Appendix 3

Previous Threatened and Endangered Species Coordination (2016/2017)

US Army Corps Of Engineers
Charleston District

BUREAU OF OCEAN ENERGY MANAGEMENT

BIOLOGICAL ASSESSMENT OF THREATENED AND ENDANGERED SPECIES

FOR
GARDEN CITY/SURFSIDE BEACH (REACH 3)

Of the

MYRTLE BEACH
STORM DAMAGE REDUCTION PROJECT

HORRY and GEORGETOWN COUNTIES,
SOUTH CAROLINA

April 2016

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1.0 BACKGROUND AND AUTHORIZATION

The U.S. Army Corps of Engineers (USACE) and the Bureau of Ocean Energy Management (BOEM) are acting as cooperating agencies in the analyses required by the National Environmental Policy Act (NEPA), Endangered Species Act (ESA), and other federal laws governing environmental protection. This Biological Assessment (BA) has been prepared by USACE in cooperation with the BOEM in order to meet the federal agency consultation requirements of Section 7 of the ESA. This document evaluates the effects of the proposed beach renourishment project on federally listed and proposed threatened and endangered species under the jurisdiction of the United States Fish and Wildlife Service (USFWS) and the National Marine Fisheries Service (NMFS). Consultation with NMFS is not required because in-water impacts of the project are covered by the NMFS South Atlantic Regional Biological Opinion (NMFS 1997).

The Myrtle Beach Storm Damage Reduction Project was authorized for construction by Section 101 of the Water Resources Development Act of 1990, Public Law 101-640. Section 934 of the Water Resources Development Act of 1986 (WRDA86), Public Law 99-662, authorized the Government to extend the Federal participation in periodic beach nourishment until 2046. The final Environmental Impact Statement (EIS) was completed in January 1993 with the Record of Decision (ROD) being signed on 1 November 1993.

The authorized project calls for construction of a separate protective beach in three separable reaches, North Myrtle Beach (Reach 1), Myrtle Beach (Reach 2), and Garden City/Surfside Beach (Reach 3). The total project reach is 25.4 miles (Figure 1).

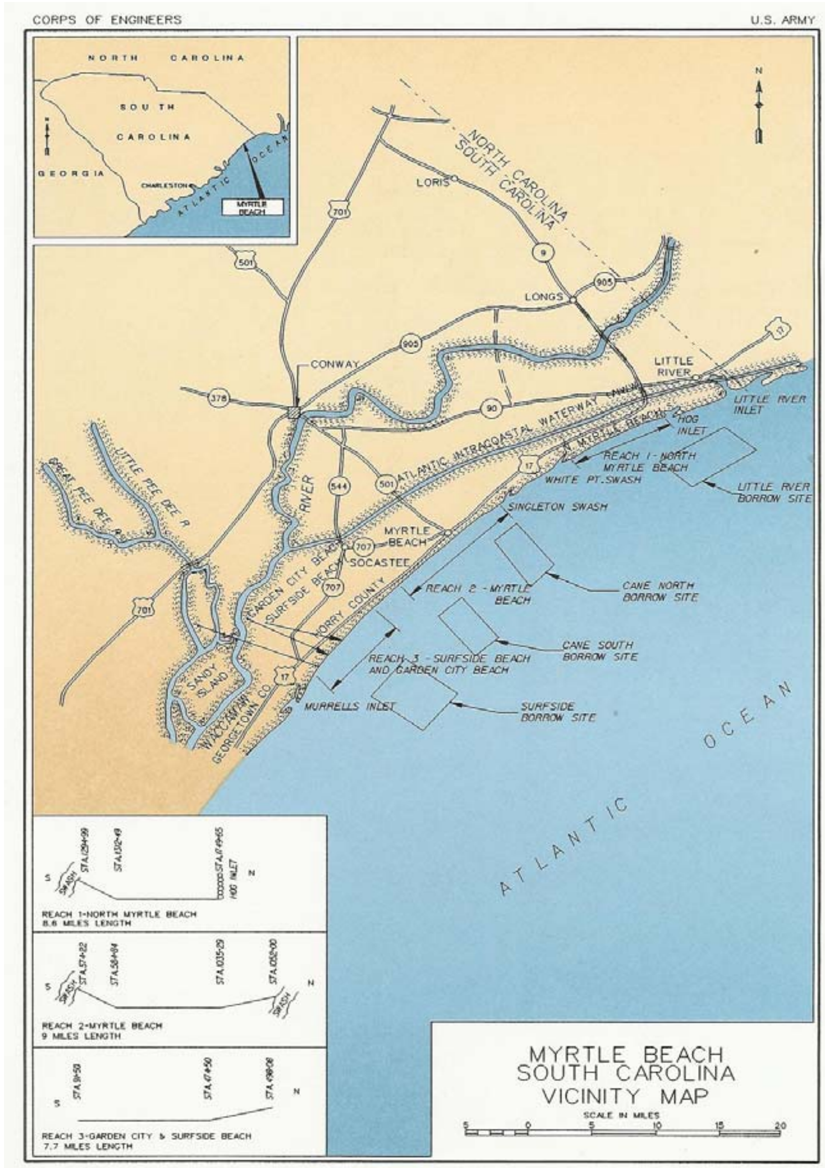

Figure 1. Myrtle Beach Storm Damage Reduction Project Reaches and Borrow Areas

Initial construction of North Myrtle Beach (Reach 1) was completed in May 1997. Initial placement consisted of 57.7 cubic yards per linear foot along 8.6 miles of beach. This quantity includes material for the protective berm, advanced nourishment and overfill ratio, for a total placement of 2,622,900 cubic yards. Future re-nourishment of 490,000 cubic yards was planned for every ten years. Initial construction of Myrtle Beach (Reach 2) was completed in December 1997. Initial placement consisted of 47.1 cubic yards per linear foot along 9.0 miles of beach. This quantity includes material for the protective berm, advanced nourishment and overfill ratio, for a total placement of 2,250,000 cubic yards. Future re-nourishment of 440,000 cubic yards was planned for every eight years with the final nourishment being 550,000 cubic yards for the last ten years of the project life. Initial construction of Surfside/Garden City Beach (Reach 3) was completed in November 1998, with approximately 1,517,494 cubic yards of sand was placed along 7.7 miles of beach in Horry and Georgetown Counties extending from 1.2 miles south of the Horry/Georgetown County line to Myrtle Beach State Park in Horry County. Future re-nourishment of 360,000 cubic yards was planned for every eight years with the final nourishment being 450,000 cubic yards for the last ten years of the project life.

Along with long term coastal erosion processes, the 2005 hurricane season resulted in significant coastal erosion. As a result of erosion caused by Hurricane Ophelia, the Grand Strand Storm Damage Reduction project qualified for restoration under the authority of Public Law 84-99. In 2007/2008 approximately 902,725 yards (Reach 1), 1,497.975 yards (Reach 2), and 857,633 yards (Reach 3) of Federal outer continental shelf (OCS) sand from Little River, Cane South, and Surfside borrow areas, respectively, was used to re-nourish 25.3 miles of shoreline along the Grand Strand. Material was excavated from borrow areas located within the OCS and therefore the Bureau of Ocean Energy Management (BOEM) was a partner on the project. Section 8(k) of the Outer Continental Shelf Lands Act (OCSLA) grants BOEM the authority to convey, on a noncompetitive basis, the rights to OCS sand, gravel, or shell resources for shore protection, beach or wetlands restoration, or for use in construction projects funded in whole or part or authorized by the federal government. In July 2007, BOEM issued USACE a noncompetitive lease for extraction of marine minerals from the Little River, Cane South, and Surfside Borrow Areas.

The project's trigger point for re-nourishment is when 25% of the project length has storm berm width less than 25%. Recent monitoring reports from the respective Sponsors show the reaches have varied success. For the 2015 Sponsor Monitoring Reports, 36 of the 42 monitored transects in Reach 1 (the City of North Myrtle Beach) had met the re-nourishment trigger (88% of the Reach length). In contrast Reach 2 (the City of Myrtle Beach), had no monitoring locations that approached the trigger point. The average berm width for this Reach was 69.6 feet, with only 875 feet of project (approximately 2%) meeting the trigger point. (This was limited to the Withers Swash area.) This reach has lost approximately 15% of the material placed during the last re-nourishment. With respect to Reach 3, 17 of the 29 monitored stations (approximately 59%) reached or exceeded the re-nourishment trigger point (60% of the Reach length) (Table 1). Despite the resiliency of Reach 2, when all three reaches are combined, the Project has met its official trigger point for re-nourishment, as shown in the table below. This project was first operational in 1998 (base year). As a result, the remaining project life is now 32 years. For the current project, funding is only available for Reach 3 (Garden City/Surfside Beach).

Table 1. Project Reach Lengths Met or Exceeded Re-nourishment Point

Reach	Reach Length (lf)	Reach Length Meeting Trigger Point (lf)
Reach 3	40,656	24,000

2.0 PROPOSED PROJECT

The Myrtle Beach project consists of three separable reaches which have previously been constructed simultaneously at each nourishment project. Currently, funding is only available for Reach 3, Garden City/Surfside, and therefore, this Biological Assessment will only evaluate the effects related to Reach 3 of the Myrtle Beach Storm Damage Reduction Project.

The proposed project at Reach 3 consists of a protective storm berm and an advanced nourishment construction berm. The protective storm berm reduces damages which will occur during severe storm events. The advanced nourishment berm acts as a buffer for the protective storm berm against long term erosional forces. The protective storm berm has a top elevation of 6.0 NAVD 88 and a crest width of 10 feet. The fore slope of the protective berm is 1 vertical to 20 horizontal down to natural ground. The advance nourishment berm sits adjacent the protective storm berm. The advance nourishment berm has a top elevation of 6.0 NAVD 88. The fore slope of the advance nourishment is 1 vertical to 5 horizontal down to elevation 2.0 NAVD 88 then a fore slope of 1 vertical to 20 horizontal down to the bottom. At each location, the plan includes dune grass and dune fencing. Where possible, USACE would like to plant seabeach amaranth as a small component of the dune grass planting. The length of the dune and beachfill for the project is approximately 40,300 feet.

The project is anticipated to be constructed with a hopper dredge, booster pump, and land based heavy equipment (i.e. bulldozers and front-end loaders); however, the use of a cutterhead dredge remains a possibility. Monitoring of project impacts performed by SCDNR and CCU have previously recommended the continued use of a hopper dredge of borrow areas associated with the Myrtle Beach project to minimize benthic impacts and foster quicker benthic recovery.

