial and suffocation of infaunal prey species due to sand placement can deplete the food source for shorebirds such as the piping plover. However, some studies suggest depletion of the intertidal food base on a re-nourished beach is temporary and fairly short term (less than one year) (Nelson, 1985). Beach wrack has also been recognized as important to shorebirds, including piping plovers, for camouflage and foraging. Since piping plovers spend the majority of their overwintering time in Florida foraging along the shoreline, the wrack line provides an important foraging resource for this species. Destruction of wrack, through beach nourishment eliminates this habitat.

Construction of dunes associated with the proposed Project can lead to stabilization of the shoreline which, while beneficial to beach infrastructure as well as wildlife that utilize the beach, can potentially prevent the formation of overwash areas which are an important habitat utilized by piping plovers. However, the Study Area contains and has historically contained high wide dunes which have prevented the formation of overwash areas. Therefore, because overwash areas do not exist in the Study Area, the proposed Project will not impact this type of preferred piping plover habitat. Heavy construction equipment associated with dune construction and potential planting activities may also deter piping plovers from utilizing the area on their migration routes, resulting in these birds selecting other suitable overwintering sites outside the Study Area.

Beach and dune restoration projects can benefit piping plovers, provided the Project incorporates high-quality sand that resembles the native beach environment which can help to minimize impacts to infaunal populations (Greene, 2002). Sand from either source must meet FDEP requirements for beach sand compatibility in accordance with Section 62B-41.007(2)(j), F.A.C. In addition, any sand source used for the Town of Palm Beach project must be consistent with the BMA cell-wide sediment quality specifications (Table 2-1) (FDEP, 2013). The sand source used for the County project must also meet the County's technical sand specifications outlined in the County’s Annual Dune and Wetlands Restoration contract (Appendix B). Restoration projects can also benefit piping plovers by increasing the area potentially useable for the species for foraging, roosting, and resting.

There is no federally designated piping plover critical habitat within or near Study Area; therefore, no impacts to piping plover critical habitat are anticipated.

Indirect Impacts from Groin Construction

Groin construction will not affect the piping plover.

4.3.2.8. RUFA RED KNOT

Direct Impacts from Sand Placement

Although there have been no documented sightings of rufa red knots within the Study Area, there have been 29 sightings within Palm Beach County since 2004 (e-Bird, 2015b). It may; therefore, be expected that rufa red knots have the potential to occur within the Study Area. Direct impacts for this species will be similar to those discussed above for the piping plover, and include direct disturbance and disruption of normal activities such as roosting and feeding. During construction activities and during a short post-construction period, the abundance of preferred prey, including bivalves, small snails, and crustaceans (USFWS, 2013c), within the filled areas will likely be depleted until the area is re-colonized. The loss of potential forage biomass within the Project’s intertidal footprint could affect the rufa red knot, which arrives at stopover areas along the mid-Atlantic to restore depleted energy reserves and rebuild body mass during northerly migrations (Niles et. al, 2008; USFWS, 2013c). Restoration projects can also benefit rufa red knots by increasing the area potentially useable for the species for foraging, roosting, and resting.

Direct Impacts from Groin Construction

Groin construction will not directly affect the rufa red knot.

Indirect Impacts from Sand Placement

Sand placement will not indirectly affect the rufa red knot.

Indirect Impacts from Groin Construction

Groin construction will not affect the rufa red knot.

4.3.2.9. BEACH JACQUEMONTIA

Direct Impacts from Sand Placement

Beach jacquemontia was once found at several sites in Martin, Palm Beach, Broward and Miami-Dade counties, but is no longer found north of Jupiter Inlet due to habitat destruction associated with residential construction. In Palm Beach County, naturally occurring beach jacquemontia has become rare and it has not been observed within the Study Area (CB&I, 2014). Therefore, construction activities in the form of truck haul beach nourishment will not have any direct negative effects to beach jacquemontia.

Direct Impacts from Groin Construction

Groin construction will not affect the beach jacquemontia.

Indirect Impacts from Sand Placement

Dune construction proposed under the Applicants' Preferred Alternative may indirectly benefit beach jacquemontia. This species is typically found in open areas on the crest and lee sides of stable dunes; therefore, the Project may create potential habitat in sections where dune construction will occur (R129-210 to R134+135). Restoring beach and dune habitat through dune building and stabilization projects is one of the habitat-level recovery actions listed by the USFWS for this species (USFWS, 1999).

Indirect Impacts from Groin Construction

Groin construction will not affect the beach jacquemontia.

4.3.2.10. SCLERACTINIAN CORALS

Direct Impacts from Sand Placement

Sand placement will not directly affect the scleractinian corals.

Direct Impacts from Groin Construction

Groin construction will not affect the scleractinian corals.

Indirect Impacts from Sand Placement

Based on the engineering and Delft3D modeling results, it is predicted that the Applicants' Preferred Alternative may result in permanent impacts to between 3.86 and 3.99 ac of hardbottom, and temporary impacts to between 9.53 and 9.93 ac of hardbottom (Tables 4-1 through 4-3; Figures 4-1 through 4-3). This resource serves as habitat for an opportunistic benthic assemblage including recruitment of scleractinians, primarily of the species *Siderastrea siderea* (all observations < 5 cm).

Recent surveys of the nearshore hardbottom habitat have not documented any colonies of *Acropora palmata, A. cervicornis* or any colonies of the five recently listed coral species in the Study Area (PBC-ERM, 2013c – Appendix C; CB&I, 2014 – Appendix D). Therefore, no indirect impacts are anticipated for these species.

Indirect Impacts from Groin Construction

Groin construction will not affect the scleractinian corals.

4.3.2.11. EASTERN INDIGO SNAKE

Direct Effects

No anticipated direct impacts in the form of mortality, injury, or loss of habitat to the eastern indigo snake.

Indirect Effects

Increased traffic and noise disturbance from trucks hauling sand from the stockpile or preferred upland sand mines have the potential to indirectly affect the Eastern indigo snake through vehicle strike. However, this effect is expected to be minimal because the snake will likely avoid the traffic and disturbance.

Eastern indigo snakes primarily inhabit inland areas such as sandhill regions, flatwoods, praires, and hammocks. They do utilize coastal dune environments; however, much of the native dune system with the Project Area has been lost to beach erosion and intense coastal development. While beach nourishment projects do not directly impact this species, as offshore sediment resources continue to be depleted, this may result in more frequent use of upland mines. The preferred upland mines where sand will be transported from via truck haul to the Project Area are not located in habitats frequented by the eastern indigo snake. However, transport of sand along the roadways from the mines may intersect with these habitats. Therefore, the increased traffic and noise disturbance may impact the eastern indigo snake along the truck routes or increase the risk of vehicle strike. Apart from potential temporary disturbances, no long-term negative effects are anticipated.

4.3.3. ALTERNATIVE 3 – THE APPLICANTS' PREFERRED PROJECT WITHOUT SHORELINE PROTECTION STRUCTURES

4.3.3.1. SEA TURTLES AND NESTING HABITAT

Direct Impacts from Sand Placement

Alternative 3 has the same direct impacts from sand placement as Alternative 2.

Indirect Impacts from Sand Placement

Alternative 3 has the same indirect impacts from sand placement as Alternative 2. The exclusion of the shoreline protection structure component for Alternative 3 will eliminate additional potential indirect impacts, such as interactions with the groin by females attempting to nest or hatchlings migrating to sea.

4.3.3.2. SEA TURTLES AND NEARSHORE MARINE HABITAT

Direct Impacts from Sand Placement

In order to minimize direct impacts to swimming sea turtles during construction, any vessels used will comply with the NMFS *Sea Turtle and Smalltooth Sawfish Construction Conditions* (NMFS, 2006).

Indirect Impacts from Sand Placement

Alternative 3 has the same direct impacts as Alternative 2 minus the impacts associated with groin construction except the area of permanent impacts to hardbottom will be smaller while the temporary impacts will be larger. Based on the engineering and Delft3D modeling results, it is predicted that Alternative 3 may result in permanent impacts to between 2.70 and 2.87 acres of hardbottom, and temporary impacts to between 12.13 and 12.41 acres of hardbottom. (Table 4-1). These impacts to nearshore hardbottom may displace juvenile sea turtles to adjacent areas of nearshore hardbottom to the north and south of the Study Area to find suitable foraging habitat. Macroalgae are generally well suited to periodic scouring and can often recover quickly from this type of disturbance as long as substrate is available for recolonization (CPE, 2013).

The survival of sea turtle species is unlikely to be impacted due to the availability of foraging opportunities in nearby regions.

4.3.3.3 LOGGERHEAD CRITICAL HABITAT

Direct Impacts from Sand Placement

Alternative 3 has the same direct impacts from sand placement as Alternative 2.

Indirect Impacts from Sand Placement

Alternative 3 has the same indirect impacts from sand placement as Alternative 2.

4.3.3.4. FLORIDA MANATEE

Direct Impacts from Sand Placement

Alternative 3 has the same direct impacts from sand placement as Alternative 2.

Indirect Effects from Sand Placement

There will be no indirect effects to the manatee from Alternative 3.

4.3.3.5 FLORIDA PANTHER

Direct Impacts from Sand Placement

Alternative 3 has the same direct impacts as Alternative 2.

Indirect Effects from Sand Placement

Alternative 3 has the same indirect impacts as Alternative 2.

4.3.3.6. SMALLTOOTH SAWFISH

Direct Impacts from Sand Placement

Alternative 3 has the same direct impacts from sand placement as Alternative 2.

Indirect Effects from Sand Placement

There will be no indirect effects to the smalltooth sawfish from Alternative 3.

4.3.3.7 PIPING PLOVER

Direct Effects from Sand Placement

Alternative 3 has the same direct impacts as Alternative 2.

Indirect Effects from Sand Placement

Alternative 3 has the same indirect impacts as Alternative 2.

4.3.3.8. RUFA RED KNOT

Direct Effects from Sand Placement

Alternative 3 has the same direct impacts as Alternative 2.

Indirect Effects from Sand Placement

Alternative 3 has the same indirect impacts as Alternative 2.

4.3.3.9. BEACH JACQUEMONTIA

Direct Effects from Sand Placement

Alternative 3 has the same direct impacts as Alternative 2.

Indirect Effects from Sand Placement

Alternative 3 has the same indirect impacts as Alternative 2.

4.3.3.10. SCLERACTINIAN CORALS

Direct Effects from Sand Placement

Alternative 3 has the same direct impacts as Alternative 2.

Indirect Effects from Sand Placement

Based on the engineering and Delft3D modeling results, it is predicted that Alternative 3 may result in permanent impacts to between 2.70 and 2.87 ac of hardbottom, and temporary impacts to between 12.13 and 12.41 ac. This resource serves as habitat for an opportunistic benthic assemblage including recruitment of scleractinians, primarily of the species *Siderastrea siderea* (all observations < 5 cm). Construction of mitigative artificial reef habitat will be required to offset hardbottom impacts; this reef could provide potential substrate for *Acropora* colonization and the five recently listed coral species. The artificial reefs will be constructed at least 7.5 m (25 ft) from any existing hardbottom resources to minimize potential impacts to natural hardbottom habitat.

Recent surveys of the nearshore hardbottom habitat have not documented any colonies of *Acropora palmata, A. cervicornis* or any colonies of the five recently listed coral species in the Study Area (PBC-ERM, 2013c – Appendix C; CB&I, 2014 – Appendix D). Therefore, no direct or indirect impacts are anticipated for these species.

4.3.3.11 EASTERN INDIGO SNAKE

Direct Effects from Sand Placement

Alternative 3 has the same direct effects from sand placement as Alternative 2.

Indirect Effects from Sand Placement

Alternative 3 has the same indirect effects from sand placement as Alternative 2.

4.3.4. ALTERNATIVE 4 – THE TOWN OF PALM BEACH PREFERRED PROJECT AND COUNTY INCREASED SAND VOLUME PROJECT WITHOUT SHORELINE PROTECTION STRUCTURES

4.3.4.1. SEA TURTLES AND NESTING HABITAT

Direct Impacts from Sand Placement

Alternative 4 has the same direct impacts from sand placement as Alternative 2.

Indirect Impacts from Sand Placement

Alternative 4 has the same indirect impacts as Alternative 2. The exclusion of the shoreline protection structure component for Alternative 4 will eliminate additional potential indirect impacts, such as interactions with the groin by females attempting to nest or hatchlings migrating to sea.

4.3.4.2. NEARSHORE MARINE HABITAT

Direct Impacts from Sand Placement

Alternative 4 has the same direct impacts from sand placement as Alternative 2.

Indirect Impacts from Sand Placement

Alternative 4 has the same direct impacts from sand placement as Alternative 2 except the area of permanent and temporary impacts to hardbottom will be larger due to the increased volume of sand and lack of groins. Based on the engineering and Delft3D modeling results, it is predicted that Alternative 4 may result in permanent impacts to between 6.51 and 6.71 ac of hardbottom, and temporary impacts to between 13.17 and 13.57 ac (Table 4-1). Burial of additional hardbottom resources are predicted to occur with this alternative due to the increased sand volume being placed below MHW. This will reduce the amount of sea turtle foraging habitat within the Study Area. Burial of nearshore hardbottom may deplete food resources (macroalgae) for sea turtles forcing them to seek foraging habitat elsewhere. It is unlikely that the survival of sea turtle species will be impacted due to foraging opportunities in nearby regions.

4.3.4.3. LOGGERHEAD CRITICAL HABITAT

Direct Impacts from Sand Placement

Alternative 4 has the same direct impacts as Alternative 2 minus the impacts associated with groin construction.

Indirect Impacts from Sand Placement

Alternative 4 has the same indirect impacts as Alternative 2 minus the impacts associated with groin construction.

4.3.4.2. FLORIDA MANATEE

Direct Impacts from Sand Placement

Alternative 4 has the same direct impacts from sand placement as Alternative 2.

Indirect Effects from Sand Placement

There will be no indirect effects to the manatee from Alternative 4.

4.3.4.3 FLORIDA PANTHER

Direct Impacts from Sand Placement

Alternative 4 has the same direct impacts as Alternative 2.

Indirect Effects from Sand Placement

Alternative 4 has the same indirect impacts as Alternative 2 except the increased volume of sand would further increase the vehicle traffic impacts on the panther due to increased truck loads.

4.3.4.4 SMALLTOOTH SAWFISH

Direct Impacts from Sand Placement

Alternative 4 has the same direct impacts from sand placement as Alternative 2.

Indirect Effects from Sand Placement

There will be no indirect effects to the smalltooth sawfish from Alternative 4.

4.3.4.5 PIPING PLOVER

Direct Effects from Sand Placement

Alternative 34 has the same direct impacts as Alternative 2.

Indirect Effects from Sand Placement

Alternative 4 has the same indirect impacts as Alternative 2.

4.3.4.6. RUFA RED KNOT

Direct Effects from Sand Placement

Alternative 4 has the same direct impacts as Alternative 2.

Indirect Effects from Sand Placement

Alternative 4 has the same indirect impacts as Alternative 2.

4.3.4.7. BEACH JACQUEMONTIA

Direct Effects from Sand Placement

Alternative 4 has the same direct impacts as Alternative 2.

Indirect Effects from Sand Placement

Alternative 4 has the same indirect impacts as Alternative 2.

4.3.4.8. SCLERACTINIAN CORALS

Direct Effects from Sand Placement

Alternative 4 has the same direct impacts as Alternative 2.

Indirect Effects from Sand Placement

Based on the engineering and Delft3D modeling results, it is predicted that Alternative 4 may result in permanent impacts to between 6.51 and 6.71 ac of hardbottom, and temporary impacts to between 13.17 and 13.57 ac. This resource serves as habitat for coral recruitment. Construction of mitigative artificial reef habitat will be required to offset hardbottom impacts; this reef could provide potential substrate for *Acropora* colonization and the five recently listed coral species. The artificial reefs will be constructed at least 7.5 m (25 ft.) from any existing hardbottom resources to minimize potential impacts to natural hardbottom habitat.

Recent surveys of the nearshore hardbottom habitat have not documented any colonies of *Acropora palmata, A. cervicornis* or any colonies of the five recently listed coral species in the Study Area (PBC-ERM, 2013c – Appendix C; CB&I, 2014 – Appendix D). Therefore, no direct or indirect impacts are anticipated for these species.

4.3.4.9 EASTERN INDIGO SNAKE

Direct Effects from Sand Placement

Alternative 4 has the same direct effects from sand placement as Alternative 2.

Indirect Effects from Sand Placement

Alternative 4 has the same indirect effects from sand placement as Alternative 2.

4.3.5. ALTERNATIVE 5 – THE TOWN OF PALM BEACH INCREASED SAND VOLUME PROJECT AND COUNTY PREFERRED PROJECT

4.3.5.1. SEA TURTLES AND NESTING HABITAT

Direct Impacts from Sand Placement

Alternative 5 has the same direct impacts from sand placement as Alternative 2.

Direct Impacts from Groin Construction

Alternative 5 has the same direct impacts from groin construction as Alternative 2.

Indirect Impacts from Sand Placement

Alternative 5 has the same indirect impacts from sand placement as Alternative 2.

Indirect Impacts from Groin Construction

Alternative 5 has the same indirect impacts from groin construction as Alternative 2.

4.3.5.2. SEA TURTLES NEARSHORE MARINE HABITAT

Direct Impacts from Sand Placement

Alternative 5 has the same direct impacts from sand placement as Alternative 2.

Direct Impacts from Groin Construction

Alternative 5 has the same direct impacts from groin construction as Alternative 2.

Indirect Impacts from Sand Placement

Alternative 5 has the same direct impacts from sand placement as Alternative 2 except the area of permanent impacts to hardbottom is similar but the temporary impacts to hardbottom are larger. Based on the engineering and Delft3D modeling results, it is predicted that this Alternative 5 may result in permanent impacts to between 3.45 and 4.23 ac of hardbottom, and temporary impacts to between 14.34 and 15.6 ac (Table 4-1). Temporary impacts to additional hardbottom resources are predicted to occur with this alternative due to the increased sand volume being placed below MHW. This may negatively affect sea turtle foraging habitat within the Study Area and may result in sea turtles seeking foraging habitat in adjacent areas. However, it is anticipated that artificial reefs constructed as mitigation for impacts to hardbottom will provide substrate for macroalgae recruitment.

Indirect Impacts from Groin Construction

Alternative 5 has the same indirect impacts from groin construction as Alternative 2.

4.3.5.3 LOGGERHEAD CRITICAL HABITAT

Direct Impacts from Sand Placement

Alternative 5 has the same direct impacts from sand placement as Alternative 2.

Direct Impacts from Groin Construction

Alternative 5 has the same direct impacts from groin construction as Alternative 2.

Indirect Impacts from Sand Placement

Alternative 5 has the same indirect impacts from sand placement as Alternative 2.

Indirect Impacts from Groin Construction

Alternative 5 has the same indirect impacts from groin construction as Alternative 2.

4.3.5.4. FLORIDA MANATEE

Direct Impacts from Sand Placement

Alternative 5 has the same direct impacts from sand placement as Alternative 2.

Direct Impacts from Groin Construction

Alternative 5 has the same direct impacts from groin construction as Alternative 2.

Indirect Impacts from Sand Placement

Alternative 5 has the same indirect impacts from sand placement as Alternative 2.

Indirect Impacts from Groin Construction

Alternative 5 has the same indirect impacts from groin construction as Alternative 2.

4.3.5.5 FLORIDA PANTHER

Direct Impacts from Sand Placement

Alternative 5 has the same direct impacts from sand placement as Alternative 2.

Direct Impacts from Groin Construction

Alternative 5 has the same direct impacts from groin construction as Alternative 2.

Indirect Impacts from Sand Placement

Alternative 5 has the same indirect impacts from sand placement as Alternative 2.

Indirect Impacts from Groin Construction

Alternative 5 has the same indirect impacts from groin construction as Alternative 2.

4.3.5.6. SMALLTOOTH SAWFISH

Direct Impacts from Sand Placement

Alternative 5 has the same direct impacts from sand placement as Alternative 2.

Direct Impacts from Groin Construction

Alternative 5 has the same direct impacts from groin construction as Alternative 2.

Indirect Impacts from Sand Placement

Alternative 5 has the same indirect impacts from sand placement as Alternative 2.

Indirect Impacts from Groin Construction

Alternative 5 has the same indirect impacts from groin construction as Alternative 2.

4.3.5.7 PIPING PLOVER

Direct Impacts from Sand Placement

Alternative 5 has the same direct impacts from sand placement as Alternative 2.

Direct Impacts from Groin Construction

Alternative 5 has the same direct impacts from groin construction as Alternative 2.

Indirect Impacts from Sand Placement

Alternative 5 has the same indirect impacts from sand placement as Alternative 2.

Indirect Impacts from Groin Construction

Alternative 5 has the same indirect impacts from groin construction as Alternative 2.

4.3.5.8 RUFA RED KNOT

Direct Impacts from Sand Placement

Alternative 5 has the same direct impacts from sand placement as Alternative 2.

Direct Impacts from Groin Construction

Alternative 5 has the same direct impacts from groin construction as Alternative 2.

Indirect Impacts from Sand Placement

Alternative 5 has the same indirect impacts from sand placement as Alternative 2.

Indirect Impacts from Groin Construction

Alternative 5 has the same indirect impacts from groin construction as Alternative 2.

4.3.5.9. BEACH JACQUEMONTIA

Direct Impacts from Sand Placement

Alternative 5 has the same direct impacts from sand placement as Alternative 2.

Direct Impacts from Groin Construction

Alternative 5 has the same direct impacts from groin construction as Alternative 2.

Indirect Impacts from Sand Placement

Alternative 5 has the same indirect impacts from sand placement as Alternative 2.

Indirect Impacts from Groin Construction

Alternative 5 has the same indirect impacts from groin construction as Alternative 2.

4.3.5.10. SCLERACTINIAN CORALS

Direct Impacts from Sand Placement

Alternative 5 has the same direct impacts from sand placement as Alternative 2.

Direct Impacts from Groin Construction

Alternative 5 has the same direct impacts from groin construction as Alternative 2.

Indirect Effects from Sand Placement

Based on the engineering and Delft3D modeling results, it is predicted that Alternative 5 may result in permanent impacts to between 3.45 and 4.23 ac of hardbottom, and temporary impacts to between 14.34 and 15.6 ac . This resource serves as habitat for an opportunistic benthic assemblage including recruitment of scleractinians, primarily of the species *Siderastrea siderea* (all observations < 5 cm). Construction of mitigative artificial reef habitat will be required to offset hardbottom impacts; this reef could provide potential substrate for *Acropora* colonization and the five recently listed coral species. The artificial reefs will be constructed at least 7.5 m (25 ft) from any existing hardbottom resources to minimize potential impacts to natural hardbottom habitat.

Recent surveys of the nearshore hardbottom habitat have not documented any colonies of *Acropora palmata, A. cervicornis* or any colonies of the five recently listed coral species in the Study Area (PBC-ERM, 2013c – Appendix C; CB&I, 2014 – Appendix D). Therefore, no direct or indirect impacts are anticipated for these species.

Indirect Impacts from Groin Construction

Alternative 5 has the same indirect impacts from groin construction as Alternative 2.

4.3.5.11 EASTERN INDIGO SNAKE

Direct Effects from Sand Placement

Alternative 5 has the same direct effects from sand placement as Alternative 2.

Indirect Effects from Sand Placement

Alternative 5 has the same indirect effects from sand placement as Alternative 2.

4.3.6. ALTERNATIVE 6 – THE TOWN OF PALM BEACH INCREASED SAND VOLUME PROJECT AND COUNTY INCREASED SAND VOLUME PROJECT WITHOUT SHORELINE PROTECTION STRUCTURES

4.3.6.1. SEA TURTLES AND NESTING HABITAT

Direct Impacts from Sand Placement

Alternative 6 has the same direct impacts from sand placement as Alternative 2.

Indirect Impacts from Sand Placement

Alternative 6 has the same indirect impacts as Alternative 2 minus the impacts associated with groin construction. The exclusion of the shoreline protection structure component for Alternative 6 will eliminate additional potential indirect impacts, such as interactions with the groin by females attempting to nest or hatchlings migrating to sea.

4.3.6.2. SEA TURTLES AND NEARSHORE MARINE HABITAT

Direct Impacts from Sand Placement

Alternative 6 has the same direct impacts from sand placement as Alternative 2.

Indirect Impacts from Sand Placement

Alternative 6 has the same direct impacts from sand placement as Alternative 2 except the area of permanent and temporary impacts to hardbottom will be larger due to the increased volume of sand and lack of groins. Based on the engineering and Delft3D modeling results, it is predicted that the Alternative 6 may result in permanent impacts to between 6.07 and 6.92 ac of hardbottom, and temporary impacts to between 17.42 and 18.34 ac (Table 4-1). These impacts to nearshore hardbottom may displace juvenile sea turtles to adjacent areas of nearshore hardbottom to the north and south of the Study Area to find suitable foraging habitat. Macroalgae are generally well suited to periodic scouring and can often recover quickly from this type of disturbance as long as substrate is available for recolonization (CPE, 2013).

4.3.6.3. SEA TURTLES AND LOGGERHEAD CRITICAL HABITAT

Direct Impacts from Sand Placement

Alternative 6 has the same direct impacts as Alternative 2 minus the impacts associated with groin construction.

Indirect Impacts from Sand Placement

Alternative 6 has the same indirect impacts as Alternative 2 minus the impacts associated with groin construction.

4.3.6.4. FLORIDA MANATEE

Direct Impacts from Sand Placement

Alternative 6 has the same direct impacts from sand placement as Alternative 2.

Indirect Effects from Sand Placement

There will be no indirect effects to the manatee from Alternative 6.

4.3.6.5. FLORIDA PANTHER

Direct Effects

Alternative 6 has the same direct impacts as Alternative 2.

Indirect Effects

Alternative 6 has the same indirect impacts as Alternative 2.

4.3.6.6. SMALLTOOTH SAWFISH

Direct Impacts from Sand Placement

Alternative 6 has the same direct impacts from sand placement as Alternative 2.

Indirect Effects from Sand Placement

There will be no indirect effects to the smalltooth sawfish from Alternative 6.

4.3.6.7. PIPING PLOVER

Direct Effects from Sand Placement

Alternative 6 has the same direct impacts as Alternative 2.

Indirect Effects from Sand Placement

Alternative 6 has the same indirect impacts as Alternative 2.

4.3.6.8. RUFA RED KNOT

Direct Effects from Sand Placement

Alternative 6 has the same direct impacts as Alternative 2.

Indirect Effects from Sand Placement

Alternative 6 has the same indirect impacts as Alternative 2.

4.3.6.9. BEACH JACQUEMONTIA

Direct Effects from Sand Placement

Alternative 6 has the same direct impacts as Alternative 2.

Indirect Effects from Sand Placement

Alternative 6 has the same indirect impacts as Alternative 2.

4.3.6.10 SCLERACTINIAN CORALS

Direct Effects from Sand Placement

Alternative 6 has the same direct impacts as Alternative 2.

Indirect Effects from Sand Placement

Based on the engineering and Delft3D modeling results, it is predicted that Alternative 6 may result in permanent impacts to between 6.07 and 6.92 ac of hardbottom, and temporary impacts to between 17.42 and 18.34 ac . This resource serves as habitat for an opportunistic benthic assemblage including recruitment of scleractinians, primarily of the species *Siderastrea siderea* (all observations < 5 cm).Construction of mitigative artificial reef habitat will be required to offset hardbottom impacts; this reef could provide potential substrate for *Acropora* colonization and the five recently listed coral species. The artificial reefs will be constructed at least 7.5 m (25 ft) from any existing hardbottom resources to minimize potential impacts to natural hardbottom habitat.

Recent surveys of the nearshore hardbottom habitat have not documented any colonies of *Acropora palmata, A. cervicornis* or any colonies of the five recently listed coral species in the Study Area (PBC-ERM, 2013c – Appendix C; CB&I, 2014 – Appendix D). Therefore, no direct or indirect impacts are anticipated for these species.

4.3.6.11 EASTERN INDIGO SNAKE

Direct Effects from Sand Placement

Alternative 6 has the same direct effects from sand placement as Alternative 2.

Indirect Effects from Sand Placement

Alternative 6 has the same indirect effects from sand placement as Alternative 2.

4.3.7. ALTERNATIVE 7b – THE TOWN OF PALM BEACH INCREASED SAND VOLUME WITH TWO SHORELINE PROTECTION STRUCTURES (THE COALITION TO SAVE OUR SHORELINE, INC. (SOS) ALTERNATIVE) AND THE COUNTY PREFERRED PROJECT

4.3.7.1. SEA TURTLES AND NESTING HABITAT

Direct Impacts from Sand Placement

Alternative 7b has the same direct impacts from sand placement as Alternative 2.

Direct Impacts from Groin Construction

Alternative 7b has the same direct impacts from groin construction as Alternative 2 because it also include construction of the king pile groins. However, this alternative also proposes the installation of two T-shaped groins. T-shaped groins will be constructed using in-water methods, potential direct effects on the manatee include vessel strikes or mechanized machinery injuries, or indirect effects from noise and/or vibrations where they may temporarily leave or avoid the area. However, if used, all vessels will reduce the potential for manatee impacts by complying with the FWC *Standard Manatee Construction Conditions for In-Water Work* (FWC, 2011).

Indirect Impacts from Sand Placement

Alternative 7b has the same indirect impacts from sand placement as Alternative 2.

Indirect Impacts from Groin Construction

Alternative 7b has the same indirect impacts from groin construction as Alternative 2.

4.3.7.2. SEA TURTLES AND NEARSHORE MARINE HABITAT

Direct Impacts from Sand Placement

Alternative 7b has the same direct impacts from sand placement as Alternative 2.

Direct Impacts from Groin Construction

Alternative 7b has the same direct impacts from groin construction as Alternative 2 because it also include construction of the king pile groins. However, this alternative also proposes the installation of two T-shaped groins. The T-shaped groins will be constructed offshore in the nearshore habitat. It is not known at this time if the groins would directly impact hardbottom, but there is a potential for direct impacts.

Indirect Impacts from Sand Placement

Alternative 7b has the same direct impacts from sand placement as Alternative 2 except the area of permanent impacts to hardbottom is similar but the temporary impacts to hardbottom are larger. Based on the engineering and Delft3D modeling results, it is predicted that the Alternative 7b may result in permanent impacts to between 5.74 and 11.25 ac of hardbottom, and temporary impacts to between 9.45 and 18.80 ac (Table 4-1). These impacts to nearshore hardbottom may displace juvenile sea turtles to adjacent areas of nearshore hardbottom to the north and south of the Study Area to find suitable foraging habitat. Macroalgae are generally well suited to periodic scouring and can often recover quickly from this type of disturbance as long as substrate is available for recolonization (CPE, 2013).

Indirect Impacts from Groin Construction

Alternative 7b has the same direct impacts from groin construction as Alternative 2 because it also include construction of the king pile groins. However, this alternative also proposes the installation of two T-shaped groins. T-shaped groins act as obstruction for nesting sea turtles. In addition, hatchling sea turtles can be trapped in the groins and create a nearshore predator concentration. In addition, the groins may cause sediment build up in the nearshore hardbottom. The groins result in a significant negative indirect impact to sea turtles in the nearshore environment.

4.3.7.3 LOGGERHEAD CRITICAL HABITAT

Direct Impacts from Sand Placement

Alternative 7b has the same direct impacts from sand placement as Alternative 2.

Direct Impacts from Groin Construction

Alternative 7b has the same direct impacts from groin construction as Alternative 2 except for the significant negative adverse impacts to the Loggerhead Nearshore Reproductive habitat. The T-shaped groins directly impact the PCEs including waters free from obstruction and waters with minimal man-made structure that could promote predators and disrupt the wave patterns.

Indirect Impacts from Sand Placement

Alternative 7b has the same indirect impacts from sand placement as Alternative 2.

Indirect Impacts from Groin Construction

Alternative 7b has the same indirect impacts from groin construction as Alternative 2.

4.3.7.4. FLORIDA MANATEE

Direct Impacts from Sand Placement

Alternative 7b has the same direct impacts from sand placement as Alternative 2.

Direct Impacts from Groin Construction

Alternative 7b has the same direct impacts from groin construction as Alternative 2.

Indirect Impacts from Sand Placement

Alternative 7b has the same indirect impacts from sand placement as Alternative 2.

Indirect Impacts from Groin Construction

Alternative 7b has the same indirect impacts from groin construction as Alternative 2.

4.3.7.5. FLORIDA PANTHER

Direct Impacts from Sand Placement

Alternative 7b has the same direct impacts from sand placement as Alternative 2.

Direct Impacts from Groin Construction

Alternative 7b has the same direct impacts from groin construction as Alternative 2.

Indirect Impacts from Sand Placement

Alternative 7b has the same indirect impacts from sand placement as Alternative 2.

Indirect Impacts from Groin Construction

Alternative 7b has the same indirect impacts from groin construction as Alternative 2.

4.3.7.6. SMALLTOOTH SAWFISH

Direct Impacts from Sand Placement

Alternative 7b has the same direct impacts from sand placement as Alternative 2.

