BIOLOGICAL ASSESSMENT
PORT ROYAL SHORELINE RESTORATION AND STABILIZATION PROJECT

TOWN OF HILTON HEAD ISLAND, SC

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BIOLOGICAL ASSESSMENT

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BIOLOGICAL ASSESSMENT
PORT ROYAL SHORELINE RESTORATION AND STABILIZATION PROJECT
TOWN OF HILTON HEAD ISLAND, SC

1.0 INTRODUCTION

1.1 PURPOSE OF BIOLOGICAL ASSESSMENT- CFR 402.12(a)

This Biological Assessment (BA) has been prepared to fulfill the U.S. Army Corps of Engineers (USACE) requirements as outlined under Section 7(c) of the Endangered Species Act (ESA) of 1973, as amended. This BA evaluates the potential impacts that the proposed Port Royal Shoreline Restoration and Stabilization Project may have on federally listed endangered and threatened species and describes the avoidance, minimization and conservation measures proposed by the applicant, the Town of Hilton Head Island, SC.

This BA is offered to assist the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) personnel in fulfilling their obligations under the ESA [50 CFR 402.12(c)(f)]. Formal Section 7 consultation is required when a Federal action may affect listed species or destroy or adversely modify designated critical habitat (50 CFR 402.14). An Environmental Assessment is under preparation to evaluate the potential environmental impacts of the proposed Port Royal Shoreline Restoration and Stabilization Project.

1.2 PROPOSED ACTION- CFR 402.14(c)(1)

The proposed project is located at the northeastern end of Hilton Head Island, SC, at the intersection of the Atlantic Ocean and Port Royal Sound shorelines. The general location of the project area is depicted in Figure 1. This section of the island's shoreline is also referred to as the "Heel" shoreline and is part of the contiguous beach that is managed by the Town of Hilton Head Island. This specific reach of shoreline has never been directly nourished; however, it is located between Atlantic Ocean and Port Royal Sound shorelines that have been nourished numerous times by the Town (Figure 2).

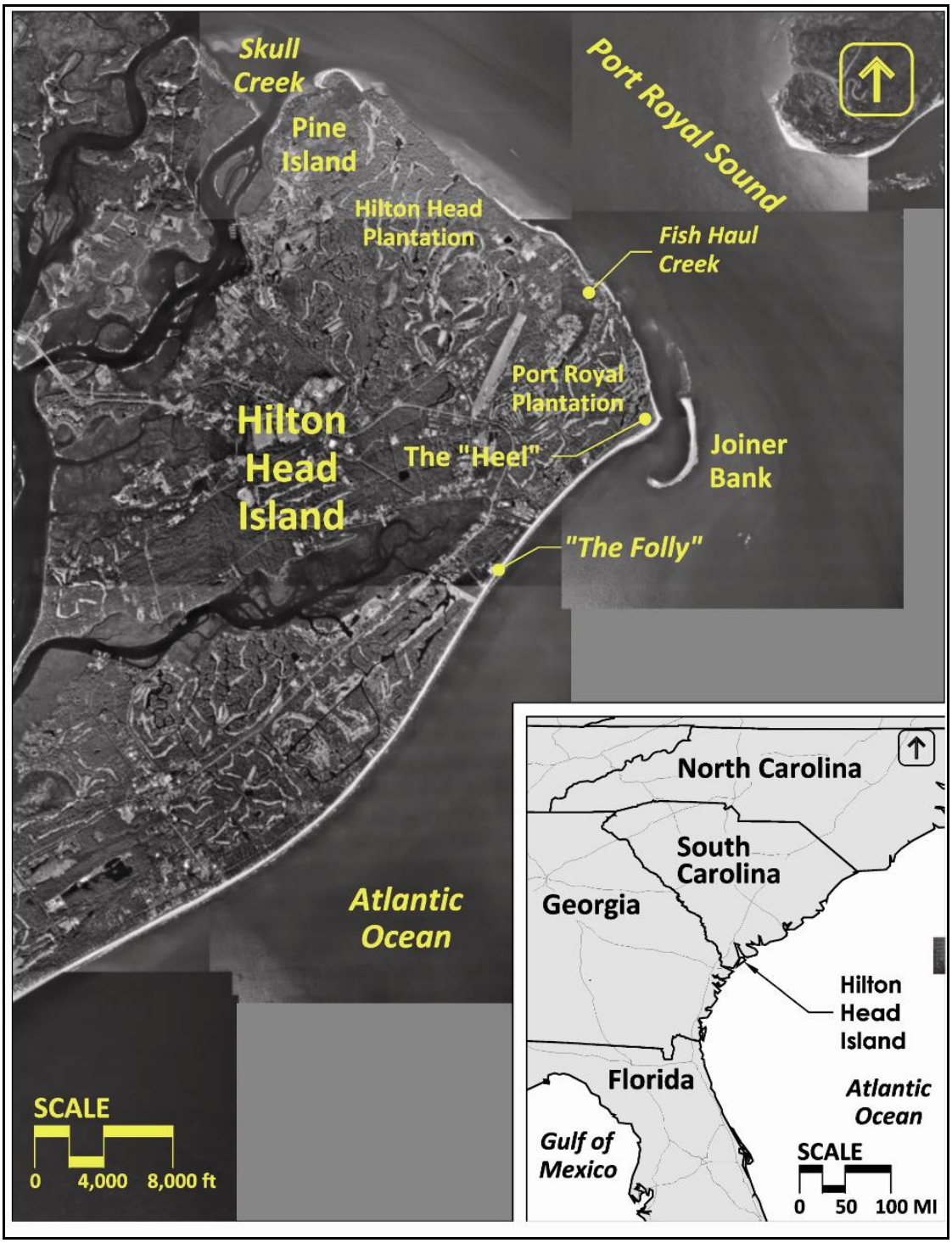

Figure 1. Study area location map, Hilton Head Island, South Carolina (Source: Olsen Associates Inc. 2008a).

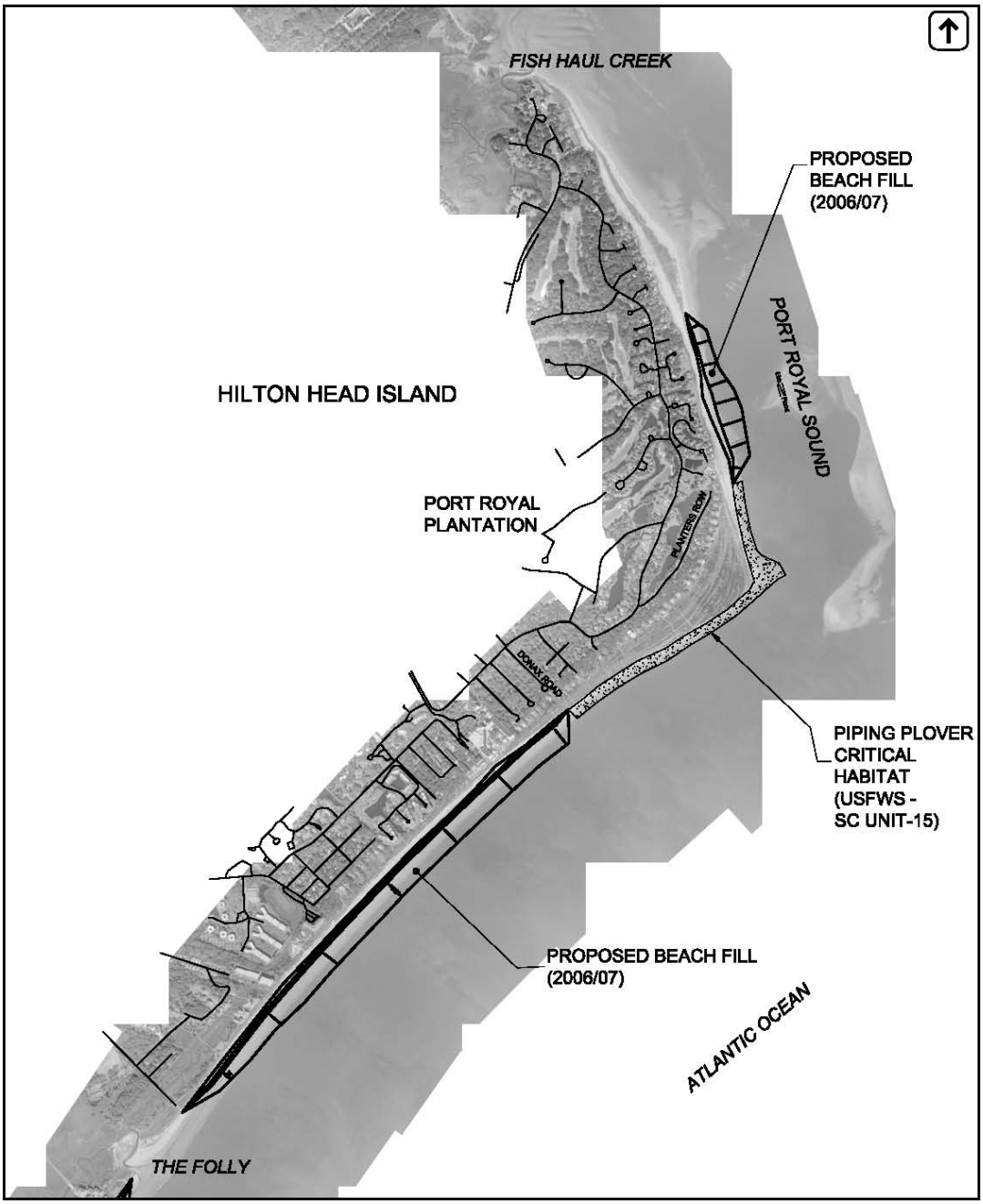

Figure 2: Location of 2006/07 Hilton Head Beach Nourishment Project fill limits and Piping Plover Critical Habitat Unit SC-15.

The project will include: 1) placement of approximately 0.8 to 1.0 million cubic yards of beach-compatible sand along approximately 5,400 feet of Atlantic Ocean shoreline between Barnacle Road (just north of The Westin Resort, Town Beach Monitoring Station HHI-27) and the southern area of the “sand spit” at the northeast tip of the island as configured at the time of construction (just south of Town Beach Monitoring Station HHI-29B); and 2) construction of a low-crested, “leaky” groin at the northern terminus of the island’s Atlantic Ocean shorefront and within the limits of the beach fill (Town Beach Monitoring Station HHI-29A). Due to the current

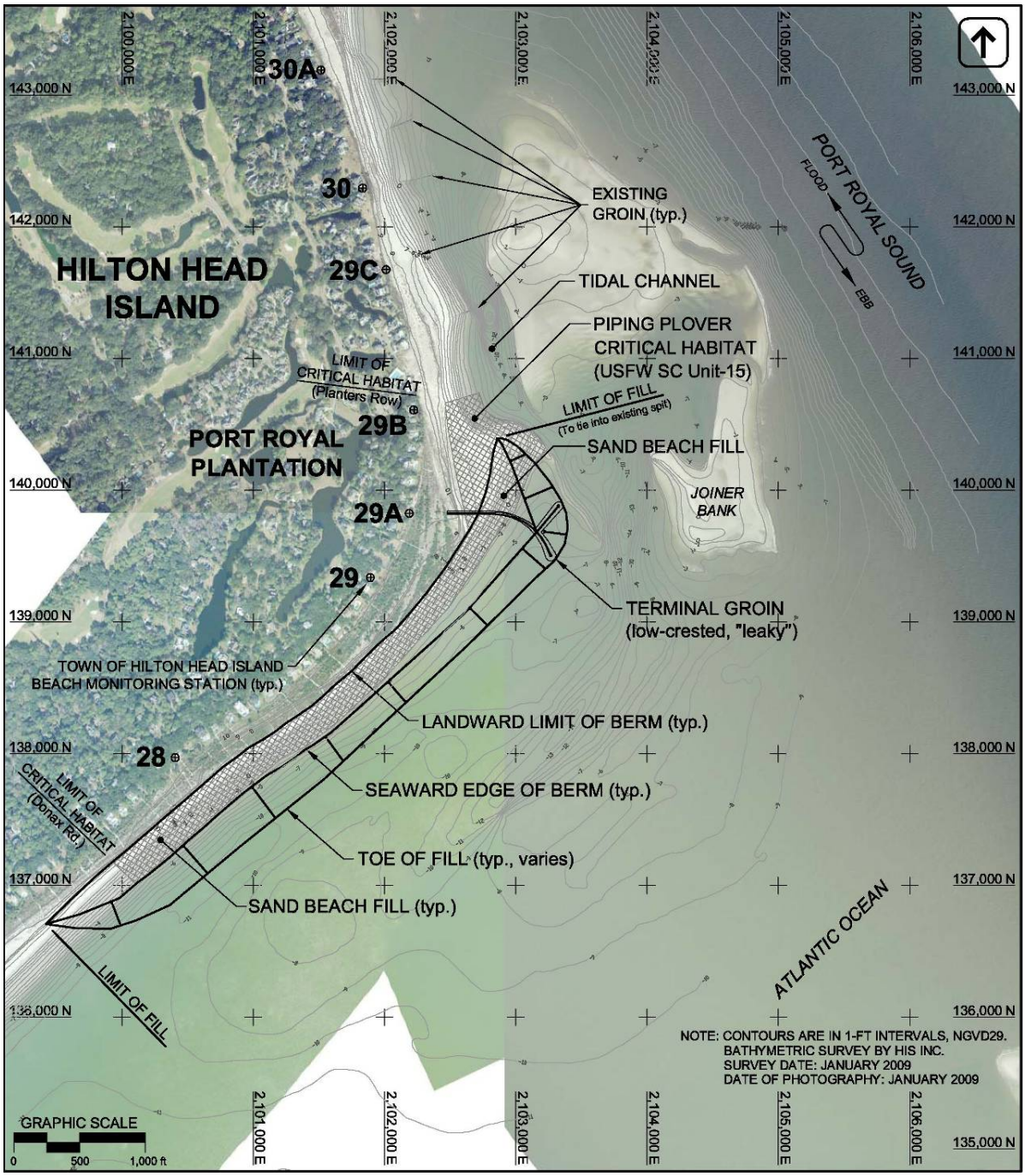

Figure 3. Graphical depiction of the principal project elements (Alternative No. 4) including the low-crested, leaky groin at the northern terminus of the island's Atlantic Ocean shorefront within the beach fill limits. Piping plover Critical Habitat Unit SC-15 is shown within the project area.

erosion rate at this location, the project design and configuration will be reevaluated immediately prior to construction in consideration of site conditions at that time. Based on recent erosion rates, the range in expected sand volume is intended to accommodate the replacement of additional sand that will likely erode from the project shoreline between the time of permit application and the time of project construction. The location and extent of the principal project elements at the "Heel" shoreline with references to Town of Hilton Head Island beach monitoring stations are depicted in Figure 3. A detailed plan view of the proposed structure is included in Figure 4.

The purpose of the proposed project is to restore an area of highly erosional beach with sand fill from an offshore borrow site and reduce future sand loss rates along the project area with a low-crested, "leaky" groin at the northern terminus of the island's Atlantic Ocean shorefront. The project will include sufficient sand volume to minimize potential downdrift effects of the proposed low-crested groin and meet typical annual sand transport volume demands expected for the period between project completion and the next planned comprehensive beach renourishment project on the island. The expected date for the next comprehensive renourishment on Hilton Head Island will be around 2015 to 2017. The risk of potential adverse effects along the adjoining Port Royal Sound shoreline will be further minimized and managed through the continued implementation of the Town of Hilton Head Island's Beach Management Program. The program includes monitoring, maintenance, management, and enhancement of the island's shorelines through periodic beach fill placement and the strategic use and maintenance of shore-stabilizing structures as needed. The shore-stabilizing benefits of some of the seventeen existing groins along approximately 9,000 feet of Port Royal Sound shoreline immediately north of the proposed "leaky" groin will assist with stabilization of the shoreline downdrift of the proposed project.

1.3 ACTION AREA- CFR 402.14(c)(2)

The Project Action Area is defined as all areas to be affected directly or indirectly by the action and not merely the immediate area involved in the action. For the proposed Port Royal Shoreline Restoration and Stabilization Project, the Project Action Area includes: 1) 21,500 linear feet of shoreline between *The Folly* and *Fish Haul Creek*; 2) the nearshore area adjacent to the proposed beach fill and structure site; and 3) the 181-acre offshore borrow site and surrounding area. Along the shoreline, the Action Area includes the portion of the beach between the primary dune through the intertidal zone through mean low low water. The nearshore area includes bathymetric features adjacent to the island's "Heel" such as the remaining portion of Joiner Bank and accompanying marginal tidal channel system. The offshore borrow site is located on the east side of the Port Royal Sound channel on a linear shoal associated with the Sound's larger ebb tidal shoal platform. The location and extent of the Project Action Area features are depicted in Figure 5.

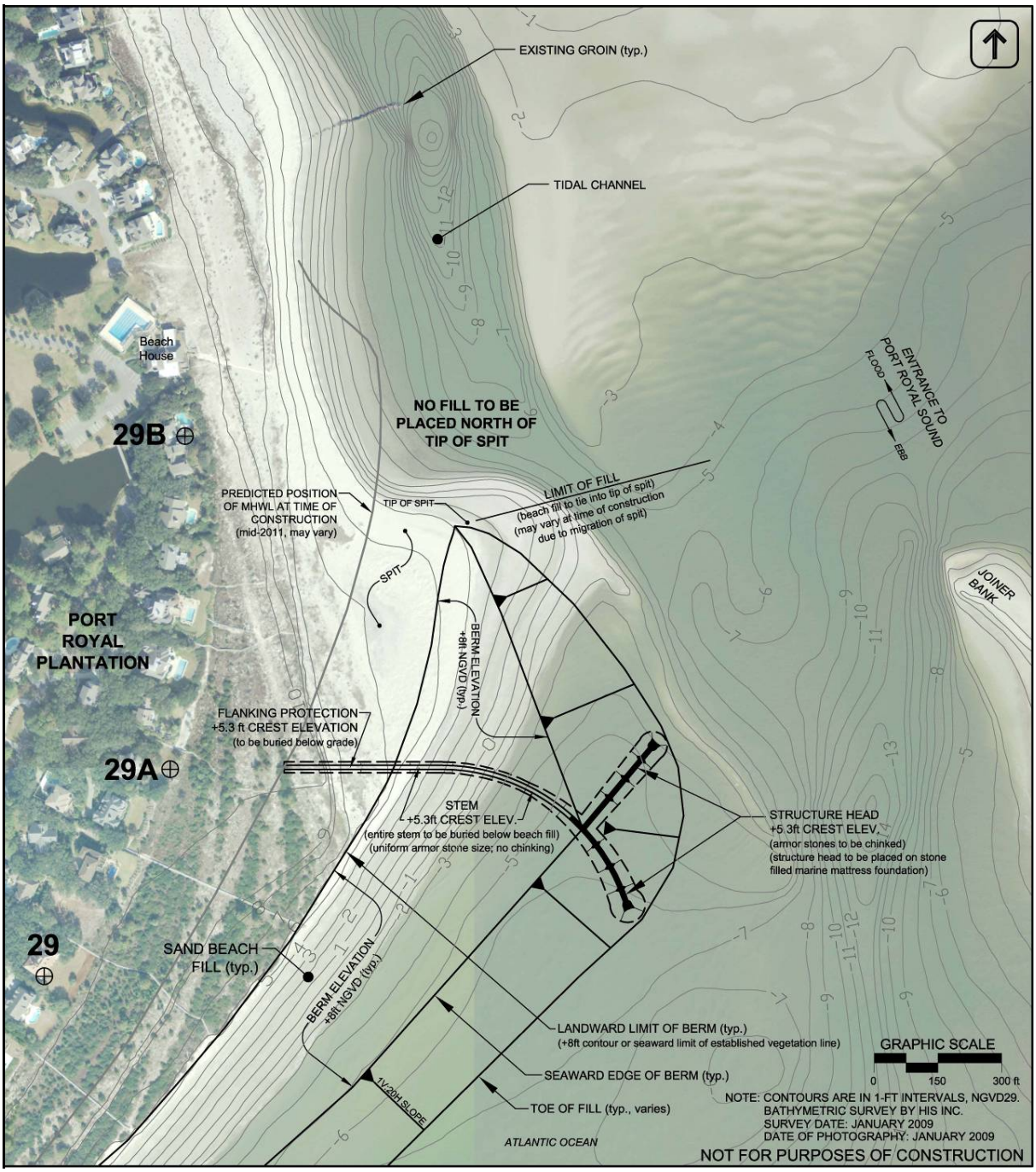

Figure 4. Plan details of proposed low-crested “leaky” groin at the northern terminus of the Atlantic Ocean shorefront of Hilton Head (Source: Olsen Associates Inc.).

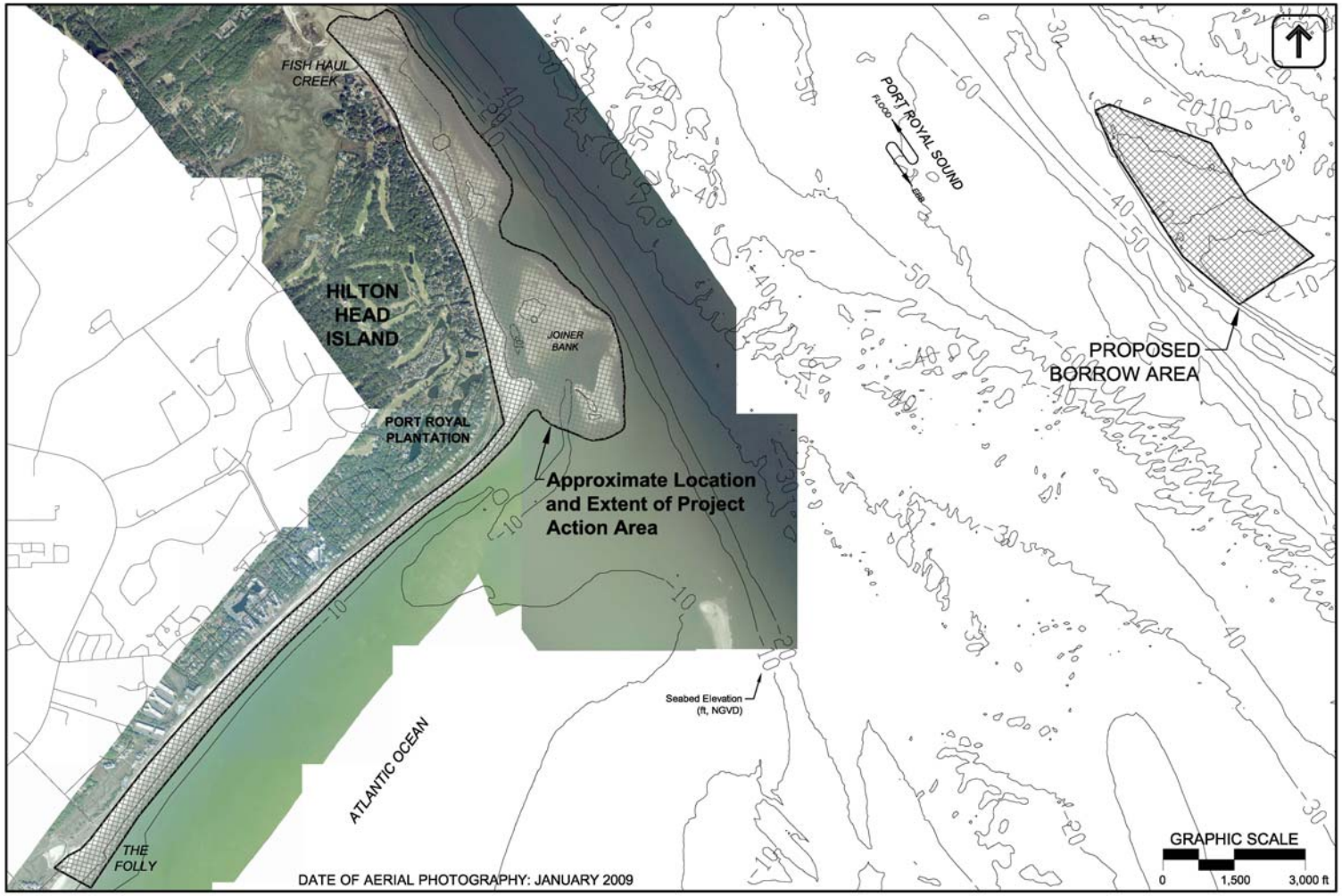

Figure 5: Approximate location and extent of Project Action Area including proposed offshore borrow area.

1.4 PHYSICAL DESCRIPTION OF HABITATS

Hilton Head Island is the second largest barrier island on the east coast of the United States. It is approximately 12 miles long and 5 miles wide and is located in Beaufort County, South Carolina, approximately 35 miles north of Savannah, Georgia. The island is typical of the Sea Islands which extend from the Santee River in eastern central South Carolina to the St. Johns River entrance in northeast Florida. The Sea Islands are characterized by short, wide barrier islands shaped primarily by tidal influences, as opposed to the long, narrow barrier islands of North Carolina which are shaped mainly by wave forces.

The beaches of South Carolina and associated transition zones are formed primarily of unconsolidated sand. Dune habitat includes sand dunes and swales, flats and pools between dunes, and other features. Seaward of the dune system, sandy flats may occur in areas where dunes have been eroded (SCDNR, 2009a). Beaches and associated habitats are influenced by windblown salt spray and sand and may be occasionally flooded, particularly during storms. Vegetated components of South Carolina's beach system include:

Maritime Grassland: This habitat includes sand dunes and swales and flats between dunes, and other features. Characteristic plants include sea oats (*Uniola paniculata*), bitter panic grass (*Panicum amarum*), seabeach evening-primrose (*Oenothera humifusa*) and dune pennywort (*Hydrocotyle bonariensis*) (SCDNR, 2009a).