The borrow area for Reach 3 was identified in the March 1993 General Design Memorandum for the project as the Surfside Borrow Area (Figure 2). Portions of it have been used in the past for the 1998 and 2007/2008 nourishment projects. The area extends from 2 to 5 miles offshore and comprises approximately 6.0 square miles. The site is generally featureless and data indicates that it is relatively homogenous and sandy. This borrow area will serve as the source of sand for the current project. The mean phi size of the material in the borrow area is 1.77; the percent passing the #200 sieve is 5.1%; and the average usable depth is 4.5'.

Figure 2 shows the areas within the overall borrow area that dredged material was removed for placement along Reach 3 in 1998 and 2007/2008. In 2005, borrow area investigations determined that the Surfside borrow area contained at least 15.2 million cubic yards of beach compatible material. The 2007/2008 renourishment project borrowed 857,633 cy from the borrow area. Based on the volume calculations from 2007, there is sufficient quantity of material within the site to complete the proposed renourishment of Reach 3. The dredge will remove the sand to a depth not to exceed ten feet within the borrow areas. The borrow area will be divided into dredging zones and the contract specifications will require the contractor remove material completely from one borrow zone prior to moving to another borrow zone.

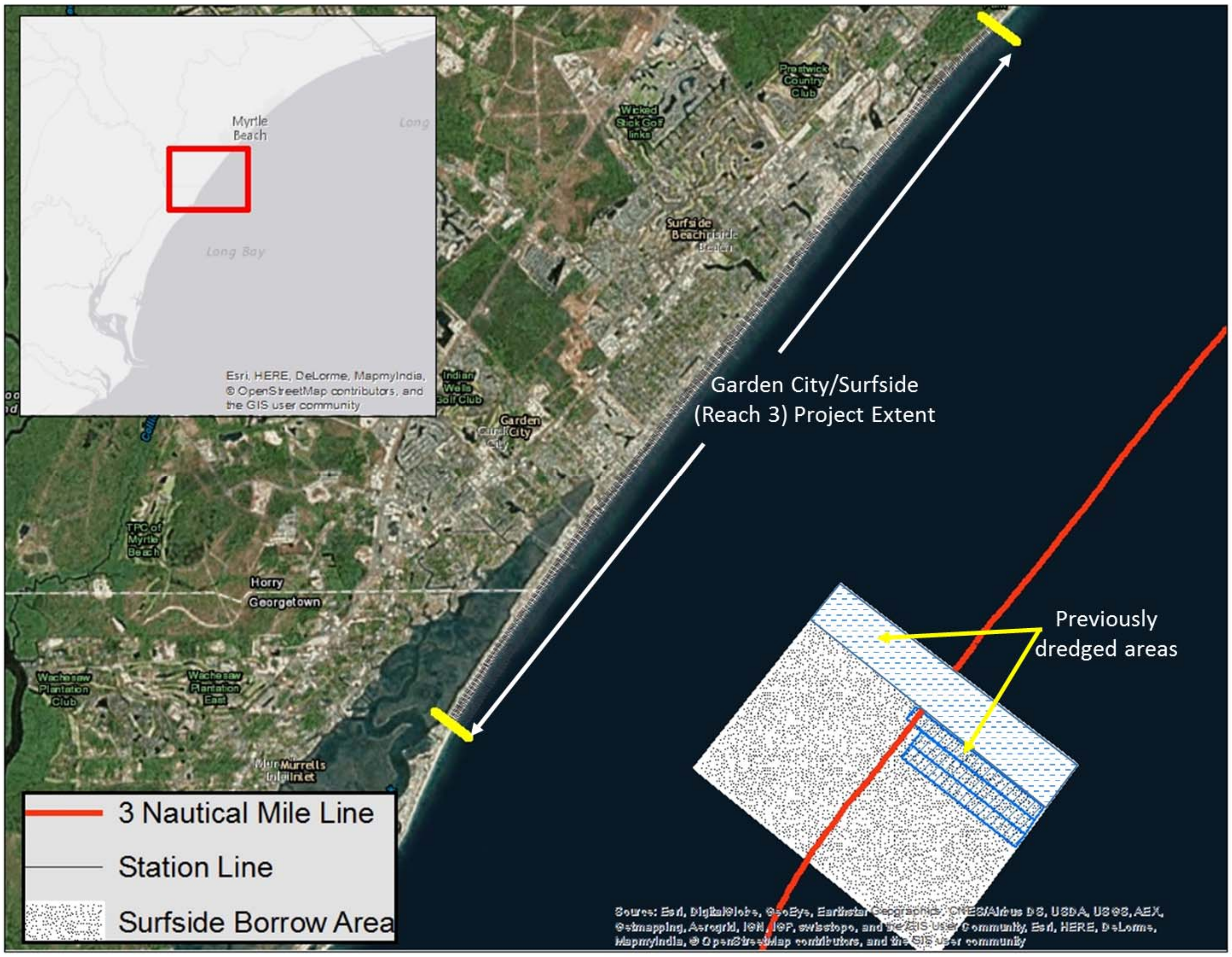

Figure 2. Garden City/Surfside (Reach 3) Project Extent and Surfside Borrow Area

Bathymetric monitoring associated with the 2007 renourishment indicated that the borrow area used in 2007 accreted approximately 452,660 CY within 1 year post-construction (Figure 3). SCDNR performed monitoring of the physical characteristics of the infill following construction. While the Surfside borrow area was not specifically monitored, results from Little River and Cane South borrow areas indicate that beach compatible material (e.g., < 10% fines) was accreting. These data indicate that the previously dredged portion of the borrow area may have recharged with beach compatible material and may be able to be used again. While the historic data indicate that the borrow area has sufficient quantity for this periodic nourishment effort, detailed borrow area investigations are ongoing to determine if previously dredged areas have recharged with beach compatible material. Figure 4 shows the locations of the 2006 vibracores that were performed as well as the locations of the 2016 targets. The ongoing geotechnical refinements include both bathymetric surveys and vibracores to determine the amount and quality of the material. The intent of this effort is to maximize the most efficient use of the borrow area for the continued longevity of the project. If suitable material is not located in previously dredge areas, undredged portions of the larger identified borrow area with known beach compatible material will be used. This information will be shared with resource agencies prior to construction.

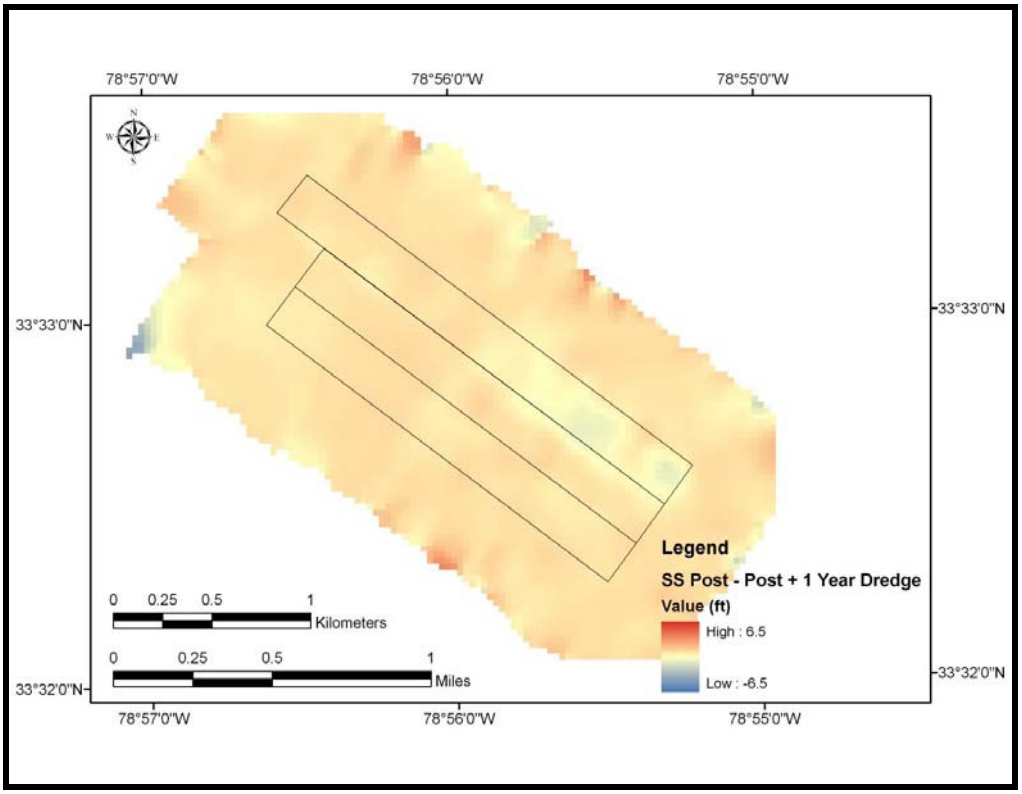

Figure 3. Surfside borrow area post dredging +1 year change map (CCU 2009)

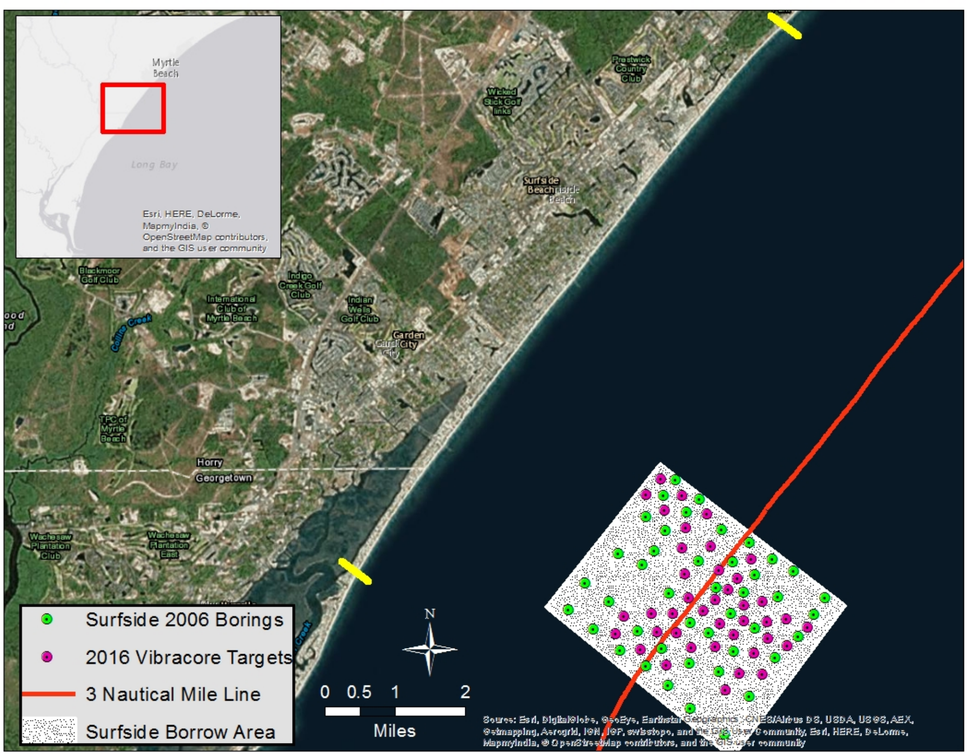

Figure 4. Vibracore Locations in Surfside Borrow Area

The beach renourishment is anticipated to start in the winter of 2016/2017 and continue 24 hours per day, 7 days per week for a period of approximately 4-5 months including mobilization.