Direct Impacts from Groin Construction

Alternative 7b has the same direct impacts from groin construction as Alternative 2.

Indirect Impacts from Sand Placement

Alternative 7b has the same indirect impacts from sand placement as Alternative 2.

Indirect Impacts from Groin Construction

Alternative 7b has the same indirect impacts from groin construction as Alternative 2.

4.3.7.7. PIPING PLOVER

Direct Impacts from Sand Placement

Alternative 7b has the same direct impacts from sand placement as Alternative 2.

Direct Impacts from Groin Construction

Alternative 7b has the same direct impacts from groin construction as Alternative 2.

Indirect Impacts from Sand Placement

Alternative 7b has the same indirect impacts from sand placement as Alternative 2.

Indirect Impacts from Groin Construction

Alternative 7b has the same indirect impacts from groin construction as Alternative 2.

4.3.7.8. RUFA RED KNOT

Direct Impacts from Sand Placement

Alternative 7b has the same direct impacts from sand placement as Alternative 2.

Direct Impacts from Groin Construction

Alternative 7b has the same direct impacts from groin construction as Alternative 2.

Indirect Impacts from Sand Placement

Alternative 7b has the same indirect impacts from sand placement as Alternative 2.

Indirect Impacts from Groin Construction

Alternative 7b has the same indirect impacts from groin construction as Alternative 2.

4.3.7.9. BEACH JACQUEMONTIA

Direct Impacts from Sand Placement

Alternative 7b has the same direct impacts from sand placement as Alternative 2.

Direct Impacts from Groin Construction

Alternative 7b has the same direct impacts from groin construction as Alternative 2.

Indirect Impacts from Sand Placement

Alternative 7b has the same indirect impacts from sand placement as Alternative 2.

Indirect Impacts from Groin Construction

Alternative 7b has the same indirect impacts from groin construction as Alternative 2.

4.3.7.10. SCLERACTINIAN CORALS

Direct Impacts from Sand Placement

Alternative 7b has the same direct impacts from sand placement as Alternative 2.

Direct Impacts from Groin Construction

Alternative 7b has the same direct impacts from groin construction as Alternative 2.

Indirect Effects from Sand Placement

Based on the engineering and Delft3D modeling results, it is predicted that Alternative 7b may result in permanent impacts to between 5.74 and 11.25 ac of hardbottom, and temporary impacts to between 9.45 and 18.80 ac. This resource serves as habitat for an opportunistic benthic assemblage including recruitment of scleractinians, primarily of the species *Siderastrea siderea* (all observations < 5 cm). Construction of mitigative artificial reef habitat will be required to offset hardbottom impacts; this reef could provide potential substrate for *Acropora* colonization and the five recently listed coral species. The artificial reefs will be constructed at least 7.5 m (25 ft.) from any existing hardbottom resources to minimize potential impacts to natural hardbottom habitat.

Recent surveys of the nearshore hardbottom habitat have not documented any colonies of *Acropora palmata, A. cervicornis* or any colonies of the five recently listed coral species in the Study Area (PBC-ERM, 2013c – Appendix C; CB&I, 2014 – Appendix D). Therefore, no direct or indirect impacts are anticipated for these species.

Indirect Impacts from Groin Construction

Alternative 7b has the same indirect impacts from groin construction as Alternative 2.

4.3.7.11. EASTERN INDIGO SNAKE

Direct Effects from Sand Placement

Alternative 5 has the same direct effects from sand placement as Alternative 2.

Indirect Effects from Sand Placement

Alternative 5 has the same indirect effects from sand placement as Alternative 2.

4.3.8. ARTIFICIAL REEF

4.3.8.1. SEA TURTLES AND NESTING HABITAT

Direct Impacts

Construction of an artificial reef, used for mitigation purposes, involves the potential for direct and indirect impacts to swimming sea turtles. Construction of the reef may require construction vessels and mechanized machinery placing large rocks in the water. Additionally the vessels may require spudding, anchoring, and other mooring that could pose the potential for impacting sea turtles. Additional potential effects on the sea turtles during construction include vessel strikes and mechanized machinery injuries. However, to minimize direct impacts to manatees, all vessels will comply with the NMFS *Sea Turtle and Smalltooth Sawfish Construction Conditions* (NMFS, 2006). The artificial reef will be constructed to prevent entrapment of sea turtles.

Indirect Impacts

Indirect effects from noise and/or vibrations may cause the sea turtle to temporarily leave or avoid the area.

4.3.8.2. SEA TURTLES AND NEARSHORE MARINE HABITAT

Direct Impacts

The artificial reef will not have a direct effect on nearshore hardbottom because it will be located in an area void of hardbottom. The Applicants will field verify that the artificial reef will be placed on unconsolidated bottom prior to deployment.

Indirect Impacts

The artificial reef will not have an indirect effect on nearshore hardbottom.

4.3.8.3. LOGGERHEAD CRITICAL HABITAT

Direct Impacts

The artificial reef will not directly affect loggerhead critical habitat PCEs. The reef will be constructed to mimic natural reefs. In addition, the reef will be submerged and will not aggregate predators or entrap hatchlings.

Indirect Impacts

The artificial reef will not indirectly effect loggerhead critical habitat.

4.3.8.4. FLORIDA MANATEE

Direct Effects

Construction of the reef may require construction vessels, mechanized machinery placing large rocks in the water. Additionally the vessels may require spudding, anchoring, and other mooring that could pose the potential for injuring manatees. Additional potential effects on the manatee during construction include vessel strikes, mechanized machinery injuries, or indirect effects from noise and/or vibrations where they may temporarily leave or avoid the area. However, to minimize direct impacts to manatees, all vessels will comply with FWC *Standard Manatee Construction Conditions for In-Water Work* (FWC, 2011).

Indirect Effects

The artificial reef will not indirectly effect the manatee.

4.3.8.5. FLORIDA PANTHER

Direct Effects

The artificial reef will not directly affect the panther because all work will be performed offshore and the panther is not present.

Indirect Effects

The artificial reef will not indirectly effect the panther.

4.3.8.6. SMALLTOOTH SAWFISH

Direct Effects

Construction of a mitigation reef may also require construction vessels and mechanized machinery placing large rocks in the water. Additionally, the vessels may require spudding, anchoring, and other mooring that could pose the potential for injuring smalltooth sawfish. Potential effects on the smalltooth sawfish during construction also include vessel strikes, mechanized machinery injuries, or indirect effects from noise and/or vibrations where they may temporarily leave or avoid the area. Construction of mitigative artificial reefs will also comply with NMFS *Sea Turtle and Smalltooth Sawfish Construction Conditions* (NMFS, 2006).

Indirect Effects

The artificial reef will not indirectly affect the smalltooth sawfish.

4.3.8.7. PIPING PLOVER

Direct Effects

The artificial reef will not directly affect the piping plover because all work will be performed offshore and the piping plover is not present.

Indirect Effects

The artificial reef will not directly affect the piping plover because all work will be performed offshore and the piping plover is not present.

4.3.8.8. RUFA RED KNOT

Direct Effects

The artificial reef will not directly affect the red knot because all work will be performed offshore and the red knot is not present.

Indirect Effects

The artificial reef will not directly affect the red knot because all work will be performed offshore and the red knot is not present.

4.3.8.9. BEACH JACQUEMONTIA

Direct Effects

The artificial reef will not directly affect the beach jacquemontia because all work will be performed offshore and the red knot is not present.

Indirect Effects

The artificial reef will not directly affect the beach jacquemontia because all work will be performed offshore and the red knot is not present.

4.3.8.10 SCLERACTINIAN CORALS

Direct Effects

The artificial reefs will be constructed at least 7.5 m (25 ft.) from any existing hardbottom resources and corals to minimize potential direct impacts.

Indirect Effects

Construction of mitigative artificial reef habitat will be required to offset hardbottom impacts; this reef could provide potential substrate for *Acropora* colonization and the five recently listed coral species.

4.3.8.11 EASTERN INDIGO SNAKE

Direct Effects

The artificial reef will not directly affect the Eastern indigo snake because all work will be performed offshore and the Eastern indigo snake is not present.

Indirect Effects

The artificial reef will not directly affect the Eastern indigo snake because all work will be performed offshore and the Eastern indigo snake is not present.

4.4. CORAL REEF AND HARDBOTTOM RESOURCES

The results of the engineering and Delft3D modeling study (Appendix G) provided polygons that represented sand accumulation in the nearshore habitat over three years due to project implementation for each alternative and for each grain size modeled. Three years selected because the desired renourishment interval is 3-4 years. Any impacts beyond 3 years post-construction were already considered permanent. These polygons were overlaid onto aerial delineations of exposed hardbottom digitized in GIS from 2003 through 2014 to determine potential impacts to this resource. From these polygons, seven levels of potential impact to hardbottom were developed based on temporal and spatial factors. These impact types are listed below in Section 4.4.2 but are also described in greater detail in Appendix H. Initial investigation of the hardbottom habitat in the project area revealed a resource that is very dynamic and ephemeral in nature. The constant burial and re-exposure of hardbottom in this area facilitates the development of an opportunistic community dominated by turf and macroalgae species that recruit quickly when substrate is available. Between 2003 and 2014, the amount of exposed hardbottom in the Project Area varied widely ranging between 1.5 ac (2009) to 36.6 ac (2006). Because of the variability observed from year to year, the USACE determined that a time-average analysis of the amount of hardbottom exposed over 10 years would best represent the habitat since it smooths out short-term fluctuations and provides longer-term trends by averaging a function over iterations of time. The 2014 dataset was added during updates to the EIS extending the time-average analysis over 11 years. In this case, the average amount of exposed hardbottom (ac) between two surveys is multiplied by the number of days between those two surveys (ac-days). The sum of ac-days is divided by the total number of days between the first survey and the last survey. This provides the time-averaged amount of hardbottom in an area. In order to determine the area of potential impact due to project construction, the amount of exposed hardbottom from each hardbottom delineation (2003 – 2014) that fell within the impact polygons generated by the Delft3D modeling was determined in GIS and these areas were input into the time-average calculation. For each alternative (and each grain size modeled), these impact areas were input into the Uniform Mitigation Assessment Method (UMAM) to determine potential mitigation requirements.

4.4.1. ALTERNATIVE 1 – NO ACTION ALTERNATIVE

Direct Effects from Sand Placement

There are no direct effects from this No Action Alternative.

Indirect Effects from Sand Placement

Dune maintenance projects would likely continue but have minimal effect on hardbottom and coral resources because the sand volume is small and unlikely to bury hardbottom.

4.4.2. ALTERNATIVE 2 – THE APPLICANTS' PREFERRED PROJECT: BEACH AND DUNE FILL WITH SHORELINE PROTECTION STRUCTURES

Direct and Indirect Impacts from Sand Placement

The placement and equilibration of fill from beach nourishment are likely to cause direct and indirect impacts to nearshore hardbottom resources. The level of impacts depends upon the depth of burial, sand characteristics of the fill, and the duration of coverage (USACE, 2012). Each direct and indirect impact is designated as temporary and permanent herein. Based on results of the engineering and Delft3D modeling analysis (Appendix G), hardbottom impacts were divided among seven impact types. These impact types are described in detail in the Draft Uniform Mitigation Assessment Method (UMAM) Analysis provided as Appendix H and include the following categories:

1. Permanent impacts
2. Direct Temporary impacts for less than 1 year
3. Direct Temporary impacts for more than 1 year
4. Direct Temporary impacts for more than 2 years
5. Indirect Temporary impacts for one year
6. Indirect Temporary impacts for two years
7. Indirect Temporary ETOF impacts

The acreage of each impact type is presented in Tables 4-1 through 4-3 for the six build alternatives (Alternatives 2 through 7b). It is predicted that the Applicants' Preferred Alternative may result in permanent impacts to between 3.86 and 3.99 acres of hardbottom, and temporary impacts to between 9.53 and 9.93 acres of hardbottom. These impacts acreages were used to complete a UMAM evaluation, which determined that between 6.55 and 6.66 acres of mitigative artificial reef would be required to offset these impacts to intertidal and subtidal hardbottom. These hardbottom impacts could reduce habitat available for macroalgae and invertebrates in the area, altering normal ecological function of the area. However, the majority of these impacts are expected to be moderate as the hardbottom in this area is highly ephemeral and it is expected that it will become re-exposed following construction as a result of the high-energy dynamics of the nearshore area (USACE, 2012). Benthic organisms that inhabit this area have high recruitment capabilities and, therefore would be expected to recolonize.

Sand placement would most likely increase turbidity at the Project site and the adjacent waters. The severity of turbidity-related impacts depends upon the sediment grain size distribution, the speed of sand placement, and the degree of nearshore circulation and mixing. Sand from either source must meet FDEP requirements for beach sand compatibility as per F.A.C., Rule 62B-41.007(2)(j). Per the FDEP BMA cell-wide sediment quality specification, mean grain size must be between 0.25 mm and 0.60 mm with a maximum silt content of 2% (FDEP, 2013). The County's technical sand specifications require the mean grain size to be between 0.30 mm and 0.70 mm with a maximum silt content of 0.6% (Appendix B). An increase in turbidity could reduce the opportunity for photosynthesis and interfere with suspension feeders. However, the short duration of the activity would result in only temporary impacts due to increased turbidity.

Direct Impacts from Groin Construction

There are no direct effects from groin construction because the groins will be constructed on the beach avoiding all nearshore hardbottom.

Indirect Impacts from Groin Construction

The construction of the groin may indirectly benefit hardbottom by helping retain the sand onshore.

Table 4-1. Summary of anticipated impact acreages and mitigation associated with Alternatives 2-7b using 0.25 mm grain size in the Town of Palm Beach and 0.36 mm grain size in the County. Acreages are based on a time-average of exposed hardbottom between 2003 and 2014.

Anticipated Impacts and Associated Mitigation (ac)	Alt 2		Alt 3		Alt 4		Alt 5		Alt 6		Alt 7b	
	Impact	Mitig	Impact	Mitig	Impact	Mitig	Impact	Mitig	Impact	Mitig	Impact	Mitig
1. Permanent	3.86	4.48	2.70	3.13	6.51	7.54	3.45	4.00	6.07	7.04	5.74	6.66
2. Direct Temporary (<1 yr)	0.87	0.03	1.43	0.04	0.38	0.01	0.82	0.02	0.26	0.01	1.75	0.05
3. Direct Temporary (>1 yr)	0.31	0.10	0.37	0.12	0.63	0.20	0.55	0.18	0.70	0.23	1.06	0.34
4. Direct Temporary (>2 yrs)	0.19	0.16	0.06	0.05	0.43	0.37	0.14	0.12	0.87	0.75	0.90	0.77
5. Indirect Temporary (1 yr)	3.35	0.53	3.91	0.62	5.06	0.80	3.89	0.62	5.92	0.94	5.51	0.88
6. Indirect Temporary (2 yrs)	1.42	0.77	1.38	0.75	2.55	1.39	1.47	0.80	2.52	1.37	3.30	1.80
7. Indirect Temporary (ETOF)	3.79	0.49	5.04	0.65	4.12	0.53	8.73	1.12	8.08	1.04	1.80	0.23
Required Mitigation	**6.55**		**5.36**		**10.84**		**6.86**		**11.37**		**10.72**	

Table 4-2. Summary of impact and mitigation acreages associated with Alternatives 2-7b using 0.36 mm grain size in the Town of Palm Beach and the County. Acreages are based on a time-average of exposed hardbottom between 2003 and 2014.

Anticipated Impacts and Associated Mitigation (ac)	Alt 2		Alt 3		Alt 4		Alt 5		Alt 6		Alt 7b	
	Impact	Mitig	Impact	Mitig	Impact	Mitig	Impact	Mitig	Impact	Mitig	Impact	Mitig
1. Permanent	3.97	4.60	2.87	3.32	6.71	7.77	3.97	4.60	6.81	7.89	11.25	13.04
2. Direct Temporary (<1 yr)	0.83	0.03	1.38	0.04	0.34	0.01	0.71	0.02	0.17	0.01	0.53	0.02
3. Direct Temporary (>1 yr)	0.33	0.11	0.39	0.13	0.33	0.11	0.35	0.11	0.61	0.20	0.35	0.11
4. Direct Temporary (>2 yrs)	0.19	0.16	0.07	0.06	0.67	0.57	0.29	0.25	0.53	0.45	0.72	0.61
5. Indirect Temporary (1 yr)	3.24	0.51	3.72	0.59	5.42	0.86	4.14	0.66	6.19	0.98	4.88	0.78
6. Indirect Temporary (2 yrs)	1.44	0.78	1.57	0.85	2.50	1.36	1.52	0.83	2.62	1.43	2.50	1.36
7. Indirect Temporary (ETOF)	3.65	0.47	5.00	0.64	3.94	0.51	7.97	1.03	7.44	0.96	0.47	0.06
Required Mitigation	**6.66**		**5.64**		**11.19**		**7.49**		**11.91**		**15.98**	

Table 4-3. Summary of impact and mitigation acreages associated with Alternatives 2-7b using 0.60 mm grain size in the Town of Palm Beach and the 0.36 mm grain size in the County. Acreages are based on a time-average of exposed hardbottom between 2003 and 2014.

Anticipated Impacts and Associated Mitigation (ac)	Alt 2		Alt 3		Alt 4		Alt 5		Alt 6		Alt 7b	
	Impact	Mitig	Impact	Mitig	Impact	Mitig	Impact	Mitig	Impact	Mitig	Impact	Mitig
1. Permanent	3.99	4.62	2.87	3.32	6.63	7.68	4.23	4.90	6.92	8.02	8.49	9.83
2. Direct Temporary (<1 yr)	0.79	0.02	1.26	0.04	0.33	0.01	0.56	0.02	0.09	0.00	4.32	0.13
3. Direct Temporary (>1 yr)	0.28	0.09	0.48	0.16	0.31	0.10	0.23	0.07	0.24	0.08	0.21	0.07
4. Direct Temporary (>2 yrs)	0.19	0.16	0.07	0.06	0.66	0.56	0.21	0.18	0.75	0.64	0.62	0.53
5. Indirect Temporary (1 yr)	3.46	0.55	3.92	0.62	5.71	0.91	4.31	0.68	5.98	0.95	4.86	0.77
6. Indirect Temporary (2 yrs)	1.33	0.73	1.54	0.84	2.80	1.52	1.36	0.74	2.90	1.58	2.16	1.17
7. Indirect Temporary (ETOF)	3.47	0.45	5.15	0.66	3.76	0.48	7.68	0.99	7.47	0.96	6.63	0.85
Required Mitigation	**6.63**		**5.70**		**11.27**		**7.59**		**12.23**		**13.36**	

4.4.3. ALTERNATIVE 3 – THE APPLICANTS' PREFERRED PROJECT WITHOUT SHORELINE PROTECTION STRUCTURES

Direct and Indirect Impacts from Sand Placement

The placement and equilibration of beach nourishment are likely to cause direct and indirect impacts to nearshore hardbottom resources. The level of impacts depends upon the depth of burial, sand characteristics of the fill, and the length coverage (USACE, 2012). The volume of sand proposed for placement for this alternative is the same as the Preferred Alternative (Alternative 2); however, Alternative 3 does not include construction of the seven (7) groins. Based on the engineering and Delft3D modeling results, it is predicted that this Alternative 3 may result in permanent impacts to between 2.70 and 2.87 acres of hardbottom, and temporary impacts to between 12.13 and 12.41 acres of hardbottom. This impact acreage was used to complete a UMAM evaluation, which determined that between 5.36 and 5.70 acres of mitigative artificial reef would be required to offset these impacts to intertidal and subtidal hardbottom. These hardbottom impacts could reduce habitat available for macroalgae and invertebrates in the area, altering normal ecological function of the area. However, these impacts are expected to be minor as the hardbottom is expected to become re-exposed following construction as a result of the high-energy dynamics of the nearshore area (USACE, 2012). Benthic organisms that inhabit this area have high recruitment capabilities and, therefore would be expected to recolonize.

Sand placement would most likely increase turbidity at the Project site and the adjacent waters. The severity of turbidity-related impacts depends upon the sediment grain size distribution, the speed of sand placement, and the degree of nearshore circulation and mixing. Sand from either source must meet FDEP requirements for beach sand compatibility as per F.A.C., Rule 62B-41.007(2)(j). Per the FDEP BMA cell-wide sediment quality specification, mean grain size must be between 0.25 mm and 0.60 mm with a maximum silt content of 2% (FDEP, 2013). The County's technical sand specifications require the mean grain size to be between 0.30 mm and 0.70 mm with a maximum silt content of 0.6% (Appendix B). An increase in turbidity could reduce the opportunity for photosynthesis and interfere with suspension feeders. However, the short duration of the activity would result in only temporary impacts from turbidity. The elimination of the seven (7) low-profile groins between R-134 to R-138+551 would not change the potential impact to turbidity caused by beach nourishment.

4.4.4. ALTERNATIVE 4 – THE TOWN OF PALM BEACH PREFERRED PROJECT AND COUNTY INCREASED SAND VOLUME WITHOUT SHORELINE PROTECTION STRUCTURES PROJECT

Direct and Indirect Impacts from Sand Placement

The placement and equilibration of beach nourishment are likely to cause direct and indirect impacts to nearshore hardbottom resources. The level of impacts depends upon the depth of burial, sand characteristics of the fill, and the length coverage (USACE, 2012). A greater volume of sand will be placed below MHW within the County in this alternative as compared to Alternative 2; therefore, impacts to nearshore hardbottom resources will be increased. The volume of sand proposed for placement for this alternative will be increased from 77,600 cy to 187,800 cy. Based on results of the engineering and Delft3D modeling analysis, it is estimated that Alternative 4 may result in permanent impacts to between 6.51 and 6.71 acres of hardbottom, and temporary impacts to between 13.17 and 13.57 acres of hardbottom. This impact acreage was used to complete a Uniform Mitigation Assessment Method (UMAM) evaluation, which determined that between 10.84 and 11.27 acres of mitigative artificial reef would be required to offset these impacts to intertidal and subtidal hardbottom. These impacts could reduce habitat available for macroalgae and invertebrates in the area, altering normal ecological function of the area. The elimination of the seven (7) low-profile groins between R-134 to R-138+551 would not change the potential impact to hardbottom resources caused by beach nourishment; however, the larger volume of sand will impact additional resources.

Increased sand placement would most likely increase turbidity at the Project site and the adjacent waters. The severity of turbidity-related impacts depends upon the sediment grain size distribution, the speed of sand placement, and the degree of nearshore circulation and mixing. Sand from either source must meet FDEP requirements for beach sand compatibility as per F.A.C., Rule 62B-41.007(2)(j). Per the FDEP BMA cell-wide sediment quality specification, mean grain size must be between 0.25 mm and 0.60 mm with a maximum silt content of 2% (FDEP, 2013). The County's technical sand specifications require the mean grain size to be between 0.30 mm and 0.70 mm with a maximum silt content of 0.6% (Appendix B). An increase in turbidity could reduce the opportunity for photosynthesis and interfere with suspension feeders. However, the short duration of the activity would result in only temporary impacts from turbidity. The elimination of the seven low-profile groins between R-134 to R-138+551 would not change the potential impact to turbidity caused by beach nourishment.

4.4.5. ALTERNATIVE 5 – THE TOWN OF PALM BEACH INCREASED SAND VOLUME AND COUNTY PREFERRED PROJECT

Direct and Indirect Impacts from Sand Placement

The placement and equilibration of beach nourishment are likely to cause direct and indirect impacts to nearshore hardbottom resources. The level of impacts depends upon the depth of burial, sand characteristics of the fill, and the length coverage (USACE, 2012). A greater volume of sand will be placed below MHW within the Town of Palm Beach for this alternative as compared to Alternative 2. Based on results of the engineering and Delft3D modeling analysis, it is predicted that Alternative 5 may result in permanent impacts to between 3.45 and 4.23 acres of hardbottom, and temporary impacts to between 14.34 and 15.60 acres of hardbottom.

The total impacts were greater for this alternative as compared to Alternative 2, although the permanent impacts were less. The modeling results indicate that there would be greater areas of sedimentation with the increased volume of sand, but the distribution of the additional sand within the coastal system may alter the sedimentation patterns. When overlain on the various hardbottom delineations, the sedimentation areas indicated that the permanent impacts would be less, but that the temporary impacts would be greater.

This impact acreage was used to complete a UMAM evaluation, which determined that between 6.86 and 7.59 acres of mitigative artificial reef would be required to offset these impacts to intertidal and subtidal hardbottom. These impacts could reduce habitat available for macroalgae and invertebrates in the area, altering normal ecological function of the area. Benthic organisms that inhabit this area have high recruitment capabilities and, therefore would be expected to recolonize relatively quickly; however, the larger volume of sand in the Town of Palm Beach will impact additional resources compared to the Preferred Alternative.

Increased sand placement would most likely increase turbidity at the Project site and the adjacent waters. The severity of turbidity-related impacts depends upon the sediment grain size distribution, the speed of sand placement, and the degree of nearshore circulation and mixing. Sand from either source must meet FDEP requirements for beach sand compatibility as per F.A.C., Rule 62B-41.007(2)(j). Per the FDEP BMA cell-wide sediment quality specification, mean grain size must be between 0.25 mm and 0.60 mm with a maximum silt content of 2% (FDEP, 2013). The County's technical sand specifications require the mean grain size to be between 0.30 mm and 0.70 mm with a maximum silt content of 0.6% (Appendix B). An increase in turbidity could reduce the opportunity for photosynthesis and interfere with suspension feeders. However, the short duration of the activity would result in only temporary impacts from turbidity.

Direct Impacts from Groin Construction

Groin construction will not directly impact hardbottom or coral.

Direct and Indirect Impacts from Sand Placement

Indirect Impacts from Groin Construction

The construction of the groin may indirectly benefit hardbottom by helping retain the sand onshore.

4.4.6 ALTERNATIVE 6 – THE TOWN OF PALM BEACH INCREASED SAND VOLUME AND COUNTY INCREASED SAND VOLUME WITHOUT SHORELINE PROTECTION STRUCTURES PROJECT

Direct and Indirect Impacts from Sand Placement

The placement and equilibration of beach nourishment are likely to cause direct and indirect impacts to nearshore hardbottom resources. The level of impacts depends upon the depth of burial, sand characteristics of the fill, and the length coverage (USACE, 2012). A greater volume of sand will be placed below MHW within the entire Project Area for this alternative as compared to Alternative 2; therefore, impacts to nearshore hardbottom resources will be increased. Based on results of the engineering and Delft3D modeling analysis, it is estimated that Alternative 6 may result in permanent impacts to between 6.07 and 6.92 acres of hardbottom, and temporary impacts to between 17.42 and 18.34 acres of hardbottom. This impact acreage was used to complete a UMAM evaluation, which determined that between 11.37 and 12.23 acres of mitigative artificial reef would be required to offset these impacts to intertidal and subtidal hardbottom. This hardbottom burial could reduce habitat available for macroalgae and invertebrates in the area, altering normal ecological function of the area. Benthic organisms that inhabit this area have high recruitment capabilities and, therefore would be expected to recolonize relatively quickly; however, the larger volume of sand in both the Town of Palm Beach and the County will impact additional resources compared to the Preferred Alternative. The elimination of the seven low-profile groins would not change the potential impact to hardbottom resources caused by beach nourishment.

Increased sand placement would most likely increase turbidity at the Project site and the adjacent waters. The severity of turbidity-related impacts depends upon the sediment grain size distribution, the speed of sand placement, and the degree of nearshore circulation and mixing. Sand from either source must meet FDEP requirements for beach sand compatibility as per F.A.C., Rule 62B-41.007(2)(j). Per the FDEP BMA cell-wide sediment quality specification, mean grain size must be between 0.25 mm and 0.60 mm with a maximum silt content of 2% (FDEP, 2013). The County's technical sand specifications require the mean grain size to be between 0.30 mm and 0.70 mm with a maximum silt content of 0.6% (Appendix B). An increase in turbidity could reduce the opportunity for photosynthesis and interfere with suspension feeders. However, the short duration of the activity would result in only temporary impacts from turbidity. The elimination of the seven (7) low-profile groins would not change the potential impact to turbidity caused by beach nourishment.

4.4.7 ALTERNATIVE 7b – THE TOWN OF PALM BEACH INCREASED SAND VOLUME WITH TWO SHORELINE PROTECTION STRUCTURES (THE COALITION TO SAVE OUR SHORELINE, INC. (SOS) ALTERNATIVE) AND THE COUNT PREFERRED ALTERNATIVE

Direct and Indirect Impacts from Sand Placement

Alternative 7b includes an increased volume of sand plus construction of two T-head groins at the southern end of Reach in the Town of Palm Beach and the County's Preferred Alternative. The placement and equilibration of beach nourishment are likely to cause direct and indirect impacts to nearshore hardbottom resources. The level of impacts depends upon the depth of burial, sand characteristics of the fill, and the length coverage (USACE, 2012). The greater volume of sand placed along the Town of Palm Beach's shoreline compared to Alternative 2 would result in increased impacts to nearshore hardbottom resources. The role of the T-head groins are to reduce sand losses from the south end of Reach 8 and prevent downdrift impacts to nearshore hardbottom (ECE, 2012). It is unknown if the T-head groins will directly impact hardbottom, but there is a potential for the groins to be placed directly over hardbottom.

Based on results of the engineering and Delft3D modeling analysis, it is estimated that Alternative 7b may result in permanent impacts to between 5.74 and 11.25 acres of hardbottom, and temporary impacts to between 9.45 and 18.80 acres of hardbottom. This impact acreage was used to complete a UMAM evaluation, which determined that between 10.72 and 15.98 acres of mitigative artificial reef would be required to offset these impacts to intertidal and subtidal hardbottom. This hardbottom burial could reduce habitat available for macroalgae and invertebrates in the area, altering normal ecological function of the area. Benthic organisms that inhabit this area have high recruitment capabilities and, therefore would be expected to recolonize relatively quickly.

Increased sand placement would most likely increase turbidity at the Project site and the adjacent waters. The severity of turbidity-related impacts depends upon the sediment grain size distribution, the speed of sand placement, and the degree of nearshore circulation and mixing. Sand from either source must meet FDEP requirements for beach sand compatibility as per F.A.C., Rule 62B-41.007(2)(j). Per the FDEP BMA cell-wide sediment quality specification, mean grain size must be between 0.25 mm and 0.60 mm with a maximum silt content of 2% (FDEP, 2013). The County's technical sand specifications require the mean grain size to be between 0.30 mm and 0.70 mm with a maximum silt content of 0.6% (Appendix B). An increase in turbidity could reduce the opportunity for photosynthesis and interfere with suspension feeders. However, the short duration of the activity would result in only temporary impacts from turbidity.

Direct Impacts from Groin Construction

The exact location of the T-head groin is unknown; however, there is potential that the groin could be placed over hardbottom resulting in permanent direct impacts.

Indirect Impacts from Groin Construction

The construction of the groin may indirectly benefit hardbottom by helping retain the sand onshore and promote EFH, worm rock, and other corals.

4.4.8 ARTIFICIAL REEF

Direct Effects

The artificial reef will be placed in an area void of coral and hardbottom; therefore, there will be no direct impacts.

Indirect Effects

The artificial reef will have beneficial indirect effects on coral by providing a substrate to allow growth.

4.5. FISH AND WILDLIFE RESOURCES

This section includes an analysis of effects to birds that are listed by the State of Florida and other wildlife that may utilize the Project Area. Some species considered include Florida sandhill crane, wading birds, little blue heron, reddish egret, roseate spoonbill, tricolored heron, seabirds, shorebirds, and migratory birds. Florida sandhill cranes have been observed in Palm Beach County (e-bird, 2015c); however, the closest observation was approximately three miles west of the Project Area, as well as upland along potential truck routes. This species is primarily found in wetland and upland environments. Therefore, the No Action Alternative is not expected to have direct or indirect impacts on the Florida sandhill crane. Wading birds have been observed in Palm Beach County (e-bird, 2015d; 2015e; 2105f; 2015g). Sightings of the reddish egret and roseate spoonbill are sparse near the Project Area, while the little blue heron and tricolored heron are more common. These species inhabit both coastal and inland areas and could be observed at the beach or along the truck routes. No direct or indirect impacts to wading birds are anticipated with the No Action Alternative.

4.5.1. ALTERNATIVE 1 – NO ACTION ALTERNATIVE

Direct Effects from Sand Placement

There are minimal negative effects to wildlife as a result of dune restoration. Wildlife will avoid the area during construction but will likely utilize one of the adjacent beaches.

Indirect Effects from Sand Placement

Dune maintenance projects would likely continue but have minimal indirect effect on nearshore habitat because the sand volume is small and unlikely to smother intertidal or subtidal habitat. Continued beach erosion would reduce the littoral beach area and dune habitat. Species affected would include those that use the littoral zone and dune zones for resting, feeding, and breeding which include shorebirds and nesting sea turtles.