Interdune Pond: Low depressions or pools within the secondary dunes that hold water either permanently or seasonally. Flora and fauna in the pools are largely determined by salinity. Interdune ponds, whether permanently or seasonally watered, may provide at least a short-term supply of low salinity water in areas where it is otherwise generally absent (SCDNR, 2009a).

Maritime Shrub Thicket: Thickets of shrubs, vines and stunted trees are often found in swales within the secondary dunes. The trees and shrubs are salt tolerant and are "pruned" by windblown salt spray and sand. Typical plants are wax myrtle (*Morella cerifera*), red bay (*Persea borbonia*), groundsel tree (*Baccharis halimifolia*), saw greenbrier (*Smilax bona-nox*) and poison ivy (*Toxicodendron radicans*) (SCDNR, 2009a).

The foredune/pioneer zone at the south end of the proposed project area is dominated by sea oats, dune pennywort, railroad vine (*Ipomea pes-caprae*), and panic grass. Within the central portion of the proposed Port Royal Sound project area between HHI-28 and HHI- 29, the foredune and associated pioneer species have been lost to beach erosion, and the maritime shrub dominated by wax myrtle has been severely eroded (Photo 1).

Photo 1: Dead dune shrub vegetation in area of high erosion near HHI-29. Photo taken near high tide on June 3, 2009 at approximately 5:00 pm.

A large sand spit is currently located between HH-29A and HHI-29B within the Action Area (Figure 4). This sand spit, which formed around April 2006, is a product of erosion from the beach to the south of HHI-28 and HHI-29 and accretion in the lee of the remaining portion of Joiner Bank. It is expected that this spit will continue to build and migrate northward along the Port Royal Sound shoreline.

The sand spit is mostly unvegetated dry beach berm and intertidal sand habitat which serve as valuable roosting and foraging habitat for shorebirds, particularly for tthreatened piping plover (Photo 2a). The intertidal mudflat just north of the sand spit provides high-quality foraging habitat for piping plovers and other shorebird species which feed on small benthic infaunal invertebrates such as polychaetes, crustaceans, and mollusks (Photo 2b). At low tide, isolated ponds form within the intertidal flats, providing optimum foraging habitat for several shorebird species. Figure 6 provides a detailed overview of the intertidal mudflat, sand spit, and Joiner Bank.

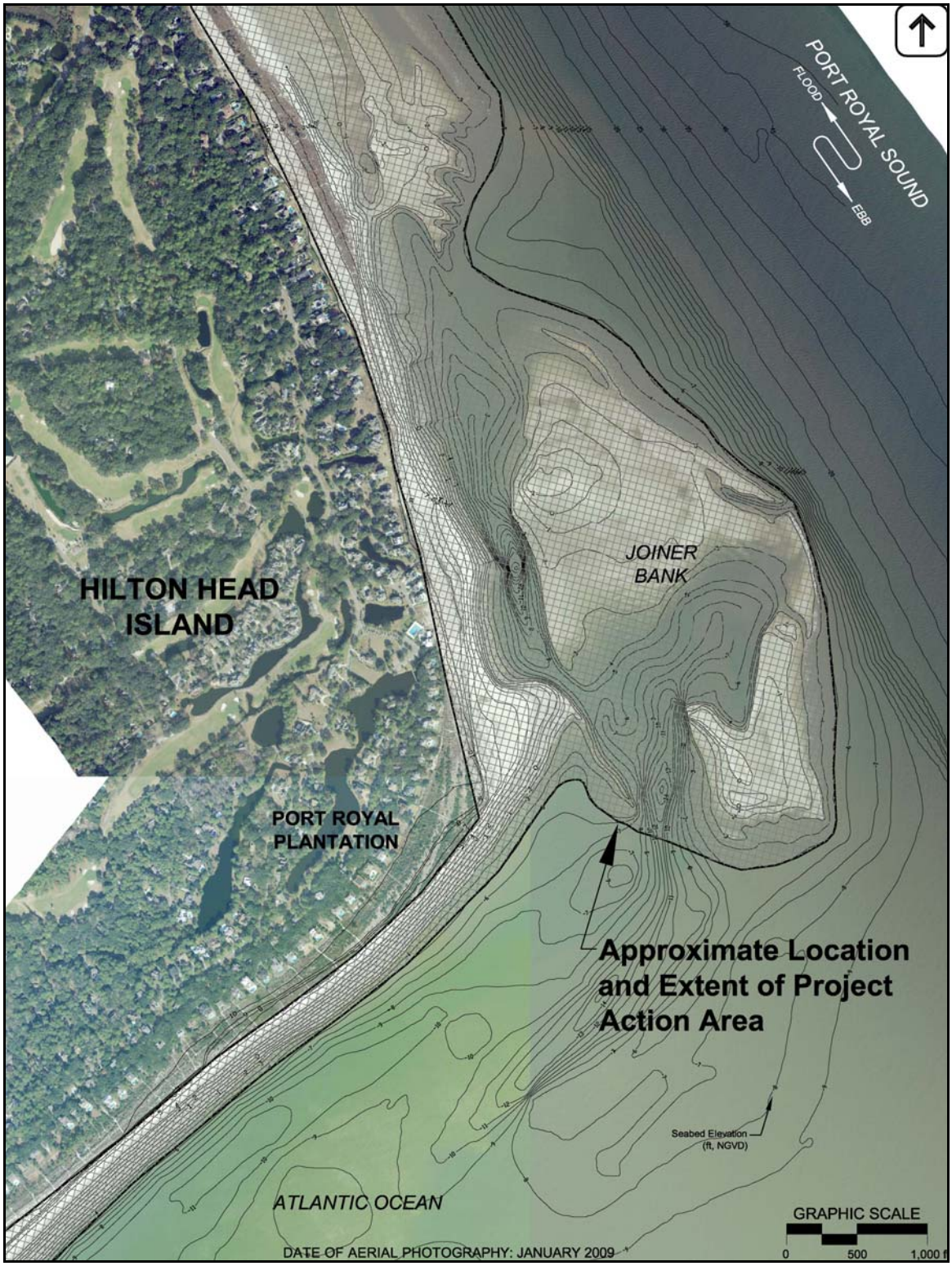

Figure 6: Detailed view of sand spit, mud flat and Joiner Bank within Project Action Area.

Photos 2a and 2b: Sand spit and intertidal mud flat located immediately north of the proposed groin structure in Critical Habitat Unit SC-15. Photos taken on 6/4/09 near low tide at 11:00 am.

1.5 ALTERNATIVES CONSIDERED- CFR 402.12(f)(5)

This section summarizes the evaluation of project alternatives considered by the Town of Hilton Head Island for the Port Royal Shoreline Restoration and Stabilization Project. The development and evaluation of the alternatives considered performance, economic, and environmental objectives and constraints. Initially, five alternatives were developed. These alternatives are summarized in the report titled "North Island Shoreline Change Study Phase I Hilton Head Island, South Carolina" (Olsen Associates Inc., 2008a). This initial evaluation resulted in a recommendation for a project that included beach nourishment and a low-crested "leaky" groin (Alternative 4 in the discussion below). Alternative 4 was revised following additional detailed engineering analysis. The revised plan was further modified following initial consultation with resources agencies in June 2009 using avoidance/minimization measures to avoid direct impacts to valuable foraging habitat for wintering piping plover within Critical Habitat Unit SC-15. This version of the project design is referred to as "Alternative 4 (Avoidance/Minimization Measures) (Section 1.5.7). A summary of each of the alternatives is provided below.

1.5.1 Status Quo: No Action (Alternative 1)

The No-Action alternative would allow the existing shoreline, tidal channel, and Joiner Bank change patterns to continue without any intervention.

1.5.1.1 Expected Shoreline Response

Based upon recent trends, the No-Action alternative will result in additional shoreline recession along the island shoreline between HHI-28 and HHI-29 and beyond. Although the ultimate extent of erosion is difficult to predict since the beach and nearshore area is continually evolving, it is not unreasonable to assume that if left unabated, the erosion will eventually encroach upon the developed upland. It is not unreasonable to expect that the shoreline could adjust to a historical location such as that recorded in 1951. It is believed that the "Heel" shoreline was not significantly affected by Joiner Shoals at the time of the 1951 shoreline photograph. Similar conditions would be expected following further dissipation of reduced effects to the shoreline from Joiner Bank.

Figure 7 presents the location of the edge of vegetation for the periods of 1951 (the earliest photograph available), 1999 (the time when the vegetation line was at its documented most seaward position), and 2008 -- relative to the seaward edge of development along the Port Royal Plantation shoreline. This representation demonstrates the highly dynamic and variable nature of historical shoreline changes in this area, as represented by the approximate edge of vegetation over the last 60 years (more or less). At its maximum, the edge of vegetation has varied in position by more than 1,000 feet.

In March 2008, the edge of vegetation continued to be well seaward of the edge of development and the 1951 location. For example, at HHI-29, the March 2008 vegetation line was some 525 feet seaward of the 1951 location and roughly 400 feet seaward of the seaward limit of the beachfront parcels. At this same location,

the 1951 edge of vegetation was approximately 125 feet landward of the seaward edge of development. However, assuming that the recent rate of shoreline recession continues in this area, it is possible that areas of the shoreline in the vicinity of the "Heel" could return to the seaward edge of development in three to five years if no action is taken.

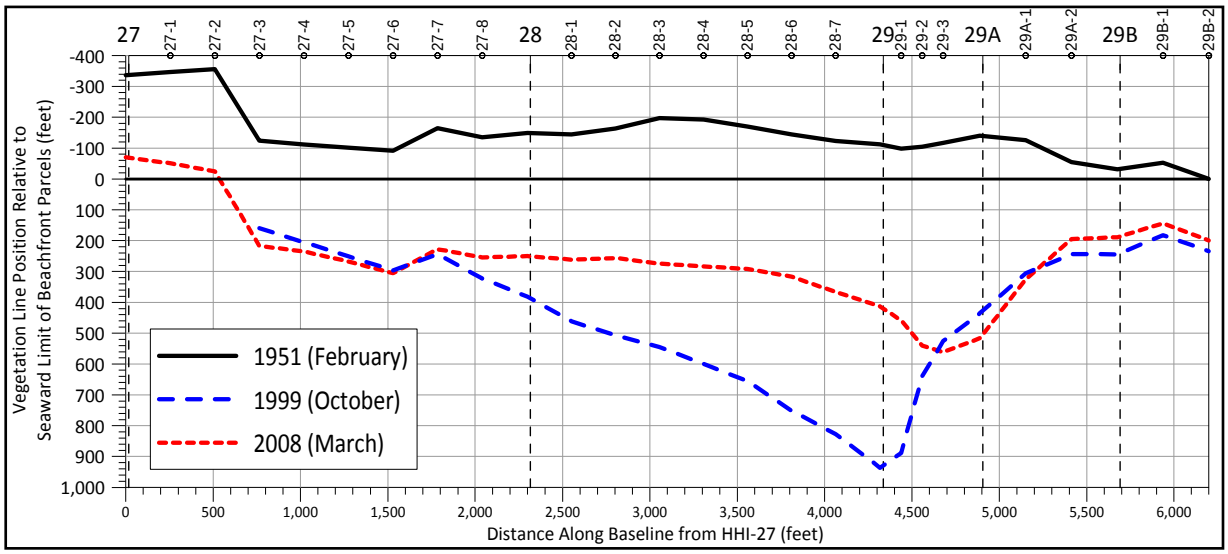

Figure 7: Historical location of the vegetation line relative to existing parcel boundaries along the "Heel" shoreline, Hilton Head Island, SC (Source: Olsen Associates, Inc., 2008a).

1.5.2 Beach Fill with Existing Conditions (Alternative 2)

This engineering alternative would be similar in configuration and scope to past beach restoration and renourishment projects on Hilton Head Island. Sand placement would occur along the most erosional portion of the "Heel" shoreline and taper to adjacent, more stable shoreline areas.

In order to mitigate a portion of the sand losses that have occurred since 1999 and to provide a reasonable amount of sand to offset expected continued future erosion along the "Heel" shoreline, this beach fill would include the placement of at least 550,000 cubic yards of beach-compatible material. At the time of construction, the actual fill volume is expected to be significantly greater. The general location, extent, and plan-form configuration of this concept are depicted in Figure 8. Beach fill placement would occur along approximately 5,300 ft of shoreline between HHI-27 and HHI-29A. The berm would be constructed to an elevation of +9 ft NGVD with an average advance of about 100 ft along the shoreline between HHI-27-3 and HHI-28, and an average berm width of about 225 ft between HHI-28 and HHI-29B-2.

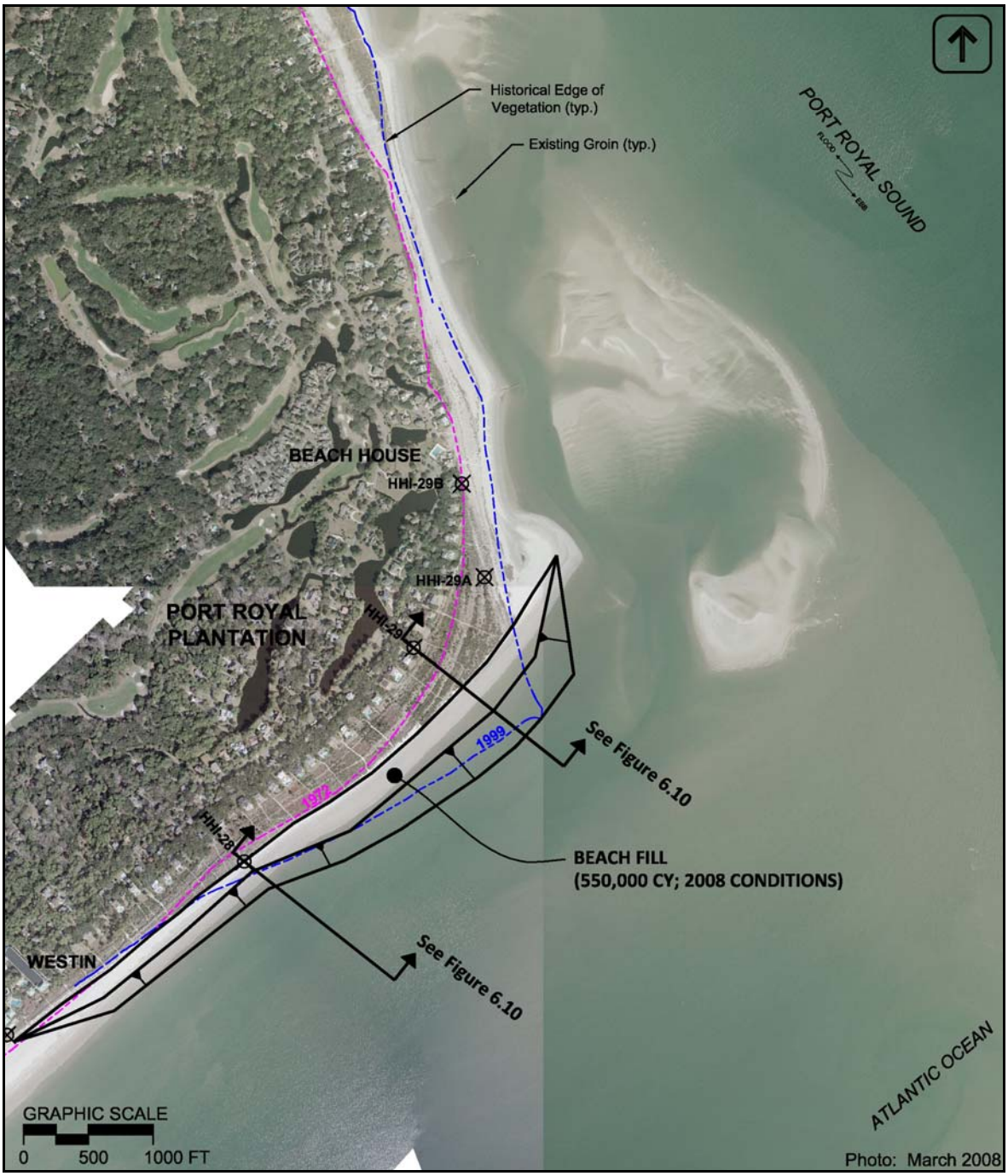

Figure 8: Graphical depiction of Alternative 2 – Beach fill placement (Source: Olsen Associates Inc., 2008a).

1.5.2.1 Expected Performance

Since the section of Joiner Bank that protected this reach of shoreline has significantly dissipated, beach fill would be subject to the extreme erosional forces that have recently influenced and continue to affect this reach of shoreline. It is possible that the magnitude of the erosional stress along the shoreline with or

without the beach fill may increase. Accordingly, the beach fill would essentially be sacrificial, serving to feed the sand-sharing system along this section of the shoreline, and could therefore have a relatively short life compared to previous beach fill projects at Hilton Head Island. Between 2003 and 2008, the average annual sand loss rate from 2,500 feet of "Heel" shoreline has been approximately 120,000 cy/yr. Absent any changes to the present littoral configuration, it is anticipated that this rate of sand loss would continue following fill placement, yielding an anticipated maximum project life of roughly four to five years. If sand transport rates continue to increase along this reach of shoreline, as the condition of Joiner Bank continues to evolve, the life of this project alternative may be significantly less than four to five years. The typical annual sand loss rate from the entire Atlantic Ocean shoreline along Hilton Head Island, which is more than 8 miles in length not including the "Heel" shoreline, is approximately 150,000 cy/yr.

Simply increasing the size of the sand fill for the purposes of potentially increasing fill longevity would be highly ineffective. Since the erosional area is relatively short in comparison to other beach fill project areas along the island, increasing the volume of sand placed along this area would increase the shoreline "perturbation" effect caused by the beach fill. In turn, this would exacerbate the sand loss rate from the area. A shoreline "perturbation" associated with a beach fill is due to the more seaward position of the shoreline within the project area than the shoreline along adjacent areas. This is an unnatural condition that waves and currents work to smooth back to a more uniform shoreline alignment. Such shoreline perturbations experience higher than typical sand loss rates during this "smoothing" process. The more pronounced the shoreline perturbation, the higher the sand loss rate from the project area.

1.5.2.2 Summary

Although beach fill would increase beach width along the "Heel" shoreline, the benefits of this plan would be temporary. Moreover, the performance of a sand fill at this location would be reduced well below the typical performance of beach fill along other areas of the island. This alternative would require frequent sand fill placement events to maintain suitable beach conditions. Moreover, there would be large variations in beach width and shoreline locations between nourishment events. These activities and the dynamic conditions within Critical Habitat Unit SC-15 would create frequent disturbances to the invertebrate prey base and temporary disruptions of roosting and foraging activities of migratory piping plovers and other shorebird species. For these reasons, the beach fill only plan is not recommended.

1.5.3 Joiner Bank Reconstruction and Beach Fill (Alternative 3)

Alternative 3 involves beach fill placement along the shoreline and reconstruction of a preexisting area of Joiner Bank. The goal would be to approximately replicate the configuration of the bank as is existed in about 1998-99. The intent of bank reconstruction would be to reestablish the sheltering effects of the feature to the leeward shoreline and the associated stable to accretional shoreline conditions.

The plan would include the placement of at least 550,000 cy of sand along the "Heel" shoreline (identical in size and scope to the beach fill described in Alternative 2) to restore the beach area lost to erosion, and the placement of roughly 1,000,000 cy of sand across a pre-existing area of Joiner Bank. A graphical depiction of this concept is provided in Figure 9.

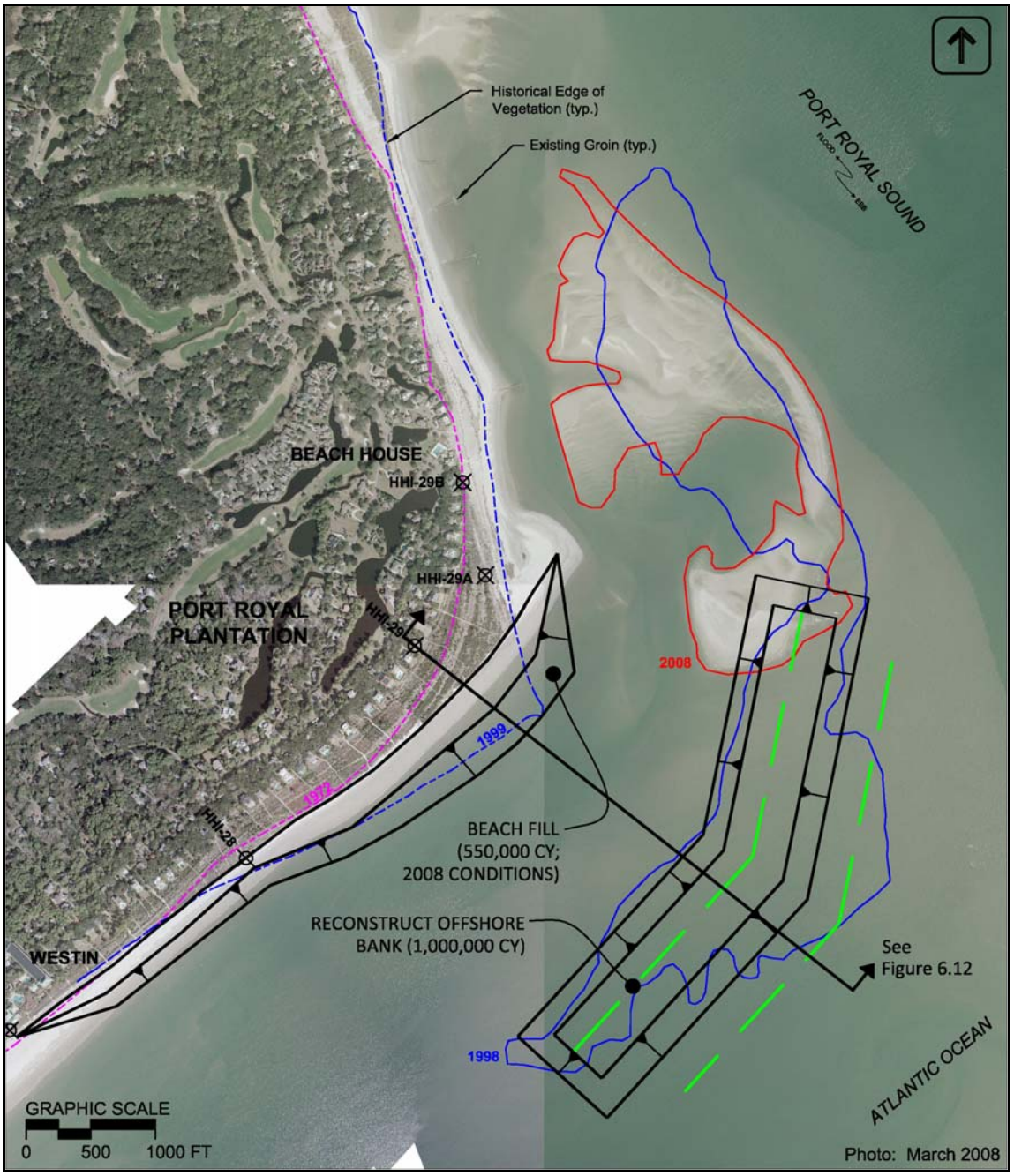

Figure 9: Graphical depiction of Alternative No. 3 – Reconstruction of a portion of Joiner Bank with beach fill (Source: Olsen Associates, Inc., 2008a).

1.5.3.1 Expected Shoreline Response and Performance

Simplistically, this alternative would temporarily return the shoal/beach system to roughly 1998 conditions. Likewise, the subsequent evolution of the reconstructed bank and beach would be expected to be similar to that documented between 1998 and present conditions. That is, immediately following completion of the project, the shoreline change conditions at the “Heel” likely would stabilize and revert to a similar accretional trend. Similar to past conditions, however, accretion along the “Heel” shoreline would reduce the supply of sand to the Port Royal Sound shoreline which, in turn, would increase the potential for erosion along portions of that shoreline to the north.

Based upon the documented behavior of Joiner Bank (post-1998) and the known effects of the tidal current and wave climate upon the offshore sand shoals, the benefits of the reconstructed bank would be highly temporary. The bank would not be stable, but rather, it would experience a period of equilibration similar to a beach fill and would eventually migrate shoreward. As bank migration evolved, there would also be a gradual lowering of the design bank crest elevation.

The rate of change to the reconstructed bank configuration is difficult to estimate, however, the sand loss rate from the reconstructed bank could be higher than that experienced during the recent natural bank evolution. Water depths immediately offshore of the existing bank are currently deeper as compared to the late 1990’s when the bank was relatively stable. It would not be possible to restore those offshore elevations to a pre-existing condition. The greater water depths around the existing bank appear to be associated with overall bank changes and the possible realignment of tidal channels in the area. Also, the overall change in channel conditions around the “Heel” area may result in a completely different bank migration and evolution pattern than observed in the recent past.

This alternative would most likely increase the longevity of a restored beach section along the “Heel” of the island. However, there would be potential corresponding negative effects to the adjacent Port Royal Sound shoreline in the form of more frequent nourishments or shore stabilization actions along this area in the future. Furthermore, the shore-stabilizing benefits associated with the reconstructed bank would be temporary and similar to a beach fill project, and the bank would most likely require future maintenance. As such, this approach would not only involve future renourishment of the “Heel” and adjacent shorelines, but would also require periodic sand replacement of the offshore bank.

Complicating the implementation are concerns associated with the experimental nature of this approach. There are uncertainties regarding the expected performance of the sand berm and the possible need for significant increases in the demand for offshore sand resources to maintain the berm. As such, reconstruction and maintenance of the sand shoal in a manner that would meet reasonable performance requirement may not be an effective use of clean, beach-compatible offshore sand resources.

1.5.3.2 Summary

Due to expected construction difficulties, the potential for adverse effects to adjacent shorelines of unknown magnitude, uncertainties associated with expected performance, high initial project cost, the likely need for continued maintenance of the beach and berm, and possible impacts to offshore sand resources, Alternative 3 is not recommended for implementation.