Sand fencing will be placed along the landward edge of the nourishment fill to promote dune growth (Figure 5). Native vegetation will be planted to further expedite dune formation and stabilization, as well as creating beach dune habitat. Fencing will be installed according to sea turtle friendly design standards included in OCRM's "How to Build a Dune" brochure. Similar sand fencing was completed in the 1998 project and the 2007/2008 project. Work is expected only during daylight hours and limited amount of equipment such as small backhoes and tractors is expected to be used on the beach. Sand fencing will be the Corps' Charleston District standard design with 5.5' spacing between panels. The planting matrix will consist of the following plants: bitter panicum (*Panicum amarum "Northpa"*), sea oats (*Uniola paniulata*), seashore elder (*Iva imbricate*), and saltmeadow cordgrass (*Spartina patens*). Sweet grass (*Muhlenbergia "filipes")* will be planted on the toe of the backside of the dune system. The plants will be space 2 feet on center, and rows will be spaced at 2 to 4 feet depending on which plant species is in the row. Fertilizer will be placed in the hole at the time of planting. As stated earlier, USACE would like to plant seabeach amaranth as a small component of the planting matrix since it is within the historic range of the plant.

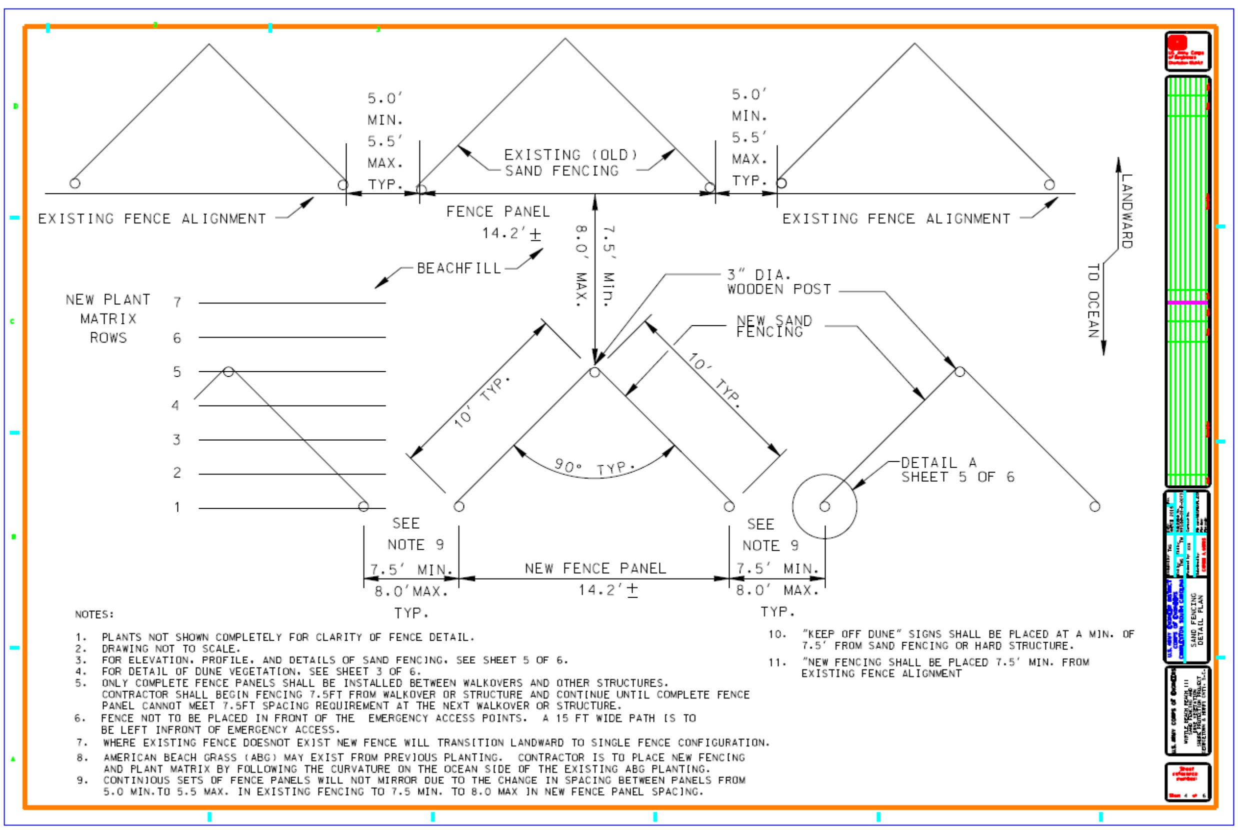

Figure 5. Sand Fencing Typical Design

This project will protect infrastructure and will restore and preserve dry sand and dune habitat used by shorebirds and endangered species, such as nesting sea turtles. Impacts of beach nourishment projects are relatively well understood and when designed properly the impacts are limited to a minimal temporal and spatial extent.

3.0 PRIOR CONSULTATIONS

Formal Section 7 consultation was conducted in 1992 regarding the Myrtle Beach project. The conclusion of the biological opinion rendered by the U.S. Fish and Wildlife Service (FWS) at that time determined that the nourishment, as proposed, had the potential to effect but was not likely to jeopardize the continued existence of the loggerhead sea turtle (*Caretta caretta*). The conclusion of the Biological Opinion rendered by the FWS was that the dredging project was not likely to adversely affect sea-beach amaranth (*Amaranthus pumilus*). For the 2007/2008 project, USACE submitted another Biological Assessment to the USFWS requesting formal consultation for impacts to sea turtles. The USFWS submitted a Biological Opinion (BiOp) on January 19, 2007. The BiOp determined that the following species were not likely to be adversely affected: sea-beach amaranth, piping plover, West Indian manatee, Kemp's ridley sea turtle, and hawksbill sea turtle. The USFWS concluded that the project was not likely to jeopardize the continued existence of the loggerhead, green, or leatherback sea turtles. The USFWS submitted several Terms and Conditions for USACE to adhere to.

4.0 LIST OF SPECIES

4.1 U.S. Department of Interior

The following species have been listed by the U.S. Department of Interior as occurring or possibly occurring along beaches in Georgetown or Horry County, South Carolina.

Key

E = Federally endangered

T = Federally threatened

CH = Critical Habitat

* = Contact NMFS for more information on this species

Common Name	Scientific Name	Status	Occurrences
West Indian manatee	*Trichechus manutus*	E	Known
Piping plover	*Charadrius melodus*	T, CH	Known
Kemp's ridley sea turtle	*Lepidochelys kempii**	E	Known
Leatherback sea turtle	*Dermochelys coriacea**	E	Known
Loggerhead sea turtle	*Caretta caretta*	T, CH	Known
Green sea turtle	*Chelonia mydas**	T	Known
Shortnose sturgeon	*Acipenser brevirostrum**	E	Known

Atlantic sturgeon	*Acipenser oxyrhynchus oxyrhynchus**	E	Known
Sea-beach amaranth	*Amaranthus pumilus*	T	Known

4.2 The National Marine Fisheries Service

The following list shows the threatened (T) and endangered (E) species and critical habitats for NMFS species found in South Carolina waters. All in-water work is covered under the existing regional Biological Opinion (NMFS, 1997) and the ongoing consultation between USAC, BOEM and NMFS for a new South Atlantic Regional Biological Opinion.

Listed Species

Common Name	Scientific Name	Status	Date Listed
Marine Mammals			
Blue whale	*Balaenoptera musculus*	E	12/02/70
Finback whale	*Balaenoptera physalus*	E	12/02/70
Humpback whale	*Megaptera novaeangliae*	E	12/02/70
Right whale	*Eubaleana glacialis*	E, CH	12/02/70
Sei whale	*Balaenotera borealis*	E	12/02/70
Sperm whale	*Physeter macrocephalus*	E	12/02/70
Turtles			
Green sea turtle	*Chelonia mydas*	T*	07/28/78
Hawksbill sea turtle	*Eretmochelys imbricata*	E	06/02/70
Kemp's ridley sea turtle	*Lepidochelys kempii*	E	12/02/70
Leatherback sea turtle	*Dermochelys coriacea*	E	06/02/70
Loggerhead sea turtle	*Caretta caretta*	T, CH	07/28/78
Fish			
Shortnose sturgeon	*Acipenser brevirostrum*	E	03/11/67
Atlantic sturgeon	*Acipenser oxyrhynchus oxyrhynchus*	E	02/06/12

Species Proposed for Listing: None

Designated Critical Habitat: North Atlantic Right Whale, Loggerhead Sea Turtle

Proposed Critical Habitat: None

Candidate Species: None

5.0 GENERAL EFFECTS ON LISTED SPECIES/CRITICAL HABITAT

Since all aspects of the proposed work will occur on the ocean beach or on a marine shoal, the project will not affect any listed species occurring in forested or freshwater habitats. Thus, the bald eagle, red-cockaded woodpecker, wood stork, Canby's dropwort, Pondberry, chaff-seed will not be affected by this construction effort.

Species that could be present in the project area during the proposed action are the shortnose and Atlantic sturgeons, and the hawksbill, Kemp's ridley, leatherback, loggerhead, and green sea turtles. However, loggerheads are the primary sea turtle nesters in this area. The West Indian manatee rarely visits the area; however, some sightings have been recorded over the years. The piping plover winters in this area and critical habitat has been designated south of the project area at Murrell's Inlet. Further, there are no known populations of sea-beach amaranth in the project area; however, the project footprint is within the historic range of the plant. On the open ocean, the blue, finback, humpback, right, sei and sperm whales are occasionally sited and are subject to influence by vessel traffic.

6.0 SPECIES ASSESSMENTS

6.1 Manatee

West Indian manatees are massive fusiform-shaped animals with skin that is uniformly dark grey, wrinkled, sparsely haired, and rubber-like. Manatees possess paddle-like forelimbs, no hind limbs, and a spatulate, horizontally flattened tail. Females have two axillary mammae, one at the base of each forelimb. Adults are about 10 feet in length and weigh 800-1200 pounds (USFWS, 2010). Newborns average 4 to 4½ feet in length and about 66 pounds (Odell 1981).