4.5.2. ALTERNATIVE 2 – THE APPLICANTS' PREFERRED PROJECT: BEACH AND DUNE FILL WITH SHORELINE PROTECTION STRUCTURES

Direct Impacts from Sand Placement

Infauna within the CTOF is expected to be directly impacted due to smothering as a result of sand placement activities. However, these losses are not expected to have a long-term adverse impact on foraging birds and other species which utilize these resources. Given the compatibility required of the stockpiled dredged sand and upland sand with the native beach and the expected recolonization rate of prey species, it is anticipated that the direct impacts to the benthic communities and the species foraging upon them at the proposed Project fill site would be minimal and short term. A review of infaunal research projects conducted by Bolam and Rees (2003) revealed that invertebrate recovery following placement of dredged material in relatively stable, unstressed marine environments generally takes between one and four years, while recovery in more naturally stressed areas is faster, often achieved within nine months. Therefore, the direct impacts will be temporary; however, these impacts will be repeated every 2 to 4 years.

The expected noise from construction and potential underwater operations may cause temporary adverse impacts. Underwater, marine mammals and fish will most likely avoid the Project Area until completed. On land, construction may affect shorebirds which are found in the vicinity of the Project Area. However, birds will most likely avoid the Project Area during construction.

Direct Impacts from Groin Construction

Groin construction will result in temporary direct effects to dry beach as a result of installation of the groins. The effect is temporary because the groins will be flush with the beach allowing species to continue utilizing the area. Construction noise will be the same as the construction from sand placement.

Indirect Impacts from Sand Placement

The Applicants' Preferred Alternative would indirectly benefit beach communities within the Study Area. The preferred alternative would result in a wider beach in those areas proposed to receive beach sand, which would help to stabilize the beach and protect upland property during storm events. After construction, the beach profile typically undergoes a period of equilibration as sand is redistributed by waves and currents. This equilibration typically occurs within about one year of sand placement. The first year post-construction would include a potential for greater-than-normal erosion of the constructed dry beach and potential narrowing of sea turtle nesting habitat when compared to the constructed beach condition.

The placement of both upland sand and stockpiled dredged sand are expected to increase turbidity at the Project site and adjacent nearshore waters during construction. Fish will most likely avoid any conditions of turbidity until water quality returns to ambient levels, which is anticipated to occur shortly after completion of construction. Implementation of proper design and best management practices may reduce the extent of the impacts from a proposed activity.

Indirect Impacts from Groin Construction

The indirect impacts from groin construction will be minimal but positive due to the stabilization of the shoreline. The groins will further stabilize the beach increase wildlife habitat.

4.5.3. ALTERNATIVE 3 – THE APPLICANTS' PREFERRED PROJECT WITHOUT SHORELINE PROTECTION STRUCTURES

Direct Impacts from Sand Placement

The direct effects from sand placement will the same as Alternative 2.

Indirect Impacts from Sand Placement

The indirect effects from sand placement will the same as Alternative 2.

4.5.4. ALTERNATIVE 4 – THE TOWN OF PALM BEACH PREFERRED PROJECT AND COUNTY INCREASED SAND VOLUME WITHOUT SHORELINE PROTECTION STRUCTURES PROJECT

Direct Impacts from Sand Placement

The direct effects from sand placement will the same as Alternative 2; however, the effects will be more significant due to the larger volume of sand.

Indirect Impacts from Sand Placement

The indirect effects from sand placement will the same as Alternative 2; however, the effects will be more significant due to the larger volume of sand.

4.5.5. ALTERNATIVE 5 – THE TOWN OF PALM BEACH INCREASED SAND VOLUME AND COUNTY PREFERRED PROJECT

Direct Impacts from Sand Placement

The direct effects from sand placement will the same as Alternative 2; however, the effects will be more significant due to the larger volume of sand.

Direct Impacts from Groin Construction

The direct effects from groin construction will the same as Alternative 2.

Indirect Impacts from Sand Placement

The indirect effects from sand placement will the same as Alternative 2; however, the effects will be more significant due to the larger volume of sand.

Indirect Impacts from Groin Construction

The indirect effects from groin construction will the same as Alternative 2.

4.5.6. ALTERNATIVE 6 – THE TOWN OF PALM BEACH INCREASED SAND VOLUME AND COUNTY INCREASED SAND VOLUME WITHOUT SHORELINE PROTECTION STRUCTURES PROJECT

Direct Impacts from Sand Placement

The direct effects from sand placement will the same as Alternative 2; however, the effects will be more significant due to the larger volume of sand.

Indirect Impacts from Sand Placement

The indirect effects from sand placement will the same as Alternative 2; however, the effects will be more significant due to the larger volume of sand.

4.5.7. ALTERNATIVE 7b – THE TOWN OF PALM BEACH INCREASED SAND VOLUME WITH TWO SHORELINE PROTECTION STRUCTURES (THE COALITION TO SAVE OUR SHORELINE, INC. (SOS) ALTERNATIVE) AND THE COUNTY PREFERRED PROJECT

Direct Impacts from Sand Placement

The direct effects from sand placement will the same as Alternative 2; however, the effects will be more significant due to the larger volume of sand.

Direct Impacts from Groin Construction

The direct effects from groin construction will the same as Alternative 2.

Indirect Impacts from Sand Placement

The indirect effects from sand placement will the same as Alternative 2; however, the effects will be more significant due to the larger volume of sand.

Indirect Impacts from Groin Construction

The indirect effects from groin construction will the same as Alternative 2.

4.5.8. ARTIFICIAL REEF

The artificial reef will not have a direct or indirect effect on birds. However, it will have a beneficial direct effect on fish by providing refuge and foraging habitat.

4.6. ESSENTIAL FISH HABITAT

The purpose of the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) is to promote the protection of essential fish habitat (EFH) in the review of Federal and state actions that may adversely affect EFH. Because the Proposed Action would impact EFH, USACE initiated consultation with NMFS. NMFS has provided EFH Conservation Recommendations. The EFH Evaluation is presented in Appendix F. USACE will provide NMFS with a detailed response to prior to final permit decision. EFH in the Project Area includes coral/live hardbottom, softbottom, and marine water column.

4.6.1. ALTERNATIVE 1 – NO ACTION ALTERNATIVE

Direct Effects from Sand Placement

There are no direct effects to EFH as a result of dune restoration.

Indirect Effects from Sand Placement

Dune maintenance projects would likely continue but have minimal indirect effect on EFH because the sand volume is small and unlikely to adversely the EFH in the Project Area.

4.6.2. ALTERNATIVE 2 – THE APPLICANTS' PREFERRED PROJECT: BEACH AND DUNE FILL WITH SHORELINE PROTECTION STRUCTURES

Direct Impacts from Sand Placement

Softbottom within the CTOF is expected to be directly impacted due to smothering as a result of sand placement activities. However, these losses are not expected to have a long-term adverse impact on managed species which utilize these resources. Given the compatibility required of the stockpiled dredged sand and upland sand with the native beach and the expected recolonization rate of prey species, it is anticipated that the direct impacts to the benthic communities and the species foraging upon them at the proposed Project fill site would be minimal and short term. A review of infaunal research projects conducted by Bolam and Rees (2003) revealed that invertebrate recovery following placement of dredged material in relatively stable, unstressed marine environments generally takes between one and four years, while recovery in more naturally stressed areas is faster, often achieved within nine months.

Direct Impacts from Groin Construction

No direct effects to EFH will occur as a result of groin construction because they will not be placed over nearshore hardbottom.

Indirect Impacts from Sand Placement

It is predicted that the Applicants' Preferred Alternative may result in permanent impacts to between 3.86 and 3.99 acres of hardbottom, and temporary impacts to between 9.53 and 9.93 acres of hardbottom (Tables 4-1 through 4-3; Figures 4-1 through 4-3). This area acts as a crucial nursery and refugee for fish species within the South Atlantic Fisheries Management Council (SAFMC) Reef Fishes and Spiny Lobster Management Units. The impact which occurs is dependent upon how much and for how long the hardbottom habitat is buried. However, juvenile fish are expected to avoid the buried area while covered because there would be a lack of food and lack of refuge from predators. Appendix F provides additional information regarding potential impacts to nearshore fish populations. The Applicants propose mitigation to offset the loss of habitat due to permanent and temporary impacts. These impacts acreages were used to complete a UMAM evaluation, which determined that between 6.55 and 6.66 acres of mitigative artificial reef would be required to offset these impacts to intertidal and subtidal hardbottom.

Placement of beach sand also impacts the non-vegetated bottom, directly burying benthic and infaunal organisms in the nearshore marine environment as the beach is widened. Effects of burial are dependent on sediment type, depth of sediment, and the size and behavior of infauna or epifauna (including the species' ability to burrow and species' mobility). Direct burial due to sand placement results in mortality to sessile or attached organisms, while some motile species can survive by moving either horizontally outside the placement area, or vertically to the surface of the sand placement (NRC, 1995). Mortality during sedimentation has been found to depend on a species' ability to burrow through re-deposited sediments and the rate at which sediment is deposited (IMG, 2004). Maurer et al. (1978) found that nearshore infaunal species are capable of burrowing through sand up to 40 cm (16 in) deep. Generally, deposits greater than 20-30 cm (8-12 in) eliminate all but the largest and most vigorous burrowers (Maurer et al., 1978). If the bottom is covered with greater than 50 cm (~20 in) of sand, most of the benthic fauna will be unable to move up through the placed fill (Speybroeck et al., 2006). Although the wet beach infauna can adapt to fluctuations in the natural environment, the addition of sediment to the wet beach would have immediate, short-term negative impacts, specifically in areas where beach sand will exceed 40 cm in depth.

However, fauna inhabiting the shallow nearshore marine habitat in the Project Area are adapted to a dynamic, ephemeral environment and the recovery of these communities can take place relatively quickly (Nelson, 1993). Nelson (1993) indicated that many organisms that reside in intertidal zones are more adaptable to fluctuations in their environment, including high sediment transport and turbidity levels. A review of infaunal studies revealed that invertebrate recovery following placement of dredged material in relatively stable, unstressed marine environments generally takes between one and four years, while recovery in more naturally stressed areas is faster, often achieved within nine months (Bolam and Rees, 2003; Kotta et al., 2009). A study conducted in Brevard County, Florida found that distribution, abundance and diversity of nearshore benthic fauna did not experience significant negative effects following beach nourishment (Gorzelany and Nelson, 1987). Most studies that did find impacts to nearshore infaunal communities generally found only limited or short-term alterations in the abundance, diversity and species composition (NRC, 1995). However, more recent studies have shown a maintained decrease of infaunal and epifaunal macroinvertebrates after sand displacement activities (Wanless and Maier, 2007; Manning et al., 2014).

A number of activities have the potential to impact water quality within the given area. Placement of sand would produce turbidity at the site and adjacent waters; however, the use of a truck haul approach minimizes these impacts. Additionally, turbidity monitoring will be required throughout construction activities. This Project will also acquire dredged material from the Reach 7 Phipps Ocean Park Beach Restoration (Phipps) and Mid-Town Beach Restoration Project (alternating between sources). The impacts associated with dredging sand would be temporary but do have the potential to interfere with the ecological functioning of the area. These impacts will be managed through separate authorization. However, implementation of proper design and best management practices can minimize impacts due to the potential for elevated turbidity. Fish will most likely avoid any turbid areas until water quality returns to normal, which is anticipated to occur shortly after completion of construction.

Indirect Impacts from Groin Construction

Groin construction will have a minimal indirect benefit to EFH because they will stabilize the shoreline.

4.6.3. ALTERNATIVE 3 – THE APPLICANTS' PREFERRED PROJECT WITHOUT SHORELINE PROTECTION STRUCTURES

Direct Impacts from Sand Placement

The direct effects from sand placement will the same as Alternative 2.

Indirect Impacts from Sand Placement

It is predicted that Alternative 3 may result in permanent impacts to between 2.70 and 2.87 acres of hardbottom, and temporary impacts to between 12.13 and 12.41 acres of hardbottom. 2.80 ac of hardbottom as well as temporary impacts to 10.97 ac of hardbottom. This area acts as a crucial nursery and refuge for fish species within the SAFMC Reef Fishes and Spiny Lobster Management Units. Juvenile fish are expected to avoid the buried area while covered because there would be a lack of food and refuge from predators. Appendix F provides additional information regarding potential impacts to nearshore fish populations. The impact acreage was used to complete a UMAM evaluation, which determined that between 5.36 and 5.70 acres of mitigative artificial reef would be required to offset these impacts to intertidal and subtidal hardbottom.

Placement of beach sand impacts the non-vegetated bottom, directly burying benthic and infaunal organisms in the nearshore marine environment as the beach is widened. Direct burial results in mortality to sessile or attached organisms, while some motile species can survive by moving either horizontally outside the placement area, or vertically to the surface of the sand placement (NRC, 1995). Mortality during sedimentation has been found to depend on a species' ability to burrow through re-deposited sediments and the rate at which sediment is deposited (IMG, 2004). Maurer et al. (1978) found that nearshore infaunal species are capable of burrowing through sand up to 40 cm (16 in) deep. Generally, deposits greater than 20-30 cm (8-12 in) eliminate all but the largest and most vigorous burrowers (Maurer et al., 1978). If the bottom is covered with greater than 50 cm (~20 in) of sand, most of the benthic fauna will be unable to move up through the placed fill (Speybroeck et al., 2006). Although the wet beach infauna can adapt to fluctuations in the natural environment, the addition of sediment to the wet beach would have immediate, short-term negative impacts, specifically in areas where beach sand will exceed 40 cm in depth.

However, fauna inhabiting the shallow nearshore marine habitat in the Project Area are adapted to a dynamic, ephemeral environment and the recovery of these communities can take place relatively quickly (Nelson, 1993). Nelson (1993) indicated that many organisms that reside in intertidal zones are more adaptable to fluctuations in their environment, including high sediment transport and turbidity levels. A review of infaunal studies revealed that invertebrate recovery following placement of dredged material in relatively stable, unstressed marine environments generally takes between one and four years, while recovery in more naturally stressed areas is faster, often achieved within nine months (Bolam and Rees, 2003; Kotta et al., 2009). A study conducted in Brevard County, Florida found that distribution, abundance and diversity of nearshore benthic fauna did not experience significant negative effects following beach nourishment (Gorzelany and Nelson, 1987). Most studies that did find impacts to nearshore infaunal communities generally found only limited or short-term alterations in the abundance, diversity and species composition (NRC, 1995). However, more recent studies have shown a maintained decrease of infaunal and epifaunal macroinvertebrates after sand displacement activities (Wanless and Maier, 2007; Manning et al., 2014).

Placement of both upland sand and stockpiled dredged sand would produce turbidity at the fill site and adjacent waters; however, the use of a truck haul approach minimizes these impacts. Additionally, turbidity monitoring will be required throughout construction activities, and implementation of proper design and best management practices can minimize impacts due to the potential for elevated turbidity. Fish will most likely avoid any turbid areas until water quality returns to normal, which is anticipated to occur shortly after completion of construction.

4.6.4. ALTERNATIVE 4 – THE TOWN OF PALM BEACH PREFERRED PROJECT AND COUNTY INCREASED SAND VOLUME WITHOUT SHORELINE PROTECTION STRUCTURES PROJECT

Direct Impacts from Sand Placement

The direct effects from sand placement will the same as Alternative 2; however, the effects will be more significant due to the larger volume of sand.

Indirect Impacts from Sand Placement

Increased sand volume associated with Alternative 4 is estimated to result in permanent impacts to between 6.51 and 6.71 acres of hardbottom, and temporary impacts to between 13.17 and 13.57 acres of hardbottom. This area acts as a crucial nursery and refuge for fish species within the SAFMC Reef Fishes and Spiny Lobster Management Units; however, juvenile fish are expected to avoid the buried area due to lack of food and refuge from predators. Appendix F provides additional information regarding potential impacts to nearshore fish populations. The increased sand volume proposed results in additional impacts (permanent and temporary) compared with Alternative 2. The Applicants propose mitigation to offset the impacts. The impact acreage was used to complete a UMAM evaluation, which determined that between 10.84 and 11.27 acres of mitigative artificial reef would be required to offset these impacts to intertidal and subtidal hardbottom.

Placement of beach sand also impacts the non-vegetated bottom, directly burying benthic organisms in the nearshore marine environment as the beach is widened. Effects of burial are dependent on sediment type, depth of sediment, and the size and behavior of infauna or epifauna (including the species' ability to burrow and species' mobility). Direct burial results in mortality to sessile or attached organisms, while some motile species can survive by moving either horizontally outside the placement area, or vertically to the surface of the sand placement (NRC, 1995). Mortality during sedimentation has been found to depend on a species' ability to burrow through re-deposited sediments and the rate at which sediment is deposited (IMG, 2004). Maurer et al. (1978) found that nearshore infaunal species are capable of burrowing through sand up to 40 cm (16 in) deep. Generally, deposits greater than 20-30 cm (8-12 in) eliminate all but the largest and most vigorous burrowers (Maurer et al., 1978). If the bottom is covered with greater than 50 cm (~20 in) of sand, most of the benthic fauna will be unable to move up through the placed fill (Speybroeck et al., 2006). Although the wet beach infauna can adapt to fluctuations in the natural environment, the addition of sediment to the wet beach would have immediate, short-term negative impacts, specifically in areas where beach sand will exceed 40 cm in depth.

However, fauna inhabiting the shallow nearshore marine habitat in the Project Area are adapted to a dynamic, ephemeral environment and the recovery of these communities can take place relatively quickly (Nelson, 1993). Nelson (1993) indicated that many organisms that reside in intertidal zones are more adaptable to fluctuations in their environment, including high sediment transport and turbidity levels. A review of infaunal studies revealed that invertebrate recovery following placement of dredged material in relatively stable, unstressed marine environments generally takes between one and four years, while recovery in more naturally stressed areas is faster, often achieved within nine months (Bolam and Rees, 2003; Kotta et al., 2009). A study conducted in Brevard County, Florida found that distribution, abundance and diversity of nearshore benthic fauna did not experience significant negative effects following beach nourishment (Gorzelany and

Nelson, 1987). Most studies that did find impacts to nearshore infaunal communities generally found only limited or short-term alterations in the abundance, diversity and species composition (NRC, 1995). However, more recent studies have shown a maintained decrease of infaunal and epifaunal macroinvertebrates after sand displacement activities (Wanless and Maier, 2007; Manning et al., 2014).

Placement of both upland sand and stockpiled dredged sand would produce turbidity at the site and adjacent waters; however, the use of a truck haul approach minimizes these impacts. Additionally, turbidity monitoring will be required throughout construction activities, and implementation of proper design and best management practices can minimize impacts due to the potential for elevated turbidity. Fish will most likely avoid any turbid areas until water quality returns to normal, which is anticipated to occur shortly after completion of construction.

4.6.5. ALTERNATIVE 5 – THE TOWN OF PALM BEACH INCREASED SAND VOLUME AND COUNTY PREFERRED PROJECT

Direct Impacts from Sand Placement

The direct effects from sand placement will the same as Alternative 2; however, the effects will be more significant due to the larger volume of sand.

Direct Impacts from Groin Construction

The direct effects from groin construction will the same as Alternative 2.

Indirect Impacts from Sand Placement

This alternative is estimated to result less permanent impacts than the Preferred Alternative. Based on results of the engineering and Delft3D modeling analysis, it is predicted that Alternative 5 may result in permanent impacts to between 3.45 and 4.23 acres of hardbottom, and temporary impacts to between 14.34 and 15.60 acres of hardbottom. This area acts as a crucial nursery and refuge for fish species within the SAFMC Reef Fishes and Spiny Lobster Management Units. Juvenile fish are expected to avoid the buried area while covered because there would be a lack of food and refuge from predators. Appendix F provides additional information regarding potential impacts to nearshore fish populations. The Applicants propose mitigation to offset the permanent and temporary impacts associated with this alternative. The impact acreage was used to complete a Uniform Mitigation Assessment Method (UMAM) evaluation, which determined that between 6.86 and 7.59 acres of mitigative artificial reef would be required to offset these impacts to intertidal and subtidal hardbottom. Groins will not be placed over hardbottom but may result in indirect impacts as they hold sand in place.

Placement of beach sand also impacts the non-vegetated bottom, directly burying benthic organisms in the nearshore marine environment as the beach is widened. Effects of burial are dependent on sediment type, depth of sediment, and the size and behavior of infauna or epifauna (including the species' ability to burrow and species' mobility). Direct burial results in mortality to sessile or attached organisms, while some motile species can survive by moving either horizontally outside the placement area, or vertically to the surface of the sand placement (NRC, 1995). Mortality during sedimentation has been found to depend on a species' ability to burrow through re-deposited sediments and the rate at which sediment is deposited (IMG, 2004). Maurer et al. (1978) found that nearshore infaunal species are capable of burrowing through sand up to 40 cm (16 in) deep. Generally, deposits greater than 20-30 cm (8-12 in) eliminate all but the largest and most vigorous burrowers (Maurer et al., 1978). If the bottom is covered with greater than 50 cm (~20 in) of sand, most of the benthic fauna will be unable to move up through the placed fill (Speybroeck et al., 2006). Although the wet beach infauna can adapt to fluctuations in the natural environment, the addition of sediment to the wet beach would have immediate, short-term negative impacts, specifically in areas where beach sand will exceed 40 cm in depth.

However, fauna inhabiting the shallow nearshore marine habitat in the Project Area are adapted to a dynamic, ephemeral environment and the recovery of these communities can take place relatively quickly (Nelson, 1993). Nelson (1993) indicated that many organisms that reside in intertidal zones are more adaptable to fluctuations in their environment, including high sediment transport and turbidity levels. A review of infaunal studies revealed that invertebrate recovery following placement of dredged material in relatively stable, unstressed marine environments generally takes between one and four years, while recovery in more naturally stressed areas is faster, often achieved within nine months (Bolam and Rees, 2003; Kotta et al., 2009). A study conducted in Brevard County, Florida found that distribution, abundance and diversity of nearshore benthic fauna did not experience significant negative effects following beach nourishment (Gorzelany and Nelson, 1987). Most studies that did find impacts to nearshore infaunal communities generally found only limited or short-term alterations in the abundance, diversity and species composition (NRC, 1995). However, more recent studies have shown a maintained decrease of infaunal and epifaunal macroinvertebrates after sand displacement activities (Wanless and Maier, 2007; Manning et al., 2014).

Placement of both upland sand and stockpiled dredged sand would produce turbidity at the fill site and adjacent waters; however, the use of a truck haul approach minimizes these impacts. Additionally, turbidity monitoring will be required throughout construction activities, and implementation of proper design and best management practices can minimize impacts due to the potential for elevated turbidity. Fish will most likely avoid any turbid areas until water quality returns to normal, which is anticipated to occur shortly after completion of construction.

Indirect Impacts from Groin Construction

The indirect effects from groin construction will the same as Alternative 2.

4.6.6. ALTERNATIVE 6 – THE TOWN OF PALM BEACH INCREASED SAND VOLUME AND COUNTY INCREASED SAND VOLUME WITHOUT SHORELINE PROTECTION STRUCTURES PROJECT

Direct Impacts from Sand Placement

The direct effects from sand placement will the same as Alternative 2; however, the effects will be more significant due to the larger volume of sand.

Indirect Impacts from Sand Placement

The increased sand volume along the Town of Palm Beach and the County shorelines associated with this alternative is estimated result in permanent impacts to between 6.07 and 6.92 acres of hardbottom, and temporary impacts to between 17.42 and 18.34 acres of hardbottom. This area acts as a crucial nursery and refuge for fish species within the SAFMC Reef Fishes and Spiny Lobster Management Units. Juvenile fish are expected to avoid the buried area while covered because there would be a lack of food and refuge from predators. Appendix F provides additional information regarding potential impacts to nearshore fish populations. The increased sand volume proposed with this alternative results in more impacts to the nearshore hardbottom compared with the other alternatives. The impact acreage was used to complete a UMAM evaluation, which determined that between 11.37 and 12.23 acres of mitigative artificial reef would be required to offset these impacts to intertidal and subtidal hardbottom.

Placement of beach sand also impacts the non-vegetated bottom, directly burying benthic organisms in the nearshore marine environment as the beach is widened. Effects of burial are dependent on sediment type, depth of sediment, and the size and behavior of infauna or epifauna (including the species' ability to burrow and species' mobility). Direct burial results in mortality to sessile or attached organisms, while some motile species can survive by moving either horizontally outside the placement area, or vertically to the surface of the sand placement (NRC, 1995). Mortality during sedimentation has been found to depend on a species' ability to burrow through re-deposited sediments and the rate at which sediment is deposited (IMG, 2004). Maurer et al. (1978) found that nearshore infaunal species are capable of burrowing through sand up to 40 cm (16 in) deep. Generally, deposits greater than 20-30 cm (8-12 in) eliminate all but the largest and most vigorous burrowers (Maurer et al., 1978). If the bottom is covered with greater than 50 cm (~20 in) of sand, most of the benthic fauna will be unable to move up through the placed fill (Speybroeck et al., 2006). Although the wet beach infauna can adapt to fluctuations in the natural environment, the addition of sediment to the wet beach would have immediate, short-term negative impacts, specifically in areas where beach sand will exceed 40 cm in depth.

However, fauna inhabiting the shallow nearshore marine habitat in the Project Area are adapted to a dynamic, ephemeral environment and the recovery of these communities can take place relatively quickly (Nelson, 1993). Nelson (1993) indicated that many organisms that reside in intertidal zones are more adaptable to fluctuations in their environment, including high sediment transport and turbidity levels. A review of infaunal studies revealed that invertebrate recovery following placement of dredged material in relatively stable, unstressed marine environments generally takes between one and four years, while recovery in more naturally stressed areas is faster, often achieved within nine months (Bolam and Rees, 2003; Kotta et al., 2009). A study conducted in Brevard County, Florida found that distribution, abundance and diversity of nearshore benthic fauna did not experience significant negative effects following beach nourishment (Gorzelany and Nelson, 1987). Most studies that did find impacts to nearshore infaunal communities generally found only limited or short-term alterations in the abundance, diversity and species composition (NRC, 1995). However, more recent studies have shown a maintained decrease of infaunal and epifaunal macroinvertebrates after sand displacement activities (Wanless and Maier, 2007; Manning et al., 2014).

Placement of both upland sand and stockpiled dredged sand would produce turbidity at the site and adjacent waters; however, the use of a truck haul approach minimizes these impacts. Additionally, turbidity monitoring will be required throughout construction activities, and implementation of proper design and best management practices can minimize impacts due to the potential for elevated turbidity. Fish will most likely avoid any turbid areas until water quality returns to normal, which is anticipated to occur shortly after completion of construction.

4.6.7. ALTERNATIVE 7b – THE TOWN OF PALM BEACH INCREASED SAND VOLUME WITH TWO SHORELINE PROTECTION STRUCTURES (THE COALITION TO SAVE OUR SHORELINE, INC. (SOS) ALTERNATIVE) AND THE COUNTY PREFERRED PROJECT

Direct Impacts from Sand Placement

The direct effects from sand placement will the same as Alternative 2; however, the effects will be more significant due to the larger volume of sand.

Direct Impacts from Groin Construction

The direct effects from groin construction will the same as Alternative 2. In addition the T-head groins may have a negative direct effect on hardbottom if the groin is placed over the resource. The T-head groin will result in a loss of softbottom habitat.

Indirect Impacts from Sand Placement

The increased sand volume along the Town of Palm Beach, plus the addition of two T-head groins at the southern end of Reach 8, associated with this alternative is estimated result in permanent impacts to between 5.74 and 11.25 acres of hardbottom, and temporary impacts to between 9.45 and 18.80 acres of hardbottom. This area acts as a crucial nursery and refuge for fish species within the SAFMC Reef Fishes and Spiny Lobster Management Units. Juvenile fish are expected to avoid the buried area while covered because there would be a lack of food and refuge from predators. Appendix F provides additional information regarding potential impacts to nearshore fish populations. The increased sand volume proposed with this alternative results in more impacts to the nearshore hardbottom compared with the other alternatives. The impact acreage was used to complete a UMAM evaluation, which determined between 10.72 and 15.98 acres of mitigative artificial reef would be required to offset these impacts to intertidal and subtidal hardbottom.

Placement of beach sand also impacts the non-vegetated bottom, directly burying benthic organisms in the nearshore marine environment as the beach is widened. Effects of burial are dependent on sediment type, depth of sediment, and the size and behavior of infauna or epifauna (including the species' ability to burrow and species' mobility). Direct burial results in mortality to sessile or attached organisms, while some motile species can survive by moving either horizontally outside the placement area, or vertically to the surface of the sand placement (NRC, 1995). Mortality during sedimentation has been found to depend on a species' ability to burrow through re-deposited sediments and the rate at which sediment is deposited (IMG, 2004). Maurer et al. (1978) found that nearshore infaunal species are capable of burrowing through sand up to 40 cm (16 in) deep. Generally, deposits greater than 20-30 cm (8-12 in) eliminate all but the largest and most vigorous burrowers (Maurer et al., 1978). If the bottom is covered with greater than 50 cm (~20 in) of sand, most of the benthic fauna will be unable to move up through the placed fill (Speybroeck et al., 2006). Although the wet beach infauna can adapt to fluctuations in the natural environment, the addition of sediment to the wet beach would have immediate, short-term negative impacts, specifically in areas where beach sand will exceed 40 cm in depth.

However, fauna inhabiting the shallow nearshore marine habitat in the Project Area are adapted to a dynamic, ephemeral environment and the recovery of these communities can take place relatively quickly (Nelson, 1993). Nelson (1993) indicated that many organisms that reside in intertidal zones are more adaptable to fluctuations in their environment, including high sediment transport and turbidity levels. A review of infaunal studies revealed that invertebrate recovery following placement of dredged material in relatively stable, unstressed marine environments generally takes between one and four years, while recovery in more naturally stressed areas is faster, often achieved within nine months (Bolam and Rees, 2003; Kotta et al., 2009). A study conducted in Brevard County, Florida found that distribution, abundance and diversity of nearshore benthic fauna did not experience significant negative effects following beach nourishment (Gorzelany and Nelson, 1987). Most studies that did find impacts to nearshore infaunal communities generally found only limited or short-term alterations in the abundance, diversity and species composition (NRC, 1995). However, more recent studies have shown a maintained decrease of infaunal and epifaunal macroinvertebrates after sand displacement activities (Wanless and Maier, 2007; Manning et al., 2014).

Placement of both upland sand and stockpiled dredged sand would produce turbidity at the site and adjacent waters; however, the use of a truck haul approach minimizes these impacts. Additionally, turbidity monitoring will be required throughout construction activities, and implementation of proper design and best management practices can minimize impacts due to the potential for elevated turbidity. Fish will most likely avoid any turbid areas until water quality returns to normal, which is anticipated to occur shortly after completion of construction.

Indirect Impacts from Groin Construction

The indirect effects from groin construction will the same as Alternative 2. The T-head groin may cause sediment to build up over softbottom and may result in additional impacts to hardbottom.

4.6.8. ARTIFICIAL REEF

The artificial reef will be placed on unvegetated bottom directly effecting softbottom. In addition, a minimal area of water column will be permanently impacted by the placement of the reef. However, the positive indirect benefits include establishment of a new reef system providing new habitat for corals and managed fisheries to utilize.

4.7. OFFSHORE BORROW AREA RESOURCES

The Town of Palm Beach's preferred sand source includes sand from North Borrow Area 1 (NBA1), South Borrow Area 2 (SBA2), South Borrow Area 3 (SBA3) (Figure 2-3) or any offshore sand source that is consistent with the BMA cell-wide sediment quality specifications (Table 2-1). The Phipps and Mid-Town projects will utilize either a hopper or cutterhead dredge to pump beach quality sand from an offshore borrow area. The effects of the dredging are not evaluated in this EIS and the utilization of the dredged sand as a source of beach compatible sand is considered in the cumulative impacts assessment. The offshore dredging activities and stockpiling of dredged sand in the Phipps and Mid-Town project templates are evaluated under the permitting process for those projects. The temporarily staged sand would be located within the footprint of either the Phipps or Mid-Town project templates. The loading of sand onto trucks for transport to the Project Area is envisioned to occur simultaneously as the sand is pumped onto the beach from the dredge vessels. It would then continuously be loaded on the trucks until all excess sand was removed from the staging area. The effects of dredging the excess volume of sand needed to fill the template of the permitted alternative for this project will be evaluated during the permitting process for Phipps and/or Mid-Town, and will consider the additional duration of dredging needed and corresponding environmental impacts. If timing of the Phipps or Mid-Town projects does not allow for use of dredged sand, the Town of Palm Beach would consider using sand from an upland source, such as Ortona. Most of the infauna inhabiting the borrow area will be unavoidably lost as a result of dredging activities. However, these losses are not expected to have a long term significant adverse impact because infauna is expected to recolonize one to three years after construction.

A study of the effects of beach nourishment activities on the intertidal zone at Bogue Banks, North Carolina (Reilly and Bellis, 1983) found that intertidal and subtidal benthic faunal density and community structure were affected both during and after nourishment activities. Species densities on the nourished beach became zero at the onset of nourishment activities, and recovery largely depended on recruitment from pelagic larval stocks. High turbidity in adjacent nearshore waters associated with these activities may prevent or slow this recruitment.