1.5.4 Low-Crested "Leaky" Groin and Beach Fill (Alternative 4)

Considering the existing and expected continued high sand transport rates and associated erosion along the "Heel" shoreline, Alternative 4 (the preferred alternative) includes the use of shore-stabilizing structures as the most effective means of adequately providing acceptable future shoreline stability at this location.

Alternative 4 includes a low-crested, "leaky" groin at the northern terminus of the island's Atlantic Ocean shorefront and within the limits of the beach fill (Figure 3). Until recently, the historical headland-shaped shoreline at this location has been maintained by the configuration and associated wave-sheltering effects of Joiner Bank. With the reduction of depositional characteristics of Joiner Bank, the headland shaped area of the shoreline is expected to be highly vulnerable to continued chronic erosion. The structure is intended to maintain the pronounced headland-shaped shoreline configuration similar to historical conditions in the absence of Joiner Bank, and also allow for continued sand transport along this area of the shoreline.

The groin structure will be constructed in conjunction with a comprehensive beach fill project. The placed sand will be shaped into the typical construction berm configuration used on the Atlantic shorefront with a crest elevation of +8 ft NGVD and a seaward slope of 1:20 (i.e., 1 vertical unit to 20 horizontal units). Fill berm widths are expected to vary from 250 to 500 feet. The variation is due to the irregular configuration of the existing, eroded shoreline. The fill will taper to the existing shoreline at both the north and south ends. At the southern end of the project, the fill will taper about 500 feet to the existing shoreline. A the northern end of the project, just north of the structure, the fill will taper from the proposed groin to the southern area of the "sand spit" as it is configured at the time of construction.

The total length of the structure will be approximately 600 feet. Most of the structure will be buried in the upland and proposed beach fill. The final location and configuration of the structure will be determined from immediate pre-design surveys and the design configuration of the beach fill. The crest elevation will be +6.0 ft. NGVD for the landward 200 feet (more or less) of the structure and +1.0 ft NGVD seaward thereof. The structure will be constructed of granite armor stone, and the seaward half will be placed upon stone-filled marine mattresses where the potential for scour is highest. The landward half of the structure will be constructed upon a geogrid/fabric composite underlayment material. The size of the armor stone will be determined during final engineering design analyses.

Similar structures which perform in the manner as described, either intentionally or unintentionally, exist at the terminal ends of several islands in South Carolina, Georgia, and northeast Florida. One structure that was specifically designed as a low-crested, “leaky” structure is located on the southern end of Amelia Island, Florida. Although this structure is longer than the structure described for the proposed project, it serves a similar purpose. Figure 10 is an aerial photograph of the southern end of Amelia Island. The terminal groin visible at the bottom of the photograph, but is mostly covered with sand. A site inspection conducted on July 21, 2009, revealed nearly complete burial of the low-crested groin structure. Only the top portion of a few rocks was exposed on the beach surface (Photo 3).

The groin was installed at the end of the island within Amelia Island State Park to stabilize the shoreline recreated by beach fill. The configuration and elevation of the structure allow for a high rate of sand transport to continue into Nassau Sound, the adjacent waterbody, for the purposes of maintaining the stability of the adjacent, downdrift interior sound shoreline, and the large sand shoals within the sound, which are important, protected habitats for resident and migratory birds. Additionally, the groin structure is located seaward of the Amelia Island Critical Wildlife Area, a protected colonial bird nesting site.

Photo 3. “Leaky” terminal groin on southern Amelia Island, FL. Photograph taken on July 21, 2009.

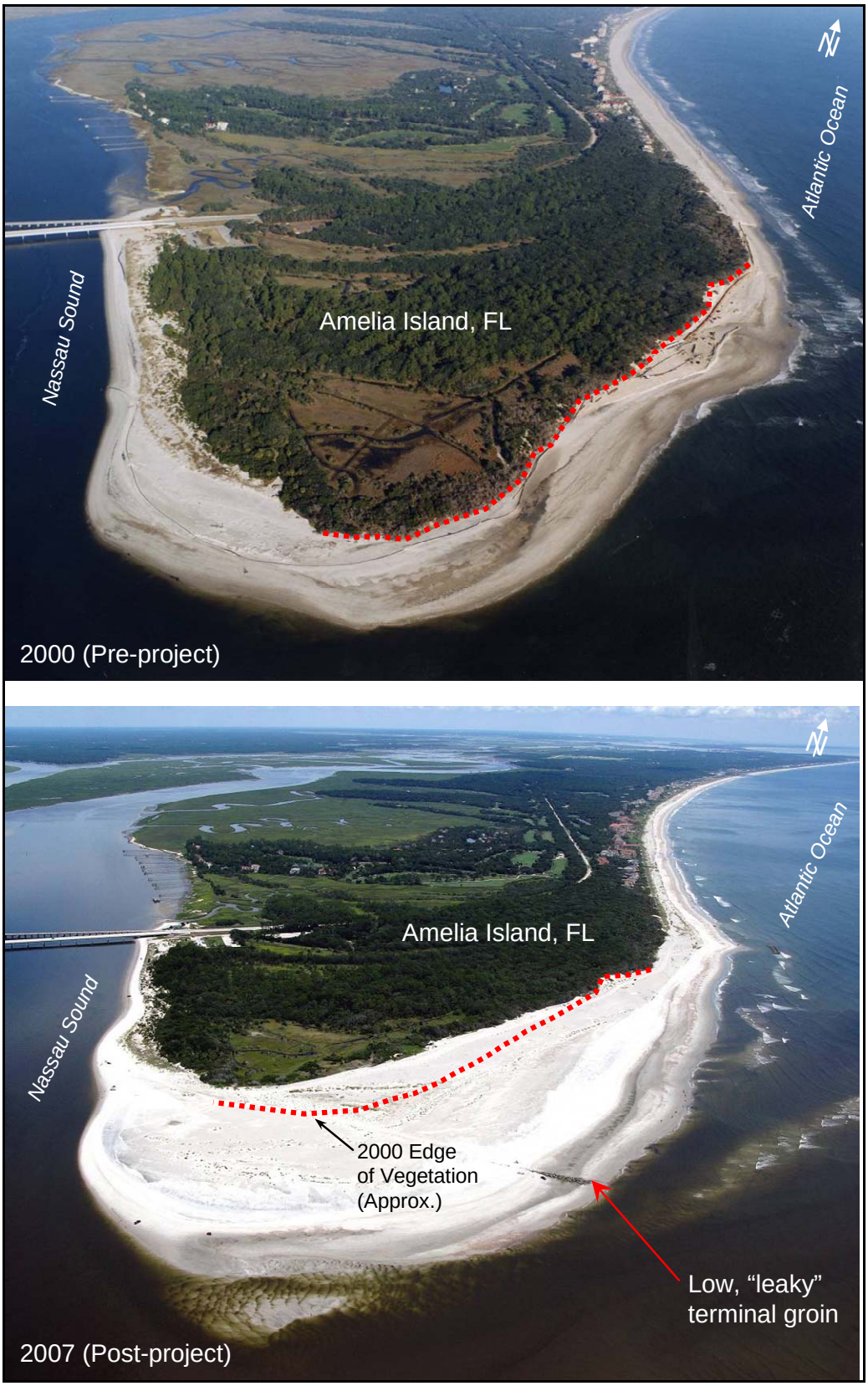

Figure 10: Aerial photographs of southern Amelia Island, FL (Source: Olsen Associates Inc. 2008a).

The low-crested, “leaky” groin is intended to reduce the rate of shoreline retreat following beach fill placement, maintain a more consistent shoreline position along the Atlantic Ocean and Port Royal Sound shorelines, and allow for continued alongshore sand transport from the Atlantic Ocean shoreline to the Port Royal Sound shoreline, which is the typical direction of natural sand transport along this area of the island. The risk of potential adverse effects along the Port Royal Sound shoreline will be further minimized and managed through the ongoing commitment by the Town of Hilton Head Island for monitoring, maintenance, and management of the island’s shorelines through periodic beach fill placement as needed. The seventeen existing groins along the 9,000 feet of Port Royal Sound shoreline immediately north of the proposed “leaky” groin will serve to stabilize the shoreline downdrift of the proposed project area.

An offshore borrow site with a sufficient volume of beach-compatible sand has been developed as the result of a detailed sand search investigation. The borrow site is located northeast of the main tidal channel of Port Royal Sound and lies approximately 3 miles east of the project area in water depths of roughly 6 to 25 ft (NGVD) (Figure 5). The seabed in the majority of the borrow site lies somewhere around the -7 to -8 ft NGVD elevation. The borrow site covers approximately 181 acres. Seventeen (17) vibracores effectively define the borrow site (thirteen lie directly within the potential excavation area).

Vibracore and seismic sub-bottom data indicate that a lens of beach-quality material extends to an elevation between -25 and -55 ft NGVD within the proposed borrow site. The -20 ft NGVD elevation has typically been the geologic horizon above which sediment has been dredged for beach nourishment at Hilton Head Island. Since beach-compatible sand in the study area is typically observed above at least the -25 ft NGVD elevation, sediment characteristics of the site were investigated above two horizons; above -20 ft NGVD and above -25 ft NGVD. Above the -20 ft horizon, the 181-acre borrow site contains approximately 2.9 million cubic yards. Above -25 ft, approximately 4.3 million cubic yards are available. It is likely that the use of the entire developed borrow site will not be required for the proposed beach restoration project.

1.5.4.1 Expected Shoreline Response

The low-crested, “leaky” groin would be configured such that the shoreline to the south would be stabilized via the maintenance of an extensive updrift impoundment fillet. The shore stabilization effects would extend to at least the typical northern end of periodic beach renourishment activities in the vicinity of the Westin Hotel (north of HHI-27). As a minimum, the intended residual or design shoreline would be at or seaward of the 1972 shoreline position.

Shoreline conditions would be maintained on the downdrift side of the structure through the transport of sand across the low-crested groin from the Atlantic shoreline, as well as the onshore migration of sand from the remaining portion of Joiner Bank.

Regardless of any plan implemented at the “Heel,” future periodic nourishment along the Atlantic Ocean, “Heel” and Port Royal Sound shoreline would be expected. The interval between periodic nourishment events would likely be similar to previous projects on the island (i.e., eight to ten years).

1.5.4.2 Summary

Beach fill with a low-crested, leaky groin is expected to provide the desired stability along the Atlantic Ocean shoreline with minimal adverse effects to the downdrift Port Royal Sound shoreline. This approach would stabilize an extended reach of the highly erosional Atlantic Ocean shoreline along the “Heel” of the island and allow continued sand transport to the Port Royal Sound shoreline to the north. Moreover, this approach would potentially reduce the required frequency of nourishment along this localized reach of shoreline compared to other areas of the island’s shorefront. This would also reduce the potential demands upon sand resources offshore of the island that are used for beach nourishment. Increased shoreline stability and infrequent renourishment activities along this reach of the island’s shoreline will provide more consistent and stable beach habitat conditions. For these reasons, Alternative 4 is the preferred approach of those evaluated in the project feasibility study (Olsen Associates, Inc., 2008a).

1.5.5 Groin Field and Beach Fill (Alternative 5)

An alternate structural stabilization plan would include eight shore perpendicular groins configured as a radial field around the “Heel” shoreline with beach fill. The field would extend from a point on the open Atlantic coastline to the southernmost existing groin along the Port Royal Plantation Port Royal Sound shoreline. Figure 11 presents a schematic of this conceptual alternative. This application of structures would provide a more even shoreline position transition from the Atlantic Ocean shorefront to the Sound shoreline as compared to the proposed groin structure in the Preferred Alternative. It is estimated that the groin field would cover between 3,000 and 3,500 feet of shoreline. The structures would be spaced roughly every 400 to 450 feet apart and would each be approximately 300 feet in length. The beach fill would be similar in scope and configuration as that described in Alternative 2.

The goal of the radial groin field plan would be to maintain a minimum beach condition seaward of the 1972 location and to allow excess sand transported to the area from the Atlantic shorefront and Joiner Bank to be delivered to the interior shoreline of Port Royal Sound. Beach width conditions would continue to fluctuate beyond the minimum as a function of wave and current conditions and sand availability.

Radial groin fields have been successfully implemented at other locations in North and South Carolina. Specifically, groin fields similar to the described concept alternative for the north end of Hilton Head Island are currently in place on Bald Head Island, NC and Edisto Island, SC. For application at Hilton Head Island, the groins could be constructed of either geotextile tubes or rip-rap rock. Geotextile tubes would be considered a temporary structural solution that would require high

frequency maintenance and/or periodic replacement of the tubes. The tubes deteriorate over-time and are susceptible to tears from floating debris and vandalism. Nonetheless, the initial cost of these geotextile tube structures would be significantly less than the initial cost for rock structures. As such, the tubes could serve as either a temporary measure or as a means to evaluate the potential effects of permanent structures on shoreline stability and the littoral system.

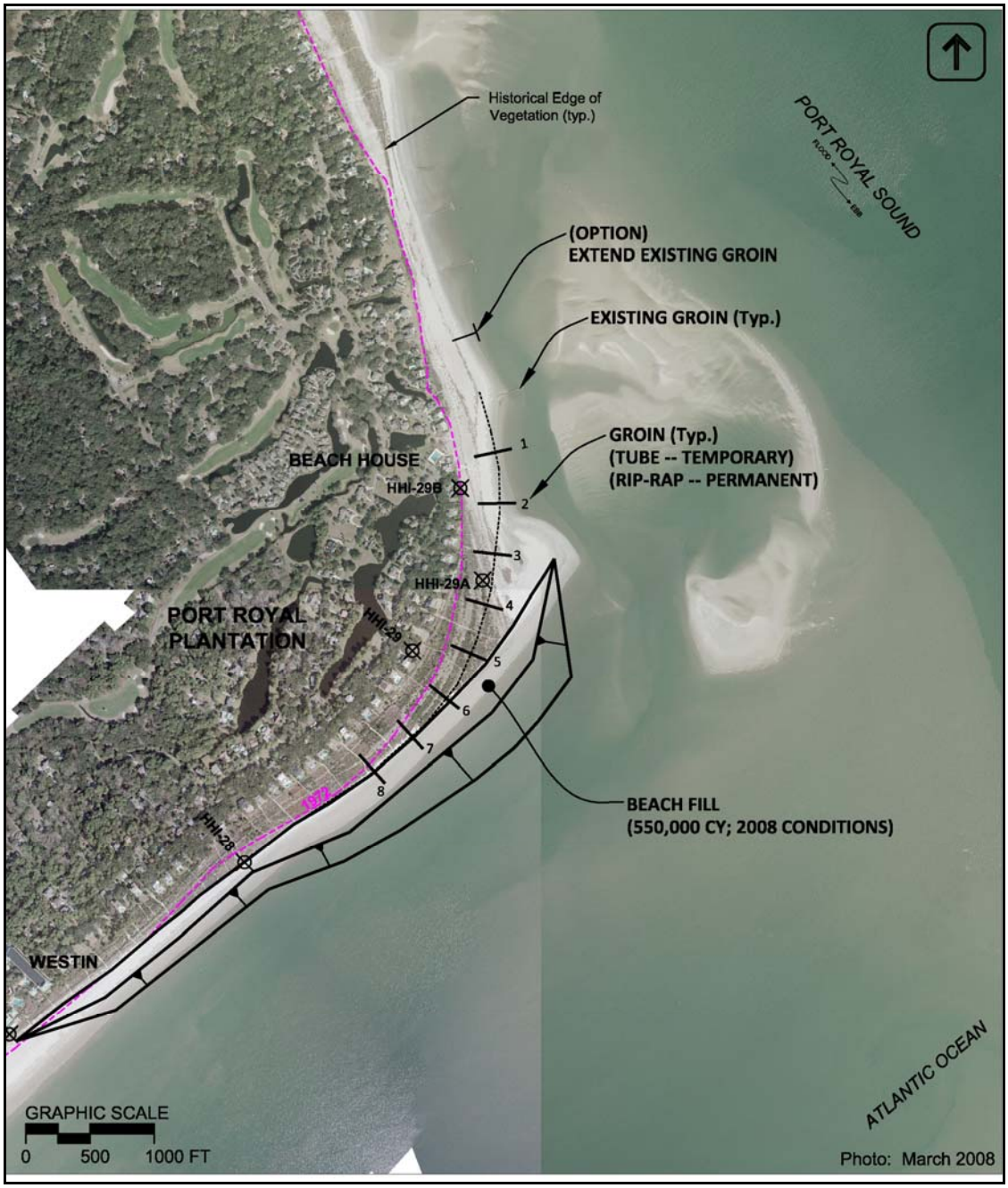

Figure 11: Graphical depiction of Alternative No. 5 – Radial groin field with beach fill (Source: Olsen Associates Inc., 2008a).

1.5.5.1 Expected Shoreline Response

A radial groin field would maintain a minimum design beach condition at a desired, designated location. As noted above, the goal would be to maintain a minimum shoreline location seaward of the 1972 position. Although the structures would facilitate a more gradual shoreline transition from the Atlantic Ocean shorefront to the interior Port Royal Sound shoreline, there would be a localized, abrupt shoreline offset across the individual groins. This effect is common where alongshore sand transport is mostly unidirectional, such as that observed along the “Heel” shoreline. The offsets would be the result of impoundment fillets on the south side of the groins and localized erosional depressions on the north sides of the groins. These localized shoreline discontinuities, as well as the structures themselves, could limit alongshore pedestrian access at high tide.

It is also possible that between renourishment events, the structures could retain sand sufficient to increase sand loss rates along the downdrift shoreline. Upland interests along the interior Port Royal Sound shoreline would be somewhat protected from an increase in sand loss rates or exacerbated erosional conditions due to the presence of the existing shore-stabilizing structures along that beach. However, the extent of protection to the upland from the existing structures would be dependent upon their condition at the time of exposure. As noted by Olsen Associates Inc., (1995), most of the structures along the Port Royal Plantation Port Royal Sound shoreline currently require varying levels of refurbishment, reconstruction, and enhancement. Some are virtually derelict.

1.5.5.2 Summary

Similar to Alternative 4, beach fill with a radial groin field would be expected to provide improved stability along the Atlantic Ocean shoreline. This approach, however, may be more impactive to downdrift shoreline conditions and alongshore pedestrian beach access. Moreover, the type of material used for structure construction (i.e., geotextile tube vs. rip-rap rock) may affect the overall project cost. If geotextile tubes are used initially, continued maintenance of the tubes and likely future replacement of the tubes with rock could significantly increase the overall cost of this plan. There would also be an increased requirement for beach access and construction activities to perform the required periodic maintenance and replacement of the structures.

1.5.6 Alternative 4 (Revised)

Following completion of the feasibility study (Olsen Associates, Inc. 2008a), a more detailed evaluation of the preferred project design was performed in preparation of an interagency meeting and permit application. This “Revised” version of Alternative 4 included a refinement of the proposed groin and an increase in the volume of sand fill to be placed north of the groin (Figure 12). This “Revised” plan proposed fill placement north of the sand spit and into the adjacent tidal channel. The intent of this added fill volume was to “overfill” the beach north of the project groin to reduce the potential for any project-related erosion effects along the Port Royal Sound

shoreline and accelerate the expected attachment of a portion of the remaining area of Joiner Bank to the Port Royal Sound shoreline.

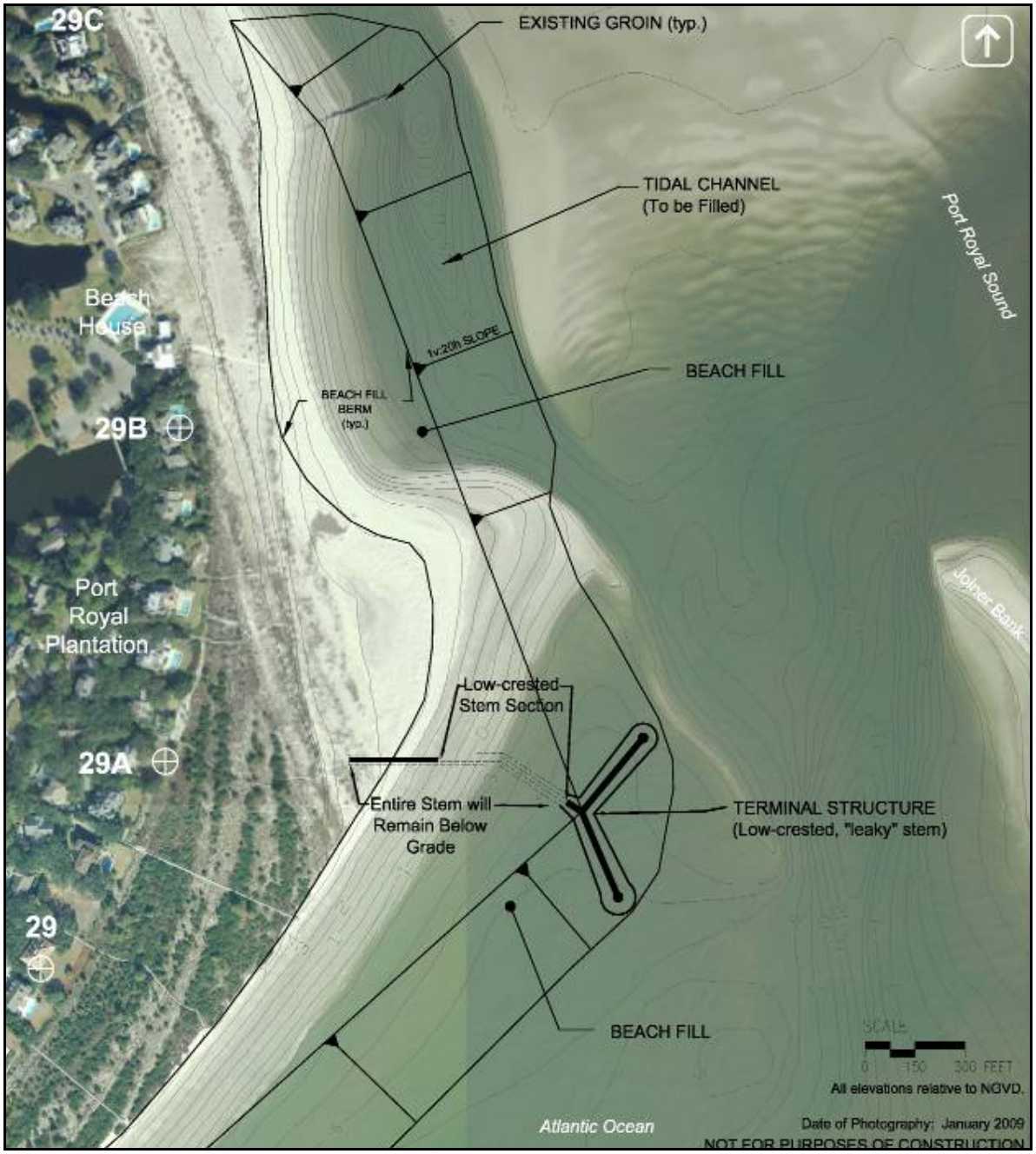

Figure 12: Alternative 4 (Revised). Project plan included an increase in the fill volume north of the groin and sand spit. It also include fill placement in the tidal channel between the Port Royal Sound shoreline and a portion of Joiner Bank.

1.5.7 Alternative 4 (Avoidance/Minimization Measures)

As proposed in Alternative 4 (Revised), beach fill would be placed north of the proposed groin structure and existing sand spit to “pre-fill” the shoreline downdrift of the groin and minimize the potential for a short-term post-construction sand deficit north of the proposed structure (Figure 13a). Fill would also be placed in the small tidal channel between the Port Royal Sound shoreline and a portion of the Joiner Bank.

A site visit and interagency meeting was held on June 4, 2009 to discuss the proposed project. Concerns were raised by the resource protection agencies regarding the proposed sand placement north of the sand spit and potential impacts to piping plover foraging habitat in this area. Areas of high-quality foraging habitat were identified in the intertidal mud flat directly north of the sand spit during the site inspection (Photos 2a and 2b). Piping plover sighting data collected between 2006 and 2009 also highlight the importance of this area to wintering piping plover (Figure 15). The agencies recommended avoidance of direct impacts to this habitat through revisions to the proposed project design.

Accordingly, the project design was further revised to avoid direct impacts to the area of valuable foraging habitat within Critical Habitat Unit SC-15 immediately north of the sand spit. This version of the project design is referred to as “Alternative 4 (Avoidance and Minimization Measures).” This design includes limited sand placement north of the groin. No direct sand placement would occur north of the sand spit across the intertidal mudflat foraging area north of the spit (Figure 13b). To compensate for the reduction in fill volume north of the proposed groin, additional sand would be added to the proposed beach fill design south of the groin. This would allow for a more gradual transition of fill migration into the habitat area rather than direct burial and mortality of the prey base. It is noted that, due to the highly dynamic shoreline conditions and spit migration trends in the project area, it is expected that the sand spit will be located farther northward along the Port Royal Sound shoreline at the time of project construction than the January 2009 location shown in Figures 13a and 13b.