The West Indian manatee (*Trichechus manatus*) was listed as endangered on March 11, 1967, under a law that preceded the Endangered Species Act of 1973, as amended (16 USC 1531 et seq.). Additional Federal protection is provided for this species under the Marine Mammal Protection Act of 1972, as amended (16 USC 1461 et seq.). The manatee population in the United States is confined during the winter months to the coastal waters of the southern half of peninsular Florida and to springs and warm water outfalls as far north as southeast Georgia (USFWS, 1996). However, during the summer months, they may migrate as far north as coastal Virginia on the East Coast and as far west as Louisiana on the Gulf of Mexico (USFWS, 1991).

a. Status. Endangered

b. Occurrence in Immediate Project Vicinity. SC DNR indicates that manatees have been observed in SC since 1850. From 1850-2004 there have been 1117 records of manatees were documented in SC. These data suggest that manatees are infrequent visitors in SC (http://www.dnr.sc.gov/manatee/dist.html, Figure 6). However, in 2012, the SCDNR online reporting system noted that manatee sightings were reported beginning in April and lasting until October. In 2014, the USFWS recorded 4 sightings of manatees in Georgetown County and 8 in Horry County (Mark Caldwell, USFWS personal communication). There is no designation of critical habitat for the West Indian manatee in SC.

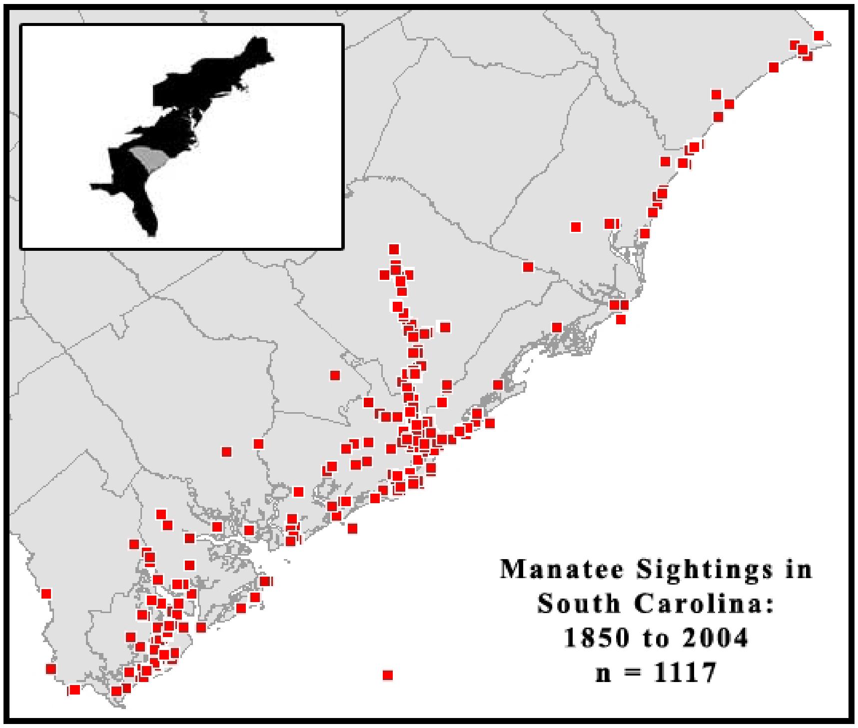

Figure 6. Manatee Sightings in SC 1850 to 2004

c. Project Impacts.

(1) Habitat. Typical coastal habitats utilized by manatees which are found within South Carolina include coastal tidal rivers, salt marshes, and vegetated bottoms where they feed on the aquatic vegetation and, in some cases, smooth cordgrass (*Spartina alterniflora*) (USFWS 2007). Project related impacts to estuarine and nearshore ocean habitat of the area associated with the placement of sediment on the beach should be minor and direct impacts to specific habitat requirements will be avoided.

(2) Food Supply. Specific food sources utilized by the manatee in South Carolina are unknown; however, the manatee diet in Florida consists primarily of vascular plants and is likely the same in South Carolina, including aquatic vegetation and salt marsh grasses. The proposed action will involve negligible change to the physical habitat of the beach and nearshore environment with no known impacts to aquatic vascular plants and overall estuarine and nearshore productivity should remain high throughout the project area. Therefore, potential food sources for the manatee should be unaffected.

(3) Relationship to Critical Periods in Life Cycle. Since the manatee is considered to be an infrequent summer resident of the South Carolina coast, the proposed action should have little effect on the manatee since its habitat and food supply will not be significantly impacted. The Corps will implement precautionary measures for avoiding impacts to manatees from associated transiting vessels during construction activities, as detailed in the "Guidelines for Avoiding Impacts to the West Indian Manatee" established by the USFWS.

(4) Effect Determination. Since the habitat and food supply of the manatee will not be significantly impacted, overall occurrence of manatees in the project vicinity is infrequent, all dredging will occur in the offshore environment, and precautionary measures for avoiding impacts to manatees, as established by USFWS, will be implemented for transiting vessels associated with the project, the proposed action is **not likely to adversely affect the west Indian manatee**. To ensure the protection of manatees, all Federal and contract personnel associated with this project will be instructed on the potential presence of manatees and the need to avoid vessel or plant collisions with manatees. Construction that takes place in the warmer months will abide by the *Standard Manatee Construction Conditions* (FL Fish and Wildlife Commission 2005).

6.2 Kemp's ridley, leatherback, loggerhead, green, and hawksbill sea turtles

a. Status. There are five species of sea turtles on the Atlantic Coast, Kemp's ridley sea turtle (*Lepidochelys kempii*), Leatherback sea turtle (*Dermochelys coriacea*), Loggerhead sea turtle (*Caretta caretta*), Green sea turtle (*Chelonia mydas)*, and the Hawksbill sea turtle (*Eretmochelys imbricata*). These five species of sea turtles are protected by the Convention on International Trade in Endangered Species (CITES). They are also listed as endangered or vulnerable in the Red Data Book by the International Union for the Conservation of Nature (IUCN). The hawksbill, Kemp's ridley and leatherback were listed as endangered by the U. S. Endangered Species Act in 1973. The green turtle and the loggerhead were added to the list as threatened in 1978. A final rule to establish 9 Distinct Population Segments for the loggerhead sea turtle was established in 2001 (76 FR 58868). The Northwest Atlantic Ocean DPS is within the range of the proposed project.

b. Critical Habitat. The USFWS has designated critical habitat for nesting loggerheads in South Carolina (Federal Register/ Vol. 79, No. 132. July 10, 2014). There is no designated critical habitat in the project vicinity. The closest designated habitat is LOGG-T-SC-01 "North Island" which is approximately 18 miles south of the project area. NMFS designated critical habitat for the loggerhead sea turtle in a final ruling on July 10, 2014 (FR Vol. 79, No. 132). This ruling established critical habitat for 5 habitat types based on their Physical or Biological Features (PBFs) and the Primary Constituent Elements (PCEs) that support the PBFs: nearshore reproductive, overwintering, breeding, migratory, and sargassum. None of these habitat types are located in or near the project area.

c. Background. Sea turtles vary in size from an average of 75 pounds for the olive ridley (does not occur in the project area) to the giant leatherback, which may exceed 800 pounds. Modified for living in the open ocean, they have paddle-like front limbs for swimming. The thick neck and head cannot be drawn back into the body. Sea turtles also have special respiratory mechanisms and organs to excrete excess salt taken in with seawater when they feed.

Detailed life history information associated with the in-water life cycle requirements for sea turtles and a subsequent analysis of impacts from the proposed dredging activities is provided within the following NMFS Section 7 consultation document:

National Marine Fisheries Service. 1997. Regional Biological Opinion for the Continued Hopper Dredging of Channels and Borrow Areas in the Southeastern

United States. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Silver Spring, Maryland

d. Occurrence in Immediate Project Vicinity. Of the five listed species of sea turtles, only the loggerhead is considered to be a regular nester in SC. However, in September 1996, a green sea turtle nested on Garden City Beach and another also nested on Garden City Beach in September 2002. Leatherback nests were recorded on Huntington Beach State Park in 2000, at Botany Bay in June 2003, on Folly Beach in July 2003, and on Edisto Beach in 2009. During the last renourishment project in 2007 and 2008, USACE implemented a monitoring program for sea turtle nesting activity at the Myrtle Beach and North Myrtle Beach Reaches of the overall project. Garden City/Surfside was not monitored because nourishment took place in the winter at that Reach. A total of 21 nests (all loggerheads) were found, 16 in Myrtle Beach and 5 in North Myrtle Beach. Nests in Myrtle Beach were relocated to Myrtle Beach State Park and nests from North Myrtle Beach were relocated to Waites Island. Nests from Myrtle Beach and North Myrtle Beach had an average hatch success rate of 79% and 38%, respectively. The success rate from North Myrtle Beach was skewed from the fact that 3 of the 5 nests were washed away during erosion from Tropical Storm Hanna that heavily impacted Waites Island (0% success). Grand and Beissinger (1997) found that the average in situ hatch success in South Carolina is 72.3%. Excluding the three nests that were damaged from erosion, both project reaches exceeded the average hatch success rate.

Figure 7 and Table 2 show the history of sea turtle nesting at Garden City and Surfside Beaches over the last 7 years (SCDNR unpublished data).