The recovery of beach benthic fauna within renourished beach habitats occurs through mechanisms such as the vertical migration of existing beach fauna through the sediment overburden and recruitment of pelagic larvae, juveniles, and adult organisms to the target beach from adjacent areas (Greene, 2002). Historic data suggest that recovery of these areas should occur within one to two seasons following the Project, assuming the nourishment material is compatible with the natural beach sediments.

Dredging of sand at the offshore borrow area could produce localized increased in turbidity. The impacts associated with dredging would be temporary but have the potential to interfere with the ecological functioning of the area. Fish will most likely avoid any turbid areas until water quality returns to normal. Implementation of proper design and best management practices can reduce the extent of the turbidity impacts from the proposed activity.

The effects from the No Action alternative are

4.8. COASTAL BARRIER RESOURCES

There are no Coastal Barrier Resources Act (CBRA) Units in or near the Project Area therefore there will be no impacts to coastal barrier resources under the No Action or the build alternatives.

4.9. WATER QUALITY

Turbidity within Palm Beach County is generally lowest in the summer months and highest in the winter months (as a result of storms or high storm water [fresh water] releases). The intertidal areas are subject to periodic increases of turbidity as a result of storms and wave activities. The species which inhabit these areas are, therefore, stress tolerant. Turbidity levels will not be affected if no action is taken.

Implementing any of the build alternatives would most likely result in temporary increases in turbidity due to the movement and placement of beach compatible sand within and beyond the beach. Turbidity results from the suspension of fine grained fractions of the sand material within the water column. As a result, physical or behavioral changes to invertebrates (i.e. hardbottom dwelling sessile organisms) may occur. The grain size of the sand material determines the amount of impact on organisms; elevated amounts of fine grained material can lead to long term effects, whereas smaller amounts will diminish quickly.

Turbidity levels will be monitored and controlled during construction to minimize the effects to the surrounding waters and nearshore habitat areas. Long-term effects of turbidity produced during construction are not expected and any elevated turbidity is anticipated to return to ambient conditions shortly after completion of construction.

The No Action Alternatives will not cause turbidity.

Turbidity from the artificial reef construction will result during deployment of the reef materials but will be minimal and localized.

4.10. HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE

There is a potential for hydrocarbon spills with construction equipment associated with implementation of any of the build alternatives; however, accident and spill prevention plans in the contract specifications should prevent the release of any hazardous or toxic waste.

4.11. AIR QUALITY

The short-term impact from emissions by construction equipment associated with the six build alternative, No Action, and Artificial Reef will not significantly impact air quality. Exhaust emissions of the construction equipment would have a temporary effect on the air quality, but no permanent impacts are anticipated.

4.12. NOISE

Construction the six build alternatives, No Action, and Artificial Reef would temporarily raise the noise, as well as vibration levels in the areas in which construction is occurring. These elevated levels have the potential to disturb animals such as fishes, sea turtles, marine mammals, and seabirds. Construction equipment would be properly maintained to minimize these effects in compliance with local laws. The alternatives including groin construction would slightly increase the noise effects as a result of installation of the sheet piles and placement of boulders.

4.13. AESTHETIC RESOURCES

The No Action Alternative would result in a loss of aesthetic value as the beach is anticipated to continue to erode and diminish. Furthermore, the likelihood of constructing numerous emergency shoreline armoring structures would increase under the No Action Alternative. Such structures would result in a long term and permanent reduction in the aesthetic value of the Project Area.

All build alternatives may temporarily impact aesthetic resources due to the presence of construction equipment, noise, and the turbidity which will occur at the Project location. The earth moving equipment has the potential to create visual and noise disturbance, as well as exhaust fumes; therefore, decreasing aesthetic value temporarily. Furthermore, the placement of sand may cause an increase in nearshore turbidity for the short term. A change in the color and clarity would negatively impact the aesthetic value of the water, as well. The groins installed under Alternatives 2 and 5 would have minimal effect on aesthetics because they will be installed flush with the beach; however, over time portions of the groin may become visible. The t-shaped groins proposed under Alternative 7b may a moderate negative affect on aesthetics because they will be visible from the shore and adjacent properties

4.14. RECREATION RESOURCES

The No Action Alternative would result in a long term and permanent reduction in recreational use of the beach area due to continued erosion and beach narrowing as well as the installation of seawalls. However, offshore recreation (scuba diving, snorkeling, boating, fishing, etc.) would not be impacted by the No Action Alternative.

Recreational resources may be impacted, temporarily, if the build alternatives are implemented. Limited and/or restricted access within the Project Area, as well as an increase in turbidity within the water could limit recreational opportunities.

Recreational use of the beaches and coastal waters within the Project Area would temporarily decrease. Due to the need for public safety, beachgoers would not be permitted within the area during construction.

A potential, temporary, increase in turbidity would reduce the visibility within the water, and reduce the opportunity for scuba diving, snorkeling, etc. within the Project Area. The six build alternatives are not expected to affect nearshore/coastal boating or fishing.

The proposed artificial reef will have a positive direct effect on nearshore/coastal boating and fishing because it will provide new habitat for fish and a new area for diving.

4.15. NAVIGATION

The waters near and within the Project Area are used by small commercial and recreational boaters. Lake Worth Inlet and South Lake Worth Inlet (Boynton Inlet) are access points for recreational and commercial vessels year round. The number of vessels utilizing the area is directly correlated to seasonal use, and with winter comes an increase in vessel abundance. Boaters frequently visit the nearshore and offshore Atlantic for recreational purposes. Project construction will not impact vessel usage within the Project Area as construction will be occurring in less than six feet of water. Therefore, there will not be any direct or indirect effect on navigation.

The mitigation reefs would be constructed in the nearshore environment, at depths similar to the impact area. All artificial reefs will be reported to the NOAA Charting Division to ensure the potential obstruction is identified on the nautical charts. Therefore, there will not be any direct or indirect effect on navigation.

4.16. CULTURAL RESOURCES AND HISTORIC PROPERTIES

If a permit is issued for any of the build alternatives a condition will be included requiring these cultural resources be avoided with buffers during construction in order to avoid impacts. As a result of the buffers, none of the build alternatives will have a direct or indirect effect on cultural resources or historic properties. The No Action Alternatives would not have a direct impact on historical and cultural resources, but may have an indirect effect because continued erosion could uncover and destroy cultural artifacts.

4.17. SOCIOECONOMICS

All other build alternatives and the Dune Fill Only No Action Alternative would result in a wider more stable beach. The benefit increases as the volume of sand increases. The beaches of Palm Beach County play an important economic role in the recreational resources of the area. The tourist dollars that come into the county each year account for a significant portion of the county’s revenue base (Kildow, 2008). The coast is of primary importance and many tourist oriented businesses depend upon the generated revenue.

4.18. ENVIRONMENTAL JUSTICE

For the environmental justice analysis for this EIS, the Study Area was examined, including the coastal beach owned by the state, up to the high tide line. The Project is not anticipated to disproportionately affect any community.

4.19. SURFABILITY

There are no direct effects to surfability from the No Action or build alternatives including the mitigation reef. No structures will be placed within the surf zone that affects waves. Indirect effects to surfability from the No Action Alternative and build alternatives include:

- Differences of significant wave heights (Hs) between the No Action Alternative and build alternatives scenarios were more noticeable for alternatives with higher amount of sediment placement.
- A decrease of wave height was observed near the beach for all alternatives. This decrease would not impact surfing directly since it happened after wave breaking, landward of surfing area.
- The wave condition that showed more impact from the alternatives was the southeast waves. Under this condition (smaller waves with smaller periods) the waves would break close to the beach where the differences in bathymetry (between build alternatives and the No Action Alternative) are higher. For hurricane and cold front wave conditions (higher waves with higher periods) the waves would break offshore where the bathymetry presents little or no differences between the No Action Alternative and the build alternatives.
- In general, a small variation in peel angle, peel rate and velocity of surfer was observed in all the simulations for the different alternatives. The changes in the surfability at the two locations due to the alternatives were also small.

The mitigation reef will not indirectly effect surfability. Indirect affects range from minimal to moderate increasing with the increase in volume of sand.

4.20. ADJACENT PROPERTIES

Two condominium communities and single family homes, all of which are lined with seawalls, are located immediately south of the southern Project boundary. Immediately north of the northern Project boundary is City of Lake Worth Property, including Lake Worth Pier, which is lined with vegetated dunes. The No Action Alternative and all of the build alternatives will have no direct impact to adjacent properties. The build alternatives may have an indirect positive impact on the adjacent properties as natural spreading of nourished sand may provide temporary storm protection.

4.21. DRINKING WATER

No municipal or private water supplies are located in or near the Project site; therefore, drinking water supplies will not be directly or indirectly effected by the build alternatives. The No Action Alternative may expedite saltwater intrusion leading to drinking water contamination in the aquifer.

4.22. PUBLIC SAFETY

The Project Area is characterized by a shoreline with a mixture of hotel and residential development, with limited public access to the beach. Many opportunities for recreation exist within the area. However, this area has been narrowed as a result of past hurricanes and tropical storms. Therefore, a No Action Alternative would encourage further erosion, allowing the ocean surf to come landward, which could minimize or eliminate emergency response access along the beach where the surf intercepts exposed seawalls.

Under the action alternatives, as a public safety measure, beach and water related recreation will be prohibited within the vicinity during construction. Long-term effects on public safety are not anticipated from the build alternatives.

4.23. ENERGY REQUIREMENTS AND CONSERVATION

Energy requirements for the proposed Project would consist of fuel for the trucks hauling sediment, construction equipment, labor, and transportation. Increased energy expenditure will be required because the sand will be coming from a distant source. The No Action Alternative however would encourage erosion to continue and could potentially require even greater energy during the use of preventive measures and/or post storm clean up if a storm occurs (USACE, 2012).

4.24. NATURAL OR DEPLETABLE RESOURCES

The volume of sand that will be used as a source of beach/dune fill from offshore borrow areas and an upland mine is considered a nonrenewable source.

The No Action Alternative would result in no impact to natural sand reserves. Sand would remain intact, with the exception of movement during natural cycles and storm events. The limited sand within the beach and dune system would continue to be depleted by erosion.

4.25. REUSE AND CONSERVATION POTENTIAL

There is no potential for reuse associated with the proposed Project activities. Therefore, this is not applicable to the proposed Project.

4.26. URBAN QUALITY

No direct or permanent impacts are expected to urban quality. However, implementation of this Project has the potential to indirectly affect urban quality in a positive way. By restoring an eroded beach, recreational activity would increase, as well as tourism and the finances which come with tourism.

Commercial businesses and residences would greatly benefit from storm protection and the reduction of the risk of property damage. Construction equipment could temporarily reduce the aesthetic value of the Project Area, but upon completion this would not be an issue.

4.27. SOLID WASTE

Solid waste is generally described as any garbage or sludge from industrial, commercial, mining, and agricultural activity. No impacts related to solid waste are expected to emerge from any of the alternatives. No solid waste will be disposed into the Atlantic Ocean.

4.28. SCIENTIFIC RESOURCES

There are no known impacts to scientific resources associated with any of the alternatives.

4.29. NATIVE AMERICANS

None of the alternatives are anticipated to occur on land belonging to Native Americans, or in areas historically relevant to them. Implementation of the proposed Project is not anticipated to affect resources, lands, or other factors relevant to Native Americans; however, the USACE will notify the federally recognized tribes of the EIS and will work with them based on their requests for coordination.

4.30. CUMULATIVE EFFECTS

Appendix J provides an evaluation of the anticipated cumulative impacts to resources resulting from past, present, and reasonably foreseeable future actions.

4.30.1 CUMULATIVE ACTIVITIES SCENARIO

Cumulative impacts are known as 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” (40 CFR 1508.7). Implementation of any of the alternatives, when combined with past projects and reasonably foreseeable future actions, would result in impacts to the beach, nearshore hardbottom, epibenthic communities, fish communities, and other resources. The beach will continue to be maintained as an area suitable for shoreline protection, recreation, and wildlife habitat. Utilization of upland sources may involve natural resource impacts to habitats adjacent to the commercial sand mines.

The No Action Alternative will result in continued erosion of the beach and dunes, an increase in the potential for storm related property damage, and a loss of property. Specifically, the littoral sand budget in the Project Area has an insufficient quantity of sand

and the No Action Alternative provides no additional sand to ameliorate the expected loss of sand due to erosion. Without the addition of sand, and frequent storm occurrences, the dune could eventually be completely eroded, and the MHW line may reach the upland seawall or other improved infrastructure. The existing erosion and shore protection problems would remain or become worse if the seawalls failed due to scour.

No adverse environmental impacts to nearshore and offshore hardbottom habitats and fish communities are anticipated based on the No Action Alternative. An increased exposure of nearshore hardbottom due to continued beach erosion is possible, which could provide increased habitat for surf zone fishes. Continued erosion of the beach could threaten the existence of the remaining dune vegetation and adjacent habitat in Palm Beach County, which would decrease available habitat for birds and dune species. If the shoreline continues to reduce, available sea turtle nesting habitat will be lost.

A summary of the cumulative impacts identified as past, present, and reasonable foreseeable future conditions of the various resources for the alternatives are presented in Table 4-4.

Table 4-4. Summary of past, present and future with and without project impacts.

Resource	Past and Present (Baseline/Existing Condition)	Future without Shoreline Stabilization Project	Future with Shoreline Stabilization Project
Sea Turtles	Past and current threats to sea turtle populations are abundant and include artificial lighting, beach armoring, anthropogenic disturbances, trawling, dredging, vessel strikes, fishing gear entanglement, and marine debris.	Continued erosion could cause sea turtles to lose valuable nesting habitat. Loss of nesting habitat may occur from reduced area of beach above mean high tide elevation. In addition, loss of nesting opportunity above high tide line may result in turtle nesting at lower elevations where nests may wash out	Burial of nearshore hardbottom could prove to have detrimental effects for juvenile green sea turtles. Sea turtles may also be negatively impacted by turbidity and/or noise during the construction period.
Florida Manatee	The most significant threat of manatee death in Palm Beach County is watercraft collision. Other known causes of manatee deaths are the result of being crushed by canal locks and flood control structures, fish hooks, monofilament, entanglement, vandalism, and habitat loss.	Florida Manatee will continue to occur in the area.	There exists the possibility of increased turbidity and noise disturbing the animals during construction. These small disturbances are not anticipated to have major impacts. However more frequent nourishment projects may result in larger impacts.
Smalltooth Sawfish	Fisheries' by-catch has caused smalltooth sawfish numbers to decline. Habitat loss and degradation, entanglement in marine debris, and pollution have also contributed to this decline.	Smalltooth Sawfish will continue to occur in the area.	Construction related turbidity and noise may disturb the smalltooth sawfish. With mitigation measures in place, however, it is believed that the potential for smalltooth sawfish "take" will be greatly reduced. Smalltooth sawfish are expected to avoid the small habitat area used during construction. However more frequent nourishment projects may result in larger impacts.
Piping Plover	Population decline has primarily been attributed to habitat loss, human disturbances, predators, and storm tides which inundate nests.	Continued erosion may directly impact piping plovers by potentially decreasing wintering habitat and altering the spatial composition of foraging habitat.	Construction activities, development, and human disturbance could have the potential to cumulatively impact piping plover. Piping plovers are expected to avoid the small habitat area used during construction. However, there still exists the possibility of increased noise disturbing the animals during construction; more frequent nourishment projects may result in larger impacts.
Rufa Red Knot	Threats to the rufa red knot include sea level rise; coastal development; shoreline stabilization; dredging; reduced food availability at stopover areas; disturbance by vehicles, people, dogs, aircraft, and boats; and climate change.	Continued erosion may directly impact rufa red knot by potentially decreasing wintering habitat and altering the spatial composition of foraging habitat.	Construction activities, development, and human disturbance could have the potential to cumulatively impact rufa red knots. More frequent nourishment projects may also result in larger impacts.
Beach Jacquemontia	Beach jacquemontia became listed as a result of a loss of habitat due to urbanization and beach erosion.	Continued erosion may directly impact vegetation by potentially decreasing habitat.	The restoration of beach dune habitat through dune building and stabilization projects could have positive cumulative impacts in the long term by restoring Beach jacquemontia habitat.
Scleractinian Corals	The mid-Holocene was the last time that *Acropora* spp. were the dominant species on Palm Beach County reefs. After the mid-Holocene time, the ranges of *Acropora* spp. tapered south to the northern Florida Keys due to climatic cooling and a rise in sea level. Anthropogenic influences to corals such as physical damage (vessel groundings, anchors, divers/snorkelers), increased land-based sources of pollution, and coastal construction have exacerbated declines resulting in a synergistic effect that greatly diminishes the survival of these corals.	Corals would continue to exist in the area, subject to the natural dynamics of the nearshore environment including sand movement, scouring, and alternating burial/exposure. While ocean acidification has not been demonstrated to have caused appreciable declines in coral populations so far, it is considered to be a significant threat to corals by 2100 (Brainard et al., 2011).	Recent surveys of the nearshore hardbottom habitat have not documented any colonies of *Acropora palmata* or *A. cervicornis* colonies, or any of the five recently listed coral species. There is no evidence to suggest the presence of *A. cervicornis* or *A. palmata* in water depths of less than 15 m (50 ft.) north of South Lake Worth Inlet in Palm Beach County. Critical habitat does not exist in the Project Area.

Table 4-4 (cont.). Summary of past, present and future with and with project impacts.

Resource	Past and Present (Baseline/Existing Condition)	Future without Shoreline Stabilization Project	Future with Shoreline Stabilization Project
Hardbottom and Corals	Hardbottom communities are ephemeral and are subjected to the dynamics of the nearshore environment including sand movement, scouring, and alternating burial/exposure.	The Project Area shoreline would continue to erode, which could result in greater exposure of intertidal and shallow subtidal hardbottom.	The proposed Project, in addition to past projects and any future actions within the proposed Project Area, may impact nearshore habitats including hardbottom benthic communities and coral reef resources. The main unavoidable adverse impact from the Applicants' Preferred Alternative is the burial of nearshore hardbottom habitat. Mitigation to offset impacts has been proposed.
Fish & Wildlife Resources	Past studies show that no significant cumulative impacts to benthic infauna and fishes have occurred.	Continued beach erosion would reduce the littoral beach area and dune habitat. Species affected would include those that use the littoral zone and dune zones for resting, feeding, and breeding.	There will be a change in infaunal community structure; grazers and detrivores that feed upon the macroinvertebrates may be temporarily displaced during construction activities. Direct impacts to fish communities will be minimal. The motility of most reef fish species should allow these species to leave the disturbed area during construction activities and return when conditions return to pre-construction conditions.
Essential Fish Habitat	EFH within the Project Area includes nearshore coral/live hardbottom, water column, and unconsolidated (soft) bottom. Managed species and species groups with EFH in the Project Area include coral/live hardbottom, softbottom, marine water column, penaeid shrimp, snapper grouper complex, spiny lobster, coastal migratory pelagic species, dolphin and wahoo, and highly migratory species.	The No Action Alternative would not affect Essential Fish Habitat in the Project Area.	The Applicants' Preferred Alternative could result in the burial of nearshore hardbottom habitat, which could result in an incremental loss of EFH for hardbottom and coral species, as well as reef fish.
Water Quality	Evidence for eutrophication along the coastal waters of Palm Beach County has been documented during the past several decades. An increase in population, development, and urbanization within southern Florida has increased water degradation.	Turbidity would continue to occur intermittently due to storm activity, rainfall, currents, and other natural phenomena.	Local, short-term impacts of sedimentation will occur adjacent to the beach fill sites and offshore borrow areas during project construction. Preventative measures and monitoring during construction should minimize these impacts.

4.30.1.1. PAST CONDITIONS AND ACTIVITIES

The Palm Beach Island shoreline has experienced a gradual loss of sand over the years. Beach erosion has been a chronic problem since the construction of the Lake Worth Inlet navigation channel and jetties and a series of hurricanes and storms which impacted the island between 1920 and 1950 (CEL, 1986). The Town of Palm Beach and Palm Beach County have responded to this erosion over the years through sponsorship and participation in beach nourishment projects, seawall and groin construction and a sand bypass program (Table 4-5). Lake Worth Inlet was first cut in the early 1860’s to provide access to the ocean from Lake Worth. The inlet was prone to migration and closure and was relocated to the north; however the new location also proved unstable. Beginning in 1918, the inlet was stabilized at its original location; at the same time, the Port of Palm Beach was becoming a vital shipping facility (PBC-ERM, 2003). The channel was widened and deepened in the following years, and in 1925 jetties were constructed. South Lake Worth Inlet was cut from 1925 to 1927, built primarily for health and sanitation purposes due to the declining water quality in southern Lake Worth. Jetties were constructed to stabilize the inlet, and in 1937 a fixed sand transfer plan was constructed on the north jetty, the first such plant ever constructed (PBC-ERM, 2003).

In the 1920’s, the Town of Palm Beach developed a seawall and groin construction program in response to a series of hurricanes that impacted South Florida (CEL, 1986). In 1932, the Town of Palm Beach adopted a groin and bulkhead ordinance and in 1935 a long term plan for shore protection structures was completed. In 1936 the USACE finished a study of shoreline erosion south of the inlet and experimental groins were installed by the Town of Palm Beach. Over the next decade, groin performance was monitored and a joint USACE/University of Florida report was issued stating that the groins alone were not solving the erosion problems within the Town of Palm Beach. It was determined that additional sand would be required to offset erosion (CEL, 1986). Table 4-5 summarizes beach nourishment projects constructed on Palm Beach Island.

Table 4-5. Recent beach nourishment and dune restoration projects on Palm Beach Island.

Date	Project	Project Extents	Volume (cy)	Sand Source
1976	Beach Nourishment	Sloan's to Widener's Curve (R-117)	100,000	Import Fill
1977	Beach Nourishment	Chilean Avenue (R-98)	86,000	Onshore Excavation
1995	Mid-Town Beach Renourishment and Groin Field[1]	R-95 to R-100	880,000	Offshore Borrow Area
1997	Lake Worth Municipal Beach Dune Restoration	0.51 acres of dune restored	Unknown	Unknown
2003	Mid-Town Expanded Beach Renourishment	R-90.5 to R-101	1,273,100	Offshore Borrow Area
2003	SPB/Lantana Dune Restoration[2]	R-135+460 to R-137+410	1,000	Upland
2004	SPB Dune Restoration	0.66 acres of dune restored	Unknown	Unknown
2005	SPB /Lantana Dune Restoration[2]	R-135+460 to R-137+410	3,132	Upland
2005	SPB /Lantana Dune Restoration[2]	R-135+460 to R-137+410	5,814	Upland
2006	Mid-Town Beach Renourishment	R-90 to R-94.2; R-94.5 to R-101	893,000	Offshore Borrow Area
2006	Phipps Ocean Park Beach Restoration[3]	R-118+700 to R-126	1,100,000	Offshore Borrow Area
2006	FDEP Hurricane Recovery Program Dune Restoration Project[2]	R-116.5 to R-119-300; R-126 to R-127+100; R-129+200 to R-133+500	141,458	Offshore Borrow Area
2007	SPB /Lantana Dune Restoration[2]	R-135+460 to R-137+410	6,750	Upland
2008	SPB /Lantana Dune Restoration[2]	R-135+460 to R-137+410	11,000	Upland
2009	SPB /Lantana Dune Restoration[2]	R-135+460 to R-137+410	10,000	Upland
2010	FEMA truck haul partial nourishment event	R-96 to R-100	52,000	Upland
2011	Phipps Ocean Park Beach and Dune Restoration[2]	Dune R-129 to R-133	56,000	Upland
2015	Mid-Town Beach Renourishment	R-90.4 to R-101.4	1,000,000	Offshore Borrow Area
2015	Reach 8 Dune Restoration	R-128+500 to R-134	34,902	Offshore from Mid-Town Project
2016	Phipps Ocean Park Beach and Dune Restoration[2]	R-116 to R-127	1,100,000	Offshore Borrow Area
2016	Reach 8 Dune Restoration	R-128+500 to R-134	10,026	Offshore from Phipps Project
2016	Mid-Town Dune Restoration	R-90 to R-93	15,000	Offshore from Phipps Project

[1] Mid-Town Beach Experimental PEP Reef constructed 1992, was removed in 1995.

[2] Project located within Study Area.

[3] As mitigation, a 3.1 acre artificial reef was constructed in 2004; additional 0.8 ac artificial reef constructed in 2007 as additional mitigation required by USACE.

A sand transfer plant was constructed in 1958 to bypass sand across the Lake Worth Inlet from the north beach to the south beach (PBC-ERM, 2003). From 1944 to 1986 approximately 6.5 million cy of sand were either placed in various locations throughout Palm Beach Island or bypassed at Lake Worth Inlet by the sand transfer plant (CEL, 1986).

In addition to the sand bypassed by the sand transfer plant, the USACE maintains the Lake Worth Inlet by periodically dredging the Harbor and Inlet (settling basin, entrance channel, inner channel, turning basin). The dredged material is either placed landward of the -17 ft mean low water (MLW) contour, seaward of the MHW line, or on the dry beach immediately south of the inlet. Between 1944 and 2010, approximately six million cubic yards of material was dredged from the Port and deposited south of the inlet.

In 1976, the Town of Palm Beach placed approximately 100,000 cy of sand along the shoreline from Sloan’s Curve to Widener’s Curve (R-117). One year later approximately 86,000 cy of sand, provided from local building construction of a private development, was placed on the beach near Chilean Avenue (R-98) (CEL, 1986)

In 1986, the Town of Palm Beach Town Council approved the implementation of the Comprehensive Coastal Management Plan (CCMP), developed by Cubit Engineering Limited (CEL) (Resolution No. 38-86). The plan included a Town-wide purpose and need that incorporated both storm protection and recreation enhancement. South of the Lake Worth Pier, the 1986 plan called for monitoring and no immediate action. “Full hurricane protection” was to be provided in the form of existing seawalls which were buried in front of the high-rise structures. To maintain a recreational beach, the plan identified a potential beach nourishment project of 375,000 cy. The 1986 plan recognized that the placement of any fill in this area would be subject to both the state and Federal Government giving consent to bury nearshore rock. Finally, the 1986 plan recommended that the program be planned with a 10-year minimum implementation schedule and revised annually (CEL, 1986).

The first Mid-Town project was constructed in 1995 from R-95 to R-100, placing 880,000 cy of sand dredged from an offshore borrow area. A groin field was also installed during the 1995 renourishment. Two years later, Palm Beach County restored 1,000 linear feet of dune at the Lake Worth Municipal Beach in 1997 (Table 4-5).

In March 1997, the Town of Palm Beach Town Council decided to update the CCMP. Following a peer review by Aubrey Consulting, Inc. (now Woods Hole Group) and a recommendation from the Town of Palm Beach Shore Protection Board, Town Council approved Resolution No. l6-99 on May 11, 1999, accepting the 1998 CCMP Update (ATM, 1998). The scope of the 1998 CCMP Update was expanded from the 1986 CCMP to include not only the 12.2 miles of Town of Palm Beach shoreline, but the entire 15.7 miles of Palm Beach Island. The principle objective of the 1998 CCMP Update was to provide a level of storm protection to the entire Palm Beach Island shoreline. The targeted level of storm protection for all beach restoration projects on the Island would enable any individually-considered shoreline restoration segment to avoid significant damage from a 15-year return interval storm (with approximate erosion losses of 17 cy per linear ft) at any time between initial restoration and subsequent nourishments. Subsequent to regulatory permitting constraints, the 1998 CCMP Update referenced a combined Reach 7 and 8 project outlined by the USACE in July 1996. The referenced project suggested full beach nourishment south of the Lake Worth Pier to approximately FDEP R-monument T-131 and tapering between T-131 to the southern Town of Palm Beach limits with a small density of fill coupled with six (6) T-head groins.

In 2002 (revised in 2005), Applied Technology & Management, Inc. performed a feasibility study for coastal project alternatives in Reach 8. The two primary goals for a project in Reach 8 were:

1. Mitigate the historical and ongoing sand depletion associated with the disruption to the longshore sand transport, attributable to Lake Worth Inlet and shorefront hardening structures along the beach between the inlet and Reach 8; and

2. Provide storm protection for the upland property and infrastructure.

When evaluating the potential alternatives within the feasibility study, additional goals included recreational enhancement and minimization of environmental impacts.

The preferred alternative identified in the feasibility study was a continuous beach fill project from Ambassador Hotel (T-125) to La Bonne Vie Condominium (R-134+110).

In 2003, an expanded Mid-Town Project (Reaches 3 and 4) was completed to include a greater nourishment area than the 1995 project. The project included placement of 1.2 million cy of sand (dredged from an offshore borrow area) on the Mid-Town beaches from R-90.5 to R-101. This was followed by a Town of Palm Beach emergency berm and dune repair project in response to hurricanes Frances, Jeanne and Wilma in 2004-2005. The emergency berm and dune repair project occurred in 2006 and included placement of 893,000 cy of sand dredged from an offshore borrow area on the Mid-Town beaches from R-90 to R-94.2 and R-94.5 to R-101. A FEMA truck haul partial nourishment event took place in 2010 from R-96 to R-100 within the Town of Palm Beach using fill material (52,000 cy) from an upland sand source.

In addition to the expanded Mid-Town Project, Palm Beach County completed a dune restoration project in 2003 from R-135+460 to R-137+410 excluding the Mayfair House Condominium and Lantana Municipal Park (within the Study Area). The fill material (1,000 cy) came from an upland sand source. Palm Beach County completed additional dune restoration projects within the same area in 2004 (1,151 linear feet of dune), February 2005 (3,132 cy), December 2005 (5,814 cy), June 2007 (6,750 cy), January 2008 (11,000 cy) and January 2009 (10,000 cy).

In 2006, the Phipps Ocean Park Beach Restoration Project was constructed from R-118+700 to R-126 with approximately 1.1 million cy of beach fill from an offshore borrow area. A 3.1 ac artificial reef was constructed as mitigation for the project in 2004. In July 2007, the Town of Palm Beach constructed an additional 0.8 ac mitigation artificial reef offshore of R-105 as part of the federal mitigation requirement in USACE Permit No. SAJ-2000-380 (IP-PLC) for the same project. The 0.8 ac reef was not required by FDEP, who determined that the 3.1 ac mitigative artificial reef constructed in 2004 completely offset nearshore hardbottom project impacts.

The FDEP Hurricane Recovery Program Dune Restoration Project was completed in 2006, with 141,458 cy of trucked-hauled fill placed in the dune north of the permitted

Reach 7 beach fill construction template (R-116.5 to R-119-300) and in the dune south of Reach 7 in the Reach 8 segment study area (R-126 to R-127+100; R-129+200 to R-133+500). This project was repeated in 2011 (R-129 to R-133) with the placement of 56,000 cy of material trucked in from an upland source.

The Mid-Town Project was renourished in winter 2014-2015 between R-90.4 and R-101.4 with approximately 1.4 million cy of sand from an offshore borrow area. Nearly 35,000 cy of dredged sand was stockpiled, transported and placed within the Reach 8 dune project area. The Phipps Ocean Park Beach Restoration Project was renourished from R-116 to R-127 with approximately 1,010,000 cy of beach fill from an offshore borrow area in the winter of 2015-2016. Just over 10,000 cy of dredged sand was stockpiled, transported and placed within the Reach 8 dune project area and approximately 15,000 cy was stockpiled, transported and placed within the Mid-Town dune between R-90 and R-93.

4.30.1.2. PRESENT AND ONGOING ACTIVITIES

The Town of Palm Beach recently constructed the Mid-Town (2015) and Phipps (2016) beach nourishment projects to the north of the Project Area.

4.30.1.3. REASONABLY FORESEEABLE FUTURE ACTIVITIES

The municipalities within Palm Beach Island will continue to maintain the beaches through monitoring and nourishment using sand from either offshore sources or upland mines, construct restoration projects in environmentally suitable areas, and continue to conduct dune restoration where feasible. Per the Palm Beach Island BMA, the following projects have been approved: Lake Worth Inlet Maintenance Dredging, Lake Worth Inlet Sand Transfer Plant, Mid-Town Beach Nourishment Project, Phipps Ocean Park Beach Restoration Project, Palm Beach Groin Rehabilitation, and Dune and Backshore Berm Restoration and Maintenance (FDEP, 2013). The proposed Project, Phipps Project and Mid-Town Project are each considered single and complete projects. The USACE is considering authorizing the proposed Project under a 10-year permit that would allow for initial project construction and maintenance for up to two renourishments.