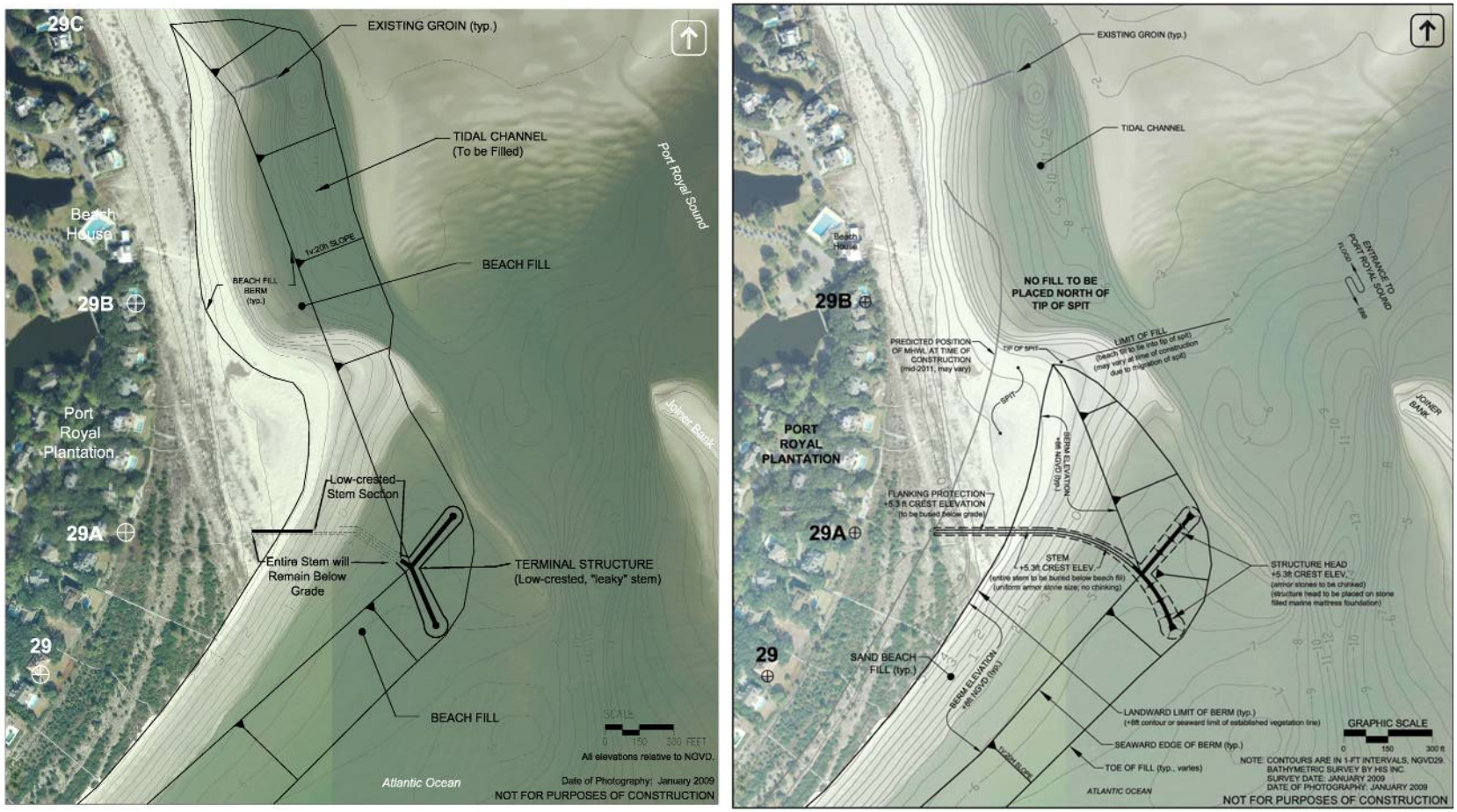

Figure 13a and 13b: a) Alternative 4 (Revised) prior to avoidance/minimization of impacts to high-quality foraging habitat for piping plover within Critical Habitat Unit SC-15. In this “Revised” plan, significant fill placement was proposed north of the structure to pre-fill the shoreline downdrift of the structure; b) Alternative 4 (Avoidance and Minimization Measures) considered impacts to critical habitat for wintering piping plover. Fill placement north of the spit has been eliminated from the project design.

1.6 CONSIDERATION OF DREDGING METHODS- CFR 402.12(f)(5)

The proposed project will be constructed using a 24 or 30-inch hydraulic cutterhead dredge. A hopper dredge will not be used for construction of this project. Pipeline/ cutterhead dredges typically provide high dredging and sand placement rates, particularly in projects where the sand borrow site is relatively close (< 5 miles) from the fill site. These dredges are also best for shallow (<20 ft deep) sand borrow sites. The maximum expected pipeline length for the proposed project is about 20,000 feet (~3.8 miles). A 24-inch dredge might require the use of a pipeline booster for a pipeline length of this size. Most 30-inch dredges in the US could work with a pipeline length of this size with or without a pipeline booster. Ambient water depths in the borrow site vary from about -3 to -20 feet relative to the mean low water elevation.

2.0 STATUS OF LISTED SPECIES AND HABITAT IN THE ACTION AREA– CFR 402.12(c)(f) & 402.14(c)(2)(3)

In the assessment of potential impacts of the proposed Port Royal Shoreline Restoration and Stabilization Project on federally listed endangered and threatened species, Coastal Eco-Group marine scientists: 1) conducted a review of databases and websites prepared by the South Carolina Division of Natural Resources (SCDNR), USFWS, and the NMFS, and searched for other scientific data, literature and unpublished reports to determine species distributions and habitat requirements; 2) interviewed recognized experts on the listed species, including local authorities and Federal and State resource and regulatory agency staff; and 3) conducted a site inspection of the biological resources within the project area. Literature sources consulted during preparation of this BA include Federal status reports and recovery plans, peer-reviewed journals, and environmental documents. A complete list of literature sources cited during preparation of this BA is provided in the References section. The Environmental Assessment for the Port Royal Shoreline Restoration and Stabilization Project (in preparation) contains a detailed evaluation of the direct, indirect, and cumulative environmental effects of the proposed project on biological communities, habitats, and listed species.

Table 1 provides a list of State and Federally protected species with the potential to occur within the vicinity of the Hilton Head Island (Beaufort County) Action Area [50 CFR 402.12(c) and 50 CFR 404.14(c)]. Of the listed and protected species potentially occurring in the Project Action Area, the applicant believes that the following species may be potentially affected by the proposed project and submits this list for Service approval [50 CFR 402.12(c)]:

Loggerhead turtle (*Caretta caretta*)
Atlantic green turtle (*Chelonia mydas*)
Leatherback turtle (*Dermochelys coriacea*)
Kemp's ridley sea turtle (*Lepidochelys kempii*)
Shortnose sturgeon (*Acipenser brevirostrum*)
West Indian manatee (*Trichechus manatus*)
Piping Plover (*Charadrius melodus*)
North Atlantic right whale (*Eubalaena glacialis*)
Blue Whale (*Balaenoptera musculus*)
Finback Whale (*Balaenoptera physalus*)
Humpback Whale (*Megaptera novaeangliae*)
Sei Whale (*Balaenoptera borealis*)
Sperm Whale (*Physeter macrocephalus*)

Table 1: State and federally listed species within the Hilton Head Island (Beaufort County) study area.

Common Name	Scientific Name	State	Federal
Fish			
Shortnose sturgeon	*Acipenser brevirostrum*	E	E
Reptiles			
Loggerhead turtle	*Caretta caretta*	T	T
Leatherback turtle	*Dermochelys coriacea*	E	E
Atlantic green turtle	*Chelonia mydas*	T	E
Kemp's ridley sea turtle	*Lepidochelys kempii*	E	E
Birds			
Piping plover	*Charadrius melodus*	T	T
Bald eagle	*Haliaeetus leucocephalus*	BGEPA	BGEPA
Brown pelican	*Pelecanus occidentalis*	SSC	n/a
Least tern	*Sterna antillarum*	T	n/a
Wood stork	*Mycteria americana*	E	E
Mammals			
West Indian manatee	*Trichechus manatus*	E	E
North Atlantic right whale	*Eubalaena glacialis*	n/a	E
Blue whale	*Balaenoptera musculus*	n/a	E
Fin whale	*Balaenoptera physalus*	n/a	E
Humpback whale	*Megaptera novaeangliae*	n/a	E
Sei whale	*Balaenoptera borealis*	n/a	E
Sperm whale	*Physeter macrocephalus*	n/a	E

State listings are taken from the South Carolina Department of Natural Resources. Federal listings are taken from the NOAA Fisheries Service and the United States Fish and Wildlife Service- State and Federal Threatened, Endangered, and Other Species of Concern likely to occur in Beaufort County, SC, Compiled May 2009. E = Endangered; T = Threatened; SSC = Species of Special Concern; BGEPA = federally protected under the Bald and Golden Eagle Protection Act; n/a = information not available or no designation listed.

2.1 LOGGERHEAD SEA TURTLE

2.1.1 Status and Threats

The loggerhead turtle (*Caretta caretta*) was listed by the USFWS as threatened throughout its range on July 28, 1978 (43 FR 32808). The loggerhead is the most abundant sea turtle species in U.S. coastal waters (NMFS and USFWS, 1991a).

Genetic research has identified four different loggerhead nesting subpopulations in the southeastern United States: (1) the Northern Subpopulation ranging from North Carolina to Northeast Florida; (2) South Florida Subpopulation ranging from just north of Cape Canaveral, Florida and extending to Sarasota, Florida; (3) Dry Tortugas, Florida, Subpopulation, and (4) Northwest Florida Subpopulation on the beaches of Florida's Panhandle (Bowen et al., 1993; Bowen et al., 1994; Bowen, 1995; Encalada et al., 1998; Pearce, 2001). Each nesting subpopulation is considered a distinct reproductive population. Due to the high site fidelity of nesting females to their natal region and low gene flow among nesting assemblages, most western North Atlantic loggerhead nesting assemblages are vulnerable to extirpation. Nesting efforts in South Carolina constitute 56% of the northern sub-population nesting (TEWG, 2000).

Based upon nesting data collected on index nesting beaches in the U.S. from 1989-1998, the total number of loggerhead nests laid along the U.S. Atlantic and Gulf coasts ranged from 53,016 nests to 89,034 nests annually. On average, 90.7% of the nests were from the South Florida population, 8.5% were from the northern subpopulation, and 0.8% of the nests were from the Florida Panhandle subpopulation. Based upon this information, there is a limited number of nesting females in the Northern and Panhandle subpopulation, which may be partially related to the temperature-dependent sex determination in sea turtles. Relative to the threshold temperature range between 28 and 30 degrees Celsius, warmer temperatures result in the production of female hatchlings while cooler temperatures results in the production of male hatchlings (Mrosovsky, 1995).

The most significant threats to the loggerhead sea turtle population are coastal development, commercial fisheries and marine pollution (NMFS, 2007). Juvenile loggerhead turtles are particularly susceptible to impacts associates with shrimp fisheries offshore of the Atlantic coast and along the southeastern Atlantic coast.

Loggerhead nesting habitat is threatened with beach erosion, armoring and nourishment; artificial lighting; increased human activity associated with coastal development, including poaching activities; natural predation by fire ants, raccoons, armadillos, and opossums; and storm activity. The sea turtle nesting season on Hilton Head Island (May 1st to October 31st) overlaps with the hurricane season in the Caribbean Sea and northwest Atlantic Ocean (June to November). Hurricanes can have a devastating effect on sea turtle reproductive success.

Negative impacts to sea turtle nesting and hatching success in Beaufort County include predation, hatchling disorientation due to artificial upland lighting, human activity/disturbance, and lost or damaged nests due to storm activity.

2.1.2 Distribution and Range

Loggerhead sea turtles occur throughout the temperate and tropical regions of the Atlantic, Gulf of Mexico, Pacific and Indian Oceans. The loggerhead sea turtle occurs in open water as far as 500 miles from shore, but is mainly found over the continental shelf, and in bays, estuaries, lagoons, creeks, and mouths of rivers. The loggerhead favors warm temperate and subtropical regions in relatively close proximity to shorelines. Similar to other sea turtle species, water temperature influences the movements of loggerheads, and they do not usually appear at summer foraging grounds until June, although some individuals can be found in Virginia as early as April. Immature stages of loggerheads (i.e. juveniles/sub-adults) which forage in the northeastern U.S. are known to migrate southward in the fall as water temperatures drop, and migrate northward in spring.

2.1.3 Habitat

Loggerheads are primarily carnivorous, feeding on sponges, squid, sea urchins, crabs, horseshoe crabs, shrimp, basket starfish, and a variety of mollusks, which they crush with their beak-like jaws prior to swallowing. Loggerhead sea turtles are primarily bottom feeders; however, they also feed on jellyfish while swimming in the water column or resting/basking near the surface of the water. Under certain conditions, loggerheads may prey upon slow-moving, demersal fish species. Hatchlings and juveniles feed on prey concentrated at the surface such as gastropods and *Sargassum*.

Adult loggerheads occupy various habitats from turbid bays to clear waters of reefs. After emergence from the nest, hatchlings move out to sea, and spend approximately 3 to 5 years in the pelagic immature stage, generally associated with floating *Sargassum* mats (NMFS and USFWS, 1991). The pelagic lifestage may span as long as 7 to 12 years. Juveniles/subadults occur mainly in nearshore and estuarine waters and use these habitats for feeding. As loggerheads mature, they travel and forage through nearshore waters until their breeding season, when they return to the nesting beach. The estimated age at maturity is approximately 21 to 35 years (Frazer and Ehrhart, 1985; Frazer et al., 1994). The majority of mature loggerheads appear to nest on a two or three year cycle.

Major nesting beaches for loggerheads include the Sultanate of Oman, southeastern United States, and eastern Australia. In the continental U.S., loggerhead sea turtles nest along the Atlantic coast from Florida to New Jersey (Musick, 1979). In the western Atlantic, most loggerhead nesting occurs from North Carolina to Florida and the Gulf coast. The southeastern nesting population is critical to the survival of the species and is second in size only to the nesting aggregation on Masirah Island, Oman. Steeply sloped beaches with gradually sloped offshore approaches are generally favored by nesting females.

2.1.4 Presence in the Project Area

Loggerhead nesting season in Beaufort County extends from May 1st through October 31st with highest nesting activity observed in June and July. Sea turtle nesting data for Hilton Head Island is available from the Coastal Discovery Museum. During nesting season, loggerhead sea turtles nest on the 14 miles of beaches on Hilton Head. The Coastal Discovery Museum, with funding provided by the Town, conducts the Sea Turtle Protection Project in conjunction with the South Carolina Department of Natural Resources. If nests are found in unsuitable locations, they are relocated for the safety of the hatchlings. After the hatchlings leave the nests, the Sea Turtle Protection Project inventories each nest to determine how many eggs successfully hatched. This data aids in determining population trends for this species (Coastal Discovery Museum, 2009).

The loggerhead sea turtle is responsible for nearly all of the recorded nesting on Hilton Head Island with an annual average of 153 nests/year deposited along the entire island between 1999 and 2008, and 39 nests/year within the project area from Fish Haul Creek to the Westin Hotel (HHI-27) (Beach Sections 111 to 134) (Table 2). The lowest annual number of nests throughout the entire island during the 10–year period between 1999 and 2008 was 66 nests in 2004, and the highest number of nests was 218 in 1999. Based on a 21-year average between 1985 and 2005, loggerhead nesting on Hilton Head Island averaged 120.5 nests/years (USFWS 2005).

Table 2. Loggerhead nesting activity within the Port Royal Shoreline Restoration and Stabilization Project area: 1999-2008.

	Beach Sections 111-121	**Beach Sections 121-131**	**Beach Sections 131-134**
Year	**Nests**	**Nests**	**Nests**
1999	28	10	0
2000	12	8	5
2001	22	1	0
2002	48	15	7
2003	20	8	1
2004	17	3	1
2005	19	8	6
2006	22	35	8
2007	15	7	2
2008	39	22	4
Total	**242**	**117**	**34**

Source: Town of Hilton Head Island Government, 2009

Loggerhead nesting success [ratio of nesting emergences to non-nesting emergences (i.e. false crawls)] is variable over the 5-year period for which false crawl data was recorded by GPS. False crawl data collection with GPS ceased in 2003. The annual average number of false crawls from 1999-2003 was 65 false crawls/year along the entire island and 47 false crawls/year within the Project Action Area from Fish Haul Creek to the Westin Hotel (HHI-27) (Beach Sections 111 to

134). The lowest annual number of false crawls throughout the entire island during the 10–year period between 1999 and 2003 was 64 in 2002, and the highest number of false crawls was 255 in 1999.

Negative impacts to sea turtle nesting and hatching success in South Carolina include coastal development and beach armoring, predation, hatchling disorientation due to artificial upland lighting, human activity/disturbance, and lost or damaged nests due to storm activity. Between 1980 and 2007, nesting has decreased annually by 1.9% in South Carolina (NMFS & USFWS, 2008).

2.2 GREEN SEA TURTLE

2.2.1 Status and Threats

The green sea turtle (*Chelonia mydas*) was listed on July 28, 1978 as threatened, except for Florida and the Pacific Coast of Mexico (including the Gulf of California), where it was listed as endangered (43 FR 32808). The greatest cause of the worldwide decline in green turtle populations is the commercial harvest for eggs and meat. In Florida, the nesting population was nearly extirpated within 100 years of the initiation of commercial exploitation.

Green sea turtle populations in Florida, Hawaii, and other parts of the world have experienced significant mortality from the disease, fibropapillomatosis, which is a disease characterized by the development of multiple tumors on the skin and internal organs. The tumors interfere with swimming, eating, breathing, vision and reproduction. Turtles with large tumor overgrowths may become severely debilitated and die. Other threats to green sea turtles include loss or degradation of nesting habitat from coastal development and beach armoring; disorientation of hatchlings by beachfront lighting; excessive nest predation by fire ants, raccoons, and opossums; degradation of foraging habitat; marine pollution and debris; watercraft strikes; and incidental take from commercial fishing operations such as shrimp trawling.

Due to their main dietary component of seagrass, Caribbean green sea turtles are considered to be nutrient-limited, resulting in low growth rates, delayed sexual maturity, and low annual reproductive effort. This low reproductive effort makes recovery of the species slow once the adult population numbers have been severely reduced (Bjorndal, 1981). Estimates of age at sexual maturity range from 20 to 50 years (Balazs, 1982; Frazer and Ehrhart, 1985), and the lifespan may be over 100 years.

2.2.2 Distribution and Range

The green sea turtle is a circumglobal species in tropical and subtropical waters. In U.S. Atlantic waters, it occurs around the U.S. Virgin Islands, Puerto Rico, and continental U.S. from Massachusetts to Texas. Relatively small numbers nest in Florida with even smaller numbers in Georgia, North Carolina, and Texas (NMFS and USFWS, 1991b; Hirth, 1997). Green turtles are distributed more widely in the

summer when warmer temperatures allow them to migrate north along the Atlantic coast. Juvenile and sub-adult green sea turtles can be found in estuarine and coastal waters from Long Island Sound, Chesapeake Bay, and North Carolina sounds south throughout the tropics (Musick and Limpus, 1997). As the water temperatures decline during the winter months, green sea turtles that are found north of Florida migrate south into subtropical and tropical water.

Major nesting areas for green sea turtles in the Atlantic include Surinam, Guyana, French Guyana, Costa Rica, the Leeward Islands, and Ascension Island in the mid-Atlantic. Historically in the U. S., green turtles have been known to nest in the Florida Keys and Dry Tortugas. Green sea turtles primarily nest on selected beaches along the coast of eastern Florida, predominantly Brevard through Broward Counties. In the southeastern U.S., the majority of nesting occurs during the months of June, July and August.

2.2.3 Habitat

The green turtle primarily utilizes shallow habitats such as lagoons, bays, inlets, shoals, estuaries and other areas with an abundance of marine algae and seagrasses. Individuals observed in the open ocean are believed to be migrating to feeding grounds or nesting beaches (Meylan, 1982). Hatchlings often float in masses of algae (*Sargassum* spp.) in convergence zones. Coral reefs and rock outcrops are often used as resting areas.

Green sea turtle hatchlings are believed to feed mainly on jellyfish and other invertebrates. Adult green sea turtles prefer an herbivorous diet frequenting shallow water flats for feeding (Fritts et al., 1983). Adult turtles feed primarily on seagrasses such as Thalassia testudinum. This vegetation provides the turtles with a high fiber content and low forage quality (Bjorndal, 1981). Green turtles migrate long distances between feeding and nesting areas (Carr and Hirth, 1962). Nocturnal resting sites may be a considerable distance from feeding areas, and distribution of the species is generally correlated with seagrass bed distribution, location of resting beaches, and possibly ocean currents (Hirth, 1971). In the Gulf of Mexico, principal foraging areas are located in the upper west coast of Florida. Green sea turtle hatchlings are believed to feed mainly on jellyfish and other invertebrates.

Nesting occurs nocturnally at 2, 3, or 4-year intervals, and females only occasionally produce clutches in successive years. Little is known about the pelagic distribution of hatchlings to juvenile size. When juveniles reach a carapace length of approximately 20 to 25 cm, they leave their pelagic habitats and enter benthic foraging areas, shifting to an herbivorous diet.

2.2.4 Presence in the Project Area

Since 1999, there has been one record of green turtle nesting on Hilton Head Island in 2003. Statewide green turtle nesting is infrequent to rare.

2.3 KEMP'S RIDLEY SEA TURTLE

2.3.1 Status and Threats

Kemp's ridley sea turtle (*Lepidochelys kempii*) was listed as endangered throughout its range on December 2, 1970 (35 FR 18320). Of the seven extant species of sea turtles, the Kemp's ridley has declined to the lowest population level. Recent studies suggest increased nesting activities and an overall increase in population size due to increased hatchling production and survival rates of immature turtles (USFWS 2000). Kemp's ridleys have been subject to high levels of incidental take by shrimp trawlers (USFWS and NMFS, 1992). In 1990, the National Research Council's Committee on Sea Turtle Conservation estimated that 86% of human-caused death of juvenile and adult loggerheads and Kemp's ridleys resulted from shrimp trawling (Campbell, 1995). The recent increased survival of juvenile and subadult individuals is partly attributed to the use of turtle exclusion devices (TEDs) in commercial shrimping fleets.

The primary decline of Kemp's ridley is due to human activities including collection of eggs, fishing for juveniles and adults, and direct take for indigenous use. Dredging operations affect Kemp's ridley turtles through incidental take and degradation of habitat. Incidental take of Kemp's ridley has been documented with hopper dredging. Similar to other sea turtle species, future threats to the Kemp's ridley include interaction with fishery gear; marine pollution which results in the ingestion of manmade debris and garbage; destruction of foraging habitat; illegal poaching; and impacts to nesting beaches associated with rising sea level, development, artificial lighting and tourism pressure.

2.3.2 Distribution and Range

Adults are primarily restricted to the Gulf of Mexico, although juveniles may range throughout the Atlantic Ocean since they have been observed as far north as Nova Scotia (Musick, 1979). Important foraging areas include Campeche Bay, Mexico, and Louisiana coastal waters. Nearly the entire population of Kemp's ridleys nests on an 11-mile stretch of coastline near Rancho Nuevo, Tamaulipas, Mexico, approximately 190 miles south of the Rio Grande. A second nesting aggregation occurs at Tuxpan, Veracruz.

Junveniles and sub-adults have been found along the eastern seaboard of the U.S. and in the Gulf of Mexico. Studies suggest that the benthic-stage juvenile turtles stay in shallow, warm, nearshore waters in the northern Gulf until cooling waters force them offshore or south along the Florida coast (Renaud, 1995). Little is known about the movements of the post-hatchling pelagic stage within the Gulf. Studies have indicated that this stage varies from 1 to 4 or more years and the immature stage lasts about 7 to 9 years. The maturity age of this species is estimated to be 7 to 15 years. Females return to their nesting beach approximately every other year with nesting from April into July and usually limited to the western Gulf of Mexico. The mean clutch size for this species is about 100 eggs per nest and an average of 2.5 nests per female per season.

2.3.3 Habitat

Kemp's ridleys inhabit shallow coastal and estuarine waters, usually over sand or mud bottoms. Adults are primarily shallow-water benthic feeders that specialize on crabs, especially portunid crabs, while juveniles feed on *Sargassum* spp. and associated infauna, and other epipelagic species of the Gulf (USFWS and NMFS, 1992). Other food items include shrimp, snails, bivalves, sea urchin, jellyfish, sea stars, fish and occasionally marine plants (Pritchard and Marquez, 1973; Shaver, 1991; Campbell, 1995).

2.3.4 Presence in the Project Area

There is no documentation of nesting by Kemp's ridley sea turtles within Beaufort County. However, hatchlings remain in the pelagic environment one to two years and some leave the Gulf of Mexico and are distributed along the east coast (Florida to Massachusetts) of the United States. Small juveniles of this species {18 to 65 cm (11 to 26 in)} occur along the South Carolina coast during the summer. In 1992 and 2008, two Kemp's ridley nests were laid in South Carolina. This species also represents the second most common turtle to strand on the South Carolina coast. It is possible that the recent increases in Kemp's ridley strandings may be a result of an increasing population size (SCDNR, 2009b).

2.4 LEATHERBACK SEA TURTLE

2.4.1 Status and Threats

The leatherback sea turtle (*Dermochelys coriacea*) was listed as endangered throughout its range on June 2, 1970 (35 FR 8495), with critical habitat designated in the U.S. Virgin Islands on 26 September 26, 1978 and March 23, 1979 (43 FR 43688–43689 and 44 FR 17710–17712, respectively).

The general decline of the leatherback sea turtle is attributed to exploitation of eggs (Ross, 1981). The population has been threatened by egg-harvesting in countries such as Malaysia, Surinam, the Guianas, the west coast of Mexico, Costa Rica, and in several Caribbean islands. In the past, leatherbacks were killed for their abundant oil, which was used for oil lamps and for caulking wooden boats. Similar to other sea turtle species, ingestion of man-made debris, such as plastic bags and other plastic waste, is a significant cause of mortality in leatherbacks turtles.

Leatherbacks prefer open access beaches possibly to avoid damage to their soft plastron and flippers. Unfortunately, open beaches with little shoreline protection are vulnerable to beach erosion triggered by seasonal changes in wind and wave direction. Nests are more susceptible to inundation on open beaches during severe erosion events.