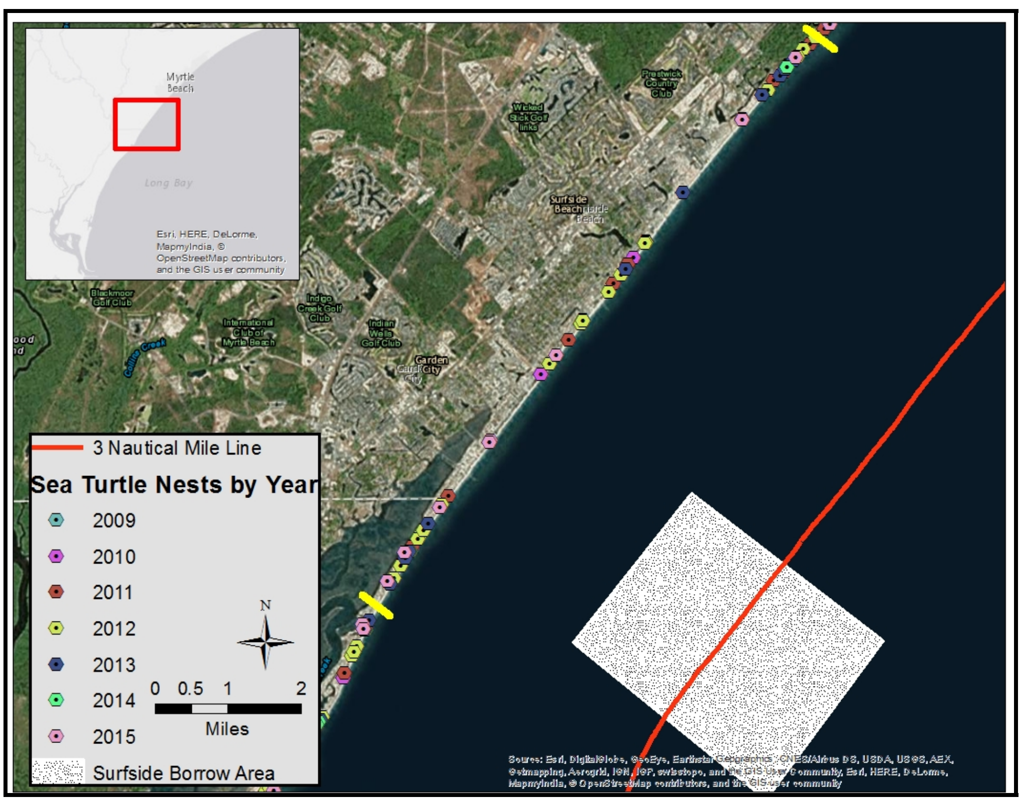

Figure 7. Garden City/Surfside Beach and sea turtle nesting locations (2007-2015)

Table 2. Turtle nesting in Garden City and Surfside Beaches from 2009 through 2015

Year	Project Beach	Observed Nests	False Crawls
2009	Garden City	0	0
2010	Garden City	5	2
2011	Garden City	6	4
2012	Garden City	16	4
2013	Garden City	10	6
2014	Garden City	6	11
2015	Garden City	7	1
2009	Surfside	1	0
2010	Surfside	2	0
2011	Surfside	5	3
2012	Surfside	7	2
2013	Surfside	1	1
2014	Surfside	0	0
2015	Surfside	1	0

The 2007 Biological Opinion was issued for loggerhead, green and leatherback sea turtles. USFWS used historic nesting data as an estimate of the number of nests that could be affected by the project. The following table was provided to show the average number of nests that could be taken (Table 2).

Table 2. Average Number of Sea Turtle Nests that could be taken (USFWS 2007 Myrtle Beach BiOp)

SPECIES	NESTS*	TAKE TYPE	CRITICAL HABITAT AFFECTED
loggerhead sea turtle	12.94	harm/harassment	none
green sea turtle	0.29	harm/harassment	none
leatherback sea turtle	0	none	none

SCDNR data over the last several years has shown that green sea turtles are nesting along these beaches every other year. For the Garden City/Surfside proposed project, it appears like the average nesting rate is higher for green sea turtles and is approximately 2 nests per year for this reach, while the number of nesting loggerheads per year is approximately 7.14. The average nesting density over the last 7 years has been 0.81 nests/mile/year. No leatherbacks were observed nesting along Garden City or Surfside Beaches over the last 7 years.

Table 2. Turtle nesting by Species at Garden City and Surfside Beaches from 2009 through 2015

Beach	Year	Species	Number of Nests	False Crawls
Garden City	2009	Loggerhead	0	0
		Green	0	0
	2010	Loggerhead	1	0
		Green	4	2
	2011	Loggerhead	6	4
		Green	0	0
	2012	Loggerhead	11	2
		Green	5	2
	2013	Loggerhead	10	6
		Green	0	0
	2014	Loggerhead	0	0
		Green	6	11
	2015	Loggerhead	6	1
		Green	1	0
Surfside	2009	Loggerhead	1	1
		Green	0	0
	2010	Loggerhead	1	0
		Green	1	0
	2011	Loggerhead	5	2
		Green	0	0
	2012	Loggerhead	7	0
		Green	0	0
	2013	Loggerhead	1	1
		Green	0	0
	2014	Loggerhead	0	0
		Green	0	0
	2015	Loggerhead	1	0
		Green	0	0

e. Current Threats to Continued Use of the Area. In addition to affecting the coastal human population, coastal sediment loss also poses a threat to nesting sea turtles. A large percentage of sea turtles in the United States nest on nourished beaches (Nelson and Dickerson 1988a), therefore, nourishment has become an important technique for nesting beach restoration (Crain *et al.* 1995). Most of the project area has experienced consistent erosion over the last decades.

The primary threats facing these species worldwide are the same ones facing them in the project area. Of these threats, the most serious seem to be loss of breeding females through accidental drowning by shrimpers (Crouse, *et al.* 1987) and human encroachment on traditional nesting beaches. Research has shown that the turtle populations have greatly declined in the last 20 years due to a loss of nesting habitat along the beachfront and by incidental drowning in shrimp trawl nets. It appears that the combination of poorly placed nests coupled with unrestrained human use of the beach by auto and foot traffic has impacted this species greatly. Other threats to these sea turtles include excessive natural predation in some areas and potential interactions with hopper dredges during the excavation of dredged material. With the exception of hopper dredges, none of the dredge plants (i.e., pipeline dredges) proposed for potential use in the construction of this project are known to take sea turtles.

f. Project Impacts. The areas of affected environment for this proposed project are the borrow area (an approximately 6 mi2 site and located between 2 and 5 miles offshore) (see Figure 2) and the placement of approximately 1.7 million cubic yards of sand along 40,656 feet of beach along Garden City and Surfside Beaches (see Figure 2). This sand placement will result in an increase in the size of the dry beach, conversion of existing intertidal beach to dry beach and shifting the intertidal zone seaward from its existing location, and conversion of some subtidal beach to intertidal beach and shifting the subtidal zone seaward from its existing location.

In order to avoid periods of peak sea turtle abundance during warm water months and minimize impacts to sea turtles in the offshore environment, beach placement of sediment will be targeted to occur outside of the South Carolina sea turtle nesting season of 1 May through 31 October, where practicable. The South Atlantic Regional Biological Opinion (SARBO) authorizes year round hopper dredging at borrow areas in South Carolina. However, the Charleston District will attempt to complete the project within the winter months to avoid impacts to nesting turtles and minimize impacts to turtles in the offshore environment. This assessment only analyzes impacts to nesting sea turtles. Offshore impacts to turtles are covered in the SARBO.

In the event that construction activities extend into the nesting season (i.e. weather, equipment breakdown, logistics, etc.), all available data associated with the nesting activities within the project area will be utilized to consider risks of working within the nesting season. Upon evaluation of site-specific conditions, if nourishment beach activities extend into a portion of the nesting season, monitoring for sea turtle nesting activity will be considered throughout the construction area including the disposal area and beachfront pipeline routes so that nests laid in a potential construction zone can be bypassed and/or relocated outside of the construction zone prior to project commencement. The location and operation of heavy equipment on the beach within the project area will be limited to daylight hours to the maximum extent practicable in order to minimize impacts to nesting sea turtles.

(1) Beach Placement. Post-nourishment monitoring efforts have documented potential impacts on nesting loggerhead sea turtles for many years (Fletemeyer 1984; Raymond 1984; Nelson and Dickerson 1989; Ryder 1993; Bagley *et al*. 1994; Crain *et al*. 1995; Milton *et al*. 1997; Steinitz *et al.* 1998; Trindell *et al*. 1998; Davis *et al*. 1999; Ecological Associates, Inc. 1999; Herren 1999; Rumbold *et al*. 2001; Brock 2005; and Brock *et al.* 2009). Results from these studies indicate that, in most cases, nesting success decreases during the year following nourishment as a result of escarpments obstructing beach

accessibility, altered beach profiles, and increased compaction. A comprehensive post-nourishment study conducted by Ernest and Martin (1999) documented an increase in abandoned nest attempts on nourished beaches compared to control or pre-nourished beaches as well as a change in nest placement with subsequent increase in wash-out of nests during the beach equilibration process.

As suggested by the historical literature, there are inherent changes in beach characteristics as a result of mechanically placing sediment on a beach from alternate sources. The change in beach characteristics often results in short-term decreases in nest success and/or alterations in nesting processes. However, when done properly, beach construction projects may mitigate the loss of nesting beach when the alternative is severely degraded or non-existent habitat (Brock et al. 2009). This section of the South Carolina coast is a relatively low density nesting area. As stated earlier, the nesting density from 2007-2015 in Reach 3 was 0.81 nests/mile/year. At the south end of Garden City Beach (near Murrells Inlet) the nesting density has still only been 1.71 nests/mile/year (SCDNR unpublished data).

i. <u>Pipe Placement</u>. In the event that construction operations extend into the sea turtle nesting season pipeline routes and pipe staging areas may act as an impediment to nesting females approaching available nesting habitat or to hatchlings orienting to the water's edge. If the pipeline route or staging areas extend along the beach face, including the frontal dune, beach berm, mean high water line, etc., some portion of the available nesting habitat will be blocked. Nesting females may either encounter the pipe and false crawl, or nest in front of the pipeline in a potentially vulnerable area to heavy equipment operation, erosion, and washover. If nests are laid prior to placement of pipe and are landward of the pipeline, hatchlings may be blocked or mis-oriented during their approach to the water.

Though pipeline alignments and staging areas may pose impacts to nesting females and hatchlings during the nesting season, several measures can be implemented to minimize these impacts. If construction activities extend into the nesting season, monitoring will be done in advance to document all nests within the beach placement template. Construction operations and pipeline placement could be modified to bypass existing nests. If bypassing is not a practical alternative for a given project, the relocation of nests outside of construction areas would be implemented. Throughout the period of sea turtle nesting and hatching, construction pipe that is placed on the beach parallel to the shoreline should be placed as far landward as possible so that a significant portion of available nesting habitat can be utilized and nest placement is not subject to inundation or wash out. Furthermore, temporary storage of pipes and equipment can be located off the beach to the maximum extent practicable. If placement on the beach is necessary, it will be done in a manner so as to impact the least amount of nesting habitat by placing pipes perpendicular to shore and as far landward as possible without compromising the integrity of the existing or constructed dune system.

ii. <u>Slope and escarpments</u>. Beach nourishment projects are designed and constructed to equilibrate to a more natural profile over time relative to the wave climate of a given area. Changes in beach slope as well as the development of steep escarpments may develop along the mean high water line as the constructed beach adjusts from a construction profile to a natural beach profile (Nelson *et al.* 1987). Though escarpment formation is a natural response to shoreline erosion, the escarpment formation as a result of the equilibration process during a short period following a nourishment event may have a steeper and higher vertical face than natural escarpment formation and may slough off more rapidly landward.