The Town of Palm Beach and County plan to maintain the Project approximately every three to four years. Therefore, future renourishments at the Project Area at least every four years is a reasonably foreseeable action included within Appendix J - CIA. Also, in order to minimize environmental impacts and maximize efficiency, the Town of Palm Beach would prefer to utilize sand from offshore borrow areas dredged during future Phipps and Mid-Town beach renourishment projects. The dredged sand would be temporarily staged in the uplands at Phipps and Mid-Town, mechanically loaded on trucks, and hauled to the Project Area for placement and grading on the Town of Palm Beach’s portion of the Project Area. The Phipps and Mid-Town projects are anticipated to be constructed every eight years, but timed so that they are built four years apart. The 2014 permit for Mid-Town expires in 2019 and is for a one-time regulated activity, whereas the 2015 permit for Phipps provides a 10-year authorization with renourishments as needed within the proposed template. If timing of the Phipps or Mid-Town projects does not allow for use of dredged sand, the Town of Palm Beach would consider using sand from an upland source. Appendix J provides an evaluation of the anticipated cumulative impacts to resources resulting from past, present and reasonably foreseeable future actions.

4.28.1.4. SEA-LEVEL CHANGE

Potential relative sea level change must be considered. Sea level change over the next 50-100 years is likely to result in both direct and indirect impacts on nearshore marine resources in the Project Area. Direct impacts could include changes in the extent of exposed hardbottom habitat due to offshore sand migration. Indirect impacts could result from increased beach erosion, which may prompt more frequent (and possibly more extensive) beach nourishment projects in the area. The impacts of climate change including shoreline erosion, coastal flooding, and water pollution are likely to exacerbate many problems that coastal areas already face (EPA, 2014).

4.30.2. CUMULATIVE EFFECTS BY RESOURCE

In accordance with the approach recommended by the Council on Environmental Quality (CEQ) (1997), this analysis focuses on the potential cumulative impacts that are significant. The marine resources that are included in the cumulative analysis are threatened and endangered species, nearshore hardbottom, fish and wildlife resources, EFH, and water quality.

4.30.2.1. THREATENED AND ENDANGERED SPECIES

4.30.2.1.1. SEA TURTLES

Past and current threats to sea turtle populations are abundant and include artificial lighting, beach armoring, anthropogenic disturbances, trawling, dredging, vessel strikes, fishing gear entanglement, and marine debris (USACE, 2013). The threats are expected to continue into the future.

This Project, in conjunction with cumulative effects from previous projects, could result in the burial of nearshore hardbottom, which could prove to have detrimental effects for juvenile green sea turtles. Section 4.3 details the potential benefits and impacts that each alternative may have on the nesting and nearshore habitats of sea turtles.

Sea turtles may also be negatively impacted by turbidity and/ or noise during the construction period. To avoid these adverse effects and/or reduce the impact the Project should comply with the NMFS *Sea Turtle and Smalltooth Sawfish Construction Conditions* (NMFS, 2006), which attempts to reduce harm to these species. With these mitigation measures in place, it is believed that the potential for sea turtle “take” will be greatly reduced.

The Project presented, as a single nourishment, includes a 2.07 mile segment of beach and would require a short duration in order to construct. Therefore, no significant impacts on sea turtles during a single event are expected. It is anticipated that this Project will continue to be constructed at least every 4 years for the next 50 years; therefore, the Project itself will continue to contribute to cumulative impacts to sea turtles.

4.30.2.1.2. FLORIDA MANATEE

Manatees are most commonly seen during the winter months, primarily in submerged seagrass beds. Manatees are prone to human induced harm and/or death. The most significant threat of death in Palm Beach County is watercraft collision, which results in 35% of all manatee strandings (PBC-ERM, 2013d). Other known causes of manatee deaths are the result of being crushed by canal locks and flood control structures, fish hooks, monofilament, entanglement, vandalism, and habitat loss (PBC-ERM, 2013d). These anthropogenic threats, coupled with the manatee’s life history of long lived low reproduction, are responsible for their endangered status.

Most marine species are expected to avoid the small habitat area used during construction. However, there still exists the possibility of increased turbidity and noise disturbing the animals during construction. In order to minimize direct impacts to manatees, all vessels will comply with FWC *Standard Manatee Construction Conditions for In-Water Work* (FWC, 2011).

4.30.2.1.3. SMALLTOOTH SAWFISH

As a result of fisheries’ by-catch, smalltooth sawfish numbers have been declining. Habitat loss and degradation, entanglement in marine debris, and pollution have also contributed to this decline. These widespread and ongoing impacts are expected to continue in the future regardless of the Project.

Construction related turbidity and noise may disturb the smalltooth sawfish. To avoid these adverse effects and/or reduce the impact, the Project should comply with the NMFS *Sea Turtle and Smalltooth Sawfish Construction Conditions* (NMFS, 2006). With mitigation measures in place it is believed that the potential for smalltooth sawfish “take” will be greatly reduced.

Smalltooth sawfish are expected to avoid the small habitat area used during construction. However, there still exists the possibility of increased turbidity and noise disturbing the animals during construction.

4.30.2.1.4. PIPING PLOVER

The piping plover’s decline has primarily been attributed to habitat loss (as a result of development), human disturbances, predators, and storm tides which inundate nests (USFWS, 2012).

Construction activities, development, and human disturbance could have the potential to cumulatively impact piping plover. To reduce the impact of the Project on the piping plover, the guidelines of the Migratory Bird Treaty Act and Migratory Bird Conservation Act will be followed. The acts stipulate protections for the birds, as well as the habitats necessary for their survival. Thus, impacts to migratory birds and the piping plover will be mitigated by implementation of conservation measures required by these treaties (USACE, 2012).

Piping plovers are expected to avoid the small habitat area used during construction. However, there still exists the possibility of increased noise disturbing the animals during construction. These small disturbances are not anticipated to have major impacts. Continued erosion may also cause property owners to explore alternative erosion control solutions, such as coastal shoreline armoring with concrete groins, retaining walls or bulkhead.

4.30.2.1.5. RUFA RED KNOT

Rufa red knots are expected to avoid the small habitat area used during construction. However, there still exists the possibility of increased noise disturbing the animals during construction. These small disturbances are not anticipated to have major impacts. However, more frequent nourishment projects may result in larger impacts. Continued erosion may also cause property owners to explore alternative erosion control solutions, such as armoring. The assemblage(s) of benthic macroinfaunal invertebrates buried during beach nourishment activities will remain unavailable to listed birds as a source of food until recolonization of the habitat. A study on the effects of beach nourishment on waterbirds and shorebirds in Brunswick County, North Carolina found no significant effect from replenishment on mean bird abundances. Conversely, study data suggested that habitat use by these birds might have actually increased at replenished beaches. Waterbird feeding activity, however, declined significantly after replenishment but, overall, no strong evidence indicates that replenishment alters either shorebird or waterbird feeding activity (Grippo et al., 2007).

4.30.2.1.6. BEACH JACQUEMONTIA

It is believed that due to the limited geographic distribution, fragmentation of habitat, small population size, and the randomness of natural events that many populations of beach jacquemontia will not exist within 100 years (USFWS, 1999). Therefore, the restoration of beach dune habitat through dune building and stabilization projects could have positive cumulative effects in the long term by restoring beach jacquemontia habitat.

4.30.2.1.7. SCLERACTINIAN CORALS

Acropora spp. was widespread on Palm Beach County reefs in the early to mid-Holocene (~10,000-6,000 years ago), confirmed by a 10-m thick fossilized record of *Acropora* dominated reef (Blanchon et al., 2002). Oceanic conditions and warmer sea temperatures during the mid-Holocene favored growth and accumulation of *Acropora* spp. along the shelf margin of the Florida reef tract, and the mid-Holocene was the last time that *Acropora* spp. were the dominant species on Palm Beach County reefs. After the mid-

Holocene time, the ranges of *Acropora* spp. tapered south to the northern Florida Keys due to cumulative effects including climatic cooling and a rise in sea level. Isolated colonies of *A. cervicornis* have been documented in deeper water (16 to 30 m) as far north as Palm Beach; however, no colonies of *Acropora* were observed in the nearshore hardbottom that may be impacted by this Project. Therefore cumulative impacts to these species are not anticipated.

The five recently listed coral species have experienced declines over the last several decades throughout their ranges. Cumulative effects including anthropogenic influences such as physical damage (vessel groundings, anchors, divers/snorkelers), increased land-based sources of pollution, and coastal construction have exacerbated these declines resulting in a synergistic effect that greatly diminishes the survival of these corals. Additionally, while ocean acidification has not been demonstrated to have caused appreciable declines in coral populations so far, it is considered to be a significant threat to corals by 2100 (Brainard et al., 2011). However, none of the recently listed coral species have been observed in the nearshore hardbottom that may be impacted by the proposed Project. Therefore cumulative effects to these species are not anticipated.

4.30.2.2. CORAL REEF AND HARDBOTTOM RESOURCES

The proposed Project, in addition to past projects and any future actions within the proposed Project Area, may result in permanent and temporary direct and indirect effects to nearshore habitats including the hardbottom habitat. The main unavoidable adverse impact from the Applicants' Preferred Alternative is the permanent impacts to between 3.86 and 3.99 acres of hardbottom, and temporary impacts to between 9.53 and 9.93 acres of hardbottom (Tables 4-1 through 4-3; Figures 4-1 through 4-3). The Applicants propose mitigation for unavoidable impacts through construction and monitoring of artificial reefs.

4.30.2.3. FISH AND WILDLIFE RESOURCES

A review of infaunal studies revealed that invertebrate recovery following placement of dredged material in relatively stable, unstressed marine environments generally takes between one and four years, while recovery in more naturally stressed areas is faster, often achieved within nine months (Bolam and Rees, 2003; Kotta et al., 2009). The Project Area is characterized as a highly dynamic ephemeral habitat. It is therefore anticipated that recolonization of benthic infauna will occur relatively quickly. There may be a change in infaunal community structure; grazers and detritivores that feed upon the macroinvertebrates may be temporarily displaced during construction activities. If this change in structure persists for a few years, short term impacts to selective bottom feeders may also occur due to a loss of specific prey species within the Project Area. Based on the ephemeral nature of the affected habitat and the literature reviewed, significant cumulative impacts to the infaunal community in the Project Area are not anticipated.

Direct impacts to fish communities will also be minimal. The motility of most reef fish species should allow these species to leave the disturbed area during construction activities and return when conditions return to pre-construction conditions. Adverse secondary impacts to fish species may also occur as a result of sedimentation. These are short term affects, limited to Project Area and duration. No significant cumulative effects to reef fish populations are anticipated.

While the Preferred Alternative may potentially negatively impact the settlement of juvenile fish and eliminate foraging resources, mitigation has been designed to offset these impacts. Reduced feeding success may influence survival, year-class strength, and recruitment of juvenile fish that inhabit nearshore hardbottom. Thus, impacting larger fish as their prey is affected. However, significant reduction in feeding success is not anticipated.

4.30.2.4. ESSENTIAL FISH HABITAT

The Applicants' Preferred Alternative could result in the burial of nearshore hardbottom habitat, which could result in an incremental loss of EFH for hardbottom and coral species, as well as reef fish. Appendix F provides a detailed analysis of the potential impacts to EFH. Although the Project described herein proposes to place a small amount of sand below MHW, past, present and projects that are likely to occur within the foreseeable future on Palm Beach Island may contribute to cumulative impacts to EFH. Based on the ephemeral nature of the affected habitat and the literature reviewed (see Section 4.28.2.3), significant cumulative impacts to the infaunal community in the Project Area are not anticipated.

4.30.2.5. WATER QUALITY

Evidence for eutrophication along the coastal waters of Palm Beach County has been documented during the past several decades. A bloom of the green macroalgae, *Codium isthmocladum* occurred on Palm Beach County in 1990 and subsequent years following. These blooms caused a depletion of oxygen, leading to fish relocation and/or epibenthic organism suffocation. An increase in population, development, and urbanization within southern Florida has increased water degradation (Lapointe et al, 2005).

Turbidity impacts are chronic perturbations that cause long-term reductions in primary and secondary productivity of reef epibenthic communities by reducing the amount of light available for photosynthesis. Local, short-term impacts of sedimentation will occur adjacent to the beach fill sites and offshore borrow areas during project construction. Preventative measures and monitoring, outlined in the project permits, during construction should minimize these impacts.

4.30.3. CONCLUSIONS

A number of beach restoration activities have occurred in southern Florida. Adverse cumulative effects associated with beach nourishment have been offset with adherence to the 401 Water Quality Certification, successful compensatory mitigation for unavoidable impacts, adherence to the construction conditions for endangered species such as manatee, sawfish and swimming sea turtles, nesting surveys, and with construction activities occurring outside the nesting periods for protected species (USACE, 2012). However, as long as the coastal environment remains dynamic, ongoing erosion and accretion effects will continue as well as the potential for cumulative effects.

Continued erosion resulting in more frequent nourishment events, may result in an increase in the number of direct (changes in exposed hardbottom as a result to sand movement) and indirect (increased erosion resulting in more frequent nourishment projects) impacts. All reasonably foreseeable activities have been included in the cumulative effects analysis.

Vessel strikes on mammals or sea turtles would have detrimental cumulative effects as a result of their population sizes. Strikes on the other species would be less severe. However, to reduce the risk the Project would comply with the "*Vessel Strike Avoidance Measures and Reporting for Mariners*" issued by NOAA Fisheries (NOAA, 2008). Proper mitigation techniques will be taken to avoid the loss of plant and animal species.

Currently, there exists a low possibility of cumulative impacts on nearshore resources, as a result of repeated nourishment events. Hardbottom impacts that are anticipated to result from the initial construction of the build alternatives, as well as future renourishments permitted under the Project, will be fully mitigated for through the construction of two artificial reefs (Chapter 5).

4.31. IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

4.31.1. IRREVERSIBLE

An irreversible commitment of resources occurs when is a resource is forever lost. In this alternatives use of sand from borrow areas (offshore and upland) would commit sand resources to the given project, thus diminishing chances for future use in nourishment projects. Furthermore, the use of offshore sand would prevent its use as habitat for benthic organisms.

The impacts of beach restoration on nearshore hardbottom communities are reversible. Hardbottom cover and exposure is a cyclic process as a result of seasonal and temporal changes. Complete recovery of preexisting conditions is possible.

Also, for the build alternatives, the fossil fuels that are used for the construction equipment and transport vehicles, as well as the public funds used represent an irreversible commitment of resources.

4.31.2. IRRETRIEVABLE

An irretrievable commitment of resources is that in which opportunities for other uses are forgone for the period of the Proposed Action. Renewable resources, such as human effort, are an example.

All build alternatives discussed would result in a temporary commitment of nearshore hardbottom areas as sand placement areas. Therefore, this results in a temporary loss of habitat during the duration of the given Project.

Temporary reduction of benthic communities, aesthetics, recreational opportunities, water quality and air quality represent irretrievable commitments of resources. This is defined as opportunities lost for a period to use or enjoy the resource as the presently exist.

4.32. UNAVOIDABLE ADVERSE ENVIRONMENTAL EFFECTS

Unavoidable adverse environmental impacts resulting from the Proposed Action include a temporary loss of beach habitat, a localized increase in turbidity levels, a temporary reduction in sea turtle nesting, degradation of the infaunal community, and loss of benthic communities in the nearshore area.

Most of the infauna which currently inhabit the area of the proposed Project will be unavoidably lost as a result of the sand placement activities. However, these losses are not expected to have a long-term significant adverse impact based on the dynamic habitat in the Project Area (Bolam and Rees, 2003; Kotta et al., 2009).

4.33. LOCAL SHORT-TERM USES AND MAINTENANCE/ENHANCEMENT OF LONG-TERM PRODUCTIVITY

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. The segments of Palm Beach County which are subject to this Project will experience localized, temporary turbidity plumes, and sedimentation. Beach fill projects have short term impacts on benthic and fishery communities, and marine turtle nesting. Most motile organisms within the nearshore zone should be able to avoid this, while others may not. However, the impacts are typically short-lived; benthos recovers quickly and extended periods of improved conditions for turtle nesting follow equilibration of the beach profile. Appropriate mitigation and monitoring should ensure that these populations remain sustainable.

4.34. INDIRECT EFFECTS

Studies have shown that beach replenishment frequently leads to more development in greater density within shorefront communities, encouraging more drastic stabilization measures in the future. Shoreline management creates an upward spiral of initial protective measures resulting in more expensive development, which leads to the need for more and larger protective measures. No sites in the uplands adjacent to the proposed Project Area remain available for development; therefore, there is no opportunity for future development.

4.35. UNCERTAIN, UNIQUE, OR UNKNOWN RISKS

No uncertain, unique, or unknown risks have been identified to date.

4.36. PRECEDENT AND PRINCIPLE FOR FUTURE ACTIONS

Only dune restoration projects have taken place in the Project Area (no beach nourishments have been authorized) (see Section 4.28.1.11). Permits issued to date have authorized one-time dune projects but no authorization has been required by the USACE since sand has not been placed in waters subject to jurisdiction under Section 10 of the Rivers and Harbors Act and Section 404 of the Clean Water Act. FDEP will require any future project on Palm Beach Island to comply with the Palm Beach Island BMA, which provides regional management of the coastal system rather than the conventional project-by-project permitting process. A new USACE permit application with independent evaluation and assessment of anticipated project effects on the environment would be required at the time of application for new permits; however, the USACE is considering authorization of the initial project with no more than three renourishment events for maintenance. Outside of the Project Area, dune restoration, beach nourishment and groin projects have occurred within the region of south Florida that provide precedent action, including projects on Palm Beach Island. It is reasonable to assume that future coastal construction projects in the region will be authorized.

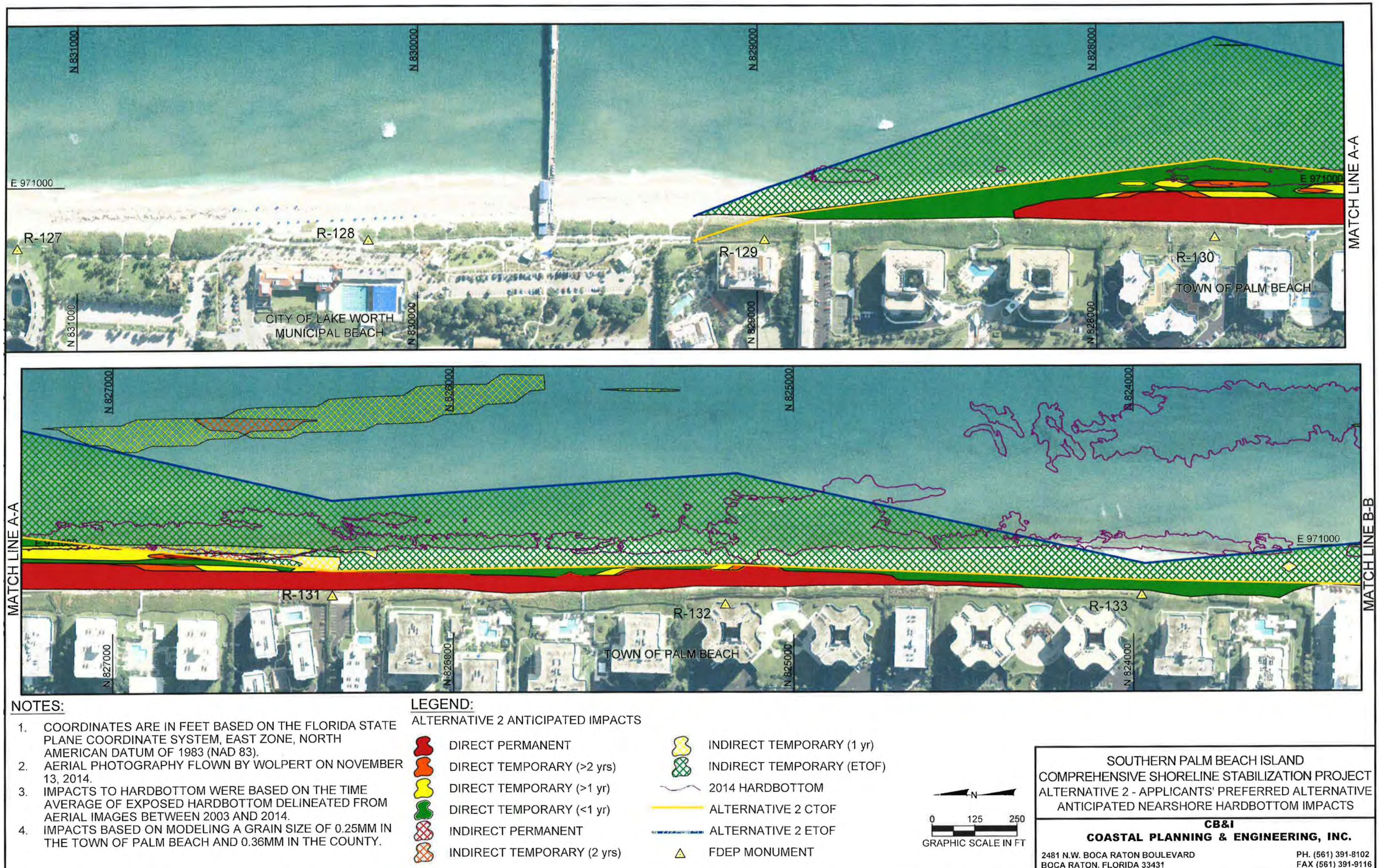

Figure 4-1. Anticipated nearshore hardbottom impacts from Alternative 2 – Applicants' Preferred Alternative. Impacts based on modeling a grain size of 0.25 mm in the Town of Palm Beach and 0.36 mm in the County.

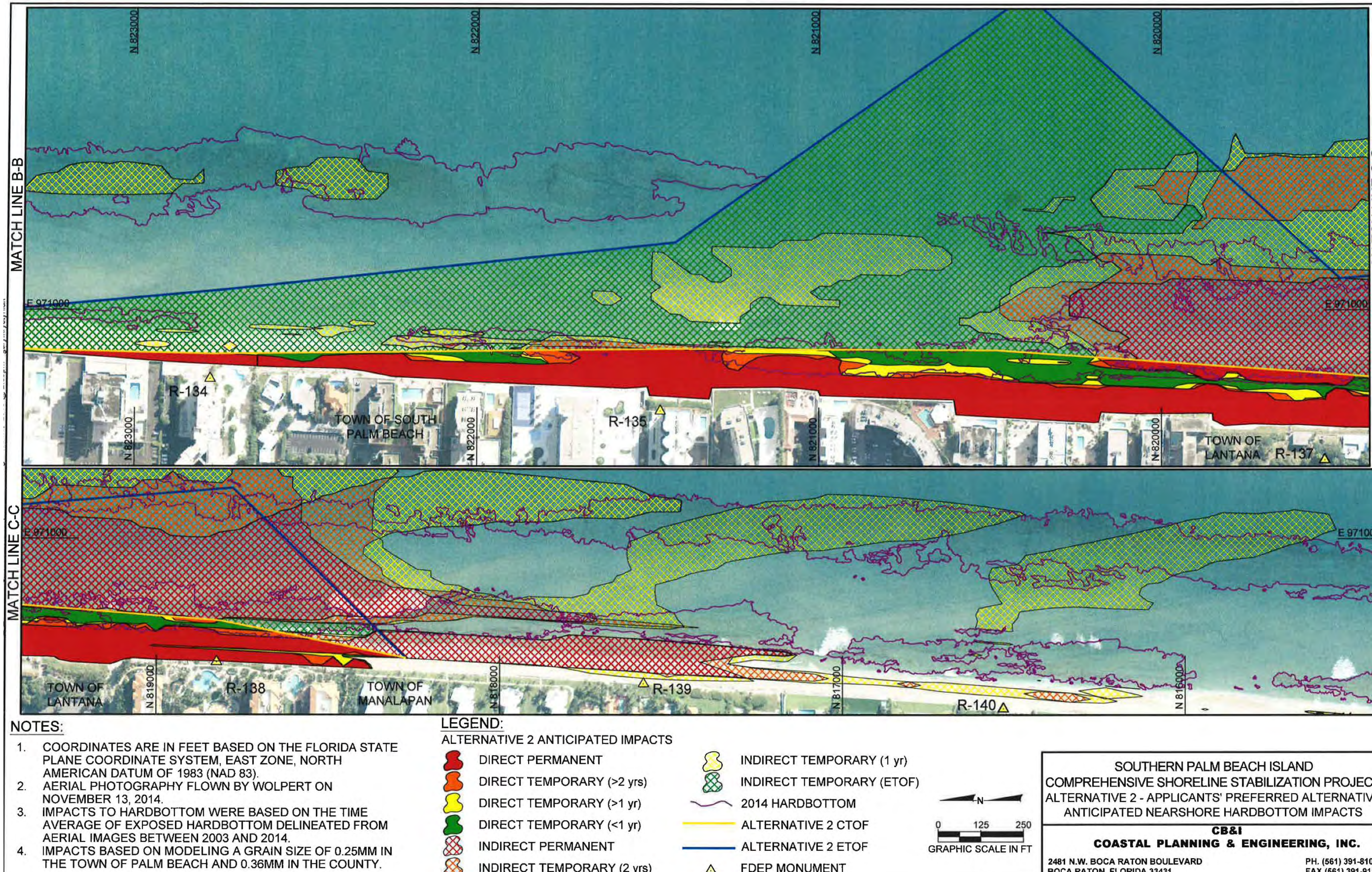

Figure 4-1 (cont.). Anticipated impacts to nearshore hardbottom resources from Alternative 2 – Applicants' Preferred Alternative. Impacts based on modeling a grain size of 0.25 mm in the Town of Palm Beach and 0.36 mm in the County.

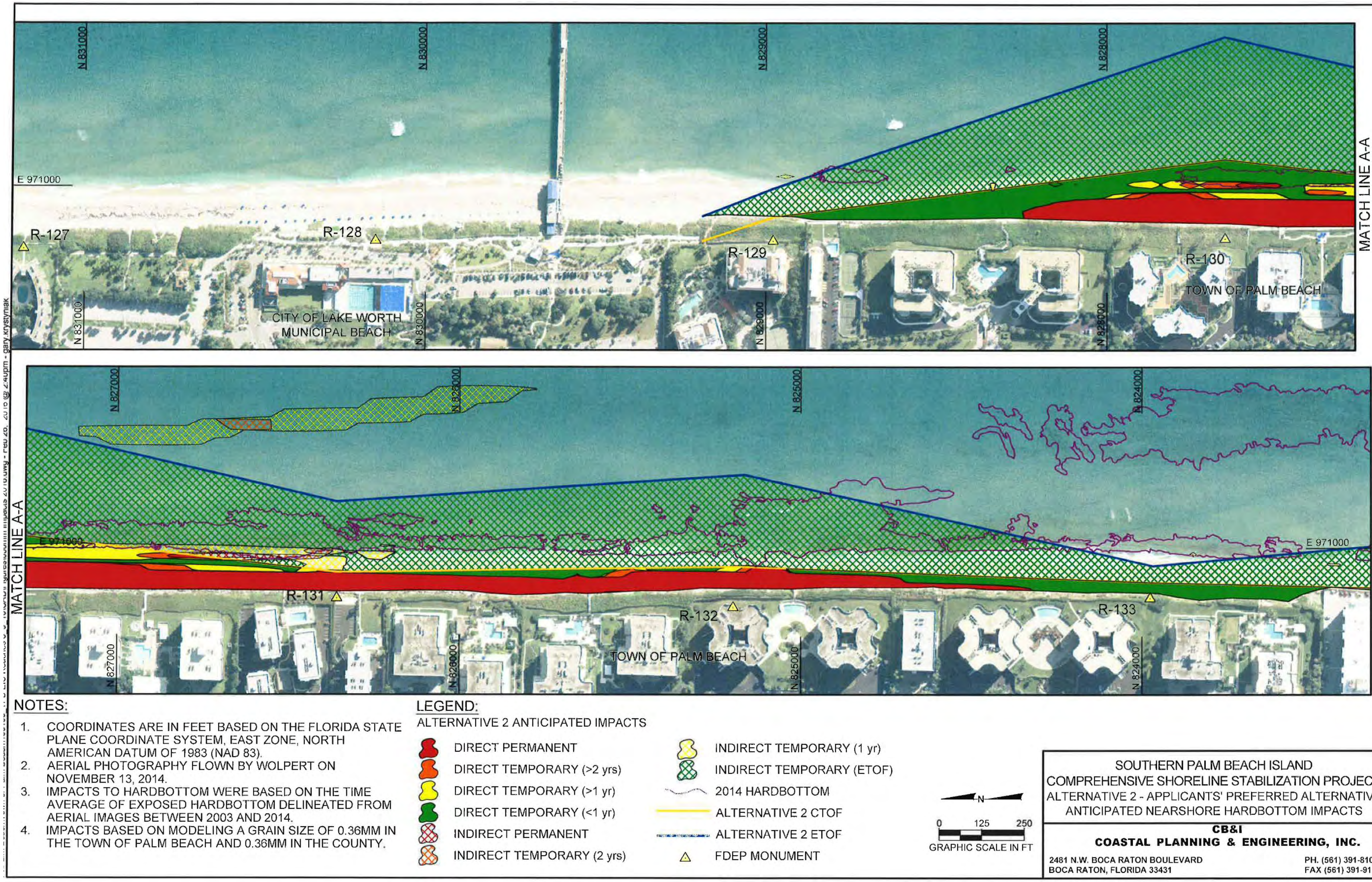

Figure 4-2. Anticipated impacts to nearshore hardbottom resources from Alternative 2 – Applicants' Preferred Alternative. Impacts based on modeling a grain size of 0.36 mm in the Town of Palm Beach and 0.36 mm in the County.

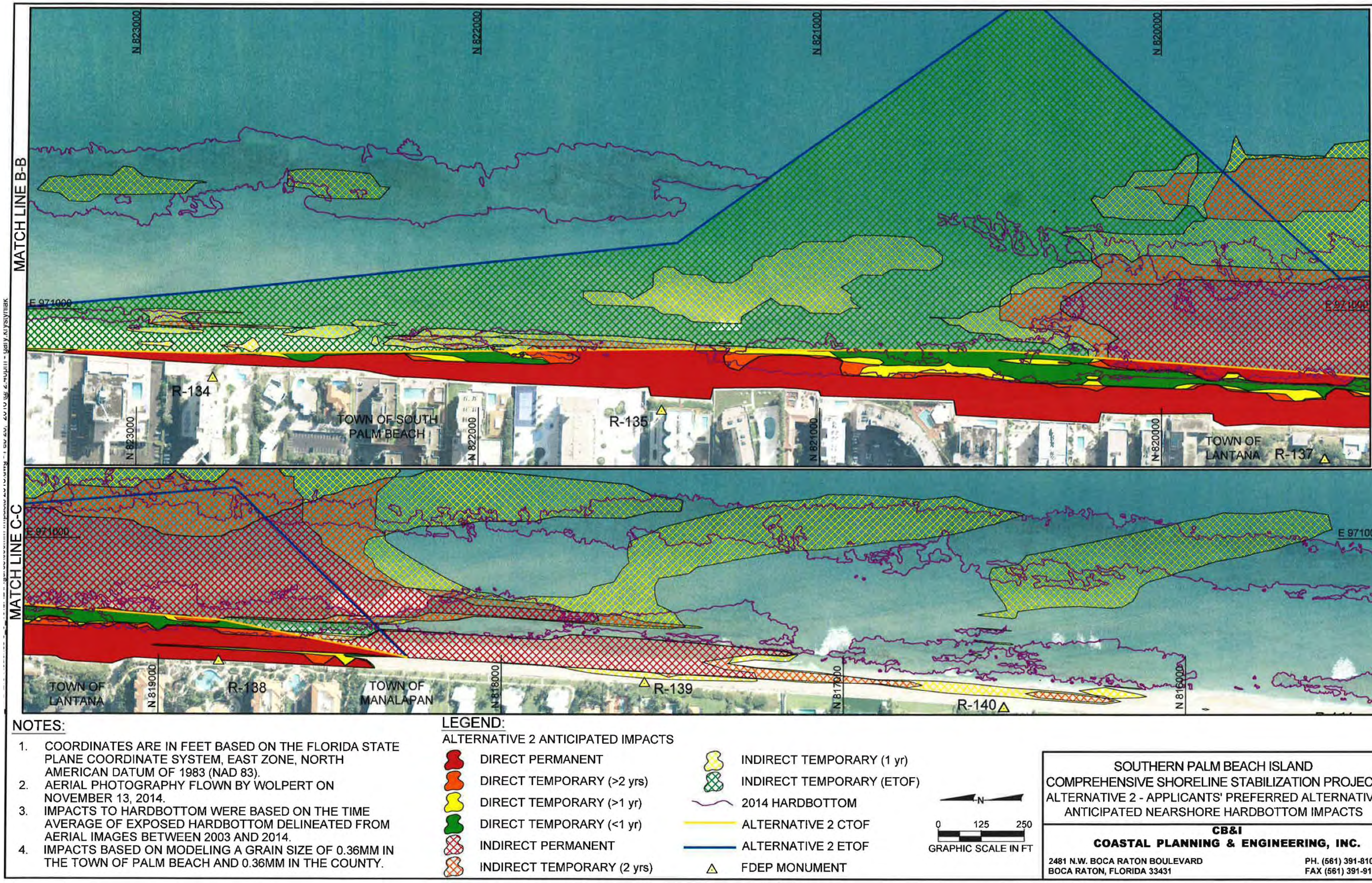

Figure 4-2 (cont.). Anticipated impacts to nearshore hardbottom resources from Alternative 2 – Applicants' Preferred Alternative. Impacts based on modeling a grain size of 0.36 mm in the Town of Palm Beach and 0.36 mm in the County.