2.4.2 Distribution and Range

The leatherback, the largest of all sea turtles, is mainly pelagic, inhabiting the open ocean and diving nearly continuously to great depths. Leatherbacks seldom approach land except for nesting (Eckert, 1992). The leatherback is probably the

most wide-ranging of all sea turtle species, occurring in the Atlantic, Pacific and Indian oceans; as far north as British Columbia, Newfoundland, Great Britain and Norway; as far south as Australia, Cape of Good Hope, and Argentina; and in other water bodies such as the Mediterranean Sea (NFWL, 1980). Distribution of this species has been linked to thermal preference and seasonal fluctuations in the Gulf Stream and other warm water features (Fritts et al., 1983).

2.4.3 Habitat

Leatherback sea turtles are omnivorous. Leatherbacks feed mainly on pelagic soft-bodied invertebrates such as jellyfish and tunicates. Their diet may include squid, fish, crustaceans, algae, and floating seaweed. Highest concentrations of these prey animals are often found in upwelling areas or where ocean currents converge. They will also ingest plastic bags and other plastic debris, which are commonly generated by oil drilling rigs and production platforms in coastal Florida, Alabama, Mississippi, and Louisiana (Fritts et al., 1983).

Leatherbacks nest primarily in tropical regions. Major nesting beaches include Malaysia, Mexico, French Guiana, Surinam, Costa Rica, and Trinidad (Ross, 1981). Leatherbacks nest only sporadically in some of the Atlantic and Gulf States of the continental U.S., with one nesting reported as far north as North Carolina (Schwartz, 1976). In the Atlantic and Caribbean, the largest nesting assemblages occur in the U.S. Virgin Islands, Puerto Rico, and Florida (NMFS, 2007). During the summer, leatherbacks tend to occur along the east coast of the U.S. from the Gulf of Maine south to the middle of Florida. Leatherback nesting is rare in Georgia, South Carolina and North Carolina (USFWS, 2005).

2.4.4 Presence in the Project Area

The leatherback nesting season for South Carolina beaches extends from April 15 through September 30. Since the late 1980's, leatherbacks have become a common visitor throughout South Carolina waters during spring. Leatherbacks are frequently seen feeding on cannonball jellyfish which are abundant in the spring. A smaller secondary peak in abundance occurs in the fall. The South Carolina Department of Natural Resources has been conducting aerial surveys to document the distribution and abundance of leatherbacks for the past 10 years. During these flights, more than 1,000 leatherbacks have been observed throughout the state. Since 1996, four leatherback nests have been documented in South Carolina (SCDNR, 2009c); one nest was located on Hilton Head Island in 2006. A leatherback false crawl was documented on Hilton Head in June 1981 during an aerial beach survey (Rabon et al., 2003), and in 2004, one false crawl was documented on Hilton Head (USFWS, 2005).

2.5 SHORTNOSE STURGEON

2.5.1 Status and Threats

The shortnose sturgeon (*Acipenser brevirostrum*) was listed as endangered on March 11, 1967 (32 FR 4001). Shortnose sturgeon remained on the endangered

species list with enactment of the ESA in 1973. In 1967, the U. S. Fish and Wildlife Service cited pollution and overharvesting as primary factors for the decline in numbers of shortnose sturgeon. Other sources contributing to population declines include incidental catch in shad gillnet fisheries, dam and bridge construction, dredging, entrapment in power plant water intake screens, and reservoir operations. In South Carolina, the primary factors affecting populations of this species are habitat alteration due to dredging, dam construction, and pollution. Construction of dams has the potential to reduce suitable spawning sites, and disturbance associated with dredging activities impacts the food supply for juvenile sturgeon (SCDNR, 2009d).

Sturgeons are commercially valuable worldwide as a source of high-grade caviar, and their meat is popular both smoked and fresh. In the past, both Atlantic and shortnose sturgeons were reported in the landings for sturgeon. In the United States, Atlantic sturgeon supported a commercial fishery; however, landings have not exceeded 300,000 lbs. since 1920, and all Atlantic states have closed their fisheries in recent years. The sturgeon fishery was closed in South Carolina in 1985 following steep declines in numbers landed in the early 1980s. Shortnose sturgeons are currently of no commercial value because of their status as an endangered species. There is no recreational fishery for this species in the United States (SCDNR, 2009d).

2.5.2 Distribution and Range

Shortnose sturgeon are anadromous, inhabiting the main stems of their natal rivers and migrating between freshwater and mesohaline river reaches. Spawning only occurs in upper freshwater areas while feeding and overwintering activities may occur in both fresh and saline habitats. A variety of substrates are utilized for spawning, including areas of gravel, mixed sand and gravel, rubble or large boulders (Dadswell et al., 1984). Shortnose sturgeons prefer lower salinity than pure seawater, typically from 30 - 31 ppt (Holland and Yelverton, 1973; Dadswell et al., 1984). In areas where *A. brevirostrum* occurs with the Atlantic sturgeon, *A. oxyrhinchus*, the two species may segregate according to salinity preferences with Atlantic sturgeon preferring more saline water. Although shortnose sturgeon are capable of entering open ocean water, it has been suggested that the species appears hesitant to enter open ocean water (Gilbert, 1989). This factor may limit extensive coastal migrations of this species. One landlocked group may exist in Lake Marion on the Santee River in South Carolina (NMFS, 2009) and one functionally landlocked segment may exist in Lake Moultrie (Cooper Population Segment). The ratio of adults to juveniles was very high in the mid 1980's to the early 1990's in the Savannah population segment indicating that recruitment is low in the Savannah River (NMFS, 1998).

Juvenile and adult sturgeon use the area located 1 to 3 miles from the freshwater/ saltwater interface throughout the year as a feeding ground. During the summer, this species tends to use deep holes at or just above the freshwater/saltwater boundary (Flournoy et al., 1992; Rogers and Weber, 1994; Hall et al., 1991).

2.5.3 Habitat

Although originally listed as endangered rangewide, the NMFS recognizes 19 distinct population segments occurring in New Brunswick, Canada (1), Maine (2), Massachusetts (1), Connecticut (1), New York (1), New Jersey/Delaware (1), Maryland/Virginia (1), North Carolina (1), South Carolina (4), Georgia (4) and Florida (2) (NMFS Final Recovery Plan 1998). Within South Carolina there are four distinct population segments of shortnose sturgeon and the Savannah segment which includes the South Carolina-Georgia border (Table 3).

Table 3. Shortnose sturgeon population segments in South Carolina

Distinct Population Segments	Rivers Inhabited by Shortnose Sturgeon
Winyah Bay	Waccamaw, Pee Dee and Black Rivers (South Carolina, North Carolina)
Santee	Santee River (South Carolina)
Cooper	Cooper River (South Carolina)
"ACE" Basin	Ashepoo, Combahee and Edisto Rivers (South Carolina)
Savannah	Savannah River (South Carolina, Georgia), and hatchery stocks

Source: NMFS, Final Recovery Plan for the Shortnose Sturgeon, December 1998.

Shortnose sturgeon are suctorial bottom feeders. They use their barbels to locate a variety of prey, such as worms, insect larvae, snails, shrimp, crayfish and plants, and then vacuum their prey items using their extendable mouths.

The recovery plan for the shortnose sturgeon references habitat degradation or loss resulting from dams, bridge construction, channel dredging, and pollutant discharge; and mortality associated with cooling water intake screens, dredging activities and incidental capture in other fisheries, as the principal threats to survival of the species (NMFS, 1998).

2.5.4 Presence in the Project Area

In South Carolina, shortnose sturgeon inhabit Winyah Bay Rivers, those that drain into Lake Marion, the Santee, Cooper and Savannah rivers, and the ACE Basin (Ashepoo, Combahee and Edisto Rivers). In the ACE Basin, shortnose sturgeon are typically found at the freshwater-saltwater interface. Adult and sub-adult shortnose sturgeon are known to inhabit this area during spring through fall. Spawning may take place well upriver; however, the existence of a spawning stock in the ACE Basin is yet to be determined (SCDNR, 2009d).

2.6 WEST INDIAN MANATEE

2.6.1 Status and Threats

The manatee is federally protected under the Marine Mammal Protection Act of 1972 and the ESA of 1973. The manatee was listed as an endangered species

throughout its range in 1967 (32 FR 4061) and received federal protection with the passage of the ESA in 1973.

Manatees have few natural predators, and the greatest natural threats are exposure to cold temperatures, hurricanes, and poisoning from red tide (USFWS, 2007).

2.6.2 Distribution and Range

During the cooler months between October and April, manatees concentrate in areas of warmer water. Manatees are thermally stressed at water temperatures below 18ºC (64.4ºF); therefore, during winter months, when ambient water temperatures approach 20ºC (68ºF), the manatee population confines itself to the coastal waters of the southern half of peninsular Florida and to springs and warm-water industrial outfalls as far north as southeast Georgia. Manatees also winter in the St. Johns River near Blue Spring State Park. Severe cold fronts have been known to kill manatees when the animals did not have access to warm water refuges. During summer months, they may migrate as far north as coastal Virginia on the east coast and the Louisiana coast on the Gulf of Mexico and appear to choose areas based on an adequate food supply, water depth, and proximity to fresh water. Annual migratory circuits of some individuals through the intracoastal waterway of the Atlantic Coast are 1,700 km round trips at seasonal travel rates as high as 50 km/day.

2.6.3 Habitat

Manatees inhabit both salt and fresh water and can be found in shallow (5 ft. to usually <20 ft.), slow-moving rivers, estuaries, saltwater bays, canals, and coastal areas throughout their range. Manatees have been occasionally observed as far as 3.7 miles off the Florida Gulf coast. The West Indian manatee is herbivorous and feeds upon aquatic plants such as hydrilla, eelgrass and water lettuce.

2.6.4 Presence in the Project Area

Manatees are found in Georgia and South Carolina mainly during warmer months of the year. In South Carolina, 1,087 manatees were sighted between 1993 and 2004. Of these sightings, approximately 50% were noted in Beaufort County, and approximately half of the statewide sightings were of single manatees, suggesting that manatees in South Carolina may be solitary animals (SCDNR, 2009e).

2.7 PIPING PLOVER

2.7.1 Status and Threats

The piping plover (*Charadrius melodus*) is a migratory shorebird endemic to North America. The piping plover was listed by the USFWS as threatened and endangered on December 11, 1985 (50 FR 50726-50734).

Plovers begin breeding as early as one year old (MacIvor, 1990; Haig, 1992); however, the percentage of birds which breed during their first adult year is unknown. Piping plovers typically fledge a single brood per season, but may nest

several times if previous nests are lost. On average, piping plovers live approximately five years, although birds have been documented as old as eleven years (Wilcox, 1959).

Behavioral observations of piping plovers on wintering grounds suggest that they spend the majority of their time foraging (Nicholls and Baldassarre, 1990; Drake, 1999; Drake, 1999a). Feeding activities occur during all hours of the day and night (Staine and Burger, 1994; Zonick, 1997), and at all stages in the tidal cycle (Goldin, 1993; Hoopes, 1993). Plovers use the beaches adjacent to foraging areas for roosting and preening, and proximity of appropriate roosting sites to foraging areas is extremely important for conservation of energy for migration activities.

Piping plovers use cryptic coloration is a primary defense mechanism; adults, chicks and nests all blend with the beach environment. Much of the decline in the piping plover population has been attributed to habitat destruction, disturbance by humans and pets and predation. Piping plovers on wintering and migration grounds respond to intruders (pedestrian, avian and mammalian) in their sites by squatting, running, and flushing which reduces their fitness due to unnecessary expenditure of energy (USFWS, 1996). In order to reduce the threat of population decline, the USFWS designated certain areas as Critical Wintering Habitat, which provide necessary protection for this species during migration and residency on wintering grounds.

The presence of pets increases disturbance to wintering and migrating piping plovers. Flushing events may be prolonged by dogs off leash in comparison to those associated with pedestrians or pedestrians with leashed dogs. A study conducted on Cape Cod, Massachusetts, found that the average distance at which piping plovers were disturbed by pets was 150 feet, compared with 75 feet for pedestrians. Furthermore, the birds reacted to the pets by moving an average of 187 feet, compared with 82 feet when the birds were reacting to a pedestrian, and the duration of the disturbance behavior stimulated by pets was significantly greater than that caused by pedestrians (Hoopes, 1993). Disturbance also reduces the amount of time which migrating shorebirds spend foraging (Burger, 1991).

Suitable wintering habitat consists of intertidal beaches, mudflats, sandflats, offshore spoil islands, lagoons, and salt marshes, where they forage for invertebrates such as polychaetes, insect larvae, crustaceans, and mollusks. Wintering plovers depend upon a mosaic of habitat patches and move among these patches depending on local weather and tidal conditions (Nicholls and Baldassarre, 1990). Drake (1999) monitored the movement of 48 piping plovers in south Texas for one season. Using 95% of the documented locations, this study recorded a mean home range of 3,117 acres. Mean linear distance moved per individual bird was two miles for the fall through the spring of 1997 through 1998 (Drake, 1999). Observations suggest that this species exhibits a high degree of wintering site fidelity (Drake et al., 2001; Stucker and Cuthbert, 2006).

2.7.2 Distribution and Range

Piping plovers breed along the Atlantic Coast from Maritime Canada to North Carolina, along the Great Lakes, and in the northern Great Plains of Canada and the United States (Johnsgard, 1981; Haig and Oring, 1985). The piping plover is a federally listed endangered species in the Great Lakes watershed, and the birds breeding on the Atlantic Coast and northern Great Plains are federally listed as threatened. The primary winter range is along the Atlantic and Gulf Coasts from North Carolina to Mexico (Haig and Oring, 1985). Piping plovers generally depart their breeding grounds for their wintering ground from July through late August and return in late March or early April.

Along the coast of South Carolina in the vicinity of Hilton Head Island, known wintering sites for the piping plover occur along the portion of Hilton Head Island locally referred to as the “Heel” (the northeastern end of Hilton Head Island at the intersection of the Atlantic Ocean and Port Royal Sound shorelines), and on Joiner Bank (Critical Wintering Habitat Unit SC-15, Figure 14). In South Carolina, the period from August 15 through April 30 is considered the migratory and wintering season for piping plover.

2.7.3 Critical Habitat

USFWS designated critical habitat for the piping plover in its wintering range on July 10, 2001 (66 FR 17; 36038-36143). Critical habitat includes the land from the seaward boundary of mean low low water (MLLW) to where densely vegetated habitat, not used by the species, begins and where the primary constituent elements no longer occur.

The primary constituent elements for piping plover wintering habitat are those biological and physical features which are essential to the conservation of the species. The primary constituent elements are the habitat components which support foraging, roosting, and sheltering and the physical features necessary for maintaining the natural processes that support these habitat components.

Primary constituent elements of wintering piping plover critical habitat include sand or mud flats or both with no or sparse emergent vegetation. Adjacent unvegetated or sparsely vegetated sand, mud, or algal flats above high tide are also important, especially for roosting piping plovers (USFWS, 2001a). Important components of the beach/dune ecosystem include surf-cast algae, sparsely-vegetated back beach and salterns, spits, and washover areas. Washover areas are broad, unvegetated zones, with little or no topographic relief, that are formed and maintained by the action of hurricanes, storm surge, or other extreme wave action.

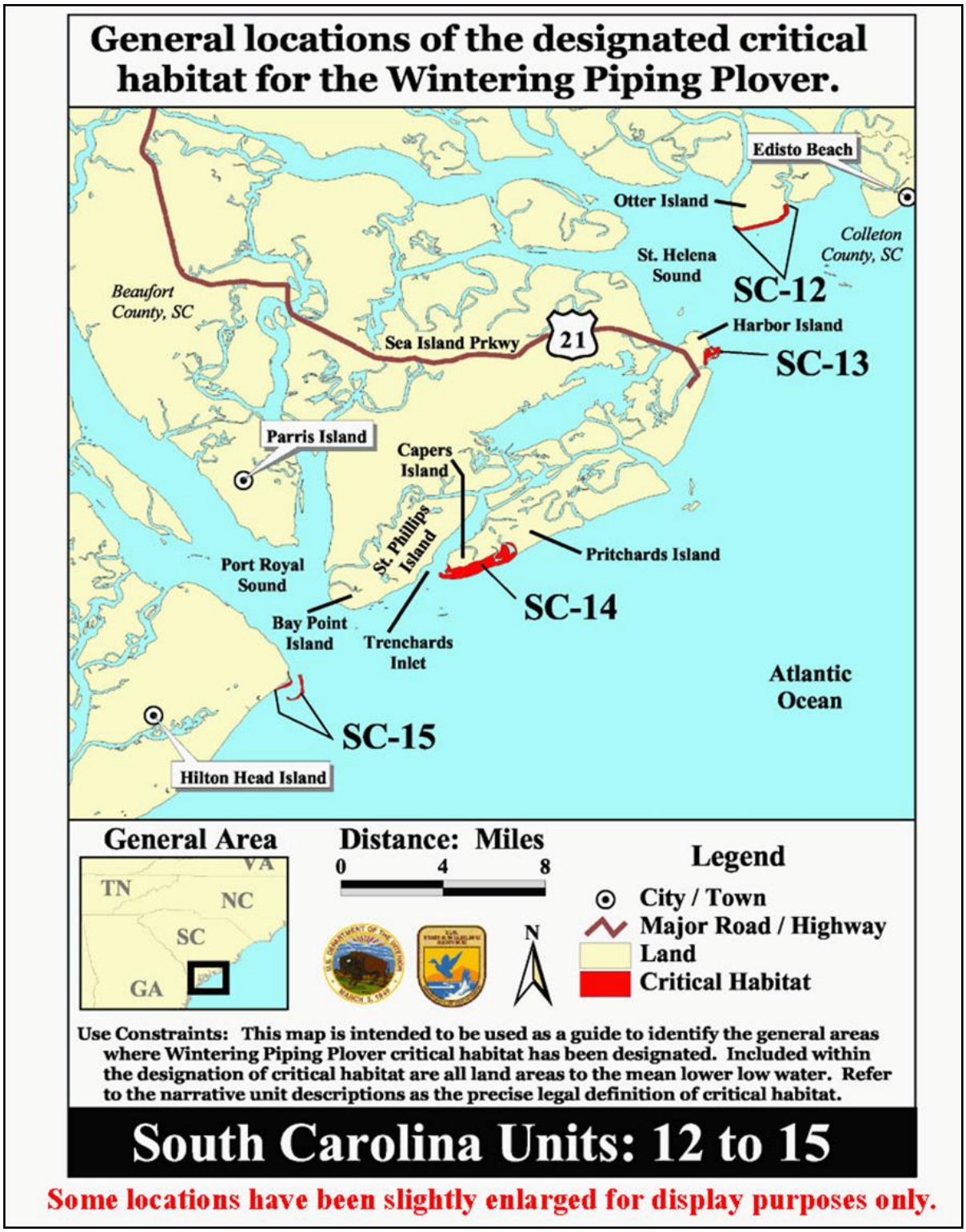

Figure 14. Piping Plover Critical Wintering Habitat Unit SC-15, Hilton Head Island (Source: USFWS).

Wintering piping plovers appear to prefer sand flats adjacent to inlets or passes, overwash areas, emphemeral pools, and sandy mud flats along prograding spits as foraging habitats (USFWS, 2008). These substrate types have a richer infauna than the foreshore of high energy beaches and often attract large numbers of shorebirds (Cohen et al., 2006). Plovers forage on moist substrate features such as intertidal flats, algal flats, and ephemeral pools (USFWS, 2001a; Nicholls and Baldassarre, 1990; Wilkinson and Spinks, 1994).

2.7.4 Presence in the Project Area

The proposed project fill area and groin footprint is located within Critical Habitat Unit SC-15. The majority of Critical Habitat Unit SC-15 is State-owned. This unit includes the northeastern tip (Atlantic Ocean side) of Hilton Head Island and all of Joiner Bank. It begins at the shoreline east of northern Planters Row and ends at the shoreline east of Donax Road. It includes the MLLW of Port Royal Sound and the Atlantic Ocean to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. All of Joiner Bank to MLLW is included (Federal Register, Vol. 66, No. 132, July 10, 2001). The total area of critical habitat includes 43 ha (106 ac) in Beaufort County, SC.

A large sand spit has formed in Critical Habitat Unit SC-15 near HHI-29A due to dramatic localized accretion since April 2006 (Figures 3 and 4). Sandy mud flats along prograding spits offer moist substrate with rich infaunal communities in comparison to high energy beaches. The intertidal mudflat just north of the sand spit provides high-quality foraging habitat for piping plovers. As shown in Photo 4, this area is rich in surf-cast algae and provides a diverse infauna/macrofaunal community of preferred food items for plovers such as polychaetes, crustaceans, mollusks and small sea cucumbers. The close proximity of the sand spit to the adjacent intertidal mudflat provides valuable roosting habitat for piping plover with minimal expenditure of energy.

A monitoring program for piping plovers was implemented in association with the 2006-07 Hilton Head Beach Nourishment Project. Surveys are conducted by the Hilton Head Island Audubon Society. A total of 356 piping plovers were sighted during these surveys conducted during the wintering seasons of 2006 through 2009 within the vicinity of Critical Habitat Unit SC-15 between the Westin Resort and Fish Haul Creek (Table 4). Piping plover observations from September 2006 through May 2009 within the spit and intertidal mud flat in Critical Habitat Unit SC-15 are shown in Figure 15.

Since April 2006, localized accretion near HHI-29A has formed the large sand spit from the release of sand from the beach to the south, as well as the sheltering effects of the remaining portion of Joiner Bank. It is expected that the spit will continue to build into the marginal tidal channel and ultimately merge with the Port Royal Sound shoreline. Figure 16 shows the northern migration of the sand spit and intertidal mud flat to the north and the dissipation of Joiner Bank between 2005

and 2009, indicating the shift in piping plover foraging habitat to the north during the past several years.

Photo 4. High-quality foraging habitat within the Critical Habitat Unit SC-15, Photo taken at low tide on June 4, 2009 at approximately 11 am. Adjacent sand spit provides roosting habitat for wintering piping plover.

Table 4. Piping plover sighting data within the project area vicinity: September 2006 to May 2009.

DATE	LOCATION	TOTAL PIPING PLOVERS	START TIME	END TIME	TIDE	ACTIVITY	HABITAT
7-Sep-06	Port Royal Plantation-NE corner of HHI; Westin Resort to Fish Haul Creek	5	9:00 AM	3:00 PM	High 8:07 AM; 8.1'	foraging, roosting	Oceanfront, Sanflat/mudflat
25-Sep-06	Port Royal Plantation	15	10:30 AM	4:30PM	High 10:30 AM, 7.4'	foraging, roosting	Oceanfront, Sanflat/mudflat
9-Oct-06	Port Royal Plantation	8	10:30 AM	4:30 PM	High 10:30 AM 9.0'	foraging, roosting	Oceanfront, Sanflat/mudflat
24-Oct-06	Port Royal Plantation	16	9:30 AM	3:30 PM	High 9:57 AM, 7.7'	foraging, roosting	Oceanfront, Sanflat/mudflat
13-Nov-06	Port Royal Plantation, NE corner of HH, Westin Resort to Fish Haul Creek	18	11:00 AM	5:00 PM	High 2:17 PM, 6.8'	foraging, roosting	Oceanfront, Sanflat/mudflat
30-Nov-06	Port Royal Plantation	19	11:00 AM	5:00 PM	High 3:45 PM, 7.2'	foraging, roosting	Oceanfront
13-Dec-06	Port Royal Plantation	13	10:30 AM	4:30 PM	High 2:19 PM, 6.1'	foraging, roosting	Oceanfront
24-Dec-06	Port Royal Plantation	13	10:00 AM	4:00 PM	High 10:30 AM, 7.5'	foraging, roosting	Oceanfront, sandbar/shoal
15-Jan-07	Port Royal Plantation	17	12:00 PM	6:00 PM	High 5 PM, 5.7'	foraging, roosting	oceanfront
28-Jan-07	Port Royal Plantation	16	12:00 PM	6:00 PM	High 4:08 PM, 5.7'	foraging	oceanfront
2-Feb-07	Port Royal Plantation	18	8:00 AM	2:00 PM	High 8 AM, 7.4'	foraging, roosting	oceanfront
20-Feb-07	Port Royal Plantation	11	9:00 AM	3:00 PM	High 9:58 AM, 7.6'	roosting	oceanfront
14-Mar-07	Port Royal Plantation	18	12:00 PM	6:00 PM	High 3:52 PM, 5.9'	foraging, roosting	oceanfront
23-Mar-07	Port Royal Plantation	19	11:00 AM	5:00 PM	High 11: 30 AM, 6.7'		oceanfront
8-Nov-08	Port Royal Plantation	14	10:30 AM	4:30 PM		roosting	
1-Dec-08	Port Royal Plantation	8	10:00 AM	4:00 PM	9:52 AM	roosting	oceanfront
15-Dec-08	Port Royal Plantation	16	9:30 AM	3:00 PM	9:50 AM	roosting	oceanfront
30-Dec-08	Port Royal Plantation	16	9:30 AM	3:00 PM	9:36 AM	foraging, roosting	oceanfront
12-Jan-09	Port Royal Plantation	13		11:00 AM	8:55 AM	foraging, roosting	oceanfront
28-Jan-09	Port Royal Plantation	11	9:00 AM		9:03 AM 9ft.	roosting	oceanfront
10-Feb-09	Port Royal Plantation	15	8:00 AM	12:36 PM	8:29 AM; 8.2'	rooting, foraging	sandflat/mudflat, beach wrack
28-Feb-09	Port Royal Plantation	12	9:00 AM		9:19 AM; 6.9 ft.	roosting	beach wrack
13-Mar-09	Port Royal Plantation	17	10:15 AM	4:00 PM	10:54 AM; 7.6 '	roosting, foraging	oceanfront, sandbar/shoal, sand flat/ mudflat, overwash, beach wrack
26-Mar-09	Port Royal Plantation	18	8:30 AM	1:00 PM	8:39 AM; 7.0'	foraging, roosting	
23-Apr-09	Port Royal Plantation	10	7:26 AM	1:30 PM	7:26 AM	roosting	
12-May-09	Port Royal Plantation	0	11:00 AM	5:00 PM	12:28 PM		

Note: Surveys conducted by Hilton Head Audubon Society. Data provided by the USFWS.