Though the equilibration process and subsequent escarpment formation are features of most beach projects, management techniques can be implemented to reduce the impact of escarpment formations. For completed sections of beach during beach construction operations, and for subsequent months following as the construction profile approaches a more natural profile, visual surveys for escarpments and slope adjustments could be performed. Escarpments that are identified prior to or during the nesting season that interfere with sea turtle nesting (exceed 18 inches in height for a distance of 100 ft.) can be leveled to the natural beach for a given area. If it is determined that escarpment leveling is required during the nesting or hatching season, leveling actions will be coordinated with the project sponsor.

iii. Incubation Environment. Physical changes in sediment properties that result from the placement of sediment, from alternate sources, on the beach pose concerns for nesting sea turtles and subsequent nest success. Nesting can be affected by insufficient oxygen diffusion and variability in moisture contenct levels within the egg clutch. Additionally, nest temperature can affect the sex ratio of developing turtles. Eggs incubated at constant temperatures of 28°C or below develop into males. Those kept at 32°C or above develop into females. Therefore, the pivotal temperature, those giving approximately equal numbers of males and females, is approximately 30°C (Yntema and Mrosovsky 1982). Matching borrow site sands with the native beach sands is extremely important to maintain consistency. As addressed previously, the borrow site sand and native beach sands have historically been shown to be compatible. USACE is evaluating specific areas within the borrow site for dredging and will share this information with resource agencies, including USFWS, when available. Only beach compatible sands will be used.

iv. Lighting. Artificial beachfront lighting from buildings, streetlights, dune crossovers, vehicles and other types of beachfront lights has been documented in the disorientation (loss of bearings) and misorientation (incorrect orientation) of hatchling turtles. Artificial lighting on beaches also tends to deter sea turtles from emerging from the sea to nest; thus, evidence of lighting impacts on nesting females is not likely to be revealed by nest to false crawl ratios considering that no emergence may occur (Mattison *et al*. 1993; Witherington 1992; Raymond 1984). The presence of artificial lighting on or within the vicinity of nesting beaches is detrimental to critical behavioral aspects of the nesting process including nesting female emergence, nest site selection, and the nocturnal sea-finding behavior of both hatchlings and nesting females. The impact of light on nesting females and hatchlings can be minimized by reducing the number and wattage of light sources or by modifying the direction of light sources through shielding, redirection, elevation modifications, etc. (Figure 8). If shielding of light sources is not effective, it is important that any light reaching the beach has spectral properties that are minimally disruptive to sea turtles like long wavelength light. The spectral properties of low-pressure sodium vapor lighting are the least disruptive to sea turtles among other commercially available light sources.

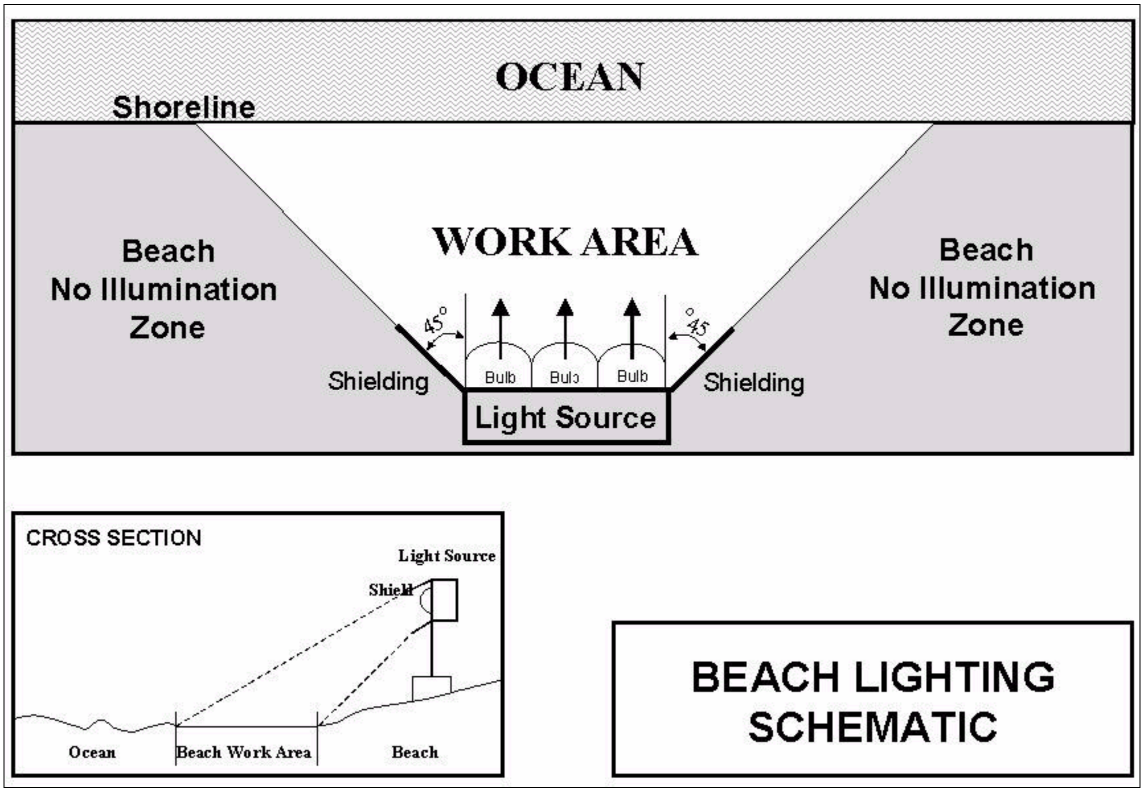

Figure 8. Beach lighting schematic

During beach placement construction operations associated with the proposed project, lighting is required during nighttime activities at both the hopper dredge pumpout site and the location on the beach where sediment is being placed. In compliance with the US Army Corps of Engineers Safety and Health Requirements Manual (2008), a minimum luminance of 30 lm/ft2 is required for dredge operations and a minimum of 3 lm/ft2 is required for construction activities on the beach. For dredging vessels, appropriate lighting is necessary to provide a safe working environment during nighttime activities on deck (i.e. general maintenance work deck, endangered species observers, etc.). During beach construction operations, lighting is generally associated with the active construction zone around outflow pipe and the use of heavy equipment in the construction zone (i.e. bulldozers) in order to maintain safe construction operations at night.

USFWS has expressed concerns that on newly nourished beaches where the elevation of the beach berm is raised for coastal storm damage reduction purposes, it is possible that lighting impacts to nesting females and emerging hatchlings from adjacent lighting sources (streets, parking lots, hotels, etc) may become more problematic as shading from dunes, vegetation, etc. is no longer evident (Brock 2005; Brock et al. 2009; Ehrhart and Roberts 2001). In a study on Brevard county beaches, Brock (2005) found that loggerhead hatchling disorientations increased significantly post-nourishment. This was attributed to the increase in light sources not previously visible to be seen by hatchlings as a result of the increase in profile elevation combined with an easterly expansion of the beach.

If beach construction activities extend into the sea turtle nesting and hatching season, all lighting associated with project construction will be minimized to the maximum extent practicable while maintaining compliance with all Corps, U.S. Coast Guard, and OSHA safety requirements. Direct lighting of the beach and near shore waters will be limited the immediate construction area(s). Lighting aboard dredges and associated vessels, barges, etc. operating near the sea turtle nesting beach shall be limited to the minimal lighting necessary to comply with the Corps, U.S. Coast Guard, and OSHA requirements. Lighting on offshore or onshore equipment will be minimized through reduced wattage, shielding, lowering, and/or use of low pressure sodium lights, in order to reduce illumination of adjacent beach and nearshore waters will be used to the extent practicable.

(2) Dredging Impacts. The effects of dredging are evidenced through the degradation of habitat and incidental take of marine turtles. Channelization of inshore and nearshore habitat and the disposal of dredged material in the marine environment can destroy or disrupt resting or foraging grounds (including grass beds and coral reefs) and may affect nesting distribution through the alteration of physical features in the marine environment. Hopper dredges are responsible for incidental take and mortality of marine turtles during dredging operations, however the use of turtle deflectors on the drag heads has dramatically reduced the incidence of “takes”. Other types of dredges (clamshell and pipeline) have not been implicated in incidental take (NMFS and USFWS, 1991). Incidental takes of sea turtles by hopper dredges comes under the jurisdiction of NOAA Fisheries and is covered by a separate Biological Opinion (NMFS, 1997).

(3) Summary Effect. This project is not being designed to enhance turtle habitat; however, because turtles may attempt to nest here and false crawls may occur due to the lack of suitable habitat, it has been determined that the project may adversely affect the loggerhead and green sea turtle populations. Upon completion of the project, the total area of suitable nesting habitat will be increased.

Placement of the dredged material is anticipated to occur during the months of November through April; however, it is possible that the start of construction work will be delayed until nesting season or that completion of the project will be delayed and construction will extend into the nesting season. If any construction work occurs during sea turtle nesting season, then the following precautions will be taken to minimize the effects to sea turtles:

- If any construction of the project occurs during the period between May 1 and September 15, the dredging contractor will provide nighttime monitoring along the beach where construction is taking place to ensure the safety of female turtles attempting to nest. Cease construction activities if a sea turtle is sighted on an area of beach scheduled for fill until the turtle returns to the ocean. A buffer zone around the female will be imposed in the event of an attempt to nest.

- If any construction of the project occurs during the period between May 1 and September 15, daily nesting surveys will be conducted starting either May 1 or 65 days prior to the start of construction, whichever is later. These surveys will be performed between sunrise and 9:00 A.M. and will continue until the end of the project, or September 15, whichever is earlier. Any nests found in the area that will be impacted by construction activities will be moved to a safe location. The nesting surveys and nest relocations will only be performed by people with a valid South Carolina DNR license.

- For construction activities occurring during the period May 1 through October 31, staging areas for equipment and supplies will be located off of the beach to the maximum extent possible.
- For construction activities occurring during the period May 1 through October 31, use of heavy equipment will be limited to the area undergoing renourishment.
- For construction activities occurring during the period May 1 through October 31, all on-beach lighting associated with the project will be limited to the minimum amount necessary around active construction areas to satisfy Occupational Safety and Health Administration (OSHA) requirements.
- For construction activities occurring during the period May 1 through October 31, use predator proof trash receptacles to minimize presence of species that prey upon hatchlings.
- USACE will adhere to all terms and conditions of the South Atlantic Regional Biological Opinion which evaluates in-water impacts on sea turtles, sturgeon and large whales.
- The USFWS and SCDNR will be notified immediately if a sea turtle, nest, or hatchlings are impacted by the construction.