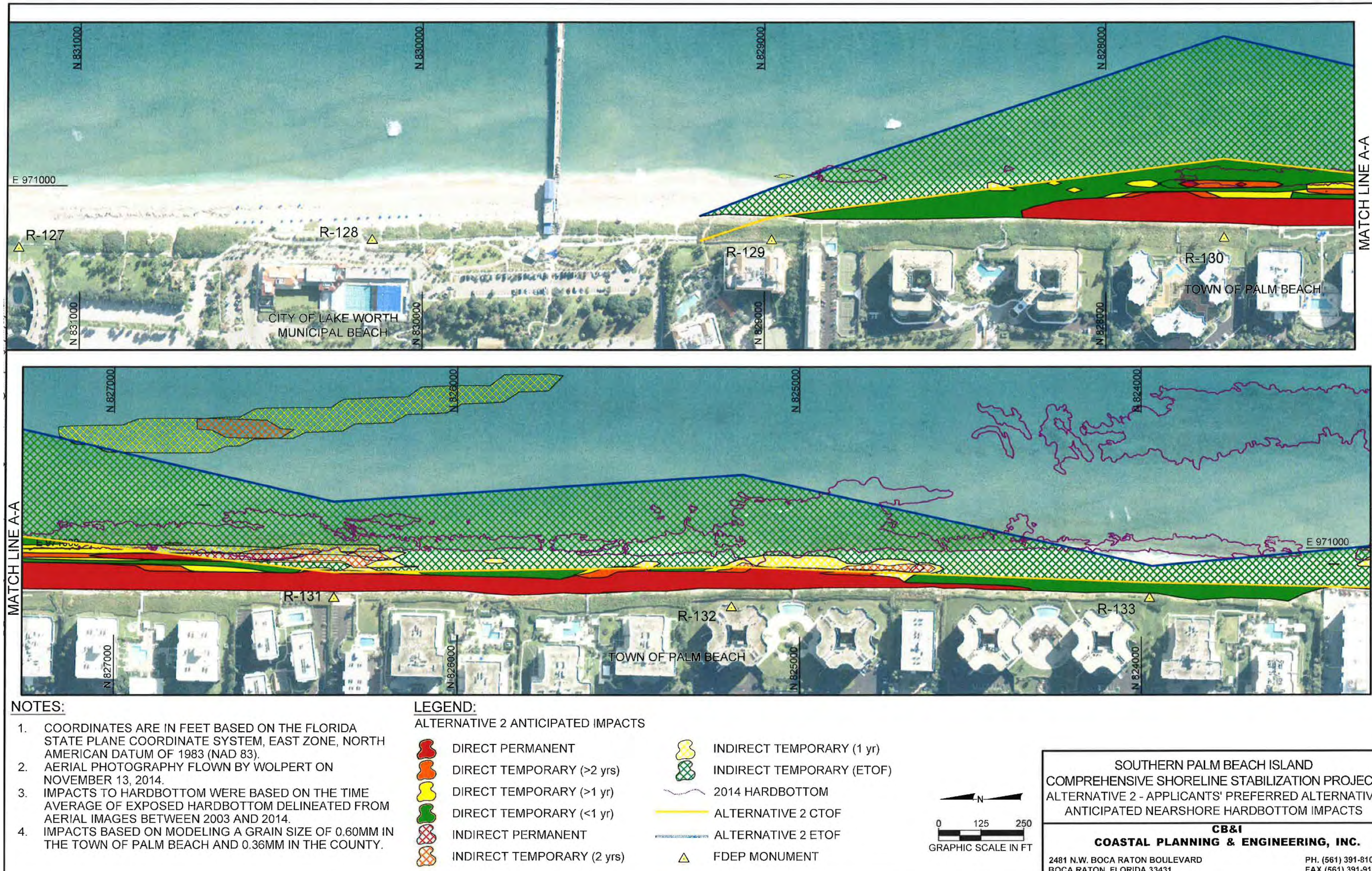

Figure 4-3. Anticipated impacts to nearshore hardbottom resources from Alternative 2 – Applicants' Preferred Alternative. Impacts based on modeling a grain size of 0.60 mm in the Town of Palm Beach and 0.36 mm in the County.

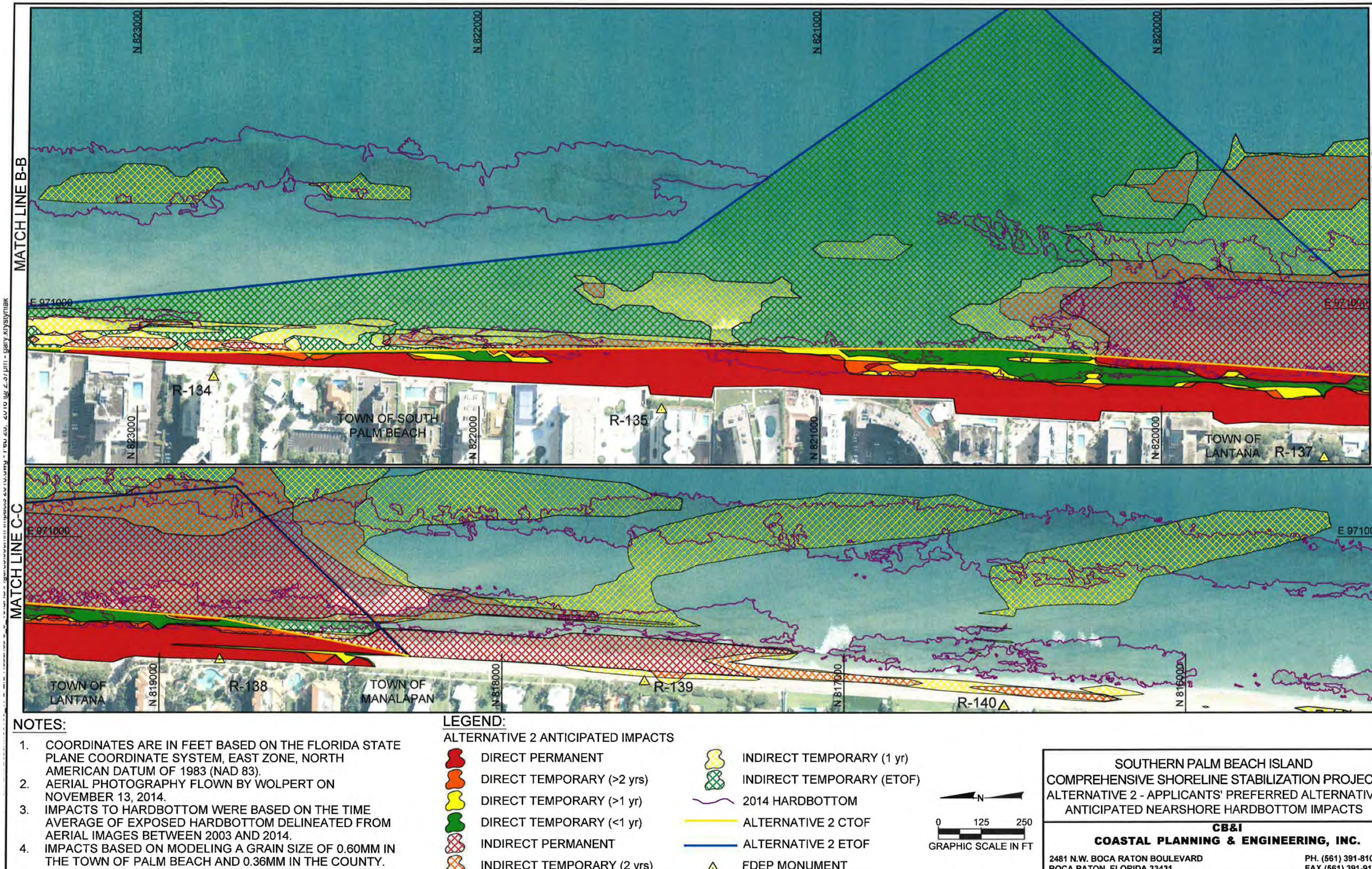

Figure 4-3 (cont.). Anticipated impacts to nearshore hardbottom resources from Alternative 2 – Applicants' Preferred Alternative. Impacts based on modeling a grain size of 0.60 mm in the Town of Palm Beach and 0.36 mm in the County.

CHAPTER 5

MITIGATION

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5.0. MITIGATION

As defined by the Council on Environmental Quality (CEQ), Title 40 Code of Federal Regulation (CFR) §1508.20, mitigation requirements include the following:

- Avoiding the impact altogether by not taking a certain action or parts of an action;
- Minimizing impacts by limiting the degree or magnitude of the action and its implementation;
- Rectifying the impact by repairing, rehabilitating, or restoring the affected environment;
- Reducing or eliminating the impacts over time by preservation and maintenance operations during the life of the action; and
- Compensating for the impacts by replacing or providing substitute resources or environments.

Under the Clean Water Act (CWA) Section 404(b)(1) Guidelines implemented through 40 CFR Part 230, the permittee shall be required to take all appropriate and practicable steps to avoid and minimize adverse impacts to waters of the United States. Compensatory mitigation for unavoidable adverse impacts may be required to ensure that an activity requiring a section 404 permit complies with the Section 404(b)(1) Guidelines. As described in this chapter, mitigation measures for the action alternatives were identified, including best management practices (BMPs) and compensatory mitigation as proposed by the applicants.

5.1. ENVIRONMENTAL COMMITMENTS

An Environmental Commitment is a measure that an applicant commits to implement in order to avoid, minimize and mitigate a real or potential environmental impact. It can be identified as early as the planning and scoping stages, during the environmental document or design processes, or as late as construction or maintenance of a project.

5.1.1. NEARSHORE HARDBOTTOM IMPACTS

5.1.1.1. AVOIDANCE AND MINIMIZATION MEASURES

Standard conservation measures will be implemented for the proposed Project, including avoidance and minimization. In order to minimize impacts to nearshore hardbottom, both Applicants propose to place the least amount of fill volume below mean high water (MHW) that is necessary to still achieve the overall Project purpose. The total volume of sand needed to construct each alternative will be dependent on the results from surveys conducted immediately prior to construction. The volumes of sand detailed in this chapter are based on the 2014 beach surveys. The Town of Palm Beach proposes to place approximately 3,400 cy of the 65,200 cy volume (5%) below MHW and the County plans to place approximately 26,600 cy of the 77,600 cy volume (34%) below MHW. Between the two projects, approximately 21% of the proposed total fill volume will be placed below MHW.

For any alternative including beach and dune fill, potential sand sources include stockpiled offshore dredged material and upland mines. The County proposes to use sand transported via truck haul from an upland sand mine for their portion of the Project. In order to minimize environmental impacts and maximize efficiency, the Town of Palm Beach proposes to dredge sand from a borrow area for the Project at the same time as future planned and separately permitted beach renourishment projects for Phipps and Mid-Town. The dredged sand will then be temporarily staged in the upland sand dunes at Phipps and Mid-Town, mechanically loaded on trucks, and hauled to the Project Area for placement and grading on the Town of Palm Beach's portion of the Project Area. This measure would avoid the adverse effects associated with dredging along the Project Area, including placement of pipelines along the seafloor that could leak sand onto hardbottom resources or physically damage hardbottom resources by direct contact. Increased turbidity in the nearshore environment would be minimized due to mechanical placement of sand rather than hydraulic placement of a sand/water slurry. All in-water fill activities would require turbidity monitoring to demonstrate turbidity levels remain within state water quality standards. In the event that the Phipps and Mid-town dredged sand is no longer available, the Town of Palm Beach would consider using upland sand as they have done in the past.

The build alternatives in this evaluation would result in unavoidable direct and indirect impacts to nearshore hardbottom resources. Hardbottom closest to shore will be directly buried by placement of beach sand immediately following construction, while equilibration will impact additional hardbottom outside the construction toe of fill over time. The engineering and Delft3D modeling results were analyzed in GIS to estimate the anticipated area of direct and indirect impacts that may occur due to construction of each alternative. This included permanent and temporary impacts. In order to conservatively quantify impacts, the area within the equilibrium toe of fill (ETOF) was also evaluated for potential impacts. Tables 5-1 through 5-3 presents the area of potential impact and mitigation required (based on UMAM evaluations) of each impact type for each alternative based on grain size analyzed. See Section 4.4 for details on the decision to use and the application of the time-average methodology.

Table 5-1. Summary of impact to nearshore hardbottom acreage and associated required mitigation acreage for Alternatives 2-7b using 0.25 mm grain size in the Town of Palm Beach and 0.36 mm grain size in the County. Acreages are based on a time-average of exposed hardbottom between 2003 and 2014.

Anticipated Impacts and Associated Mitigation (ac)	Alt 2		Alt 3		Alt 4		Alt 5		Alt 6		Alt 7b	
	Impact	Mitig	Impact	Mitig	Impact	Mitig	Impact	Mitig	Impact	Mitig	Impact	Mitig
1. Permanent	3.86	4.48	2.70	3.13	6.51	7.54	3.45	4.00	6.07	7.04	5.74	6.66
2. Direct Temporary (<1 yr)	0.87	0.03	1.43	0.04	0.38	0.01	0.82	0.02	0.26	0.01	1.75	0.05
3. Direct Temporary (>1 yr)	0.31	0.10	0.37	0.12	0.63	0.20	0.55	0.18	0.70	0.23	1.06	0.34
4. Direct Temporary (>2 yrs)	0.19	0.16	0.06	0.05	0.43	0.37	0.14	0.12	0.87	0.75	0.90	0.77
5. Indirect Temporary (1 yr)	3.35	0.53	3.91	0.62	5.06	0.80	3.89	0.62	5.92	0.94	5.51	0.88
6. Indirect Temporary (2 yrs)	1.42	0.77	1.38	0.75	2.55	1.39	1.47	0.80	2.52	1.37	3.30	1.80
7. Indirect Temporary (ETOF)	3.79	0.49	5.04	0.65	4.12	0.53	8.73	1.12	8.08	1.04	1.80	0.23
Required Mitigation	**6.55**		**5.36**		**10.84**		**6.86**		**11.37**		**10.72**	

Table 5-2. Summary of impact to nearshore hardbottom and associated required mitigation acreage for Alternatives 2-7b using 0.36 mm grain size in the Town of Palm Beach and the County. Acreages are based on a time-average of exposed hardbottom between 2003 and 2014.

Anticipated Impacts and Associated Mitigation (ac)	Alt 2		Alt 3		Alt 4		Alt 5		Alt 6		Alt 7b	
	Impact	Mitig	Impact	Mitig	Impact	Mitig	Impact	Mitig	Impact	Mitig	Impact	Mitig
1. Permanent	3.97	4.60	2.87	3.32	6.71	7.77	3.97	4.60	6.81	7.89	11.25	13.04
2. Direct Temporary (<1 yr)	0.83	0.03	1.38	0.04	0.34	0.01	0.71	0.02	0.17	0.01	0.53	0.02
3. Direct Temporary (>1 yr)	0.33	0.11	0.39	0.13	0.33	0.11	0.35	0.11	0.61	0.20	0.35	0.11
4. Direct Temporary (>2 yrs)	0.19	0.16	0.07	0.06	0.67	0.57	0.29	0.25	0.53	0.45	0.72	0.61
5. Indirect Temporary (1 yr)	3.24	0.51	3.72	0.59	5.42	0.86	4.14	0.66	6.19	0.98	4.88	0.78
6. Indirect Temporary (2 yrs)	1.44	0.78	1.57	0.85	2.50	1.36	1.52	0.83	2.62	1.43	2.50	1.36
7. Indirect Temporary (ETOF)	3.65	0.47	5.00	0.64	3.94	0.51	7.97	1.03	7.44	0.96	0.47	0.06
Required Mitigation	**6.66**		**5.64**		**11.19**		**7.49**		**11.91**		**15.98**	

Table 5-3. Summary of impact to nearshore hardbottom acreage and associated required mitigation acreage for Alternatives 2-7b using 0.60 mm grain size in the Town of Palm Beach and the 0.36 mm grain size in the County. Acreages are based on a time-average of exposed hardbottom between 2003 and 2014.

Anticipated Impacts and Associated Mitigation (ac)	Alt 2		Alt 3		Alt 4		Alt 5		Alt 6		Alt 7b	
	Impact	Mitig	Impact	Mitig	Impact	Mitig	Impact	Mitig	Impact	Mitig	Impact	Mitig
1. Permanent	3.99	4.62	2.87	3.32	6.63	7.68	4.23	4.90	6.92	8.02	8.49	9.83
2. Direct Temporary (<1 yr)	0.79	0.02	1.26	0.04	0.33	0.01	0.56	0.02	0.09	0.00	4.32	0.13
3. Direct Temporary (>1 yr)	0.28	0.09	0.48	0.16	0.31	0.10	0.23	0.07	0.24	0.08	0.21	0.07
4. Direct Temporary (>2 yrs)	0.19	0.16	0.07	0.06	0.66	0.56	0.21	0.18	0.75	0.64	0.62	0.53
5. Indirect Temporary (1 yr)	3.46	0.55	3.92	0.62	5.71	0.91	4.31	0.68	5.98	0.95	4.86	0.77
6. Indirect Temporary (2 yrs)	1.33	0.73	1.54	0.84	2.80	1.52	1.36	0.74	2.90	1.58	2.16	1.17
7. Indirect Temporary (ETOF)	3.47	0.45	5.15	0.66	3.76	0.48	7.68	0.99	7.47	0.96	6.63	0.85
Required Mitigation	**6.63**		**5.70**		**11.27**		**7.59**		**12.23**		**13.36**	

Impacts resulting in loss of ecological functions and services would require mitigation, which is described below in Sections 5.1.1.2 and 5.1.1.3. Pre-construction and post-construction biological monitoring of the nearshore hardbottom adjacent to the Project Area will provide a means for tracking potential project-related impacts to the hardbottom community (see Section 5.2.3.). Monitoring will also be conducted on the artificial reefs, the proposed mitigation, to document the success of the mitigation compared to the nearshore hardbottom habitat it is meant to mimic (see Section 5.2.4).

5.1.1.2. UNIFORM MITIGATION ASSESSMENT METHOD (UMAM) EVALUATION

The area of impact determined from the engineering analysis and Delft3D modeling study (Appendix G) was used to complete a Uniform Mitigation Assessment Method (UMAM) evaluation (Chapter 62-345, F.A.C.) for the Southern Palm Beach Island Comprehensive Shoreline Stabilization Project (Project). UMAM assesses the functions and services of the hardbottom resources predicted to be impacted, and determines the amount of appropriate mitigation to compensate for impacts to these resources. Time lag and risk are incorporated into the calculations to ensure the appropriate amount of compensatory mitigation is identified that will offset the loss of ecological functions and services due to hardbottom impacts. Time lag refers to the period of time between when the functions are lost at an impact site and when those functions are replaced by the mitigation. Mitigation risk accounts for the degree of uncertainty that the proposed mitigation will succeed at offsetting project impacts.

The UMAM evaluation presented herein was developed to specifically assess the anticipated loss of nearshore hardbottom function attributed to the construction of the Applicants' Preferred Alternative as well as to all action alternatives evaluated in the Environmental Impact Statement (EIS). Based on the modeling and ETOF analyses, seven (7) types of impacts to hardbottom were defined for the purpose of this UMAM evaluation. These impact types are described in the UMAM Analysis, provided as Appendix H. Tables 5-1 through 5-3 summarize the estimated impact acreage for each impact type and the associated mitigation which may be required for each alternative based on the grain size analyzed. In the Town of Palm Beach project area, the difference in grain size did not significantly affect the modeling results in terms of hardbottom impact when the volume of sand was relatively small (Alternative 2T). However, as the volume of sand increased, the level of impacts was affected by the grain size modeled (Alternatives 6T and 7bT) (Tables 5-4 through 5-6).

5.1.1.2.1. UMAM for Separate Town of Palm Beach and County Projects

This EIS is intended to evaluate the impacts of the two similar actions; therefore, the alternatives evaluated consist of various combinations of three potential Town of Palm Beach (T) projects and three potential County (C) projects.

The Town of Palm Beach separated alternatives include:

1. Alternative 2T - fill placed on beach and dune
2. Alternative 6T - an increased volume of fill placed on the beach and dune
3. Alternative 7bT - an increased volume of fill placed on beach with two T-head groins

The County separated alternatives include:

1. Alternative 2C - fill placed on beach with king pile and panel groins
2. Alternative 3C - fill only placed on beach (same fill volume without groins)
3. Alternative 4C - an increased volume of fill placed on the beach without groins

The various combinations of these projects make up the seven alternatives evaluated as follows:

- Alternative 1 = No Action (status quo)
- Alternative 2 = 2T + 2C
- Alternative 3 = 2T + 3C
- Alternative 4 = 2T + 4C
- Alternative 5 = 6T + 2C
- Alternative 6 = 6T + 4C
- Alternative 7b = 7bT + 2C

Since the Applicants must obtain separate permits, the Town of Palm Beach and County projects were also modeled as standalone projects. “Separated” alternatives were not modeled for every combined alternative because the separated fill templates were captured within other model runs. For example, the combined project for Alternative 2 includes the Town and the County’s preferred projects (Alt 2 = 2T + 2C), whereas Alternatives 3 and 4 also include the Town’s preferred project but variations of the County’s project as presented above (Alt 3 = 2T + 3C, Alt 4 = 2T + 4C). Therefore, during the impact analysis, the model run of Alternative 2 for the Town of Palm Beach (2T) provides the same results as Alternatives 3 and 4, which also include 2T.

Along with the combined alternatives, UMAM evaluations were conducted for the separated Town of Palm Beach and County projects. UMAM forms for the Preferred Alternative (Alternative 2) for the Town of Palm Beach and the County are provided as Sub-Appendices H-2 and H-3, respectively. A range of grain sizes were modeled for the Town of Palm Beach to provide flexibility in sand source. The County proposes only to use upland sand and therefore only one grain size was assessed for the County portion of the Project Area. Tables 5-4 through 5-6 summarize the impact and associated mitigation acreages for each alternative that may be required for the Town of Palm Beach’s standalone project. Table 5-7 summarizes the impact and mitigation acreages for the County’s standalone project.

Table 5-4. Summary of anticipated hardbottom impact and mitigation acreages for the Town of Palm Beach's standalone projects of Alternatives 2, 6 and 7b based on a grain size of 0.25 mm. Acreages are based on a time-average of exposed hardbottom between 2003 and 2014.

Town of Palm Beach Project	Alt 2		Alt 6		Alt 7b	
	Impact	Mitig	Impact	Mitig	Impact	Mitig
1. Permanent	0.01	0.01	0.07	0.08	3.98	4.61
2. Direct Temporary (<1 yr)	0.30	0.01	0.13	0.00	0.52	0.02
3. Direct Temporary (>1 yr)	0.05	0.02	0.06	0.02	0.73	0.24
4. Direct Temporary (>2 yrs)	0.03	0.03	0.02	0.02	0.56	0.48
5. Indirect Temporary (1 yr)	0.59	0.09	1.25	0.20	3.13	0.50
6. Indirect Temporary (2 yrs)	0.03	0.02	0.03	0.02	0.95	0.52
7. Indirect Temporary (ETOF)	2.80	0.36	7.03	0.91	0.76	0.10
Required Mitigation	**0.53**		**1.25**		**6.45**	
Estimated Cost of Mitigation	**$485,000**		**$1,144,000**		**$5,902,000**	

Note: Mitigation cost per acre was provided by the Town of Palm Beach at $915,000/ac.

Table 5-5. Summary of anticipated hardbottom impact and mitigation acreages for the Town of Palm Beach's standalone projects of Alternatives 2, 6 and 7b based on a grain size of 0.36 mm. Acreages are based on a time-average of exposed hardbottom between 2003 and 2014.

Town of Palm Beach Project	Alt 2		Alt 6		Alt 7b	
	Impact	Mitig	Impact	Mitig	Impact	Mitig
1. Permanent	0.03	0.03	0.13	0.15	6.77	7.85
2. Direct Temporary (<1 yr)	0.28	0.01	0.09	0.00	0.01	0.00
3. Direct Temporary (>1 yr)	0.06	0.02	0.04	0.01	0.01	0.00
4. Direct Temporary (>2 yrs)	0.03	0.02	0.05	0.04	0.04	0.03
5. Indirect Temporary (1 yr)	0.14	0.02	1.22	0.19	1.83	0.29
6. Indirect Temporary (2 yrs)	0.05	0.03	0.26	0.14	1.00	0.55
7. Indirect Temporary (ETOF)	2.79	0.36	6.52	0.84	0.21	0.03
Required Mitigation	**0.49**		**1.38**		**8.75**	
Estimated Cost of Mitigation	**$449,000**		**$1,263,000**		**$8,007,000**	

Note: Mitigation cost per acre was provided by the Town of Palm Beach at $915,000/ac.

Table 5-6. Summary of anticipated hardbottom impact and mitigation acreages for the Town of Palm Beach's standalone projects of Alternatives 2, 6 and 7b based on a grain size of 0.60 mm. Acreages are based on a time-average of exposed hardbottom between 2003 and 2014.

Town of Palm Beach Project	Alt 2		Alt 6		Alt 7b	
	Impact	Mitig	Impact	Mitig	Impact	Mitig
1. Permanent	0.05	0.06	0.36	0.42	5.11	5.92
2. Direct Temporary (<1 yr)	0.26	0.01	0.03	0.00	0.00	0.00
3. Direct Temporary (>1 yr)	0.08	0.03	0.04	0.01	0.00	0.00
4. Direct Temporary (>2 yrs)	0.03	0.03	0.04	0.04	0.07	0.06
5. Indirect Temporary (1 yr)	0.39	0.06	1.08	0.17	1.20	0.19
6. Indirect Temporary (2 yrs)	0.08	0.05	0.23	0.12	1.00	0.54
7. Indirect Temporary (ETOF)	2.70	0.35	6.45	0.83	1.72	0.22
Required Mitigation	**0.57**		**1.59**		**6.93**	
Estimated Cost of Mitigation	**$522,000**		**$1,455,000**		**$6,341,000**	

Note: Mitigation cost per acre was provided by the Town of Palm Beach at $915,000/ac.

Table 5-7. Summary of anticipated hardbottom impact and mitigation acreages for Palm Beach County's standalone projects of Alternatives 2, 3 and 6 based on a grain size of 0.36 mm. Acreages are based on a time-average of exposed hardbottom between 2003 and 2014.

Palm Beach County Project	Alt 2		Alt 3		Alt 6	
	Impact	Mitig	Impact	Mitig	Impact	Mitig
1. Permanent	3.93	4.55	2.89	3.35	6.83	7.92
2. Direct Temporary (<1 yr)	0.57	0.02	1.08	0.03	0.22	0.01
3. Direct Temporary (>1 yr)	0.25	0.08	0.35	0.11	0.24	0.08
4. Direct Temporary (>2 yrs)	0.17	0.14	0.04	0.03	0.65	0.56
5. Indirect Temporary (1 yr)	3.03	0.48	3.67	0.58	3.67	0.58
6. Indirect Temporary (2 yrs)	1.42	0.77	1.63	0.89	1.63	0.89
7. Indirect Temporary (ETOF)	0.78	0.10	2.04	0.26	2.04	0.26
Required Mitigation	**6.15**		**5.26**		**10.29**	
Estimated Cost of Mitigation	**$4,920,000**		**$4,208,000**		**$8,232,000**	

Note: Mitigation cost per acre was provided by the County at $800,000/ac.

5.1.1.3. COMPENSATORY MITIGATION

In order to offset the ecological functions of the intertidal and subtidal hardbottom which may be impacted by the Applicants' Preferred Project or any other alternative, the mitigation would be designed and located so that it will mimic the impacted resources as closely as possible. The Applicants intend to create artificial habitat that closely mimics the characteristics of adjacent nearshore habitat, which is typically low relief limestone pavement colonized by an opportunistic community dominated by turf and macroalgae species that recruit quickly when substrate is available. The artificial reef should replicate the physical appearance, texture, relief and ecological function of the habitat it is meant to replace. Limestone is very similar to natural hardbottom substrate, and is typically used in construction of artificial reefs in Florida. A recent deployment of mitigative artificial reef in the County included modules consisting of a concrete slab with limestone cobbles. The Town of Palm Beach and the County both propose to construct mitigation reefs that will consist of a single layer of limestone boulders. The artificial reefs that will be constructed will be placed in a similar depth and in the general vicinity of the impacted hardbottom.

Planning for the Project was formulated to include a 50-year horizon considering sand resource utilization and project life-spans of approximately 3-4 years. Assessment of the mitigation requirements for impacts to nearshore hardbottom was computed over an indefinite (perpetual) horizon, i.e., presuming perpetual impacts to resources. The development of the seven impact types was driven by the numerical modeling approach to determine sand movement and accumulation as well as the ephemeral nature of this particular hardbottom habitat. From aerial analysis, the hardbottom is constantly subject to burial and exposure. It is anticipated that project construction would contribute to the permanent and temporary burial of some hardbottom habitat; however, the UMAM captures these impacts and assumes that mitigation required for the initial placement would address all impacts associated with future renourishments permitted under this Project.

The general artificial reef-siting criteria being used by the Town of Palm Beach and the County are as follows:

1. Similar water depth to impacted hardbottom resources to facilitate similar benthic recruitment;
2. Maintain a protective buffer of at least 7.6 m (25 ft) from exposed nearshore hardbottom in order to avoid additional impacts or influence;

3. Underlying sediment thickness between 0.3 and 0.9 m (1 and 3 ft) to avoid subsidence of the artificial reef.

The Town of Palm Beach and County have each identified potential locations for artificial reefs (Figure 5-1); however, the final determinations would be based on additional surveys and on final mitigation conditions which would be required by any project permits. Additional details are provided in Appendix I – Mitigation Plan.

The preferred location for the Town of Palm Beach County's mitigation reef is in the nearshore zone in the vicinity of R-104.5, approximately 244 m (800 ft) seaward of the MHW line in approximately 4.6 m (15 ft) water depth (Figure 5-1). Field surveys of the area have been conducted to support mitigation reef siting for the Mid-Town Project. These were completed in August 2014 and are based on the most recent site information including probe measurements of nominal sand depth. The proposed mitigation reef dimensions would be approximately 91 m x 23 m (300 ft x 75 ft) and would consist of one layer of limestone boulders providing 0.3-1.2 m (1-4 ft) vertical relief with a maximum of 1.8 m (6 ft) vertical relief. Details of the Town of Palm Beach's mitigation are provided in Appendix I and Sub-Appendix I-1.

The preferred location for the County's mitigation reef is in the nearshore zone between R-137-330 and R-137+400 (Lantana Public Beach) (Figure 5-1). A seismic survey was completed in October 2014 between R-134 and R-139 in order to map the vertical extent of sand overlying hardbottom. The mitigation reef would consist of a single layer of limestone boulders clusters in approximately -2 m to -6 m (-6 ft to -20 ft) NGVD and would be placed on substrate that is approximately 0.3-0.9 m (1-3 ft) of sand over bedrock. To minimize potential impacts to sediment transport, the spacing between the clusters may be similar to those of the mitigation built for the Juno Beach Renourishment Project. The clusters would likely have a dimension of 6 m x 12 m (20 ft x 40 ft) and space between each cluster would likely be 11 m (35 ft) laterally and 9 m (30 ft) longitudinally. The limestone boulders shall have a minimum weight of 998 kg (2,200 lbs) and shall not exceed 2,722 kg (6,000 lbs) with at least 95% of the boulders between 998 kg (2,200 lbs) and 2,631 kg (5,800 lbs). Construction shall be consistent with the FDEP approved mitigation for the Juno Beach Renourishment (FDEP Permit No. 0267415-001-JC). Sketches of the typical layout and cross-section of the proposed artificial reef designed by Palm Beach County Department of Environmental Resources Management (PBC-ERM) are included in Sub-Appendix I-2.