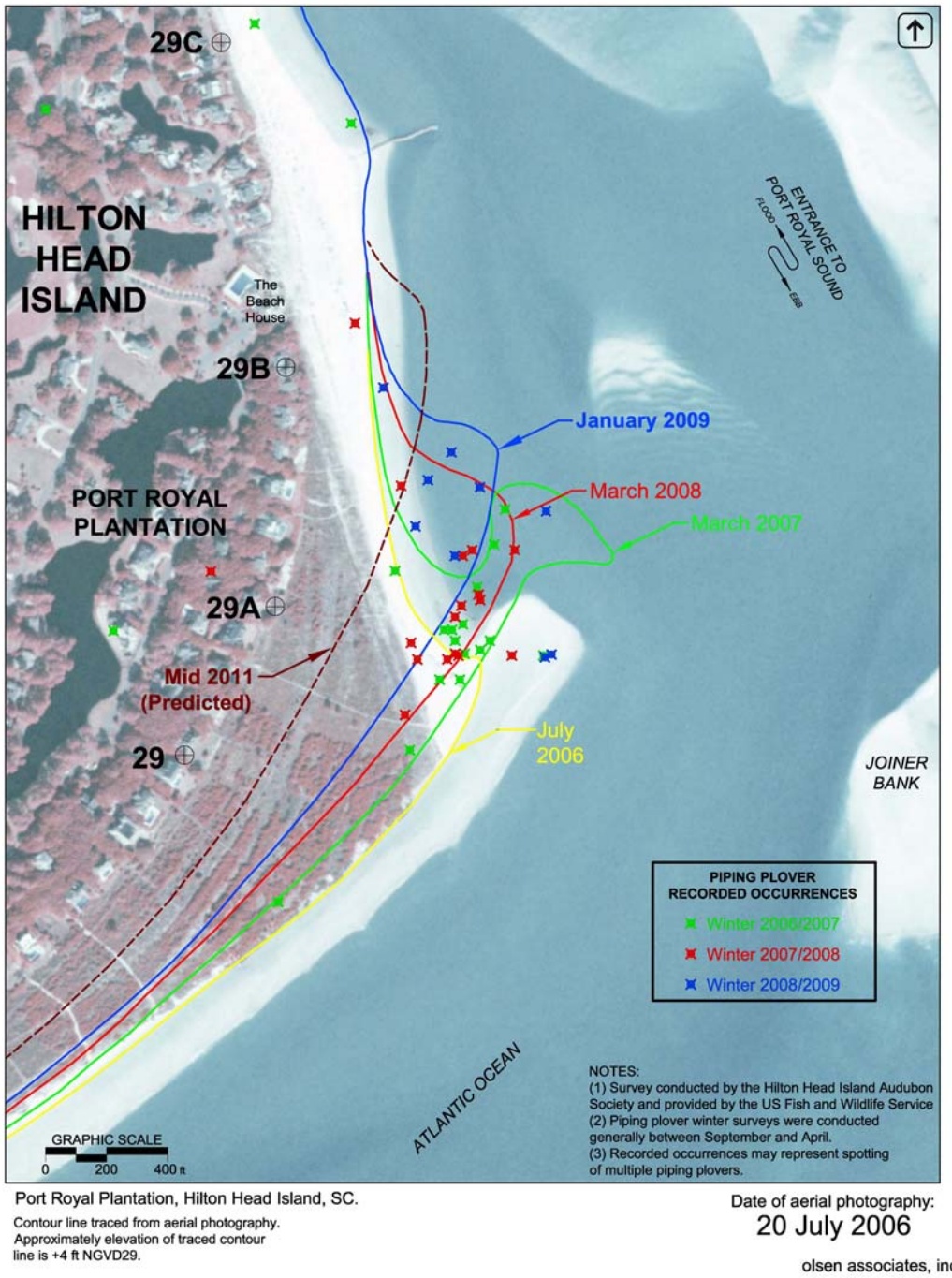

Figure 15. Piping plover observations from 2006-2009 within spit and intertidal areas at the north end of the project area. Occurrences may represent observations of multiple piping plovers (Source: Surveys conducted by the Hilton Head Island Audubon Society. Data provided by the USFWS). Figure prepared by Olsen Associates, Inc.

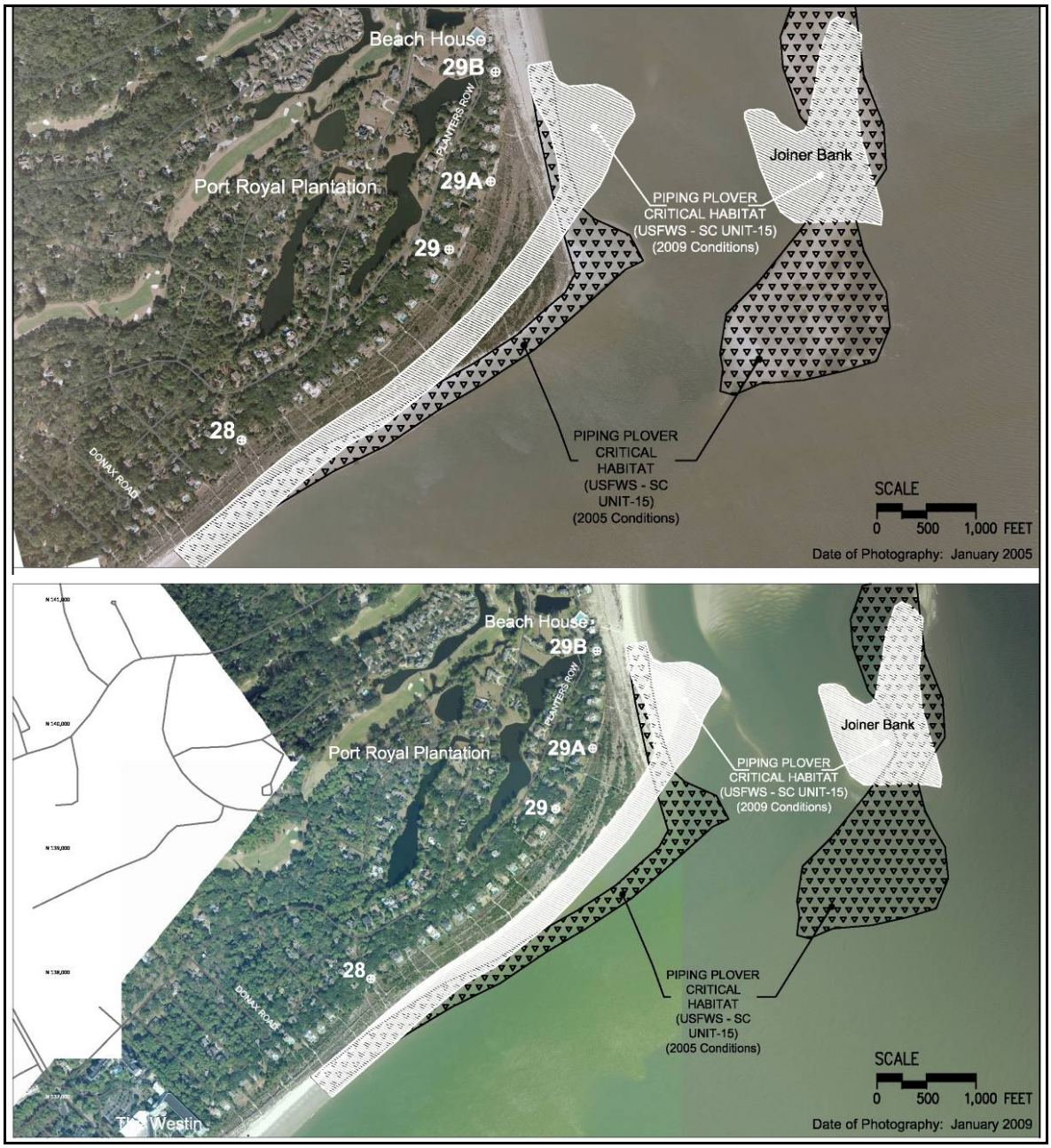

Figure 16. Photographic comparison of 2005 and 2009 conditions in Critical Habitat Unit SC-15. Accumulation and northern migration of the sand spit and high-quality foraging habitat located north of the sand spit is evident (Figure prepared by Olsen Associates, Inc.).

2.8 NORTH ATLANTIC RIGHT WHALE

The North Atlantic right whale (*Eubalaena glacialis*) has been listed as endangered under the ESA since 1973. There are two Atlantic populations of North Atlantic right whales. Precise estimates of abundance are not available;

however, it appears that the eastern North Atlantic population is nearly extinct and the western North Atlantic population number is around 300 to 325 individuals. Right whales are the rarest of all large whale species and are among the rarest of all marine mammal species (http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/ rightwhale_northern.htm; accessed on May 26, 2009).

In December 1991, NMFS approved the Final Recovery Plan for the North Atlantic right whale. The Recovery Plan identifies the coastal waters of the southeastern United States, and particularly, the shallow waters from Savannah, GA, south to Cape Canaveral, Florida, as the wintering ground for a small but significant part of the Atlantic right whale population.

In June 1994, NMFS designated three areas as critical habitat for the western North Atlantic right whale population. They include:

1. Coastal Florida and Georgia (Sebastian Inlet, FL to the Altamaha River, GA),
2. Great South Channel (east of Cape Cod), and
3. Massachusetts Bay and Cape Cod Bay

(http://www.nmfs.noaa.gov/pr/species/mammals/cetaceans/rightwhale_northern.htm; accessed on May 26, 2009).

The only known calving grounds for the North Atlantic right whale are off the coasts of Georgia and Florida. However, during the winters of 2001 and 2002, eight calves were sighted off of the North Carolina coast, suggesting that the calving grounds may extend as far north as Cape Fear (NOAA, 2008a). The whales migrate from their feeding and nursery areas in the northeast to their calving grounds during the fall months. They arrive in the southeast from late November through January.

Most right whales spotted in the southeast are from 1 to 15 nautical miles offshore (Kraus et al., 1993; Ellis et al., 1993). Human activities, including pollution, ship traffic, fisheries activities and habitat loss, have been suggested to be significantly affecting the species (Kraus et al., 1993). A review of the “Large Whale Ship Strike Database” (Jensen and Silber, 2003) found no recorded ship strikes of North Atlantic right whale whales in South Carolina.

2.9 BLUE WHALE

The blue whale (*Balaenoptera musculus*) is best considered as an occasional visitor in US Atlantic Exclusive Economic Zone (EEZ) waters, which may represent the current southern limit of its feeding range (CETAP, 1982; Wenzel et al., 1988). Yochem and Leatherwood (1985) summarized records that suggested an occurrence of this species south to Florida and the Gulf of Mexico, although the actual southern limit of the species’ range is unknown.

Using the U.S. Navy's Sound Surveillance System (SOSUS) program, blue whales have been detected and tracked acoustically in much of the North Atlantic, including in subtropical waters north of the West Indies and in deep water east of the U.S. EEZ (Clark, 1995). Most of the acoustic detections were around the Grand Banks area of Newfoundland and west of the British Isles. Sigurjónsson and Gunnlaugsson (1990) note that North Atlantic blue whales appear to have been depleted by commercial whaling to such an extent that they remain rare in some formerly important habitats, notably in the northern and northeastern North Atlantic.

As of the NOAA January 2002 Stock Assessment report on the western north Atlantic stock of blue whales, little was known about the population size of the blue whales except for the Gulf of St. Lawrence area. The minimum population estimate for the western north Atlantic stock is 308. According to the stock assessment, there are insufficient data to determine population trends for this species. PBR for the western Atlantic stock of blue whales cannot be calculated because the minimum population estimate is more than 10 years old. A review of the "Large Whale Ship Strike Database" (Jensen and Silber, 2003) found no recorded ship strikes of blue whales in South Carolina.

2.10 FIN WHALE

The fin whale (*Balaenoptera physalus*) is ubiquitous in the North Atlantic and occurs from the Gulf of Mexico and Mediterranean Sea northward to the edges of the Arctic ice pack (Waring et al., 1999). The International Whaling Commission (IWC) has proposed a stock boundary for the north Atlantic fin whale, currently all fin whales in the north Atlantic are believed to constitute one stock. This may change with future study. Based on acoustic recordings from hydrophone arrays, Clark (1995) reported a general southward "flow pattern" of fin whales in the fall from the Labrador/Newfoundland region, south past Bermuda, and into the West Indies. The overall distribution may be based on prey availability. This species preys opportunistically on both invertebrates and fish. Fin whales are larger and faster than humpback and right whales and are less concentrated in nearshore environments. Due to these traits, fin whales are less prone to entanglements than are right and humpback whales, but because they do occur in many of the same areas, the potential for entanglement exists.

As of the NOAA October 2008 Stock Assessment report on the north Atlantic stock of fin whales, the best estimate of stock size is estimated to be 2,267 whales (CV=0.37). The minimum population estimate for the north Atlantic stock is 1,678. According to the stock assessment, there are insufficient data to determine population trends for this species. PBR for the Gulf of Maine humpback whale is calculated to be 3.4 whales (NOAA, 2008c). A review of the "Large Whale Ship Strike Database" (Jensen and Silber, 2003) found no recorded ship strikes of fin whales in South Carolina.

2.11 HUMPBACK WHALE

Humpback whales (*Megaptera novaeangliae*) feed in the northwestern Atlantic during the summer months and migrate to calving and mating areas in the Caribbean. Five separate feeding areas are utilized in northern waters after their return; one of which, the Gulf of Maine feeding population, lies within U.S. waters and is the stock of humpback whales which are found in the project area vicinity. Most of the humpbacks that forage in the Gulf of Maine visit Stellwagen Bank and the waters of Massachusetts and Cape Cod bays. Sightings are most frequent from mid-March through November between 41ºN and 43ºN, from the Great South Channel north along the outside of Cape Cod to Stellwagen Bank and Jeffreys Ledge (CETAP, 1982), and peak in May and August. Small numbers of individuals may be present in this area year-round, including the waters of Stellwagen Bank. Humpback whales pass close to the south Florida coast while migrating from northern feeding waters to mating and calving locations in the Caribbean in the fall and on the return to the north in the spring.

As of the March 2007 NMFS Stock Assessment report on the North Atlantic population of humpback whales (including the Gulf of Maine stock), the stock is estimated to be 4,894 males (95% CI=3,374-7,123) and 2,804 females (95% CI=1,776-4,463). The minimum population estimate for the Gulf of Maine stock is 549. According to the stock assessment, current data suggests that the Gulf of Maine stock is steadily increasing in size. PBR for the Gulf of Maine humpback whale is calculated to be 1.1 whales. A review of the NOAA stock assessment report (NOAA, 2008b) found one recorded ship strike of a female humpback whale (14 meters) in Charleston, South Carolina which resulted in mortality on January 9, 2006. A humpback whale stranded in South Carolina in 1993 (SCDNR, 2009f).

2.12 SEI WHALE

Indications are that, at least during the feeding season, a major portion of the sei whale (*Balaenoptera borealis*) population is centered in Northerly waters, perhaps on the Scotian Shelf (Mitchell and Chapman, 1977). The southern portion of the species' range during spring and summer includes the northern portions of the U.S. Atlantic Exclusive Economic Zone (EEZ) (the Gulf of Maine and Georges Bank). The period of greatest abundance in that area is in spring, with sightings concentrated along the eastern margin of Georges Bank and into the Northeast Channel area, and along the southwestern edge of Georges Bank in the area of Hydrographer Canyon (CETAP, 1982). The sei whale is generally found in the deeper waters characteristic of the continental shelf edge region. Mitchell (1975) similarly reported that sei whales off Nova Scotia were often distributed closer to the 2,000 m depth contour than were fin whales.

This general offshore pattern of sei whale distribution is disrupted during episodic incursions into more shallow and inshore waters. The sei whale, similar to the North Atlantic right whale, is largely planktivorous and feeds primarily on euphausiids and copepods. In years of reduced predation on copepods by other

predators, and thus greater abundance of this prey source, sei whales are reported in more inshore locations, such as the Great South Channel (in 1987 and 1989) and Stellwagen Bank (in 1986) areas (Payne et al., 1990). An influx of sei whales into the southern Gulf of Maine occurred in the summer of 1986 (Schilling et al., 1992). Such episodes, often punctuated by years or even decades of absence from an area, have been reported for sei whales from various places worldwide.

As of the August 2006 the Nova Scotia stock of sei whales in the US EEZ is 207 (CV=0.62). This is considered the best available for the Nova Scotia stock of sei whales because it is the most recent (NOAA, 2008d). There are no recent abundance estimates for the sei whale. The minimum population estimate for the sei whale is 128. According to the stock assessment, there is insufficient data to determine population trends for this species. PBR for the sei whale is 0.3. A review of the "Large Whale Ship Strike Database" (Jensen and Silber, 2003) found no recorded ship strikes of sei whales in South Carolina.

2.13 SPERM WHALE

There are estimated to be approximately two million sperm whales (*Physeter macrocephalus*) worldwide. In the western North Atlantic they range from Greenland to the Gulf of Mexico and the Caribbean. The sperm whales that occur in the eastern U.S. Atlantic Exclusive Economic Zone (EEZ) are believed to represent only a portion of the total stock (Blaylock et al., 1995). Sperm whales generally occur in waters greater than 180 meters in depth. While they may be encountered almost anywhere their distribution shows a preference for continental margins, sea mounts, and areas of upwelling, where food is abundant (Leatherwood and Reeves, 1983). Waring et al. (1993) suggest sperm whale distribution is closely correlated with the Gulf Stream edge. Sperm whales migrate to higher latitudes during summer months, when they are concentrated east and northeast of Cape Hatteras. Bull sperm whales migrate much farther poleward than the cows, calves, and young males. Because most of the breeding herds are confined almost exclusively to warmer waters many of the larger mature males return in the winter to the lower latitudes to breed.

As of the NOAA October 2007 Stock Assessment report on the North Atlantic Stock of sperm whales, the population is currently estimated to range between 3,539 and 4,804 (CV=0.38). According to the stock assessment, there is insufficient data to determine the population trend for the species. Potential Biological Removal (PBR) for the western North Atlantic sperm whale is calculated to be 7.1 whales. Between 2001-2005 one sperm whale stranding was reported along South Carolina in 2002 (NOAA, 2007). A review of the "Large Whale Ship Strike Database" (Jensen and Silber, 2003) found no recorded ship strikes of sperm whales in South Carolina.

3.0 ANALYSIS OF EFFECTS ON LISTED SPECIES AND HABITATS- CFR 402.12(f)(4)

3.1 SEA TURTLES

3.1.1 Direct Effects

Sea turtle nesting season extends from April 15 through October 31 due to the potential for leatherback sea turtle nests on Hilton Head Island. Construction of the beach fill portion of the project is expected to take 100 days (120 days with mobilization/demobilization activities) and construction of the groin structure is expected to take approximately 140 days (including mobilization/demobilization activities). Beach fill placement is proposed for construction between April 21, 2011 and August 22, 2011 and mobilization/demobilization on the project area beach would extend between April 1 and September 9, 2011. Construction of the low-crested groin is proposed between July 15, 2011 and December 28, 2011 with mobilization activities commencing on July 1 and demobilization completed by January 11, 2012. The potential for direct impacts to sea turtles would be limited to one sea turtle nesting season and would extend for approximately seven months due to the combined project elements.

The proposed project has the potential to adversely affect nesting females, nests and hatchlings along approximately 5,400 feet of project area shoreline, including pipeline placement, beach fill and structure footprint. Potential negative effects to sea turtles include possible destruction of nests deposited within the boundaries of the proposed project, harassment in the form of disturbing or interfering with female turtles attempting to nest within the construction area or on adjacent beaches, and disorientation of hatchlings and nesting females on beaches adjacent to the construction area as they emerge or return from the nest and crawl to the water as a result of project lighting.

Project construction during sea turtle nesting season will involve greater potential for the direct mechanical destruction of nests and burial of nests and greater likelihood for encounters with construction equipment/pipes on the beach during nesting activities. Beach restoration projects which have been constructed during turtle nesting season generally have not been detrimental to sea turtles (Fletemeyer, 1983; Wolf, 1988; Burney and Mattison, 1989). Nesting sea turtles tend to avoid the immediate construction area during beach restoration projects; however, more frequent non-nesting emergences involve an increased expenditure of energy and, therefore, a potential decrease in overall reproductive fitness.

A nest monitoring and relocation program will be required during project construction. Since about 1999, a portion of the project shoreline has experienced consistent recession rates varying from 60 to 130 feet per year (Olsen Associates Inc., 2008a). Due to these significant erosion rates over the past 10 years, sea turtle nests which are susceptible to tidal inundation have

been relocated from the project area shoreline. It is expected that sea turtle nest relocation will continue until shoreline change conditions are stabilized within the project area.

Stabilization, maintenance, and protection of the sea turtle nesting beach along the project area shoreline are principal goals and beneficial effects of the proposed project. The proposed Port Royal Shoreline Restoration and Stabilization Project should reduce the need for nest relocation activities in the future by creating a more consistent beach width and stable nesting beach. The placement of beach-compatible sand may increase the amount of available sea turtle nesting habitat due to the compatibility of the borrow site sediments with the existing beach sand, provided adherence to nest monitoring, compaction and escarpment remediation measures discussed in Section 3.1.4.

Comparisons between relocated and *in situ* nests reveal significant variations in hatching success ranging from a 21% decrease to a 9% increase for relocated nests. Comparisons of emergence success between relocated and *in situ* nests also reveal significant variability ranging from a 23% decrease to a 5% increase for relocated nests (Florida Department of Environmental Protection, unpublished data as cited by USFWS, 2005).

A high percentage of nests are currently relocated within the project area due to the eroded shoreline conditions. If possible, nests are relocated directly landward to a higher elevation near the dune if there is a safe area above the high tide line. These relocated nests are not recorded electronically. The relocation data in Table 5 only reflect the number of nests which are relocated out of the immediate area due to threat of inundation and wash-out. Therefore, the annual totals in Table 5 are lower than the actual number of nests relocated each season between 1999 and 2008.

Table 5: Relocated nests within the Port Royal Shoreline project area between 1999 and 2008 (Beach Marker 112 – 134)

Year	Number of nests
1999	21
2000	3
2001	6
2002	22
2003	9
2004	7
2005	2
2006	44
2007	ND
2008	9

Notes: Data do not reflect the number of nests which are relocated to higher elevations landward of the deposited location. ND denotes no long-distance relocation data provided.

Based upon the existing conditions within the project area and high level of nest relocation activities, it is not anticipated that implementation of a sea turtle nest relocation program for one nesting season during project construction would significantly increase the potential for incidental take.

The presence of heavy equipment and trucks on the beach during groin construction may involve destruction of nests due to the potential for missing nests during relocation and disturbance of female turtles attempting to nest within the construction area. These potential impacts can be minimized by the establishment of travel corridors along the beach for the transport of materials to the groin construction site and storage of construction equipment and materials in areas off the nesting beach. The proposed staging area for groin construction is located in close proximity to the structure location which should minimize the potential for adverse impacts due to the short transport distance (Figure 17).

3.1.2 Indirect Effects

Several studies have indicated that the principal effect of beach project construction on sea turtle reproduction is a reduction in nesting success (i.e. the percentage of emergences resulting in nests) due to beach compaction and the unnatural beach profile created during project construction. High compaction levels result in an increased expenditure of energy by nesting females due to the increased length of time required to excavate the nest, as well as repeated attempts to successfully excavate a nest. Ernest and Martin (1999) found that the principal effect on sea turtle reproduction was a reduction in nesting success during the first year after project construction in Martin County, FL. In the Martin County study, there was no change in frequency of emergence, only a reduction in nesting success on the nourished beach. The reduction in nesting success was similar in both tilled and untilled areas, indicating that factors other than compaction, such as changes in the width of the beach profile, were responsible for the decrease in attractiveness of the beach as nesting habitat (Ernest, 2001).

A study on Hilton Head Island found no immediate positive impact on sea turtle nesting following beach nourishment (Byrd, 2004). Although nest density increased after nourishment, these increases were not statistically significant and nest to total crawl ratios decreased up to two years following the nourishment project. Three years following the beach nourishment project on Hilton Head Island, nest to total crawl ratios were comparable to those found on the control beach (Byrd, 2004). While beach nourishment appeared to have an immediate adverse effect on sea turtle nesting success on Hilton Head Island, the three year monitoring results indicate that the nourishment project increased the area of suitable nesting habitat with negative effects on nesting success limited to two years following project construction.