Immediately after completion of the project, the Corps of Engineers will perform tilling to a depth of at least 24 inches in order to reduce compaction associated with newly placed sand. Visual surveys for escarpments along the project area will be made immediately after completion of the project and prior to May 1 for 3 subsequent years, if needed. Results of the surveys will be submitted to the USFWS prior to any action being taken. Since the project should not occur during the sea turtle nesting season, escarpment leveling will not be performed until immediately prior to the nesting season. The USFWS will be contacted immediately if subsequent reformation of escarpments exceeding 18 inches in height for a distance of 100 feet occurs during nesting and hatching season. This coordination will determine what appropriate action must be taken. An annual summary of escarpment surveys and action taken will be submitted to the USFWS.

Adherence to the above precautions should minimize the effects to nesting loggerhead sea turtles and emerging loggerhead sea turtle hatchlings. The monitoring and relocation program will minimize potential adverse effects to nesting sea turtles. Completion of the project will recreate lost habitat and protect existing turtle nesting habitat as well as the structures on the island. However, because of the possibility of missing a sea turtle nest during the nest monitoring program or inadvertently breaking eggs during relocation, it has been determined that the proposed project **is likely to adversely affect the loggerhead and green sea turtles for beach placement activities**. This determination has been made per USFWS ESA Consultation Handbook and states that, "in the event the overall effect of the proposed action is beneficial to the listed species, but also is likely to cause some adverse effects, then the proposed action "is likely to adversely affect" the listed species." The project will have **no effect on critical habitat (either terrestrial or marine) for loggerhead sea turtles**. Since leatherback nesting has been documented in the past but is not common, the proposed project **may affect but is not likely to adversely affect the leatherback sea turtle for beach placement activities**. **There will be no effect on all other sea turtle species for beach placement activities.** Since all in water dredging activities are addressed and covered by reference in the 1997 NMFS SARBO, no additional sea turtle consultation with NMFS is required.

6.3 Shortnose sturgeon

Detailed life history information associated with the life cycle requirements for shortnose Sturgeon and a subsequent analysis of impacts from the proposed dredging activities are provided within the following Section 7 consultation document:

> *National Marine Fisheries Service. 1997. Regional Biological Opinion for the Continued Hopper Dredging of Channels and Borrow Areas in the Southeastern United States. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Silver Spring, Maryland*

a. Status. Endangered

b. Occurrence in Immediate Project Vicinity. The Shortnose Sturgeon occurs in Atlantic seaboard rivers from southern New Brunswick, Canada to northeastern Florida, USA. They typically inhabit estuarine and riverine habitats and are not often found offshore. SCDNR reports that in SC they inhabit Winyah Bay Rivers, those that drain into Lake Marion, The Santee, Cooper and Savannah rivers, and the ACE Basin.

Studies have shown that the shortnose sturgeon exists in many of the large coastal river systems in South Carolina. Little is known about the shortnose sturgeon population level, life history or ecology. Their status is probably due to exploitation, damming of rivers and deterioration of water quality. Because there is no coastal river associated with this project, there is a lack of suitable freshwater spawning areas for the sturgeon in the immediate project area.

c. Current Threats to Continued Use of the Area. Pollution, blockage of traditional spawning grounds, and over fishing are generally considered to be the principal causes of the decline of this species.

d. Project Impacts.

(1) Habitat. The shortnose sturgeon is principally a riverine species and is known to use three distinct portions of river systems: (1) non-tidal freshwater areas for spawning and occasional over wintering; (2) tidal areas in the vicinity of the fresh/saltwater mixing zone, year-round as juveniles and during the summer months as adults; and (3) high salinity estuarine areas (15 ppt salinity or greater) as adults during the winter. Habitat conditions suitable for juvenile and adult shortnose sturgeon could occur within the estuaries behind the project area; however, spawning habitat should lie well outside of the project area and should not be affected by this project. The presence of juvenile shortnose sturgeon is not likely due to high salinity. Adults are found in shallow to deep water (6 to 30 feet) and, if present, would be expected to occupy the deeper waters during the day and the shallower areas adjacent to the deeper waters during the night (Dadswell *et al*. 1984).

(2) Food Supply. The shortnose sturgeon is a bottom feeder, consuming various invertebrates and stems and leaves of macrophytes. Adult foraging activities normally occur at night in

shallow water areas adjacent to the deep-water areas occupied during the day. Juveniles are not known to leave deep-water areas and are expected to feed there. The foraging ecology of the shortnose sturgeon is not known for any portion of its range, and little information exists on the animal's food habits (SCDNR, 2009a). Dredging for this project will occur at a borrow site located offshore; therefore, shallow water feeding areas will not be affected by the project.

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

6.4 Atlantic Sturgeon

a. Status. Endangered.

Within the Federal Register dated February 6, 2012 (Volume 77, Number 24), NMFS issued a final determination to list the Carolina and South Atlantic distinct population segments (DPSs) of Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus*) as endangered under the Endangered Species Act (ESA) of 1973, as amended. This final rule was made effective April 6, 2012. NMFS had not designated any “critical habitat” for this species at the time this document was prepared. Since the Atlantic sturgeon is found within the project area, the purpose of this section is to address project impacts on this potentially listed species.

b. Occurrence in Immediate Project Vicinity. Although specifics vary latitudinally, the general life history pattern of Atlantic sturgeon is that of a long lived, late maturing, estuarine dependent, anadromous species. The species’ historic range included major estuarine and riverine systems that spanned from Hamilton Inlet on the coast of Labrador to the Saint Johns River in Florida (Murawski and Pacheco 1977; Smith and Clungston 1997).

Atlantic sturgeon spawn in freshwater, but spend most of their adult life in the marine environment. Spawning adults generally migrate upriver in the spring/early summer; February-March in southern systems, April-May in mid-Atlantic systems, and May-July in Canadian systems (Murawski and Pacheco 1977; Smith 1985; Bain 1997; Smith and Clungston 1997; Caron *et al*. 2002). In some southern rivers, a fall spawning migration may also occur (Rogers and Weber 1995; Weber and Jennings 1996; Moser *et al.* 2000. Atlantic sturgeon spawning is believed to occur in flowing water between the salt front and fall line of large rivers, where optimal flows are 46-76 cm/s and deep depths of 11-27 meters (Borodin 1925; Leland 1968; Crance 1987; Moser *et al*. 2000; Bain *et al*. 2000). Sturgeon eggs are highly adhesive and are deposited on the bottom substrate, usually on hard surfaces (e.g., cobble) (Gilbert 1989; Smith and Clungston 1997).

Juveniles spend several years in the freshwater or tidal portions of rivers prior to migrating to sea (Gilbert 1989). Upon reaching a size of approximately 76-92 cm, the subadults may move to coastal waters (Murawski and Pacheco 1977; Smith 1985), where populations may undertake long range migrations (Dovel and Berggren 1983; Bain 1997; Van den Avyle 1984). Tagging and genetic data indicate that subadult and adult Atlantic sturgeon may travel widely once they emigrate from rivers. Subadult Atlantic sturgeon wander among coastal and estuarine habitats, undergoing rapid growth (Dovel and Berggren 1983; Stevenson 1997). These migratory subadults, as well as adult sturgeon, are normally captured in shallow (10-50m) near shore areas dominated by gravel and sand substrate (Stein *et al*. 2004). Coastal features or shorelines where migratory Atlantic sturgeon commonly aggregate include the Bay of Fundy, Massachusetts Bay, Rhode Island, New Jersey, Delaware, Delaware Bay, Chesapeake Bay, and North Carolina, which presumably provide better foraging opportunities (Dovel and Berggren 1983; Johnson *et al*. 1997; Rochard *et al*. 1997; Kynard *et al*. 2000; Eyler *et al*. 2004; Stein *et al*. 2004; Dadswell 2006). Because there is not a large coastal river associated with this project, there is a lack of suitable freshwater spawning areas for the Atlantic sturgeon in the immediate project area.

c. <u>Current Threats to Continued Use of the Area</u>. According to the Atlantic sturgeon status review (Atlantic Sturgeon Status Review Team, 2007), projects that may adversely affect sturgeon include dredging, pollutant or thermal discharges, bridge construction/removal, dam construction, removal and relicensing, and power plant construction and operation. Potential direct and indirect impacts associated with dredging that may adversely impact sturgeon include entrainment and/or capture of adults, juveniles, larvae, and eggs by dredging and closed net sea turtle relocation trawling activities, short-term impacts to foraging and refuge habitat, water quality, and sediment quality, and disruption of migratory pathways.

d. <u>Project Impacts.</u>

(1) <u>Habitat and Food Supply</u>. Dredging activities can impact benthic assemblages either directly or indirectly and may vary in nature, intensity, and duration depending on the project, site location, and time interval between maintenance operations. However, the relatively small size of the proposed borrow area, it's distance from major riverine inlets, and the short duration of disturbance will limit any disruption of food supply to the Atlantic sturgeon.

(2) <u>Relationship to Critical Periods in Life Cycle</u>. Analyses of the surficial and sub-bottom sediments have been conducted within the proposed borrow areas to assure compatibility with the native sediment. Several vibracore samples were taken to document the physical characteristics of the sediment relative to depth and sub-bottom geophysical surveys were conducted to correlate the physical samples with the underlying geology layers of the borrow area. These data are used to evaluate quality and quantity of sediment relative to depth so that post-dredging surface sediments are not different from pre-dredging conditions. Assuming similarity in post dredging composition of sediment, no long term impacts to sturgeon from alterations physical habitat (i.e. changes in benthic substrate) are expected.

(3) Effect Determination. Atlantic sturgeons have been taken by hopper dredges in the past and to lesser extent mechanical dredges. Therefore, the proposed dredging activity will have **no effect if performed by a cutterhead dredge and may affect and is likely to adversely affect the Atlantic sturgeon if performed by a hopper dredge.** Since USACE has initiated consultation with NMFS on a new regional Biological Opinion which covers dredging of borrow areas, no additional Atlantic sturgeon consultation with NMFS is required.

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

6.5 Sea beach Amaranth

a. Status. Threatened

Sea beach amaranth (*Amaranthus pumilus*) is an annual plant historically native to the barrier island beaches of the Atlantic coast from Massachusetts to South Carolina. No other vascular plant occurs closer to the ocean. The species was federally listed as threatened by the U.S. Fish and Wildlife Service in 1993 (USACE, 2001). Seabeach amaranth is listed as threatened and of national concern in South Carolina.