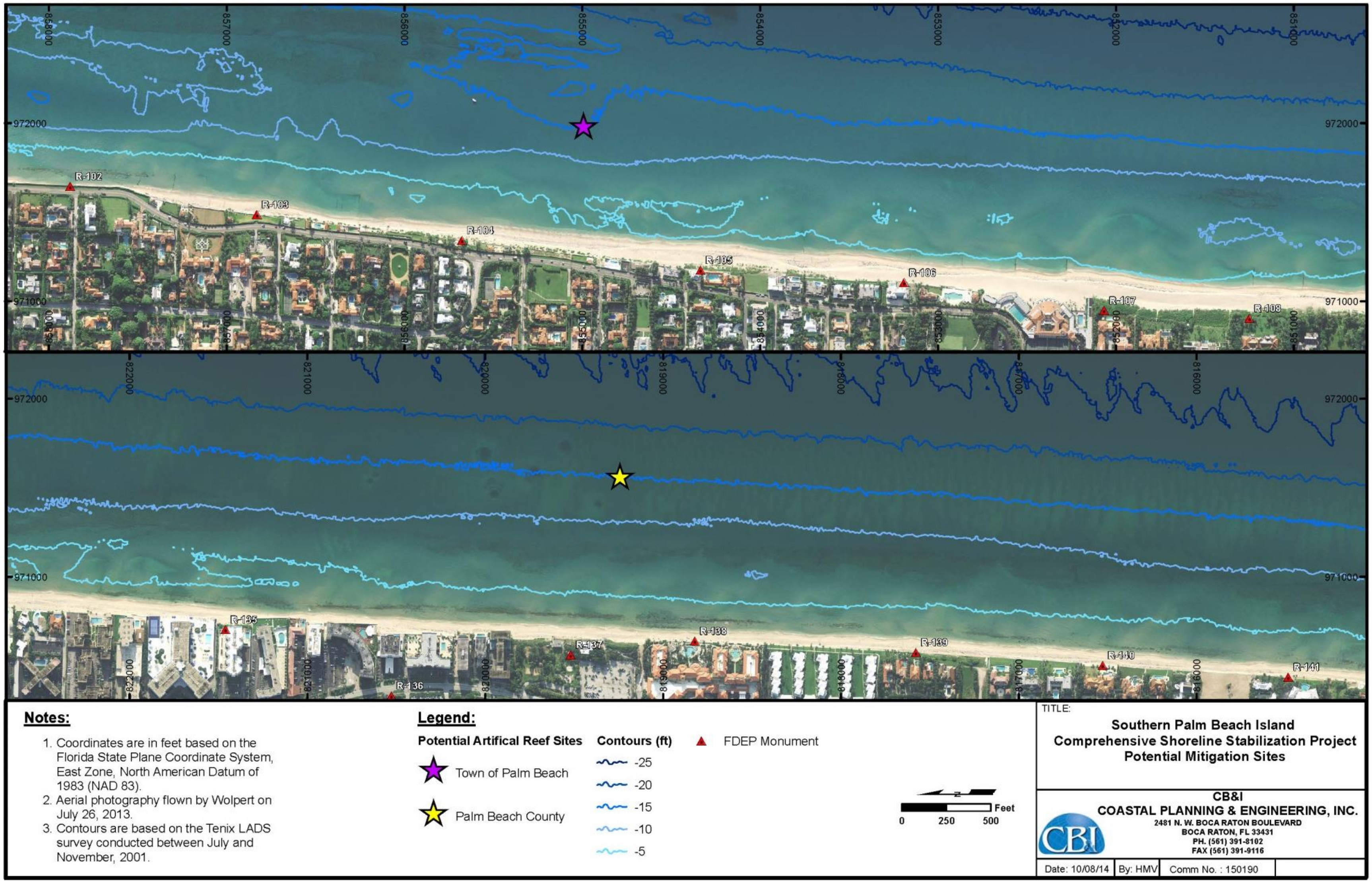

Figure 5-1. Potential mitigation sites.

5.1.2. BEST MANAGEMENT PRACTICES

During construction activities for all alternatives, the Applicants would implement standard construction BMPs to avoid affecting the surrounding environments. BMPs would also be implemented to minimize the potential for adverse effects. Standard construction BMPs include, but are not limited to:

1. During construction the Project would require the implementation of sediment barriers to ensure water quality, including construction of berms or dikes;
2. The use of a turbidity mixing zone in accordance with the 401 WQC if required by the FDEP.
3. Downstream turbidity shall be monitored to ensure state turbidity standards (29 nephelometric turbidity units above background) are not exceeded;
4. Maintaining construction equipment according to the manufacturer's specifications and storing it in designated and permitting staging areas;
5. Transporting construction debris to a landfill or otherwise disposed of in accordance with federal, state, and local requirements; and
6. Marking the mean high water line in the field and having an independent contractor on-site to verify no material is placed waterward of the mean high water line in areas where no dune-only fill is proposed.

5.1.3. THREATENED AND ENDANGERED SPECIES AND WILDLIFE HABITAT

Although specific details will be developed as ESA Section 7 consultation occurs between the U.S. Amy Corps of Engineers (USACE) and the U.S. Fish and Wildlife Service (USFWS) and NMFS, it is anticipated that at a minimum, the following measures shall be incorporated during project construction to minimize effects on any threatened or endangered species that may occur in the mitigation construction site: NMFS Sea Turtle and Smalltooth Sawfish Construction Conditions (NMFS, 2006) and FWC's *Standard Manatee Construction Conditions for In-Water Work* (FWC, 2011).

5.1.3.1. SEA TURTLES

As mentioned in Chapter 3, the three sea turtle species that frequent the Project Area are the loggerhead, green and leatherback sea turtles. On average, from 2009-2015, the Project Area supported 1,254 loggerhead sea turtle nests, 89 green sea turtle nests, and 13 leatherback sea turtle nests per nesting season (Brost, 2016). Consideration of impacts to the nesting activity of these species due to project activities was included in the effects determinations in Chapter 4. Construction activities will avoid peak sea turtle nesting season (May 1 – Oct 31) in order to minimize impacts to nesting sea turtles - the potential for direct burial of nests and disturbance to nesting sea turtles is significantly reduced. The reasonable and prudent measures and the terms and conditions for the protection of turtles from the USFWS Statewide Programmatic Biological Opinion (SPBO) will apply to this Project. Monitoring for sea turtle nesting will be consistent with requirements stated in the state and federal permits, including those outlined in the USFWS SPBO. In addition to these measures, the Applicants will comply with the NMFS Sea Turtle and Smalltooth Sawfish Construction Conditions (NMFS, 2006) and FWC's Standard Manatee Construction Conditions for In-Water Work (FWC, 2011).

Additionally, adherence to the PBC-ERM Sea Turtle Protection Ordinance will be required. This ordinance, enacted in 1987, requires that all coastal construction adhere to strict guidelines to eliminate impacts to sea turtles, prevent any more lights from being installed along the beach and require that no lights be visible from the beach from March 1 through October 31. Within the Project Area, Lantana and Manalapan are within the jurisdiction of Article 14.A of the Unified Land Development Code. This ordinance can help minimize the effect of artificial lighting by adopting more sea turtle compatible lighting. The Town of Palm Beach and South Palm Beach have opted-out of the ordinance.

The burial of potential subtidal foraging habitat within the predicted impact area will be offset through mitigation as specified in Section 5.1.1.

5.1.3.2. MANATEES

The utilization of a truck haul approach for the nourishment portion of the Project minimizes the potential to affect manatees through construction activities. However, in-water vessels may be used during turbidity monitoring during project construction as well as during construction of the low-profile groins and artificial reefs. As mentioned above under Section 5.1.3., during any in-water work, the contractor will adhere to FWC's *Standard Manatee Construction Conditions for In-Water Work* (FWC, 2011).

In July 2007, PBC-ERM developed a Manatee Protection Plan (MPP) (CUESFAU and EAI, 2007) that has been approved by FWC. Protection measures from the MPP, which incorporates the FWC measures, are outlined below and the implementation of these protection measures will minimize the potential for significant impacts to manatees by any vessels associated with construction activities.

1) The contractor will advise all personnel associated with the construction of the Project about the potential presence of manatees in the Project Area and the need to avoid collisions with manatees. All construction personnel shall be responsible for observing water-related activities for the presence of manatees and shall implement appropriate precautions to ensure the protection of manatees.

2) All construction personnel shall be advised that there are civil and criminal penalties for harming, harassing, or killing manatees which are protected under the Marine Mammals Protection Act of 1972, the Endangered Species Act of 1973, and the Florida Sanctuary Act. The contractor shall be held responsible for any manatee harmed, harassed, or killed as a result of the construction of the Project.

3) Prior to the commencement of construction, the construction contractor shall construct and install at least two temporary signs concerning manatees. One sign, for all vessels, with a size of at least 8.5 in x 11 in, shall read "Caution: Manatee Habitat. Idle Speed is Required if Operating a Vessel in the Construction Area". A second temporary sign, at least 8.5 in x 11 in, shall read "Caution: Manatee Habitat. Equipment Must be Shut down Immediately if a Manatee Comes Within 50 feet of

Operation. A collision with and/or injury to a manatee shall be immediately reported to the Florida Marine Patrol (FMP) at 1-800- DIAL FMP (1-800-342-5367) and the USFWS at 1-561-562-3909." This second sign shall be located adjacent to the displayed construction permit.

4) All vessels associated with the Project will be required to operate at "no wake" speeds at all times while in the waters where the draft of the vessel provides less than four feet of clearance from the bottom. All vessels shall follow routes of deep water whenever possible.

5) If a manatee is sighted within a hundred yards of the construction area, appropriate safeguards will be taken, including suspension of construction activities, if necessary, to avoid injury to manatees. These precautions shall include the immediate shutdown of all moving equipment when a manatee is sighted within 50 feet of construction. Construction activities shall not resume until the manatee has departed from the construction area on its own violation.

6) The contractor shall maintain a log detailing sightings, collisions, or injuries to manatees should they occur during the contract. Within 90 days after the contract period, a report summarizing incidents and sightings shall be submitted to the Florida Fish and Wildlife Conservation Commission (FWC) Bureau of Protected Species Management and to the USFWS.

7) Any collision with and/or injury to a manatee shall be reported immediately to the FMP at 1-800-DIAL-FMP (1-800-342-5367) and USFWS in Vero Beach.

5.1.3.3. SMALLTOOTH SAWFISH

Although it is unlikely that smalltooth sawfish will be present within the construction area, the Sea Turtle and Smalltooth Sawfish Construction Conditions developed by NMFS will be implemented during construction activities (NMFS, 2006).

5.1.3.4. DUNE VEGETATION

The Town of Palm Beach and the County both plan to plant their respective dunes after construction. The dune vegetation planting plan is based on the Town of Palm Beach's 2010 application to construct the south end of Reach 8. After beach construction, the dune will be planted with a mix of native coastal dune pioneer plants, which may include sea oats (*Uniola paniculata*), beach sunflower (*Helianthus debilis*), railroad vine (*Ipomoea pes-caprae*), bay bean (*Canavalia rosea*), and golden creeper (*Ernodia littoralis*), depending upon nursery availability at the time of planting (CSI, 2011b). Roughly 350,905 planting units will likely be installed 45.7 cm (18.0 in) on center in staggered rows on the dune crest. Sea oats will be planted first and will likely cover approximately 80% of the total area to be planted. Dune sunflower, railroad vine, bay bean, and golden creeper will be planted in the remaining areas, in approximately equal quantities. Planting will occur after construction of the berm is complete. The root balls of the sea oats will likely be planted 15.2-20.3 cm (6-8 in) below the soil surface. The root balls of the remaining species will likely be planted 10.2-15.2 cm (4-6 in) below the soil surface. A water management gel (i.e. horta-sorb) may be used as a soil amendment at the time of planting to assist in water maintenance to the plant material without a permanent irrigation system. Holes will be backfilled/closed and the soil tamped around each plant. Plants will be thoroughly watered immediately after planting and for 180 days (or until established) at a rate of three times per week.

5.2. MONITORING

Monitoring requirements cannot be verified until the issuance of a permit, however, the following sections summarize the monitoring requirements that are likely to be conducted in association with the Project. This information is based on standard state and federal protocols and permit requirements, recent Town of Palm Beach and County projects, and the Beach Management Agreement (BMA) (FDEP, 2013).

5.2.1. PHYSICAL

The physical monitoring for the proposed Project will include topographic and hydrographic surveys of the beach and nearshore in order to observe and assess beach conditions. Monitoring surveys are further needed to continually observe the performance of the proposed Project as well as assess effects on adjacent shorelines. Similar to previous surveys conducted within the area, the physical monitoring plan will be conducted in accordance with the FDEP's Monitoring Standards for Beach Erosion Control Projects (FDEP, 2004).

The field survey and data collection activities will most likely encompass four (4) phases. Brief descriptions of each survey phase, including methodologies and quality control/quality assurance procedures, are described below:

Phase One: Control Reconnaissance/Establishment/Verification

Prior to the start of the survey, reconnaissance of the monuments will be conducted to confirm that survey control points are in place and undisturbed. Real Time Kinematic Global Positioning System (RTK GPS) will be used to locate and confirm survey control for this Project. The vertical accuracy of control data will meet the accuracy requirements set forth in Section 01000 and Chapter 61G17-6, F.A.C. of ± 0.16 feet. The horizontal accuracy of the control data will meet the Geospatial Positioning Accuracy Standards, Range VIII of a maximum ± 0.66 feet as stated in section 01000, Beach Profile Topographic Surveying in FDEP's Monitoring Standards for Beach Erosion Control Projects (FDEP, 2004). In order to achieve required accuracy, the topographic and hydrographic surveys will be controlled using 2nd order FDEP "A" monuments. Horizontal and vertical positioning checks will be conducted at the beginning and end of each day using at least two 2nd order FDEP "A" monuments in the Project Area. The RTK GPS utilizes statistical methods to ensure the accuracy of RTK GPS data remains within the 95% confidence interval. The control check shots will be acquired using Trimble survey style Topo Shot. Topo Shot logs data for a minimum of five (5) epochs and results in a high accuracy location. Results from 2nd order "A" monument control checks are displayed showing northing, easting, monument elevation, inverses, horizontal and vertical root mean square error, location description, and photographs. Control for the individual profile monument locations will be verified using RTK GPS. Profile control information for all 3rd order FDEP R- monuments and other control stations will be digitally inserted into data collectors prior to field work.

Control information includes the northing, easting, elevation, and profile azimuth of the control station. This information is vital to quickly access R-monuments for RTK GPS topo shots or otherwise set profile control. Surveyors will set hubs, using RTK GPS, at profile locations that will require rod and level survey techniques.

Phase Two: Beach Profiles

Upon completion of the control reconnaissance survey, beach/upland and nearshore operations will be initiated. Cross-sections of the beach in the Project Area will be surveyed using extended rod RTK GPS rovers, standard RTK GPS rovers, and differential leveling techniques. Extended rod RTK GPS rovers will be used to augment RTK GPS survey capability into the nearshore. The current systems will allow surveyors to collect the entire beach profile with RTK GPS technology. Incorporation of RTK GPS into monitoring surveys greatly reduces the potential for human error during data collection and reduction. Furthermore, RTK GPS provides accuracies of 2 cm ± one (1) part per million (ppm), with true horizontal positioning to the survey data point, regardless of sea state.

Profiles will commence from the onshore control point and extended seaward, overlapping the offshore data. Nearshore portions of the profiles will be surveyed. The nearshore survey will extend seaward to a point overlapping the offshore portion of the profiles by at least 50 ft.

The upland portion of the survey will commence at the waterline and extend 150 ft landward of the vegetation line or until an obstacle is encountered. Elevations will be taken at approximately 25-ft intervals along each profile line and at all grade breaks.

Phase Three: Nearshore/Offshore Profiles

The nearshore/offshore profiles will be conducted at each R-monument within the proposed Project Area. The profiles will be obtained from the surf zone seaward out to and beyond the depth of closure. Typical profiles extend approximately 3,000 ft offshore. The landward limits of the nearshore profiles will be based on a minimum overlap of 5 ft beyond the seaward extent of beach profiles. Soundings will be collected at a maximum of 25-ft intervals, sufficient to provide an accurate depiction of the seafloor.

Horizontal and vertical positioning checks will be conducted at the beginning and end of each day. The sounder will be calibrated via bar-checks and a sound velocity probe at the beginning and end of the day. Bar-checks will be performed from a depth of 5 -25 ft.

Phase Four: Data Reduction/Submittals

Upon completion of the field work, data will be edited and reduced. The offshore raw digital data will be viewed in HYPACK (or similar program) and a comma delimited file will be created and exported to ArcGIS for the plan view plots. The offshore RTK GPS tide data will be compared to the manually collected RTK GPS nearshore tide data, observed and predicted tides, for data verification purposes. The onshore and offshore data will be merged and a representative cross-section will be derived for each profile line. The final plots will be edited and reviewed, with comparisons to previous years; to note and resolve discrepancies. The final approved cross-section data will be prepared in the required FDEP formats for submittal.

Aerial Photography

The environmental aerial photography acquisition will be conducted in accordance with section 02100, Environmental Aerial Photography in FDEP’s Monitoring Standards for Beach Erosion Control Projects (FDEP, 2004).

Aerial photography also provides information linking physical conditions and biological conditions at the Project site. This monitoring produces controlled, vertical, color aerial photography along the coastline for the primary purpose of mapping and quantifying exposed nearshore hardbottom and natural/artificial reefs. Aerial photography and biological survey work should occur as close together as reasonably possible.

The aerial photographs allow documentation and consistency between conditions identified along surveyed profile lines and the field delineation of the exposed nearshore hardbottom.

5.2.2. TURBIDITY MONITORING AND SEDIMENT QA/QC

During project construction, turbidity monitoring will be conducted to demonstrate compliance with state water quality standards at the mixing zone boundary. Monitoring will occur at both the designated background locations and at the compliance monitoring stations. Turbidity will be minimized during construction by the following means: all sand will meet technical standards, any materials deposited above the maximum tolerance elevation or outside designated Project Area will be classified as misplaced material and will result in a suspension of operations, sand deposited which does not meet the Applicants' specifications will be classified as non-compliant material and will result in a suspension of operations, all sand will be free of construction debris, rocks, clay, or other foreign matter, and all sand will have less than 1% organic material (Chapter 2, Section 2.5; Appendix B).

A sediment QA/QC plan will be provided to state and federal agencies during the permitting process, and construction will comply with this plan to ensure the quality of the sand placed on the beach.

5.2.3. NATURAL HARDBOTTOM MONITORING

The purpose of monitoring the nearshore natural hardbottom adjacent to the Project Area is to detect unanticipated project-related impacts. A pre-construction biological assessment of the nearshore hardbottom habitat will document the existing conditions of the hardbottom resources and provide a baseline for post-construction comparisons. The monitoring area will include the nearshore hardbottom resources between R-127 and R-141, and likely north and south of the Project Area, as well. While the biological monitoring which is currently conducted under the BMA, includes four transects within the Project Area (FDEP, 2013), it is proposed that the eight shore-perpendicular transects that were monitored for the Southern Palm Beach Island Comprehensive Shoreline Stabilization

Project 2013 Habitat Characterization Report (Appendix D) (where BMA transects are not located) also be monitored for the proposed Project; the addition of these transects will supplement the BMA data and will increase the ability of the monitoring to detect potential unanticipated impacts from the Project.

Monitoring for the nearshore natural hardbottom resources will be conducted in the summer and will likely include *in situ* mapping of the hardbottom resources as well as assessing the benthic habitat along shore-perpendicular transects using quadrat assessments, sediment depth measurements and video documentation. Several additional means for assessing and monitoring the nearshore hardbottom resources have been recommended by FDEP through implementation of the BMA (FDEP, 2013). These include documenting line-intercept for sediment along transects and conducting biannual aerial photograph analyses for hardbottom resources. Results for each monitoring event will be compared with previous surveys to identify if any unanticipated adverse effects or unauthorized impacts occurred. The pre-construction and post-construction monitoring plans will be coordinated with National Marine Fisheries Service Habitat Conservation Division prior to the USACE permit decision.

5.2.3.1. TRANSECT MONITORING

Shore-perpendicular transects will be established on the nearshore hardbottom to monitor for potential project-related impacts. Four BMA transects are located in the same location as transects sampled during 2013 habitat characterization survey (CB&I, 2014, Appendix D); it is proposed that the eight remaining transects which were sampled between R-130 and R-141 during the 2013 survey continue to be monitored for better analysis of potential unanticipated impacts. Some of the BMA transects which are being monitored south of the Project Area may suffice to determine any unanticipated downdrift impacts. The methodologies employed to conduct transect sampling will include a quadrat-based assessment technique to obtain quantitative data for use in spatial and temporal comparisons of the benthic community. Sediment dynamics will be monitored by measuring sediment depth and conducting line-intercept surveys along the transects. Sediment depth data will be collected at 1.0 m (3.3 ft) intervals to provide a snapshot of the cross-shore sand distribution within the nearshore habitat. Additionally, line-intercept for sediment is useful to document sediment cover and the location of physical transitions in the nearshore habitat, providing a ratio of hardbottom to sand for the area along each transect. Video documentation will also be included in all surveys.

5.2.3.2. HARDBOTTOM MAPPING – *IN SITU* AND AERIAL ANALYSIS

Mapping the location and extent of exposed nearshore hardbottom resources can be accomplished through *in situ* diver-verified delineation as well as by analysis of aerial photographs. For *in situ* delineation, the hardbottom will be mapped by recording the position of a diver swimming along the hardbottom-sand interface when water depth allows for safe boat access. The diver will tow a buoy with a GPS antenna mounted on it, attached by cable to a topside positioning system. The buoy will be on the shortest possible tether, such that the buoy is directly over the diver’s head. The diver will follow the contour of the most prominent hardbottom-sand interface, e.g., ignoring isolated mobile rubble in the midst of sand. For the intertidal hardbottom in water depths too shallow to survey with the above methods, two biologists will either snorkel or walk around the hardbottom-sand interface with a hand-held GPS. It is anticipated that mapping may be conducted twice prior to construction and three times after construction (CSI, 2011a).

Aerial analysis, currently implemented under the BMA, will provide a snapshot of the sediment dynamics within and adjacent to the Project Area at any one time and aids in understanding the natural variability of a specific area over time. When possible, it is recommended that the *in situ* mapping be conducted as close as possible to the aerial photography survey in order to have a comparison of two different methods of hardbottom edge delineation (FDEP, 2013).

5.2.4. MITIGATION REEF MONITORING

It is anticipated that the reef would be constructed in the same year as the proposed Project. Monitoring of the mitigation reefs will be conducted in the summer, likely beginning approximately one year after construction and repeated annually for three to five years post-construction. This timeframe is sometimes shortened if biological monitoring shows the reefs are trending towards success at offsetting project impacts to natural hardbottom.

The functional success of the artificial reefs will be tracked through a biological monitoring program coordinated with state and federal agencies. Depending on the layout of the reefs, transects will likely be spaced throughout the reef and quadrats will be sampled along these transects to quantify the benthic habitat. Additionally, video and photo-documentation will be collected. The perimeter of the artificial reef may be mapped to document potential subsidence of the boulders and line-intercept may also be conducted to ensure the correct rock to sand ratio is installed within the mitigation reef footprint. This monitoring will determine trends toward success or failure. Regulatory agencies may extend monitoring periods until the mitigation has obtained ecological success or met the prescribed performance standards.

5.2.5. DUNE VEGETATION MONITORING

A dune planting plan for the Town of Palm Beach South End Restoration (Reach 8) Project (CSI, 2011b) was established in December 2011 and may be adopted to evaluate the installation of plants and ensure that planting will be conducted in accordance with the plans and specifications for the proposed Project. Post-construction monitoring will also occur to determine plant survivorship and success.

5.2.6. SHOREBIRDS

Shorebird monitoring will comply with FWC requirements and the Shore Protection Activities in the Geographical Region of the North and South Florida Ecological Services Field Offices Programmatic Piping Plover Biological Opinion (P^3BO) if deemed applicable by the USFWS (USFWS, 2013e).

5.2.7. ESCARPMENT AND COMPACTION

Monitoring for escarpments during and after project construction will follow requirements stated in state and federal permits, in addition to those outlined in the USFWS SPBO.

Generally, the requirement for compaction monitoring can be eliminated if the decision is made to till regardless of post-construction compaction levels.

5.2.8. BEACHFRONT LIGHTING

Project construction will only occur during daylight hours; therefore, no project-related beachfront lighting will be required. Post-construction lighting surveys may be required as part of permit conditions for sea turtle protection.

5.2.9. MONITORING SCHEDULE

Physical and biological monitoring of the nearshore habitat will be conducted during the pre- and post-construction timeframe for a period determined appropriate by state and federal regulatory agencies. Artificial reef monitoring will likely be required for up to three to five years post-construction to document that the mitigation succeeds at offsetting hardbottom impacts. Dune vegetation monitoring will occur after dune plantings are complete and will continue as recommended by regulatory agencies. Monitoring for turbidity, sea turtles and shorebirds will occur during construction activity. Sea turtle monitoring will continue throughout nesting and hatching season and will be required for two nesting seasons following construction as per the SPBO (USFWS, 2015).

CHAPTER 6

PERMITS, LICENSES, AND COMPLIANCE WITH ENVIRONMENTAL REGULATIONS

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6.0. COMPLIANCE WITH ENVIRONMENTAL REGULATIONS

Coordination with and evaluation of required compliance with specific federal acts, executive orders, and other policies for the various alternatives was achieved, in part, by coordinating this document with appropriate agencies and the public. This section documents compliance with all applicable federal statutes, executive orders, and policies. This chapter also summarizes the federal permits and licenses that will be required for the action alternatives. The Applicants are responsible for obtaining the required regulatory documents and approvals. Chapter 4 described compliance with environmental requirements, which includes many of the same agencies and regulatory requirements as described below.

6.1. CLEAN WATER ACT OF 1972, AS AMENDED

The Federal Water Pollution Control Act Amendments of 1972 became commonly known as the Clean Water Act (CWA) with its amendment in 1977. The act established the basic structure for regulating discharges of pollutants into the waters of the United States. The Proposed Action would result in the discharge of clean fill in navigable waters and would require a CWA, Section 404 Dredge and Fill Permit issued by U.S. Army Corps of Engineers (USACE). A Section 404 permit application has been submitted to USACE. A Section 404(b) evaluation is included in Appendix L. In addition, a public notice was issued in a manner which satisfies the requirements of Section 404 of the Clean Water Act. This Environmental Impact Statement (EIS) has been prepared in accordance with the National Environmental Policy Act (NEPA) and the Council on Environmental Quality's implementing regulations, and will serve as the primary document to aid the USACE in its decision to issue, issue with special conditions, or deny the Section 404 Permit for the proposed Project. The Applicants have submitted separate applications to the USACE for their proposed projects. The USACE has decided to consider the combined impacts of these similar proposed actions in a single EIS. The Record of Decision (ROD) for each project, Town of Palm Beach and Palm Beach County, will be prepared for the EIS in accordance with NEPA, which will support the USACE's decision on any Department of the Army (DA) authorization.

Section 401 of the CWA requires an applicant for a federal permit that would result in the discharge of a pollutant into waters of the United States to obtain a certification from the State that the discharge will comply with the applicable effluent limitations and water quality standards. Prior to issuance of a DA Section 404 permit, State Water Quality Certification (WQC) must be provided. The FDEP will issue the WQC in the form of a Joint Coastal Permit (JCP). Pursuant to Section 161.055 of the Florida Statutes, the Florida Legislature has authorized FDEP to issue JCPs for coastal construction permits, environmental resource permits and sovereign submerged lands authorizations.

In addition, the Proposed Action may also require a Section 402, National Pollution Discharge Elimination System permit by Florida DEP. The National Pollution Discharge Elimination System (NPDES) permitting program regulates point sources that discharge pollutants in waters of the United States. FDEP administers Florida's NPDES permits under FAC Rule 62-621.300(4), from authority granted by USEPA. The issued NPDES permits anticipate operation of the beach project. If any of the Project build alternatives are authorized, the Applicants may be required to have their selected contractors apply for the NPDES permit from FDEP and provide a stormwater pollution prevention plan prior to start of construction.

The Proposed Action complies with the CWA of 1972, as amended.

6.2. SECTION 10 OF THE RIVERS AND HARBORS ACT OF 1899

The construction of any of the alternatives proposing work or fill within tidal waters (at or below the Mean High Water line would require authorization in accordance with Section 10 of the Rivers and Harbors Act of 1899 (RHA). The RHA covers construction, excavation, or deposition of materials in, over, or under such waters, or any work which would affect the course, location, condition, or capacity of those waters. This EIS will serve as the primary document to aid the USACE in its decision to issue, issue with special conditions, or deny the Section 10 Permits for the Applicants' proposed projects. The ROD will support the USACE's decision on any DA authorization.

6.3 COASTAL ZONE MANAGEMENT ACT OF 1972

The Coastal Zone Management Act of 1972, as amended, provides the national policy to preserve, protect, develop, and restore the nation's coastal zones and was established to encourage states to better manage their coastal resource. The statute assists coastal states in developing state coastal management programs and achieving a balance between competing uses of coastal resources. The statute requires that federal actions that may affect any land or water use of the coastal zone be "consistent" with the enforceable policies of a coastal state's or territory's federally approved coastal management program. The Proposed Action is consistent with the Florida Coastal Management Program. The Florida Department of Environmental Protection (FDEP) will determine CZMP consistency for the Proposed Action. Appendix M contains the Coastal Zone Management Act consistency evaluation and will be submitted to the Florida State Clearinghouse for review. Coastal Zone Management Act approval will be obtained prior to the USACE's permit decision.

6.4 SECTION 176(C) OF THE CLEAN AIR ACT GENERAL CONFORMITY RULE REVIEW

The General Conformity Rule ensures that the actions taken by federal agencies in nonattainment and maintenance areas do not interfere with a state's plans to meet National Ambient Air Quality Standards (NAAQS). Under the General Conformity Rule, federal agencies must work with State, Tribal and local governments in a nonattainment or maintenance area to ensure that federal actions conform to the air quality plans established in the applicable state or tribal implementation plan. Authorization by USACE for the proposed projects will be evaluated under the general conformity requirements of Section 176(c)(1) of the Clean Air Act since these projects will produce air emissions. No air quality permit will be required for this project.

6.5 MARINE PROTECTION, RESEARCH AND SANCTUARIES ACT OF 1972

Section 302 of the Marine Protection, Research and Sanctuaries Act of 1972, as amended (16 U.S.C. 1432), authorizes the Secretary of Commerce, after consultation with other interested federal agencies and with the approval of the President, to designate as marine sanctuaries those areas of the ocean waters, of the Great Lakes and their connecting waters, or of other coastal waters which he determines necessary for the purpose of preserving or restoring such areas for their conservation, recreational, ecological, or aesthetic values. After designating such an area, the Secretary of Commerce shall issue regulations to control any activities within the area. Activities in the sanctuary authorized under other authorities are valid only if the Secretary of Commerce certifies that the activities are consistent with the purposes of Title III of the Act and can be carried out within the regulations for the sanctuary. The Project Area is not within a marine sanctuary and therefore, this Act does not apply to the Proposed Action..

6.6 ENDANGERED SPECIES ACT

The Endangered Species Act (16 U.S.C. 1531 et seq.) provides protections for species that are threatened or endangered throughout all or a significant portion of their geographic range and the habitats that those species use. In the ESA, “endangered” species are defined as in danger of extinction throughout all or a significant portion of its range, and “threatened” species are likely to become endangered within the foreseeable future throughout all or a significant portion of its range. Pursuant to ESA Section 7, the USACE initiated consultation with USFWS and NMFS on February 3, 2016, under separate letters for the Town of Palm Beach (SAJ-2005-07908) and Palm Beach County (SAJ-2008-04086) projects. In accordance with 50 CFR §402.14(c), the consultation request letters contained a link to where the Biological Assessment (BA) prepared for this Project (Appendix E) is available online. The BA has been developed to assist USFWS and NMFS in completing ESA Section 7 consultation, and includes an evaluation of impacts to listed species and critical habitat from proposed activities included in the Southern Palm Beach Island Comprehensive Shoreline Stabilization Project.

The EIS assesses effects to all federal and state listed species that are expected to occur in the project-affected area, described in Chapter 3. The USACE will complete Section 7 ESA consultation with USFWS and NMFS prior to final agency action for the DA Section 404 and Section 10 permits. In response to the USACE consultation requests for the Town of Palm Beach and Palm Beach County projects, USFWS and NMFS may provide concurrence with determinations that certain activities are not likely to affect listed species or critical habitat, or Biological Opinion(s) A biological opinion will be obtained from USFWS before USACE issues the record of decision (ROD) and makes a permit decision on the Section 10/404 permit application. The USACE's decision will comply with the ESA.

6.7 MARINE MAMMAL PROTECTION ACT OF 1972

The Marine Mammal Protection Act of 1972 (16 U.S.C. 1361 *et seq.*) expresses the intent of Congress that marine mammals be protected and encouraged to develop in order to maintain the health and stability of the marine ecosystem. The Act imposes a perpetual moratorium on the harassment, hunting, capturing, or killing of marine mammals and on the importation of marine mammals and marine mammal products without a permit from either the Secretary of the Interior or the Secretary of Commerce, depending upon the species of marine mammal involved. Such permits may be issued only for purposes of scientific research and for public display if the purpose is consistent with the policies of the Act. The appropriate Secretary is also empowered in certain restricted circumstances to waive the requirements of the Act. The USACE determined the project is not likely to adversely affect the manatee and will not affect whales. The USACE initiated consultation with USFWS for the manatee.Consultation will be completed prior to the USACE issues the ROD. The USACE's decision will comply with the Marine Mammal Protection Act of 1972.

6.8 ESTUARY PROTECTION ACT OF 1968

The Estuary Protection Act emphasizes the values of estuaries and the need to conserve these natural resources. The Act authorized an inventory and studies of U.S. estuaries to determine whether these areas should be acquired by the federal government for protection, and authorized cost-sharing between the federal and state governments for management of estuary resources. The project will not affect the adjacent estuaries. The project complies with this statute.