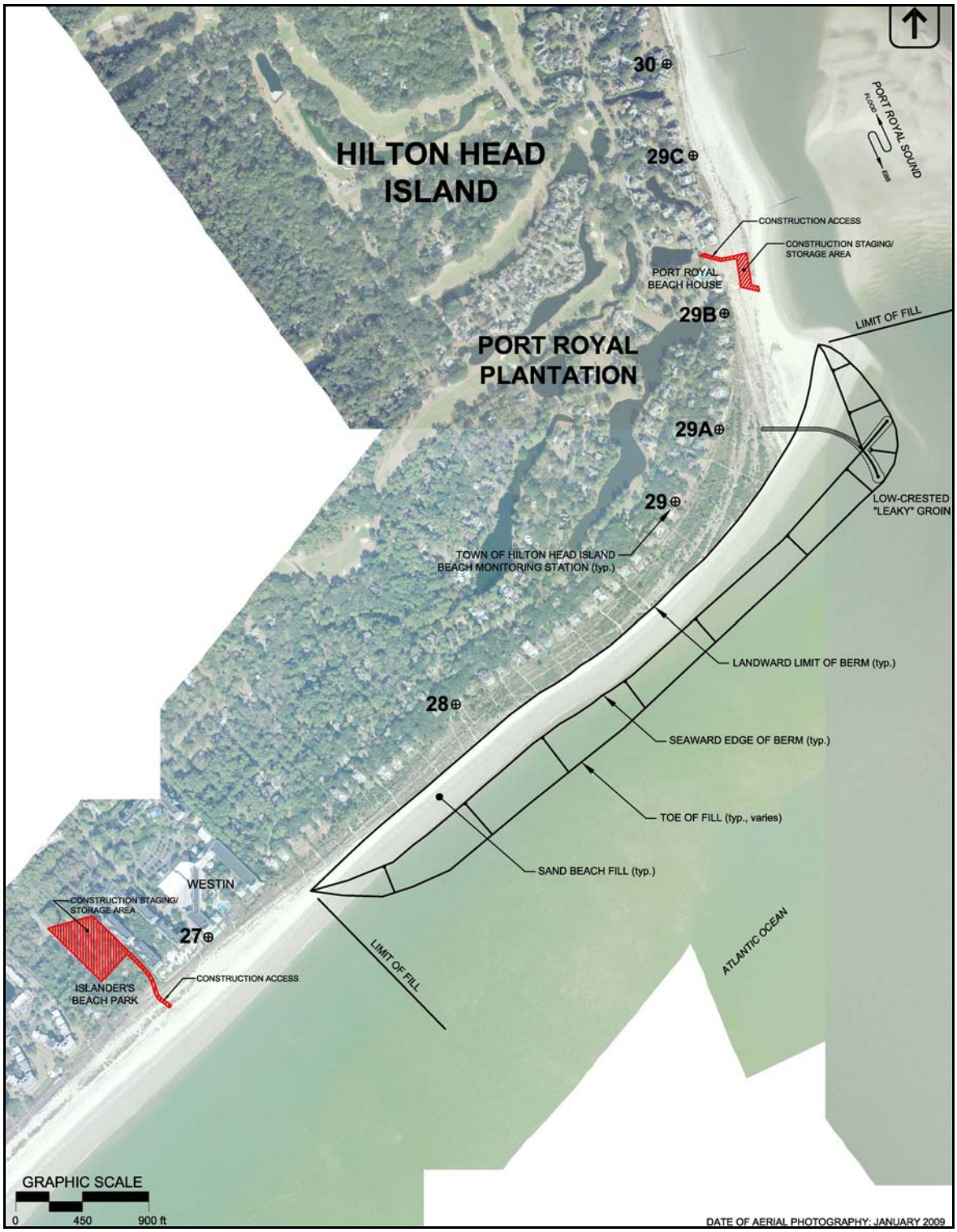

Figure 17: Proposed locations of construction staging and access areas at the north and south ends of the project area.

Sea turtle hatching success may be reduced when sediment grain size, density, shear resistance, color, gas diffusion rates, organic composition, and moisture content of the fill material are different from the natural beach sand (Nelson and Dickerson, 1988; Nelson, 1991; Ackerman, 1991; Ackerman et al. 1992; Ehrhart, 1995; Rice, 2001). Sand temperature changes can alter the incubation time, which can lead to increased predation and alter the sex ratio of hatchlings (Schulman et al., 1994). Temperature-dependent sex determination in sea turtles results in the production of female hatchlings at warm temperatures and male hatchlings at cooler temperatures relative to the threshold temperature range between 28 and 30 degrees Celsius (Mrosovsky, 1995).

Altered beach conditions may also hamper embryonic development (Ackerman et al., 1992) and reduce behavioral competence of hatchlings, including changes in locomotion (Miller et al., 1987). Beaches nourished with sand dredged from an offshore sand source have been demonstrated to be warmer due to increased water retention and the darker sediment color as compared to natural beaches (Ernest, 2001). The warmer sands of nourished beaches may significantly reduce incubation periods and contribute to a higher incidence of late-stage embryonic mortality (Ernest, 2001). No significant differences in overall reproductive success were recorded during a three-year study of nourished Martin County beaches despite changes in the temperature and moisture content of the nest cavity (Ernest, 2001). Broadwell (1991) found no difference between the hatching success for restored and natural beaches for *in situ* nests in Boca Raton and also reported that hatchling emergence success and hatchling weights were significantly greater for nests incubated on the nourished beach compared to the adjacent natural beach.

The borrow site sediment should provide suitable nesting substrate for sea turtles. Beach-quality sand will be dredged from an area of a large linear ebb tidal shoal feature on the eastern side of the Port Royal Sound ebb tidal shoal. The proposed borrow site is highly suitable for use as beach fill material on the north end of Hilton Head Island. The borrow site sediment above the -20 and -25 ft. horizons is compatible with the native beach on Hilton Head Island in terms of grain size characteristics, percentage of fine material, and shell content. "Native beach" is somewhat ambiguous since most of the shoreline has been nourished or indirectly affected by prior nourishment activities. The borrow site sediments are slightly more coarse than the existing beach material -- median grain size diameter of 0.24 mm compared to 0.16 mm for the existing beach. The larger median grain size of the material in the borrow site is primarily due to the presence of a small number of individual large shell fragments. Some of the shell pieces found in the cores were unfragmented whole shells that ranged in size from 5 to 20 mm. The large shell pieces were frequently found along the upper near-surface samples. Some very thin layers or traces of silt and clay were observed at lower elevations, usually below -20 ft NGVD.

Sediment color was not analyzed in detail; however, field observations indicate that the sediments within the borrow site match closely with the existing sediment color. Sediment color compatibility has been acceptable during previous nourishment projects on Hilton Head Island. Overall, the borrow site sand will be somewhat darker immediately following placement than the pre-fill beach sediments. Natural reworking of sediments and exposure to sunlight will lighten the beach fill prior to the subsequent sea turtle nesting season.

Given the compatibility of the proposed borrow site sediments with the native beach, minimal adverse impacts to sea turtle hatching success are expected during the first three years after beach sand placement, and the sex ratio of males to females should not be significantly altered due to changes in nest temperature associated with sand color of the nourished beach. However, an increase in the frequency of non-nesting emergences (i.e. false crawls) would involve an increased expenditure of energy and, therefore, a potential decrease in overall reproductive fitness.

The design of the low-crested, “leaky” groin structure should minimize the potential for hatchling disorientation and/or entrapment associated with interaction with the structure. Additionally, the structure should minimally interfere with access by females to the nesting beach. As shown in the Amelia Island example in Figure 10, the configuration and elevation of the structure will allow for a high rate of sand transport for the purposes of maintaining the stability of the adjacent downdrift beaches. Most of the stem along the structure will be completely buried during construction. It is expected that within a year or two after placement, a significant portion of the remaining areas of the low-crested groin structure will be nearly completely buried (see Photo 3 for example at Amelia Island). The groin structure is expected to stabilize the shoreline, assist in maintaining sea turtle nesting habitat, and reduce the frequency for beach nourishment, resulting in less frequent disturbance of nesting and hatching activities related to a more frequent nourishment interval.

The presence of heavy equipment and trucks on the beach could lead to increased beach sand compaction within the project area. These effects would be minimized by the establishment of a travel corridor for construction equipment and rock delivery and the close proximity of the rock staging area to the construction site (Figure 17). Tilling of the beach prior to the start of the following sea turtle nesting season in 2011 would alleviate beach compaction. Behavior modification of nesting females due to escarpment formation during the first two to three nesting seasons following project construction may occur, resulting in false crawls or situations where they choose marginal or unsuitable nesting areas to deposit eggs.

3.1.3 Interrelated, Interdependent and Cumulative Effects

Major development of the northern Hilton Head Island shoreline began in the early 1960’s with the establishment of Port Royal Plantation. At this time, the

sand beach between the Folly and Fish Haul Creek was mildly erosional along the Atlantic shorefront, mildly accretional at the “Heel,” and erosional along the Port Royal Sound shoreline. As shoreline erosion progressed along the Port Royal Sound shoreline, numerous shoreline stabilization structures were constructed to reduce shoreline retreat and protect the upland. Most of these structures are presently partially or completely buried with sand from past beach nourishment activities.

In the early 1960’s, two groins were constructed from palm tree trunks and granite stone at the southeastern most section of the Port Royal Sound shoreline. Between 1969 and 1974, a series of rock groins and revetments were constructed along the shoreline between the “Heel” of the island and Fish Haul Creek (USACE, 1974). In all, fifteen (15) groins and roughly 1,000 feet of revetment were constructed along the Port Royal Plantation shoreline.

In 1990, the Town of Hilton Head Island constructed a comprehensive beach restoration project which placed approximately 2.2 Mcy along roughly two-thirds of the island’s Atlantic shorefront. The final beach fill length was about 36,000 feet (6.8 miles) including the tapered ends. The project included the placement of approximately 342,000 cy of sand between the Folly and a point just north of the Westin Hotel. No sand was placed along the Port Royal Sound shoreline during this project.

By the early 1990’s, shoreline recession along the Port Royal Plantation Port Royal Sound shoreline approached a critical condition. There were limited attempts by the Port Royal Plantation Property Owner’s Association (POA) and individual property owners to offset the erosion. These efforts included the deployment of hundreds of 5-lb sand bags intended to create temporary revetments along localized, critically-eroded reaches of shoreline. Due to permitting restrictions, the sand bags were limited in size and were easily displaced during storm events. The sand bag structures did not provide adequate long-term protection to the eroding bluff or dune.

A sand scraping program was initiated in 1995 to address the problem of decreased littoral transport around the “Heel” of the island by mechanically transporting sand from the “Heel” to localized erosional “hot-spots” along the Plantation’s Port Royal Sound shoreline. The volume of sand transferred was not sufficient to offset the overall sediment deficit that continued to threaten residential development.

In response to the developing Port Royal Sound shoreline erosion problem, the Town sponsored the “Port Royal Plantation Shoreline Erosion Study” (Olsen Associates Inc., 1995). The primary conclusion of the study was that the dramatic increase in erosional stress and sand starvation along the Port Royal Sound shoreline was directly related to the landward migration of Joiner Bank that began in the early 1970’s. Simplistically, as Joiner Bank approached the

island, the bank began to function as a natural breakwater influencing the “Heel” of the island. This “breakwater effect” resulted in the sheltering of the leeward shoreline thereby creating an environment favorable for sand deposition at that location. As the bank continued to migrate toward the island, its effectiveness as a breakwater increased, resulting in an acceleration of sand deposition and shoreline accretion. As a result, the “Heel” shoreline experienced a dramatic seaward advance while the Port Royal Sound shoreline began to experience sand deprivation and significant erosion. The erosion effects were first realized along the Port Royal Plantation shoreline, but in time, the associated erosional wave propagated farther north.

Concurrent with the gradual decrease in sand transport to the Port Royal Sound shoreline, the marginal tidal channel between Joiner Bank and the Port Royal Plantation shoreline meandered toward the island. Over time, the migration of the channel accelerated and eventually the channel was positioned against the shoreline. Only the rock groins and revetment constructed in the 1960’s prevented the channel from literally migrating into the upland development. The most problematic effect of the channel migration was the eventual loss of the entire intertidal platform along about 1,000 feet of shoreline. The loss of the intertidal platform further exacerbated the erosion problem experienced along the shoreline to the north by acting as an additional barrier to any natural sand transport that may have been occurring prior to the approach of Joiner Bank.

In 1997, the Town of Hilton Head Island implemented an island-wide renourishment of the 1990 beach restoration project. As an adjunct to that project, the Town sponsored comprehensive restoration of the Port Royal Plantation Port Royal Sound shoreline. The Port Royal Sound Shoreline Restoration Project included relocation of the marginal tidal channel away from the island, reconstruction of an eroded section of the nearshore intertidal platform, and placement of over 349,400 cy of sand along approximately 8,500 feet of shoreline between the “Heel” and Fish Haul Creek (Olsen Associates Inc., 1999).

The channel relocation component of the 1997 project involved the closure of an existing tidal channel using sand excavated from a new “pilot” channel. The “pilot” channel was located at a historical channel location approximately 2,500 feet away from the 1997 channel location. The design intent was to close off the existing channel as quickly as possible while establishing an equivalent hydraulic flow capacity through the new channel. Once the old channel was effectively closed, excess sand resulting from the new channel excavation was placed along the shoreline with the intent of building-up the intertidal beach platform in order to sufficiently support and maintain the subsequent beach fill. In all, approximately 315,000 cy were excavated by dredge to create the new channel.

Renourishment of the shoreline between the Folly and just north of the Westin Hotel in 1997 included the placement of an additional 356,700 cy of sand

following channel relocation along the Port Royal Sound shoreline. The source of sand for the Atlantic shorefront renourishment north of the Folly and Port Royal Sound shoreline restoration following channel relocation was an offshore borrow site located approximately 1.5 miles seaward of Joiner Bank.

A subcomponent of the 1997 project included the construction of a rock groin along the southern bank of the Folly Inlet. The structure was intended to function as a terminal structure for the beach fill material placed south of the Folly and to provide stability to the adjacent, Town owned public recreation area. Approximately 2,900 tons of granite boulders were required to construct the 300-ft long structure. The design crest elevation of the entire groin was +6 ft-NGVD.

In 2006/07, the Town implemented the second island-wide renourishment of previously restored sections of the island's sand beaches. The project included sand placement of approximately 243,000 cy of sand between the Folly and the Westin Hotel as well as about 136,000 cy of sand along about 2,700 feet of Port Royal Plantation Port Royal Sound shoreline along the area originally restored in 1997. An additional subcomponent of the 2006/07 project included a 125-ft landward extension of the Folly groin originally constructed in 1997. The purpose of the extension was to reduce the potential for flanking of the landward end of the structure due to continued inlet tidal channel migrations.

The expected date for the next comprehensive renourishment on Hilton Head Island will be around 2015 to 2017. Future cumulative impacts within the project area may result from periodic nourishment events on the island which are scheduled to occur on 8 to 10 year intervals. The low-crested groin structure is expected to stabilize the shoreline and reduce the frequency for beach nourishment, resulting in less frequent disturbance of nesting and hatching activities due to beach nourishment activities.

3.1.4 Conservation Measures

Nest monitoring and relocation during project construction, compaction monitoring, tilling, and escarpment remediation measures will be performed in accordance with the Terms and Conditions of the USFWS Biological Opinion. These measures should minimize the potential for incidental take of sea turtles associated with the proposed Port Royal Shoreline Restoration and Stabilization Project. Project lighting shall be limited to the immediate area of active construction. Stationary lighting on the beach and all lighting on the dredge shall be minimized through screening/shielding, appropriate placement of lights to minimize illumination of the nesting beach and water, and the use of low pressure sodium lights. Travel corridors will be established for construction equipment and rock delivery, and construction equipment and material will be stored in areas off the nesting beach to minimize activity on the nesting beach. The construction staging area at the north end of the project area has been sited to minimize travel distance over the project area nesting beach, reducing the risk

of impacts due to missed nests during relocation and minimizing the secondary effects of increased sand compaction.

3.1.5 Determination

The proposed Port Royal Shoreline Restoration and Stabilization Project has the potential to adversely affect nesting loggerhead and leatherback sea turtles, nests, and hatchlings along approximately 5,400 feet of project area shoreline due to beach fill and groin construction activities.

Adverse effects to all four species sea turtles listed in this Biological Assessment are unlikely during dredging at the proposed offshore borrow site in association with the use of a hydraulic cutter-head dredge. Because the Kemp's ridley sea turtle and green sea turtle rarely nest on beaches in Beaufort County, South Carolina, the project may affect but is not likely to adversely affect the green sea turtle and Kemp's ridley sea turtle.

3.2 SHORTNOSE STURGEON

3.2.1 Direct Effects

The shortnose sturgeon lives in riverine systems migrating between freshwater and mesohaline river reaches. Spawning only occurs in upper freshwater areas while feeding and overwintering activities may occur in both fresh and saline habitats. Although shortnose sturgeon are capable of entering open ocean water, it has been suggested that the species appears hesitant to enter open ocean water (Gilbert, 1989). Construction activities associated with of the proposed project will be completed entirely on the ocean side of Hilton Head Island. Therefore, no direct impacts to the shortnose sturgeon at the beach fill area or offshore borrow site are expected.

3.2.2 Indirect Effects and Interrelated, Interdependent and Cumulative Effects

No indirect or cumulative effects to shortnose sturgeon are anticipated as a result of the proposed project.

3.2.3 Determination

It is unlikely that shortnose sturgeon utilize the habitats in the project area; however, should it occur, its habitat would be only minimally altered by the proposed project. The proposed project is not likely to adversely affect the shortnose sturgeon.

3.3 WEST INDIAN MANATEE

3.3.1 Direct Effects

Manatees are found in South Carolina mainly during warmer months of the year. Given that dredging and beach fill placement is proposed for the summer months between June 1 and October 31, it is possible, but unlikely; that manatees could

wander into close proximity of the offshore borrow site or beach fill site during dredging activities and beach project construction.

3.3.2 Indirect Effects

No indirect effects to manatees and/or their foraging habitat are anticipated as a result of the proposed project.

3.3.3 Interrelated, Interdependent and Cumulative Effects

Cumulative impacts resulting from changes in manatee foraging habitat are not anticipated.

3.3.4 Conservation Measures

To avoid contact and potential injury to manatees, the applicant will adhere to the Standard Manatee Protection Conditions included in the State and Federal permits.

3.3.5 Determination

Based upon adherence to the Standard Manatee Protection conditions, the proposed Port Royal Shoreline Restoration and Stabilization Project may affect but is not likely to adversely affect the West Indian manatee.

3.4 PIPING PLOVER

3.4.1 Direct Effects

The majority of the project area shoreline, approximately 4,700 feet of beach, is located within Critical Habitat Unit SC-15 for wintering piping plover. The critical habitat area is located between Donax Road and the northern end of Planters Row (Figure 3). The period from August 15 through April 30 is considered the migratory and wintering season for piping plover.

Construction of the beach fill portion of the project is expected to take 120 days with mobilization/demobilization activities, and construction of the groin structure is expected to take approximately 140 days including mobilization/demobilization activities. Beach fill placement is proposed between April 21, 2011 and August 22, 2011, and mobilization/demobilization on the project area beach would extend between April 1 and September 9, 2011. Therefore, the majority of the beach fill placement work within Critical Habitat Unit SC-15 would occur outside of the wintering season for piping plover.

Construction of the low-crested groin is proposed between July 15, 2011 and December 28, 2011 with mobilization activities commencing on July 1 and demobilization completed by January 11, 2012. Although construction of the groin will commence outside of the wintering season, groin construction would occur during the first half of the piping plover wintering season due to the expected timeframe required to construct the project elements. The potential for temporary direct impacts to piping plovers and critical wintering habitat within

Unit SC-15 exists for approximately six months during one wintering season due to disturbance issues from the combined project elements.

The proposed project will affect piping plover (*Charadrius melodus*) and its designated critical wintering habitat within Unit SC-15. Potential effects include harassment in the form of disturbing or interfering with plovers attempting to forage within the construction area or on adjacent beaches and behavior modification of migrating or wintering plovers due to disturbances created by the construction activities within the project area. Construction activities may also directly disturb wintering piping plovers from roosting and loafing areas. Such disturbance can result in unnecessary expenditure of energy and force birds to seek alternative areas which may be less suitable and increase their exposure to predation. Construction activities may also change the physical condition of the beach. Adverse changes can render habitat areas less suitable for foraging, roosting and/or loafing.

The roosting area on the sand spit at the north end of the project area would be temporarily disturbed by the staging, storage, and transportation of equipment, materials, supplies, and workers on the beach. This would cause birds to seek out and use alternative habitat areas outside of the influence of project activity. The proposed access, storage, and staging area for groin construction is located immediately north of the northern limit of the Critical Habitat Area. This area is the closest available access to the proposed work site. This location will reduce the spatial extent of construction-related activities along the island's shoreline, thereby minimizing the amount of disturbance to wintering piping plovers in the area (Figure 17).

Most of the construction activity will occur in the early portion of the wintering season as the birds arrive on their wintering grounds. Because mobilization and groin construction activities will commence prior to arrival of the birds and continue into the early half of the wintering season, the presence of daily activity at the groin construction site should encourage them to select alternative foraging and roosting areas upon their arrival to the wintering grounds. This scenario is preferable to commencement of groin construction later in the wintering season, which could disrupt established wintering activities, causing stress and potentially reducing individual fitness for migratory activities.

During project construction, alternative foraging and roosting habitat would be available immediately adjacent to the proposed project area in the vicinity of Fish Haul Creek and on Joiner Bank. Piping plover surveys conducted by the Hilton Head Island Audubon Society (as a subcontractor to the Town of Hilton Head Island) during the past four years have documented utilization of these adjacent areas by wintering piping plover for foraging and roosting activities (Figure 18). The proposed construction window will avoid disturbance to wintering piping plovers during their preparation for migration north to the nesting grounds in March and April. The adjacent areas to the north of the construction access

within the Project Action Area will remain undisturbed during the entire construction window, providing alternative high-quality foraging and roosting habitat which experiences minimal human disturbance. The adjacent wintering area in the vicinity of Fish Haul Creek is also within the mean linear distance of movement for piping plovers as documented during a one-year study of piping plover movement in south Texas (Drake, 1999; see Section 2.7). Based on the results of this study, the amount of energy expended in locating this alternative wintering habitat should be minimal.

The direct placement of sand will result in the burial and nearly complete mortality of benthic infauna along the 5,400 feet of beach at the project fill site. The majority of infaunal loss will be in the shallow waters of the surf zone. Infaunal prey density has frequently been shown to affect habitat use in shorebirds (Goss-Custard et al., 1991). Research by Peterson et al. (2006) suggests that impacts to foraging habitat for shorebird species may be short-term due to the temporary depletion of the intertidal food base. See Section 3.4.2 for a discussion on the indirect effects to the prey base.

Between October 2003 and March 2007, the shoreline recession rate along the beach in Critical Habitat Unit SC-15 exceeded 100 ft/year. This rate, measured at Hilton Head Island beach station HHI-29, is expected to continue in the future. Current erosional conditions significantly threaten the critical wintering habitat area and, if unaddressed, it is expected that the remaining shorefront which is designated as critical habitat within Unit SC-15 will be lost within three to five years. The increase in beach width from beach nourishment activities should increase the amount of available roosting habitat for piping plovers, and eventually increase the amount of suitable foraging habitat within Critical Habitat Unit SC-15 after benthic invertebrates repopulate the beach fill area. A wider and more stable beach following project construction may provide a more consistent buffer between important bird habitat areas and upland development and associated human activities.

Construction of the low-crested groin is expected to result in minimal direct loss of foraging and/or roosting habitat within the footprint of the structure in Unit SC-15. The low-crested groin will be buried with sand upon completion of construction, and the majority of the structure is expected to remain buried under sand for the life of the project. Refer to Photos 3 and 5 for representative photos of the low-crested groin at Amelia Island. The buried structure should not interfere with or reduce the quality of roosting and loafing activities in the vicinity of the spit. Caution signs will be placed in the area of the structure to advise of the presence of rocks and deter people from the area (Photo 5), providing secondary benefits of protection for piping plovers.

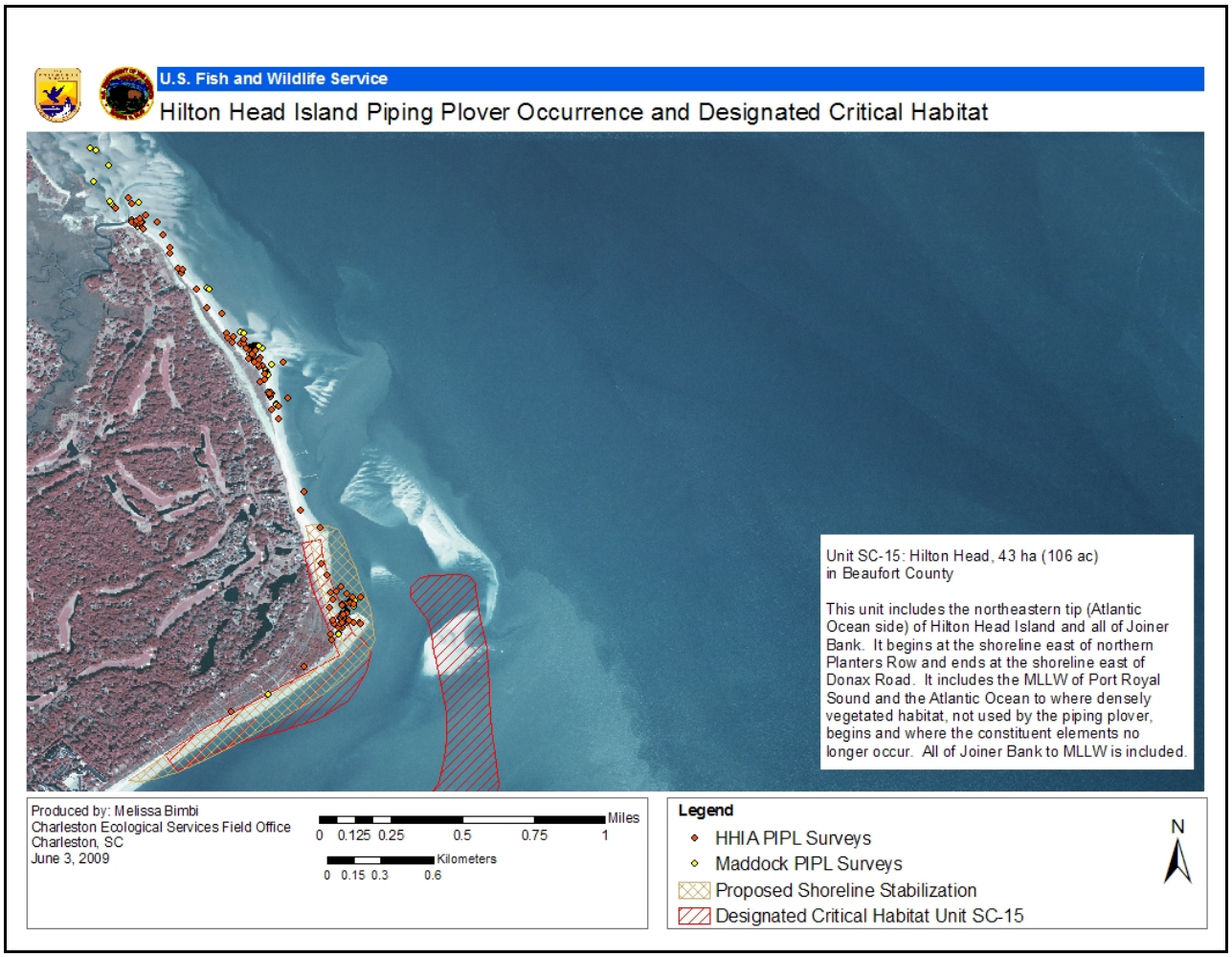

Figure 18: Piping plover survey data collected within and north of Critical Habitat Unit 15 (2006-2009) along the Port Royal Shoreline of Hilton Head Island. Figure provided by U.S. Fish & Wildlife Service using data collected by Hilton Head Island Audubon Society.