6.9 FISH AND WILDLIFE COORDINATION ACT OF 1958

The Fish and Wildlife Coordination Act (FWCA) requires that fish and wildlife receive equal consideration as other project components for proposed water resource development projects and that appropriate mitigation for impacts be provided. The USACE has complied with this statute through its consultation with the USFWS and NMFS, and through the NEPA process.

6.10 MAGNUSON-STEVENS FISHERY CONSERVATION AND MANAGEMENT ACT

The purpose of the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) is to promote the protection of essential fish habitat (EFH) in the review of Federal and state actions that may adversely affect EFH. Because the Proposed Action would impact EFH, USACE initiated consultation with NMFS. NMFS has provided EFH Conservation Recommendations. The EFH Evaluation is presented in Appendix F. USACE will provide NMFS with a detailed response to prior to final permit decision.

6.11 NATIONAL FISHING ENHANCEMENT ACT OF 1984

The National Fishing Enhancement Act of 1984 (Pub. L. 98–623) provides for the development of a National Artificial Reef Plan to promote and facilitate responsible and effective efforts to establish artificial reefs. The Act establishes procedures to be followed by the Corps in issuing DA permits for artificial reefs. The Act also establishes the liability of the permittee and the United States. The Act further creates a civil penalty for violation of any provision of a permit issued for an artificial reef. The proposed artificial reef meets the national standards for construction and siting of artificial reefs required by this Act; therefore, the project complies with the National Fishing Enhancement Act.

6.12 MIGRATORY BIRD TREATY ACT OF 1918, AS AMENDED, AND THE MIGRATORY BIRD CONSERVATION ACT

The Migratory Bird Treaty Act (MBTA) of 1918, as amended, prohibits pursuing, hunting, taking, capturing, killing, or selling migratory birds, as identified in the Act, through international conventions between the United States and Great Britain, Mexico, Japan, Canada, and Russia. The Migratory Bird Conservation Act establishes a Migratory Bird Conservation Commission that makes decisions acquiring lands or waterbodies identified by the Secretary of the Interior as necessary for the conservation of migratory birds. Wading birds may use the project area for foraging. No migratory birds or their nests will be adversely affected by the Proposed Action. This action complies with these statutes.

6.13 NATIONAL ENVIRONMENTAL POLICY ACT OF 1969

Environmental information on the project has been compiled and this environmental impact statement has been prepared in compliance with the National Environmental Policy Act (NEPA).

The purpose of NEPA is “To declare a national policy which will encourage productive and enjoyable harmony between man and his environment; to promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; to enrich the understanding of the ecological systems and natural resources important to the Nation; and to establish a Council on Environmental Quality” (42 USC Section 4321). It encourages public participation and comment, and it ensures that all branches of government consider environmental consequences of federal projects.

NEPA requires environmental impacts be considered within the federal decision-making process. CEQ established regulations for implementing NEPA (under Title 40 CFR Section 1500). The USACE has its own supplemental regulations for complying with NEPA (33 CFR 320) for the Corps regulatory program. These regulations call for the preparation of an EIS for any major federal action significantly affecting the quality of the human environment. The USACE Jacksonville District Commander is the responsible official for NEPA actions within the district. Any decision made will be in compliance with NEPA.

NEPA requires agencies to cooperate with other federal agencies and state and local governments, and to involve public stakeholders or citizens. Chapter 1 and Appendix K document the public involvement process completed as part of this EIS.

6.14 NATIONAL HISTORIC PRESERVATION ACT OF 1966, AS AMENDED

The National Historic Preservation Act (NHPA) was enacted to provide adequate protection for historic resources, including archaeological sites. The National Register of Historic Places (NRHP), National Historic Landmarks, and the posts of State Historic Preservation Officers (SHPOs) were established under this act. NHPA requires federal agencies to take into consideration the effects of their undertakings on cultural resources that are listed in, eligible for, or nominated to the NRHP. Federal agencies must consult with the SHPO and interested federally recognized Native American tribes. The SHPO reviewed the permit applications and the Draft EIS and stated that the proposed project will have no effect on historic properties if the following conditions are met: (1) sand and groins are placed/constructed on the beach in such a manner that no ground disturbance (such as trenching) is undertaken; (2) no historic structure on the beach, or uplands, are impacted; (3) the buffers as outline in the DEIS are observed during project acitivites; 500 ft buffers for known shipwrecks and 200 ft buffers for offshore anomaly clusters. If a permit is issued, the requested conditions will be made a part of the permit.

6.15 EXECUTIVE ORDER 11990, PROTECTION OF WETLANDS

Executive Order 11990 requires federal agencies to avoid, to the extent possible, the adverse impacts associated with destruction or modification of wetlands. The action complies with the goals of this executive order because no wetlands will be impacted as a result of the project.

6.16 EXECUTIVE ORDER 11988, FLOODPLAIN MANAGEMENT

Executive Order 11988 requires federal agencies to avoid, to the extent possible, the long and short-term adverse impacts associated with occupancy and modification of floodplains. It further directs federal agencies to avoid direct and indirect support of floodplain development wherever there is a practicable alternative. No activities associtesd with the propose dproject will take place within a riparian, lacustrine, or estuarine floodplain; therefore, it is anticipated that the project, if implemented, wuld remain in compliance with the goals of Executive Order 11988.

6.17 EXECUTIVE ORDER 12866, REGULATORY PLANNING AND REVIEW

Executive Order 12866 aims to improve the process of planning and reviewing of regulations and to make it more efficient. Its objective is to re-establish the federal government's primary position in the regulatory decision-making process and to make the process more accessible to the public. This Executive Order is intended only to improve the internal management of the Federal Government. The action is in compliance.

6.18 EXECUTIVE ORDER 12875, ENHANCING THE INTERGOVERNMENTAL PARTNERSHIP

The purpose of Executive Order 12875 is to enhance intergovernmental consultation and collaboration on federal matters and to prevent the federal government from imposing unfunded regulations on state, local, and tribal governments. It prohibits federal agencies from putting into effect any regulations that are not required by statute unless the affected state, local, and tribal governments are provided funds by the federal government. However, this executive order only applies to those regulations which the federal government has the power to waive. It requires federal agencies to provide the Director of the Office of Management and Budget a representation of all consultations and collaborations that occur between the agency and the affected governments. This executive order also requires that the federal agency allow time for state, local, and tribal governments to participate in the development of such regulations. The agency shall take into account any application provided by the affected government to waive regulatory requirements in order to provide flexibility to the affected government as long as these are in compliance with the federal policy objectives. The action is in compliance.

6.19 EXECUTIVE ORDER 12898, ENVIRONMENTAL JUSTICE

Executive Order 12898 requires federal agencies to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations. Executive Order 12898 requires the Federal government to review the effects of their programs and actions on minorities and low income communities. As described in Chapter 4, the effects of the Proposed Action would not be disproportionate toward any minority or low-income populations. The action complies with the goals of this Executive Order.

6.20 EXECUTIVE ORDER 13112, INVASIVE SPECIES

Executive Order 13112 requires federal agencies to, among other tasks, prevent the introduction of invasive species, monitor invasive species populations, restore native species and habitat where invasions have occurred, and promote public education. The existing dune vegetation does not contain invasive species. Furthermore, the dunes will be replanted with native vegetation. The action complies with the goals of this Executive Order.

6.21 EXECUTIVE ORDER 13089, CORAL REEF PROTECTION

The Coral Reef Protection Executive Order defines U.S. coral reef ecosystems as “those species, habitats, and other natural resources associated with coral.” The Biological Assessment (Appendix E) references the October 2013 resource surveys conducted in the Project Action Area. No corals were found within the Action Area; however, hardbottom habitats which are natural resources associated with coral are located within the Action Area. Impacts to hardbottom associated with each Alternative is detailed in Chapter 2. This Executive Order requires that all Federal agencies whose actions may affect U.S. coral reef ecosystems shall: (a) identify their actions that may affect U.S. coral reef ecosystems; (b) utilize their programs and authorities to protect and enhance the conditions of such ecosystems; and (c) to the extent permitted by law, ensure that any actions they authorize, fund, or carry out will not degrade the conditions of such ecosystems. Prior to a permit decision, USACE will ensure the project complies with this executive order.

6.22 EXECUTIVE ORDER 13653, IMPACTS OF CLIMATE CHANGE

EO 13653 requires Federal agencies to review the effect of climate change on their programs. Climate change was addressed in in detail in Chapter 3 and 4 of this EIS. The project is in compliance.

CHAPTER 7

PREPARERS, REVIEWERS AND RECIPIENTS

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7.0. PREPARERS, REVIEWERS AND RECIPIENTS

7.1. PREPARERS

This document was prepared by CB&I Coastal Planning & Engineering, Inc. (CB&I). Table 7-1 lists the individuals that contributed to the technical content in this document.

Table 7-1. List of CB&I preparers.

Preparer	Role	Education	Years of Experience
Thomas Pierro, P.E., D.CE.	Sr. Project Manager, Sr. Coastal Engineer	M.S. Ocean Engineering B.S. Ocean Engineering	14
Samantha Danchuk*, Ph.D., P.E.	Project Manager, Numerical Modeler, Coastal Engineer	Ph.D. Civil Engineering M.S. Environmental Engineering B.S. Environmental and Civil Engineering	9
David Swigler, P.E.	Coastal Engineer	M.S. Ocean Engineering B.S. Civil Engineering	6
Stacy Buck	Lead Biologist	M.S. Coastal Zone Management B.S. Marine Science	16
Lauren Floyd	Biologist	M.S. Marine Biology and Coastal Zone Management B.A. Biology and Environmental Science	15
Brad Rosov	Biologist	M.S. Marine Biology B.S. Biology	15
Robert Baron*	Biologist	M.S. Marine Biology B.S. Marine Science	14
Stephanie Bush	Biologist	M.S. Marine Biology B.S. Marine Biology	7
Kathryn Brown	Biologist	M.S. Marine Biology B.S. Environmental Science	4
Bradley Cody Bliss	Biologist	M.S. Marine Biology and Coastal Zone Management B.S. Biology	2
Douglas Mann, P.E., D.C.E.	Sr. Coastal Engineer, QA/QC Manager	M.S. Ocean Engineering B.S. Ocean Engineering	29

*No longer employed by CB&I.

Table 7-1 (cont.). List of CB&I preparers.

Preparer	Role	Education	Years of Experience
Lucas Silveira	Lead Numerical Modeler	B.S. Oceanography	6
Doris Otero	Numerical Modeler	Ph.D. Candidate Environmental Engineering M.S. Environmental Engineering B.S. Environmental Engineering	5
Zhifei Dong	Numerical Modeler	Ph.D. Candidate Civil and Environmental Engineering M.S. Civil and Environmental Engineering B.S. Marine Science	5
Morjana Signorin	Coastal Modeler	B.S. Oceanography	5
Heather Vollmer, GISP	GIS Specialist	M.S. Environmental Studies B.S. Environmental Studies	15

7.2. REVIEWERS

Table 7-2 lists the individuals from U.S. Army Corps of Engineers (USACE) who reviewed and provided comments on this document.

Table 7-2. List of USACE reviewers.

Reviewer	Role	Education	Years of Experience
Alisa Zarbo	Project Manager	B.S. Biology and Botany	17
Krista Sabin	Project Manager	M.S. Business Administration B.S. Chemistry	10
Garett Lips	Project Manager	B.S. Biology	16
Susan R. Kaynor	Supervisory Review	M.S. Environmental Science and Limnology B.S. Marine Science	28
Jason Engle	Chief, Coastal Design Section, Jacksonville District	B.S. Civil Engineering M.S. Civil and Coastal Engineering	11

7.3. RECIPIENTS

In accordance with 40 CFR 1502.19, copies of the Draft EIS (DEIS) and Final EIS (FEIS) have been provided to federal, state and local agencies, and to organizations and individuals identified as stakeholders or potential stakeholders during the the scoping process (see Public Scoping Report, Appendix A). The DEIS and FEIS is also available to the public on the USACE website at: http://www.saj.usace.army.mil/Missions/Regulatory/ItemsofInterest.aspx. The following is a list of agencies, organizations and persons to whom copies of the DEIS and FEIS have been sent.

7.3.1. PAPER COPY

The following agencies, municipalities, and libraries were sent a paper copy of the DEIS and the FEIS.

Federal Agencies
U.S. Army Corps of Engineers, Palm Beach Gardens, FL
U.S. Environmental Protection Agency, NEPA Compliance Division, Washington, DC

State Agencies
Florida Department of Environmental Protection, Florida State Clearinghouse, Tallahassee, FL
Florida Department of Environmental Protection, Beaches, Inlets & Ports, Tallahassee, FL

Libraries
Palm Beach County Main Library, West Palm Beach, FL

Local Governments
Palm Beach County Department of Environmental Resources Management, Robert Robbins
Town of Palm Beach, Peter Elwell

7.3.2. COMPACT DISC

The following agencies, municipalities, Native American Indian Tribes and organizations were provided a compact disc (CD) of the DEIS and FEIS:

Federal Agencies
U.S. Army Corps of Engineers, Palm Beach Gardens, FL
U.S. Environmental Protection Agency, West Palm Beach, FL
U.S. Environmental Protection Agency, NEPA Compliance Division, Washington, DC
U.S. Fish and Wildlife Service, Vero Beach, FL
NOAA National Marine Fisheries Service, St. Petersburg, FL

State Agencies
Florida Department of Environmental Protection, Florida State Clearinghouse, Tallahassee, FL
Florida Department of Environmental Protection, Beaches, Inlets & Ports, Tallahassee, FL
State Historic Preservation Office, Division of Historical Resources, Tallahassee, FL
Florida Fish and Wildlife Conservation Commission, West Palm Beach, FL
South Florida Water Management District, West Palm Beach, FL

Local Governments
Palm Beach County Department of Environmental Resources Management, Robert Robbins
Town of Palm Beach, Peter Elwell
Town of South Palm Beach, Rex Taylor
Town of Lantana, Deborah Manzo
Town of Manalapan, Linda Stumpf

Native American Indian Tribes
Miccosukee Tribe of Indians of Florida, Miami, FL

7.3.3. POSTCARD NOTIFICATION

The following agencies, Native American Indian Tribes, organizations, and persons were notified by postcard that the DEIS and FEIS is posted on the USACE's website. Interested parties who provided both a mailing address and an e-mail address were noticed of the DEIS and FEIS availability via e-mail (Section 7.3.4.).

State Agencies
Florida Department of Environmental Protection, Florida State Clearinghouse, Tallahassee, FL
Florida Fish and Wildlife Conservation Commission, Tallahassee, FL

Native American Indian Tribes
Miccosukee Tribe of Indians of Florida, Miami, FL
Seminole Tribe of Florida, Hollywood, FL

Libraries
Palm Beach County Main Library, West Palm Beach, FL

Public and Non-Government Organizations
South Florida Audubon Society, Doug Young, Ft. Lauderdale, FL
West Palm Beach Fishing Club, Tom Twyford, West Palm Beach, FL
Palm Beach Civic Association, Ned Barnes, Palm Beach, FL
Neighborhood Alliance of Palm Beach, Jeffrey Cloniger and Rachel Lorentzen, Palm Beach, FL
The Coalition to Save our Shoreline, Inc., Carla Herwitz, Palm Beach, FL
Palm Beach Chamber of Commerce, Kevin Lamb, Palm Beach, FL
Citizens' Association of Palm Beach, Lew Crampton, Palm Beach, FL
Judi Hilderbrandt and Gail Klewicki, Lake Worth, FL
Perk's Bait & Tackle, Lantana, FL
Sportsman Bait & Tackle, Lantana, FL

Local Elected Officials
Bill Hager, FL House of Representatives District 89, Boca Raton, FL
Senator Jeff Clemens (District 27), Lake Worth, FL
Congresswoman Lois Frankel, Boca Raton, FL

Media/Magazines
Palm Beach Daily News (The Shiney Sheet), Joyce Reingold, Palm Beach, FL
Florida Sportsman, Karl Wickstrom, Stuart, FL
Florida Today, Jim Waymer
South Florida Business Journal, Paul Brinkmann, Deerfield Beach, FL

Sea Turtle Permit Holder
Town of South Palm Beach - Bob Schoenfeld, Town of South Palm Beach, FL

Condominium Presidents (P) and Managers (M)
South Palm Residence, Ed Rice (P), South Palm Beach, FL
Tuscany, Linda Taft (P), South Palm Beach, FL
Bellaria Condominium, Stephen Jacobs (P) and Heath D. Chute (M), Palm Beach, FL
Palm Beacher Condominium, Cheryl Barnes (P) and Jaqueline Wustman (M), Palm Beach, FL
The Imperial House, Chris Wurster (M), South Palm Beach, FL
The Barclay, Andrea Horne (M), South Palm Beach, FL
Horizon East, Eric Fink (M), South Palm Beach, FL
Horizon West, Ann Molloy (M), South Palm Beach, FL
South Ocean Condo Association, Angelo Conte (M), South Palm Beach, FL
Palm Beach Windemere, Irene De Matteo (M), South Palm Beach, FL
La Pensee, John Lawson (P), South Palm Beach, FL
Palm Beach Hampton, Bernie Kossar (P) and George Cunniff (M), Palm Beach, FL
Oasis, Joshua Teverow (P) and Julian Butler (M), Palm Beach, FL
Carlton Place, Bruce Heyman (P) and Charles Linder (M), Palm Beach, FL
Enclave Palm Beach, Ira Smith (P) and Billy Parker (M), Palm Beach, FL
3200 Condominium, Bob Mangino (P) and Walter Allan (M), Palm Beach, FL
La Renaissance, Phillip Karpinsky (P) and Sibyl Hockman (M), Palm Beach, FL

Dorchester of Palm Beach, Arthur Goldmacher (P) and Ned Flemming (M), Palm Beach, FL
Meridian of Palm Beach, Madeline Shapiro (P) and Arturo Ramirez (M), Palm Beach, FL
3360 Condominium, Richard Hunegs (P) and Jimmy Aroney (M), Palm Beach, FL
Emuraude, Herbert Weinstein (P) and Tammy Breaux (M), Palm Beach, FL
Atriums of Palm Beach, Rick Mecelli (P) and Marc Richter (M), Palm Beach, FL
Halcyon, John Altimari (P) and Scott Rutan (M), Palm Beach, FL
Patrician, Jack Cohen (P) and Al Gallo (M), Palm Beach, FL
Claridges I & II, Richard Flaxman (P) and Robert McCulloch (M), Palm Beach, FL
La Bonne Vie, Ned McAdams (P), and Ed Waldman (M), Palm Beach, FL

7.3.4. EMAIL NOTIFICATION

The following agencies, organizations, and persons were notified by email that the DEIS and FEIS are available on the USACE's website.

Federal Agencies
Gulf Islands National Seashore, National Park Service, Jolene Williams
EPA, Ron Miedema
National Parks Conservation Association, Caroline Mclaughlin
NOAA National Marine Fisheries Service HCD, Mark Sramek, St. Petersburg, FL
NOAA National Marine Fisheries Service HCD, Mark Thompson, Panama City, FL
NOAA National Marine Fisheries Service, Southwest Region, Robin Wiebler, St. Petersburg, FL
U.S. Coast Guard, District 8 Bridge Office, Donna Gagliano
U.S. Fish and Wildlife Service, Patty Kelly, Panama City, FL
U.S. Fish and Wildlife Service, Lisa Lehnhoff, FL

State Agencies
Assistant General Counsel, FDOT, Kathleen Toolan, Tallahassee, FL
FDOT Environmental Management Office, Xavier Pagan, Thu-Huong Clark
FPL Environmental, Stacy Foster

Local Governments
Palm Beach County Department of Environmental Resources Management, Robert Robbins
Town of Palm Beach, Peter Elwell
Town of South Palm Beach, Rex Taylor
Town of Lantana, Deborah Manzo
Town of Manalapan, Linda Stumpf
City of Riviera Beach, Dawn Pardo

Native American Indian Tribes
Seminole Tribe of Florida, Elliott York, Hollywood, FL
Seminole Tribe of Florida, Geoffrey Wasson, Hollywood, FL
Seminole Tribe of Florida, Jennifer Pietarila, Hollywood, FL

Media/Magazines
The Coastal Star, Mary Kate Lerning, Ocean Ridge, FL
Sun-Sentinel, Andrew Reid, West Palm, FL
The Condo News, Inc., West Palm Beach, FL
Lake Worth Herald & Coastal Observer, Lake Worth, FL
Coastal Angler Magazine, Ben Martin, Indian Harbour Beach, FL
Palm Beach Post, Christine Stapleton
South Florida Sun-Sentinel, David Fleshler, Ft. Lauderdale, FL

Sea Turtle Permit Holders
Town of Palm Beach - Chris Perretta, Boca Raton, FL
Town of Lantana - Chris Redgate, Lantana, FL
Town of Manalapan - Phil Stone, Lantana, FL

Public and Non-Government Organizations
Cry of the Water, Stephanie and Dan Clark, Coral Springs, FL
Palm Beach County Reef Rescue, Boynton Beach, FL
Palm Beach Hammerheads, Lynora Mae, FL
Starfish Enterprises, Craig Smart, Lantana, FL
Wet Pleasures Dive Outfitters, Lantana, FL
Eastern Surfing Association, Palm Beach County District, Tom Warnke and Brandi Brady, Tequesta, FL
Sierra Club (Loxahatchee Group), Ricardo Zambrano, Lake Worth, FL
Surfrider Foundation (Palm Beach County Chapter), Todd Remmel, Palm Beach Gardens, FL
Sea Turtle Conservancy, David Godfrey, Gainesville, FL
Sweetwater Coalition
Charlotte County, William Byle, Charlotte County, FL
Jacksonville Marine Transportation Exchange Harbor Safety Committee, Capt. Mike
Surfrider Foundation, Holly Parker
Sierra Club (Broward Group), Matthew Schwartz
Conservancy of Southwest Florida, Amber Crooks, Naples, FL
Save the Manatee Club, Kelsey Jennings
Florida Panther Conservation, L.L.C., Les Alderman, Fort Myers, FL
Collier County Audubon Society/Audubon of Florida, Brad Cornell
Florida Wildlife Federation, Nancy Payton, Naples, FL
R.S. Environmental, Rainer Schael
The Nature Conservancy, Petra Royston, Rebecca Perry, Altamonte Springs, FL
Gulf States Marine Fishery Commission, Jeff Rester
Westervelt Ecological Services, Michelle O'Neal, Tuscaloosa, AL
Friends of Shell Island, Inc., Stephanie Somerset
Coastal Conservation Association Florida, Trip Aukerman
Conservancy of Southwest Florida, Jennifer Hecker, Naples, FL
Sun Coast Region National Parks Conservation Association, Cara Capp, Hollywood, FL
Mangrove Action Group, Marcia Cravens
Citizens' Association of Palm Beach, Lew Crampton, Palm Beach, FL

Persons
Alan Prouty, Boise, ID
Alex Larson
Allan Sosnow
Andrew J. Baumann, Lewis, Longman & Walker, West Palm Beach, FL
Annie Gomez, Ft. Lauderdale, FL
Anthony Pires, Jr., Naples, FL
Barbara Herrin
Betsy McCallum
Betty Sue Carroll
Bill Schroeder, Jacksonville, FL
Bob Hartmann
Bob Hartmann
Brandon Gray, Tampa FL
Carol Gula
Caroleen Dineen, Orlando, FL
Courtney Edwards, Maitland, FL
Cpt Alan S. Richard, Tallahassee, FL
Curtis Kruer, West Sheridan, MT
Darla Miller
Dave McIntosh, West Palm Beach, FL
David Urband
Davis Evans, Melbourne, FL
Dedra Williams, Boise, ID
Desmond Duke
Diane Brown
Dr. Steve Bortone
Dr. Tim Parsons, Tallahassee, FL
Frank Virginia
Frank Virginia
Gary Appelson
Georgette Colson
Gerald Bassett
Gil Gilley
Gletys Guardia-Montoya, Miami, FL
Greg Pintarelli
Greg White
Irene Sadowski
Jamie Scudera, Charlotte County
Jeffrey Carter
Jim Goldasich
John Landon
John Strowbridge
Jon Shepherd, Melbourne, FL
Josy Sisk
Kae Hovater

Karen Price, Port Charlotte, FL
Kathryn Wittington
Kathy L. Ridley
Ken Powell, Palm Coast, FL
Krista Sabin
Larry Goldberg
Linda Daniels
Lori Carpenter
Lynn Ferrie
Marion Hagen, Southwest Ranches, FL
Melanie Ashby
Melinda Witgenstein, Panama City, FL
Mr. Sliger
Ms. Wells
Pamela Harris
Patrick McCarthy
Patricia Curry
Percy Angelo
Peter Gaddy, Naples, FL
Ralf Brookes, Cape Coral, FL
Rebeca Mora Chavarria, San Jose, Cosa Rica
Robert Diffenderfer, West Palm Beach, FL
Robert Spoth
Robyn Greene
Roger Rice, Naples, FL
Ron Johnson
Russell Daly, Chipley, FL
Ryan Deibler
Ryan Moreau
Sandra Ripberger
Serge Bourque, Montreal (Quebec) Canada
Terry Rice
Thomas Warnke, Lantana, FL
Toni Crockett
Trygg Danforth, Baltimore, MD
Victoria Colangelo, Orlando, FL
Ward Elis
Will Huckin
William Kerr
Woody Judson

Businesses
Art Burgyone, The Bean Companies
Philip Teah, International Dock Products, Pembroke Park, FL
Duke Energy - Environmental Services, Amy Dierolf
AG Environmental, Angel Garcia, Naples, FL

GL Holmes Land Development, Anthony LoFurno, Sunrise, FL
The St.Joe Company, April Wilkes, Watersound, FL
EW Consultants Inc., Arnaud Roux
Jones Edmund & Associates, B.J. Bukata, Gainesville, FL
Chashman Dredging & Marine, Kathryn McGuckin and Bill Hussin, Quincy, MA
Aquatic Ecosystem Solutions, Inc., Beau Williams
CH2m Hill, Ben Brice
Faller, Davis & Associates, Bruce Hasbrouck, CEP, Tampa, FL
Biological Consulting Services, Inc., Joe Young, III, New Smyrna Beach, FL
Earthbalance, Cristine Borowski, North Point, FL
The Dutra Group, Denise Dutra, San Rafael, CA
Davidson Engingeering, Jeremy Sterk, Naples, FL
Balch & Bingham, LLC, Jim Noles
Amelia Island Plantation Association, Joe Bunting, Amelila Island, FL
EcoSystemPartners, Katherine Birnie
Westvelt Ecological Services, John Wigginton
Lewis, Longman & Walker, P.A., Keri-Ann Baker, West Palm Beach, FL
Scheda, Kristin Caruso, Tampa FL
ABT, Keith Rivera, Orlando FL
MacKen Environmental, Inc, Kenny MacFarlane
Tetra Tech, Kristin Bennett
Kiewit Infrastructure South CO, Langston Bates, Peachtree City, GA
Holland And Knight, Larry Sellers, Tallahassee, FL
Carnahan Proctor Cross Consulting Engineers Surveyors Planners, Greg Proctor, Margate, FL
Environmental Consulting and Design, Inc., Carl Salafrio, Gainesville, FL
Restoration Systems, LLC, Dr. David Robinson
Gatordock & Gatorbridge, David Metivier
Dock Hardware & Marine Fabrication Engineering, Matt Stevenson
Breedlove, Dennis & Associates, Debra Rivera
Jay Cashman, Inc. Erin Joyce-Brady, Quincy, MA
ECO Consulting Group, LLC, Lisa Fowler, MS, PWS
Akerman Senterfitt, Edward Cole, Jacksonville, FL
Baker Concrete Construction, Gina Ferrari, Ft. Lauderdale, FL
Miller Legg, Marina Hannwacker, Winterpark, FL
Clarke Control Consultant, Lori Clemence
LG2 Environmental Solutions, Inc., Lee Gerald, Matt Dinkins
de la Parte & Gilbert, P.A., Linda K. Foy, Tampa, FL
Everglades Law Center, Inc., Lisa Interlandi, North Palm Beach, FL
RS Environmental Consulting, Inc., Luke Krenik
Mitigation Marketing, LLC, Lynn M. Zenczak
Lucas Marine, Lyza Heffernan
ManaSota 88, Inc., Glenn Compton, Nokomis, FL
Lewis, Longman & Walker P.A., Michelle Diffenderfer, Esquire, West Palm Beach, FL
Mitigation Marketing, LLC, Megan McNeil
Sandy Creek Partners, LLC, Gray Stevens

Technomarine USA, Inc, Michael Shanley, Sarasota, FL
Alterra Group, Michael D. Mesiano, Jacksonville, FL
The Landon Companies, Mark Serrahn
Faller, Davis & Associates, Inc., Nicole Cribbs, Tampa, FL
Lifetime Dock & Lumber, Nicole Price
Amy H. Remley Foundation Inc, Norman Hopkins
Clarke, Pete Deglomine
Edmisten & Associates, Rayne Mattson, Stuart, FL
WilsonMiller/Stantec, Rita Avellaneda
Collier Enterprises, Raymond March, P.E., Immokalee, FL
Holland & Knight, Roger Sims
Heilman & Associates, Inc., Ross Heilman, Jacksonville Beach, FL
Everglades Law Center, Sara Fain
PBS&J, Scott Zengel, Tallahassee, FL
Birkitt Environmental Services, Inc., Shelby Butts
Wetlandsbank Group, Stephen Collins, West Palm Beach, FL
Faller, Davis & Associates, Inc., Shannon Ladd, Tampa, FL
Earthbalance, Sarah Laroque, Wade Waltimyer, North Point, FL
Ecological Consulting of Florida, Chris Sopotnick, Stewart, FL
Scheda Ecological Associates, Inc, Sandy Scheda
Susan Stephens, Tallahassee, FL
Sam Wiley, Jupiter, FL
Jay Cashman, Inc., Tim Ashmore
ENTRIX, Inc., Tim Neldner, PWS, Riverview, FL
Applied Technology & Management, Inc., Tim Mason, Charleston, SC
Crossroads Environmental, Toby Overdorf, Palm City, FL
Sumner Law Offices, Todd Sumner, Tallahassee, FL
Environmental Consulting and Design, Inc., Valerie Milmore, Gainesville, FL
Clarke, Victoria VonAmmon, John Greene
Cyriacks Environmental Consulting Services, Wendy Cyriacks, Deerfield Beach, FL
Onsite Environmental Consulting, LLC, Adam Hoyles, Jacksonville, Florida
Great Lakes Dredge & Dock Company, LLC, Bill Hanson, Oak Brook, IL
Environmental Services, Inc, J. Bringson, Jacksonville, FL
Wetlands Solutions, LLC, Thecia M. “Teckie” Hinkebein, Gulfport, MS
Clark Hull and Associates, Clark Hull
NOVA, Richard Grosso, Ft. Lauderdale, FL
The Beeckler Company, Thomas Beeckler, Ponte Vedra Beach, FL
Palm Beach Oceanfront Inn, Jason Mueller, South Palm Beach, FL
Ritz Carlton Hotel, Michael King, Manalapan, FL

Condominium Presidents (P) and Managers (M)
South Palm Residence, Dr. Donald Young (P), Paul Sylvestri (M), South Palm Beach, FL
PalmSea, Pat Paradowski (P) and Aless Hall (M), South Palm Beach, FL
Le Chateau Royal, Roger Lieberman (P) and Cynthia Campfield (M), South Palm Beach, FL
The Barclay, Jeff Stein (P), Andrea Horne (M), South Palm Beach, FL

Concordia West and East, Gaylord Palermo (P) and Denise Bogner (M), South Palm Beach, FL
Tuscany, Josh Debrino (M), South Palm Beach, FL
Horizon East, Suzanne Evans (VP), South Palm Beach, FL
Horizon West, Dr. David Sousa (P), South Palm Beach Beach, FL
Mayfair House Lake & Ocean, Jorge Avellana (P) and Steve Pepin (M), South Palm Beach, FL
South Ocean Condo, Laura Haimes (P) and Angelo Conte, South Palm Beach, FL
Dune Deck, Julia Koniosis (P), South Palm Beach, FL
Palm Beach Windmere, Mary Wallace (P), South Palm Beach, FL
The Imperial House, Bonnie Fischer (P), South Palm Beach, FL
La Coquille Club Villas, Steve Russell (P), Manalapan, FL
Dune Deck, Elaine Romaine (P), South Palm Beach, FL
La Pensee, John Lawson (P) and John Jahn (M), South Palm Beach, FL
Palm Beach Windemere, John Boot (M), South Palm Beach, FL

Other
Lee County Division of Environmental Sciences, Douglas Griffith, Lee County, FL
Anita Dobrosky, Nassau County Growth Management Department, Nassau County, FL
Lee County Department of Transportation, Robert K. Phelan, P.E., Fort Myers, FL

CHAPTER 8

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8.0 LITERATURE CITED

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Brost, B. 2016. Personal communication between Cody Bliss (CB&I) and Beth Brost (FWRI) via email regarding the 2015 turtle nesting data. March 2, 2016.

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