Photo 5: Example of “Caution Sign” at the low-crested groin site on Amelia Island. Note buried low-crested groin in the background.

The intertidal mudflat just north of the sand spit provides high-quality foraging habitat for piping plovers. As shown in Photo 4, this area provides important primary constituent elements of the critical wintering habitat and is rich in surf-cast algae. The close proximity of the sand spit to the adjacent intertidal mudflat provides valuable roosting habitat for piping plover with minimal expenditure of energy. In order to avoid direct impacts to this valuable foraging habitat, the project was revised to minimize fill placement north of the groin structure and eliminate the direct fill placement within the intertidal mudflat foraging area north of the spit (See Section 1.5.6). Elimination of direct fill placement in this area should result in a gradual reshaping of the area north of the spit rather than direct mortality of the infaunal communities, thereby allowing the birds to adjust to gradual shifts in the food base rather than complete loss due to burial or direct alteration of the habitat. No construction-related activities would occur in the mudflat area at any point during construction.

3.4.2 Indirect Effects

Indirect effects of the proposed project involve concern for the reduction in potential for formation of optimal foraging and roosting habitats in the project area, such as the intertidal mud flats in the area north of the spit and the remaining detached portion of Joiner Bank. If no action is taken, it is predicted that the continued landward migration of Joiner Bank would result in welding of the bank feature to the Port Royal shoreline or complete dissipation of the bank due to the erosional effects of tidal currents and waves. Under either scenario, the beneficial effects of undisturbed roosting areas on the bank would be lost.

Based upon past changes to Joiner Bank, it is expected that most of the bank habitat will eventually be lost with or without the proposed Action.

Under the No-Action Alternative, it is likely that most of the remaining Atlantic Ocean shorefront within Critical Habitat Unit SC-15 along the shoreline will be lost within three to five years due to the chronic erosion and continued beach narrowing. The proposed project should increase and stabilize the amount of available roosting habitat and foraging habitat within Unit SC-15. It is expected, however, that the quality of foraging habitat will be less than optimal for one to two years following project construction due to the newly placed beach fill. Following repopulation of the invertebrate prey base, the beneficial effects could last as long as seven to eight years until the next planned beach nourishment event. The groin structure is expected to stabilize the shoreline, assist in maintaining foraging and roosting habitat for piping plover, and reduce the frequency and future need for beach nourishment events as a component of island-wide beach nourishment requirements. The stabilizing effects of the groin will result in less frequent direct disturbances to wintering piping plover and less frequent disruptions of the prey base within the project area as compared to a nourishment-only approach (Alternative 2).

Several factors appear to influence the effects of recruitment/recolonization of infaunal populations at the beach fill site following nourishment. These factors include the size and type of the fill sediment and the compatibility of the fill to the existing beach. Some studies have suggested that changes in the geomorphology and sediment characteristics may have a greater influence on the recovery rate of invertebrates than direct burial or mortality (USDOI/FWS, 2000). Donoghue (1999) found that the timing of beach fill placement episodes, the size and type of fill, and the compatibility of the fill material to the native sediments is critical to the short-term and long-term impacts to beach invertebrate populations.

Placement of sediment that closely matches the existing beach sediment is considered extremely important in the minimization of adverse effects to beach fauna (Hayden and Dolan, 1974; Gorzelany and Nelson, 1987; SCDNR, 2008). Van Dolah et al. (1992) attributed rapid recovery to the similarity of fill material to existing sediments, as well as placement of the fill high on the beach, well above mean sea level. Peterson et al. (2000) documented a reduction of 86-99% in invertebrate populations, five (5) to ten (10) weeks following beach nourishment on Bogue Banks, NC. The extreme decrease in the population of beach infauna following nourishment was attributed to the poor match in grain size between the placed sand and natural beach. The sand source utilized in the Bogue Banks project contained a very high shell content that was not comparable to the natural beach (Peterson et al., 2000).

Peterson et al. (2006) observed significant reductions in the use of nourished beaches by shorebirds during the six months following completion of beach

nourishment (March through September 2002) on Bogue Banks, NC. The dramatic depression of abundance of feeding shorebirds persisted from March through September; however, by November 2002, seven to twelve months after the completion of nourishment, the difference between counts on filled and controlled beaches was no longer statistically significant (Peterson et al., 2006). Abundances of *Donax* spp., the biomass dominant and key prey for higher trophic levels, and haustoriid amphipods averaged less than 10% of control levels following construction during the winter of 2001-2002. Recovery on nourished beaches was not initiated by either taxon during the March to November sampling (Peterson et al., 2006).

Changes in infaunal community structure at the project fill site are possible based upon differences in generation time and reproductive strategies of infaunal organisms. For example, the failure of haustoriid amphipods to initiate recovery during the first warm season on Bogue Banks was attributed to their lack of pelagic larvae combined with the low long-shore transport rate on Bogue Banks (Peterson et al., 2006). The results of this study suggest that it is possible that the foraging habitat value of the nourished project area beach may be affected for up to two years if colonization by preferred prey species does not occur until the end of the second summer following project construction.

Sediment compatibility in beach nourishment projects in South Carolina has historically been acceptable (SCDNR, 2008) with post-nourishment sediment characteristics generally matching pre-nourishment characteristics within six months (Van Dolah et al., 1994; Jutte et al., 1999). The sediments identified as the source of sand for the proposed beach fill have been shown to be highly compatible with the existing project area beach sediments (Olsen Associates, Inc., 2009). Given the compatibility of the proposed borrow site sediments with the native beach and the expected recolonization rate of prey species, it is anticipated that the impacts to benthic communities at the project fill site would be minimal and short-term, limited in duration to the first summer following project completion.

The project area beach is currently generally accessible to pedestrian traffic at all periods of the tidal cycle except during extreme high tide. During a site inspection conducted on June 3, 2009, access along the shoreline between H-29 and H-29A was difficult for the 2-hour period prior to high tide, four days prior to a full moon. In addition to the lunar influence, tides along the entire Atlantic Coast of the United States were elevated above tidal predictions in June 2009 with water levels running above 0.6 ft to 2.0 ft above normal depending upon location (http://tidesandcurrents.noaa.gov/press/ EastCoastWaterLevelAnomaly.shtml). Anecdotal information regarding beach use in this location indicates that beach access is not impeded daily by high tide conditions, but can occur during spring tide conditions or when high water level are elevated due to periodic weather events.

The proposed project will improve pedestrian access along the project area during the highest astronomical water level (i.e. tide) conditions and possible during periods of elevated water levels associated with coastal storms. Therefore, it is reasonable to assume that the level of human activity in the project area could increase during these conditions. The level of human activity in the project area during all other tide and water level conditions is not expected to change due to the proposed project. Any improvement in access along the project area has the potential to lead to an increased disturbance of wintering piping plovers within Unit SC-15, potentially reducing fitness of individuals for successful migration and reproduction.

3.4.3 Interrelated, Interdependent and Cumulative Effects

Erosion control activities have occurred within the Town of Hilton Head Island since the early 1960's (see Section 3.1.3). The proposed project is intended to restore, stabilize and maintain the critical habitat area through initial beach restoration, groin construction, and long-term periodic renourishment, as necessary. One of the project goals is to stabilize the restored beach with the low-crested groin to better control sand loss rates in the area. Future renourishment requirements along the project area will be integrated into the island-wide renourishment program. Restoration, stabilization, and maintenance of the shorefront habitat are beneficial effects of this project.

Long-term recovery time of softbottom benthic invertebrate populations depends upon the length of the project, timing of the project and the interval between nourishment events. Continued beach nourishment at eight to ten year intervals will create temporary disruptions in the foraging food base which could persist for one to two years following fill placement. The length of time between proposed renourishment events should allow sufficient time for recovery of benthic invertebrate populations prior to the subsequent nourishment event. Dependent upon the sand source utilized for future nourishment projects, infaunal community structure changes could persist for a period of one to two years following project construction, creating chronic short-term impacts to selective birds due to the loss of specific prey species.

The groin structure is expected to stabilize the shoreline, assist in maintaining foraging and roosting habitat for piping plover, and reduce the frequency for beach nourishment events. The reduced nourishment interval will result in less frequent direct disturbances to wintering birds and less frequent disruption of the prey base within the project area. As discussed in Section 3.4.2 above, sediment compatibility in beach nourishment projects in South Carolina has historically been acceptable (SCDNR, 2008); therefore, recovery of the softbottom benthic invertebrate populations within the project area is expected within one year following beach fill placement.

3.4.4 Conservation Measures

The proposed staging area for groin construction is located in close proximity to the groin construction site, but outside of the Critical Habitat Area, which should minimize the amount of disturbance to wintering piping plover. The proposed access location is the closest available to the project area. Because mobilization activities and groin construction activities will commence prior to the arrival of the birds at the wintering site, the pre-existing daily activity within travel/work corridors should encourage plovers to select alternative foraging and roosting habitat upon their arrival to the wintering habitat. The proposed construction window will avoid disturbance during their preparation for migration north to the nesting grounds in March and April.

In order to minimize the potential for adverse direct effects to wintering piping plover, construction activities would be modified as feasible to minimize any disturbance to wintering or migratory shorebirds on site. Since the proposed staging area has been sited to minimize the travel distance over the beach within the Critical Habitat Area, there will be limited opportunity to adjust work corridor locations once they are established. Activity would be maintained within the designated construction areas and corridors on a daily basis to deter plovers from settling in close proximity to the work areas, and site-specific buffers will be implemented to minimize disturbance to birds which may settle adjacent to the travel corridors and/or staging area.

In coordination with the USFWS and in compliance with the Terms and Conditions of the Biological Opinion, beach compaction would be monitored and tilling would be conducted immediately following the 2011-12 piping plover wintering season and prior to the commencement of sea turtle nesting season in April 2012. Tilling will be conducted over the entire area of shoreline above mean high water to reduce the likelihood of impacts to foraging, roosting and loafing piping plovers.

In previous Biological Opinions issued for shore stabilization projects in the Town of Hilton Head, the USFWS recommended that the Corps endeavor to create and maintain suitable piping plover migrating and wintering habitat and allow for natural accretion at inlets. One of the direct goals and benefits of the proposed project is the reestablishment and maintenance of wintering habitat within Critical Habitat Unit SC-15. A net loss of wintering habitat within the project area should not occur as a result of the proposed project due to the reestablishment and maintenance of critical habitat associated with the placement of beach fill in the project area.

The Town of Hilton Head has revised the proposed project design to minimize fill placement north of the groin structure and eliminate the direct fill placement within the intertidal mudflat north of the spit. Elimination of direct fill placement in this area should result in a gradual reshaping of the area north of the spit rather than direct mortality of the infaunal food base. In recognition of the potential

short-term adverse impacts to wintering piping plover, the Town proposes to develop and implement a Piping Plover Monitoring and Management Plan in collaboration with Federal and State regulatory and resource agencies for the protection and management of wintering piping plovers during and following project construction. The Monitoring and Management Plan will evaluate the potential impacts to and recovery of foraging habitat within Critical Habitat Unit 15 and include success criteria and a project remediation plan with proposed mitigative measures in the event that unanticipated adverse impacts are discovered during the project monitoring.

Due to the highly dynamic shoreline and documented migration of Joiner Bank, tidal channel, and intertidal mud flat north of the spit during the past several years, it is expected that the high-quality foraging habitat north of the spit will continue to migrate north during the next 1.5 years (i.e., the expected time between submittal of the permit application and anticipated time of construction). The immediate pre-project conditions will likely be significantly different than the present condition, and the high-quality foraging areas may no longer be present in the same areas as they exist today. As such, the management plan will be adaptive and incorporate appropriate conservation goals and objectives with a series of specified activities designed to meet these objectives. The following surveys are proposed as part of this Monitoring and Management Plan:

Recommended Surveys and Methods

Piping plover surveys

- Migration timeframe surveys. The migration timeframe for piping plovers on Hilton Head Island is generally between August 15 and October 31, and between February 15 and April 30. Based on the sighting data collected during the past three wintering seasons (2006 through 2009), the Town proposes to conduct migration surveys within Critical Habitat Unit SC-15 between July 15 and October 31, and February 15 through May 1 during the wintering season preceding project construction (pre-construction), during the construction period, and for three years post-construction. The survey area will extend north to Fish Haul Creek to assess utilization of this portion of the Action Area as alternative wintering habitat during the period of project construction.

    1. One survey will be conducted every two hours of high tide and one survey within two hours of low tide every 14 days for a total of 10 survey days annually.
    2. Band combinations will be noted in the following order: Upper Left (UL), Lower Left (LL): Upper right (UR), and Lower Right (LR) using the following abbreviations:

X: metal	b: light blue	C: Atlantic Canada color metal
f: flag	G: dark green	T: Other (describe)
R: red	g: light green	/: split band
Y: yellow	L: black	//: triple split
O: orange	W: white	N: no band seen (area not visible)
B: dark blue	A: gray	-: no band

BNID: bands seen but not identified

Example: A piping plover with: UL orange flag band, LL light blue band over a black over orange over black triple split band, UR metal band, LR light green band would be noted Of,bL/O/L:X,g. A comma separates the upper and lower leg and a colon separates the legs from each other.

3. DGPS coordinates will be collected for each sighting in decimal degrees and activity/habitat description will be noted as well as presence of any intruders (pedestrian and/or dogs) and flushing events/stress responses

- Wintering timeframe surveys. Wintering surveys will be conducted between November 1 and February 15 during the wintering season preceding project construction (pre-construction), during the construction period, and for three years post-construction. The survey area will extend north to Fish Haul Creek to assess utilization of this portion of the Action Area as alternative wintering habitat during the period of project construction.
  1. One survey within two hours of high tide and one survey within two hours of low tide once every month for a total of four surveys annually
  2. Band combinations will be noted as listed above
  3. DGPS coordinates will be collected for each sighting in decimal degrees and activity/habitat description will be noted as well as presence of any intruders (pedestrian and/or dogs) and flushing events/stress responses. Representative digital photography of loafing and foraging habitats will be taken and DGPS positioning of each location will be recorded.

- Foraging area surveys. Foraging area surveys will be conducted between August 1 and April 1 during the wintering season preceding project construction (pre-construction), during the construction period, and for three years post-construction.
  1. The optimal foraging area north of the spit at the north end of the project area will be surveyed monthly during low tide by observations and delineated by recording DGPS coordinates in decimal degrees for a total of 8 surveys annually. Optimal foraging areas will be determined by the level of foraging activity observed and the presence of primary constituent elements such as muddy/sandy intertidal substrate, surf-cast algae and proximity to roosting/foraging areas.

2. Other shorebird species will be noted in active and abandoned foraging areas.
3. During surveys for piping plovers and other shorebirds, negative survey data and the amount and type of human and unleashed pet recreational pressures will be documented. When piping plovers are seen, the habitat type (intertidal area, mid-beach, etc.) and behavior (foraging, roosting, etc.) will be recorded in the database.

Data Collection and Reporting

1. Survey data will be recorded in an Excel spreadsheet (provided by USFWS) and provided to the Charleston Ecological Services Field Office annually. An annual summary report will be prepared and submitted with the raw survey data.
2. A draft of the final 3-year post-construction report including the synthesis, analysis, and interpretation of the data collected will be provided to the Charleston Ecological Services Field Office for a 30 day review period prior to being finalized.
3. The final report will be provided to the Charleston Ecological Services Field Office within one year post monitoring.

Macroinvertebrate surveys and focal species foraging success surveys
Proposed methods for the evaluation of foraging success include the assessment of abundance of preferred food items (i.e. target food species) and reestablishment of the foraging food base within the Critical Habitat Unit SC-15, and abundance of plovers observed foraging within the project area in comparison to foraging areas to the north of the project area in the vicinity of Fish Haul Creek.

The South Carolina Department of Natural Resources has established protocol for sampling benthic invertebrate communities in the evaluation of beach nourishment projects. A BACI (Before-After-Control-Impact) sampling design will be utilized to evaluate changes to the macroinvertebrate/infaunal assemblage within the project area relative to the control (i.e. reference) foraging areas to the north in the vicinity of Fish Haul Creek. Sampling will be focused on the intertidal elevations primarily utilized by piping plovers for foraging activities. Sampling will be conducted immediately prior to construction during the appropriate season to establish baseline conditions prior to any project-related impacts, immediately following construction , and annually following construction during the same timeframe as the pre-construction survey to avoid any confounding effects of seasonality. Multiple sampling events are recommended prior to project construction to establish the baseline condition in recognition of the highly dynamic shoreline conditions. In addition to replicate core samples along established benchmarks for sampling of infauna/macrofauna, the presence of important constituent components such as surf-cast algae will be recorded along the transects, and within the Critical Habitat Unit, and representative still photography of important foraging habitats will be obtained. Target food species

for piping plovers and semipalmated plovers will be established in coordination with the U.S. Fish and Wildlife Service and South Carolina Department of Natural Resources.

Physical characteristics

- Sediment characteristic surveys. Sediment samples will be collected in conjunction with the benthic invertebrate core samples and analyzed for percent sand/silt, calcium carbonate, organic content and sand grain size distribution.

- Elevation surveys and slope measurements. The topography of shorebird nesting, loafing and feeding habitat within Critical Habitat Unit 15 will be monitored using physical monitoring data collected on a semi-annual basis to evaluate changes over time. The Town's physical monitoring program will be expanded to evaluate the potential effects the sand fill project and groin structure on the adjacent beach, nearshore area, and piping plover critical habitat.

- Vegetation surveys. Primary constituent elements of wintering piping plover critical habitat include sand and/or mud flats with no or sparse emergent vegetation. The edge of dune vegetation within the project area will be located during semi-annual topographic beach surveys in conjunction with the Town's physical monitoring program. The dune vegetation line will also be mapped bimonthly with DGPS in areas of optimal foraging habitat (e.g. north end of project area in vicinity of spit) in conjunction with the monthly foraging surveys.

- Compaction surveys. In coordination with the USFWS and in compliance with the Terms and Conditions of the Biological Opinion, beach compaction would be monitored and tilling would be conducted immediately following the 2011-12 piping plover wintering season and prior to the commencement of sea turtle nesting season in April 2012 and for three years post-construction. Tilling will be conducted over the entire area of shoreline above mean high water to reduce the likelihood of impacts to foraging, roosting and loafing piping plovers.

- Aerial photography. High-resolution true-color aerial photography of the project area, including Joiner Bank and the Port Royal Sound shoreline to Fish Haul Creek, will be taken at spring low tide. A total of 7 aerial surveys will be conducted as follows: one pre-project, one immediately post-project, and one annually (July- August) for five years. In conjunction with the semi-annual physical survey data, the Town of Hilton Head Island will use the time series aerial photograph to monitor the changes in Joiner Bank and assess any potential changes to the bank and adjacent downdrift shoreline related to the structure. The Town will evaluate the aerial data surveys in conjunction with the physical survey data and

supplemental representative digital photography of the spit area and other loafing and foraging areas of concern, and prepare a report to the USFWS, Charleston Ecological Services Field Office, and SCDNR within 90 days of the aerial survey. Electronic copies of the high-resolution aerial imagery on DVD will be provided with the report.

Success Criteria

Success criteria will be established to verify repopulation of the benthic macro-invertebrate prey base by desired food species, and preservation and reestablishment of high-quality foraging and roosting habitat within Critical Habitat Unit SC-15. A BACI (Before-After-Control-Impact) sampling design and standard hypothesis procedures will be utilized to evaluate changes to the macroinvertebrate/infaunal assemblages within the project area relative to the control site(s) and the pre-project (baseline) condition. Successful reestablishment of the foraging prey base may be evaluated by the statistical similarity of the benthic community at the control and project area fill sites to the pre-project condition, and confirmation of repopulation of the project area beach by desired prey species for piping plovers. Maintenance of suitable roosting habitat within the project area will be included in the evaluation of project success.

Proposed Management Activities

Working in conjunction with SCDNR and USFWS, the Town will identify and implement appropriate management activities to enhance habitat quality for piping plovers and seabird populations. Increased public outreach and education efforts will enhance understanding and acceptance of shorebird protection measures on Hilton Head Island. This could include the strategic placement of conservation/educational signs along the beach to educate local beach users and tourists of piping plover habitat requirements and species protection measures.

Important bird roosting areas will be protected using measures similar to those used for breeding bird colonies. Such measures commonly involve establishment of recommended setback distances and use of signs, posts, high-visibility string, tape, and any other materials as necessary to prevent human approach within the setback distance. The Town will work with USFWS to develop the most appropriate marking techniques and setback distances for the project area.

If the vegetation monitoring indicates encroachment into areas identified as valuable roosting/loafing habitat prior to the start of the migratory season, USFWS and SCDNR will be consulted to determine if management activities are needed within the Critical Habitat Unit to maintain high-quality roosting habitat.

In South Carolina, dogs are required to be physically restrained when they are not on property owned by their keeper. Several dogs were observed off leash

within the Critical Habitat Area during the site inspection on June 3, 2009 (Photo 6). Absent additional public education, this is expected to be a typical condition at the project site. The Town may consider establishing an area with dog restrictions at the north end of Critical Habitat Unit SC-15 to minimize disturbance to foraging and roosting piping plovers. Should the Town determine that restrictions are appropriate, the boundaries of the restricted areas will be determined in consultation with USFWS and will be adjusted based on existing conditions at the time of project construction.

Photo 6. Dogs were observed off leash within Critical Habitat Unit SC-15 during the site inspection on June 3, 2009.

Project Remediation Plan

The direct benefits of the proposed project are reestablishment, stabilization, and long-term maintenance of wintering habitat within Critical Habitat Unit SC-15. A net loss of wintering habitat is not expected due to the reestablishment and maintenance of critical habitat associated with the project and long-term beach management objectives of the Town. If post-construction monitoring reveals that the project results in a net loss of foraging and/or roosting habitat within the project area in comparison to the pre-project condition, or significant degradation of high-quality roosting and/or foraging habitat at the north end of the project area due to the adverse secondary effects of the low-crested groin, the Town will implement mitigative measures to alleviate these disturbances and/or offset the loss of critical wintering habitat.

The mitigation trigger would be dependent upon the level of documented impact during the post-construction monitoring and a conclusive determination that the loss is related to the project. Potential mitigative measures may include adjustments in management activities such as increased and/or alternative marking of roosting/foraging areas and establishment of setbacks and/or buffers distances around high-quality foraging/roosting habitats.

3.4.5 Determination

It is anticipated that incidental take of piping plovers will occur on 4,700 feet of beach within Critical Habitat Unit SC-15, and the primary constituent elements within the critical habitat unit will be temporarily disturbed during the period of groin construction and beach fill placement. The proposed Port Royal Shoreline Restoration and Stabilization Project may affect the piping plover and its designated critical wintering habitat in Unit SC-15, but is not likely to jeopardize the continued existence of the species. The proposed monitoring and management activities and project remediation plan should minimize the potential for incidental take of wintering piping plovers.

3.5 WHALES

3.5.1 Direct Effects/Indirect Effects

Construction activities are not likely to result in any negative effects on whales. The six whale species discussed in this BA are rarely found in South Carolina. Construction activities would be limited to locations generally too shallow for whale maneuvering such that adverse effects to these species are not anticipated.

3.5.2 Conservation Measures

If a whale is sighted in the area during construction, the National Marine Fisheries Service would be notified and protective measures would be implemented.

3.5.3 Determination

The project is not likely to adversely affect the six whale species considered in this BA (North Atlantic right whale, blue whale, fin whale, humpback whale, sei whale and sperm whale).

4.0 CONCLUSIONS

Based upon the findings of this Biological Assessment and the conservation measures proposed herein, the applicant, the Town of Hilton Head Island, has found that the proposed project may affect, but should not jeopardize the continued existence of the following species:

Loggerhead sea turtle
Leatherback sea turtle
Piping plover

The applicant has also found that the proposed project may adversely affect designated critical wintering habitat for piping plover in Critical Habitat Unit SC-15.

Based upon the findings of this Biological Assessment, the applicant has found that the proposed project may affect, but is not likely to adversely affect the following species:

Green sea turtle
Kemp's ridley sea turtle
West Indian manatee

The applicant has found that the proposed project will have no effect on the following species:

Shortnose sturgeon
North Atlantic right whale
Blue Whale
Finback Whale
Humpback Whale
Sei Whale
Sperm Whale

The May Affect; May Affect, Not Likely to Adversely Affect; and the No Effect determinations for the listed species and critical habitat were concluded based upon compiled local and regional data and conservation, monitoring and mitigation measures to avoid and minimize impacts to listed species.

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