Germination takes place over a relatively long period of time, generally beginning in April and continuing at least through July. Upon germinating, this plant initially forms a small-unbranched sprig but soon begins to branch profusely into a clump, often reaching a foot in diameter and consisting of 5 to 20 branches. Occasionally a clump may get as large as a yard of more across, with hundreds of branches. The stems are fleshy and pink-red or reddish, with small rounded leaves that are 1.3 to 2.5 centimeters in diameter. The leaves are clustered toward the tip of the stem, are normally a somewhat shiny, spinach-green color, and have a small notch at the rounded tip. Flowers and fruits are relatively inconspicuous and are borne in clusters along the stems. Flowering begins as soon as plants have reached sufficient size, sometimes as early as June in the Carolinas but more typically commencing in July and continuing until their death in late fall or early winter. Seed production begins in July or August and reaches a peak in most years in September; it likewise continues until the plant dies (USACE, 2001).

Seabeach amaranth occurs on barrier island beaches, where its primary habitat consists of overwash flats at accreting ends of islands and lower foredunes and upper strands of non-eroding beaches. It occasionally establishes small temporary populations in other habitats, including sound side beaches, blowouts in foredunes and in dredged material placed for beach renourishment or disposal. Seabeach amaranth appears to be intolerant of competition and does not occur on well-vegetated sites. The species appears to need extensive areas of barrier island beaches and inlets, functioning in a relatively natural and dynamic manner. These characteristics allow it to move around in the landscape as a fugitive species, occupying suitable habitat as it becomes available (USACE, 2001).

b. Occurrence in Immediate Project Vicinity. Historically, seabeach amaranth occurred in 31 counties in 9 states from Massachusetts to South Carolina. It has been eliminated from six of the States in its historic range. The only remaining large populations are in North Carolina. Surveys in South Carolina found that the number of plants along our coast dropped by 90% (from 1,800 to 188) as a result of Hurricane Hugo, subsequent winter storms and beach rebuilding projects that occurred in its wake. South Carolina populations are still very low and exhibit a further downward trend although 1998 was a better year than most with 279 plants identified along the coast. It is possible that the abundant rainfall associated with El Nino in the spring of 1998 produced a larger than normal population. The remaining populations in areas with suitable habitat are in constant danger of extirpation from hurricanes, webworm predation, and other natural and anthropogenic factors (USACE, 2001). At the present time, there are no known populations of seabeach amaranth in the project area.

c. Current Threats to Continued Use of Area. Seabeach amaranth cannot compete with dense perennial beach vegetation and only occurs in the newly disturbed habitat of a high-energy beach. It occurs on barren or sparsely-vegetated sand above the high water line, an area classified as marine wetland. This habitat usually disappears completely when seawalls or other hard structures are built along the shoreline. This loss of habitat from seawall construction and global sea level rise are thought to be major factors in the species' extirpation throughout parts of its historic range. It has been postulated that estuarine and coastal shore plants will suffer some of the most significant impacts as a result of global climate changes. Coastal development will prevent these species from migrating up slope to slightly higher ground if sea levels rise. To a large extent, this is already occurring as beaches are being fortified to prevent erosion. Beach renourishment projects eliminate existing plants if conducted during the summer and may bury the seed needed to reestablish the plant the following year if conducted during the winter. However, beach renourishment projects often rebuild the habitat this species requires. Fortification with seawalls and other stabilization structures or heavy vehicular traffic may eliminate seabeach amaranth populations locally. Any given site will become unsuitable at some time because of natural forces. However, if a seed source is no longer available in adjacent areas, seabeach amaranth will be unable to reestablish itself when the site is once again suitable or new favorable habitat is created. In this way, it can be progressively eliminated even from generally favorable stretches of habitat surrounded by permanently unfavorable areas (USACE, 2001).

Effect Determination. Because there are no known populations of seabeach amaranth in the project area, there is also no known viable seed source. As such, the proposed project **may effect, but is not likely to adversely affect** sea beach amaranth. However, USACE has discussed with the USFWS the possibility of trying to plant the foredune area of the dune vegetation planting matrix with seabeach amaranth in select areas. USACE is requesting conservation recommendations should this be a viable option.

6.6 Piping plover and designated piping plover critical habitat

a. Status. Threatened.

Piping plovers are small shorebirds approximately six inches long with sand-colored plumage on their backs and crown and white under parts. Breeding birds have a single black breast band, a black bar across the forehead, bright orange legs and bill, and a black tip on the bill. During the winter, the birds lose the black bands, the legs fade to pale yellow, and the bill becomes mostly black.

The piping plover breeds on the northern Great Plains, in the Great Lakes region, and along the Atlantic coast (Newfoundland to North Carolina); and winters on the Atlantic and Gulf of Mexico coasts from North Carolina to Mexico, and in the Bahamas West Indies.

Piping plovers nest along the sandy beaches of the Atlantic Coast from Newfoundland to North Carolina, the gravelly shorelines of the Great Lakes, and on river sandbars and alkali wetlands throughout the Great Plains region. They prefer to nest in sparsely vegetated areas that are slightly raised in elevation (like a beach berm). Piping plover breeding territories generally include a feeding area, such as a dune pond or slough, or near the lakeshore or ocean edge. The piping plover winters along the coast, preferring areas with expansive sand or mudflats (feeding) in close proximity to a sandy beach (roosting). The primary threats to the piping plover are habitat modification and destruction, and human disturbance to nesting adults and flightless chicks. A lack of undisturbed habitat has been cited as a reason for the decline of other shorebirds such as the black skimmer and least tern (USACE, 2001).

The piping plover is an occasional visitor along the South Carolina coast during the winter months and individuals are occasionally sighted in the project area. However, there are no large wintering concentrations in the state. Piping plovers are considered a threatened species under the Endangered Species Act of 1973, as amended, when on their wintering grounds. The species is not known to nest in the project area; however, it may winter in the area. The USFWS has designated 15 areas along the South Carolina (SC) coast as critical habitat for the wintering populations of the piping plover. This includes approximately 138 miles of shoreline along the SC coast along margins of interior bays, inlets, and lagoons. There is a designated critical habitat to the south of the project at Murrells Inlet. However, there is no designation for any of the project area footprint. Public reporting of piping plover activity in the Garden City/Surfside area of South Carolina has been sparse (ebird.org, 2016).

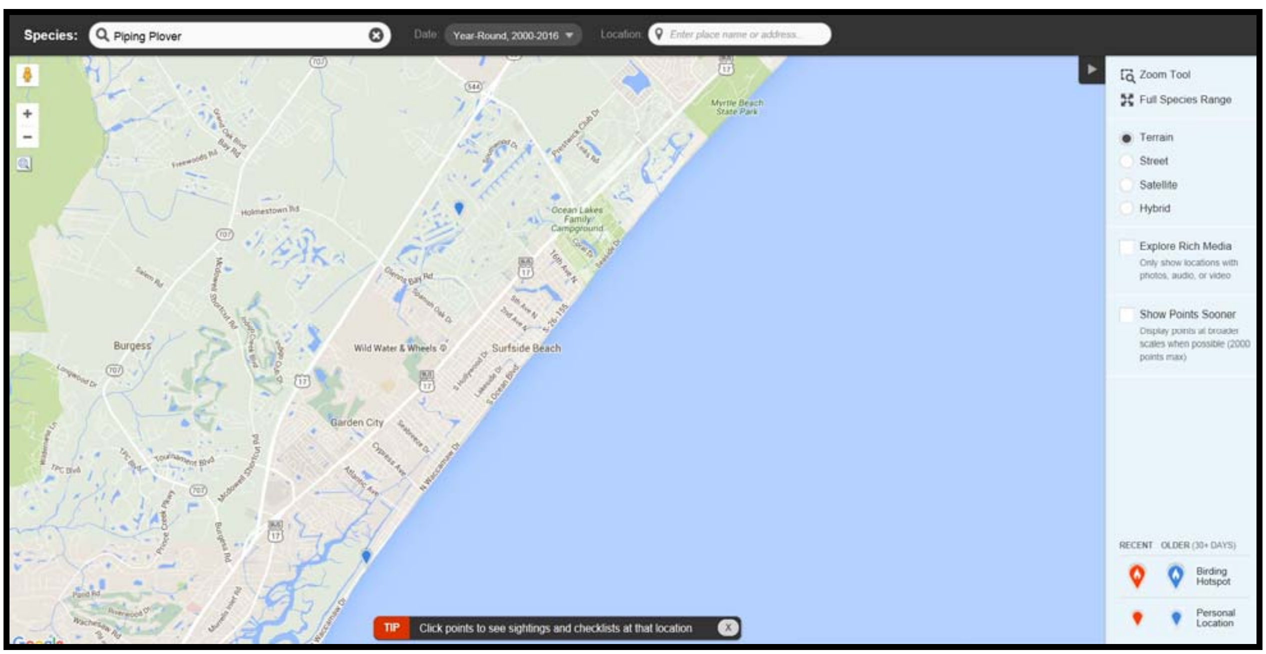

Figure 9. Piping plover reported sightings on ebird.org.

Effect Determination. Direct loss of nests from the disposal of the dredged material will not occur, as the species is not known to nest in the project area. Piping plover foraging distribution on the beach during the winter months may be altered as beach food resources may be affected by disposal of material. Such disruptions will be temporary and of minor significance since the birds can easily fly to other loafing and foraging locations. Placement of material may provide additional foraging habitat for the piping plover. For these reasons, it has been determined that the proposed project is **not likely to adversely affect the piping plover.**

6.7 Rufa Red Knot

a. Status. Threatened

Rufa red knots (*Calidris canutus rufa*) are medium-sized shorebirds approximately 9 to 11 inches long. Red knots have a proportionately small head, small eyes, and short neck, and a black bill that tapers from a stout base to a relatively fine tip. The bill length is not much longer than head length. Legs are short and typically dark gray to black, but sometimes greenish in juveniles or older birds in nonbreeding plumage. Nonbreeding plumage is dusky gray above and whitish below. Juveniles resemble nonbreeding adults, but the feathers of the scapulars (shoulders) and wing coverts (small feathers covering base of larger feathers) are edged with white and have narrow, dark bands, giving the upperparts a scalloped appearance. Breeding plumage of red knots is a distinctive rufous (red). The face, prominent stripe above the eye, breast, and upper belly are a rich rufous-red to a brick or salmon red, sometimes with a few scattered light feathers mixed in. The feathers of the lower belly and under the tail are whitish with dark flecks. Upperparts are dark brown with white and rufous feather edges; outer primary feathers are dark brown to black. Females are similar in color to males, though the rufous colors are typically less intense, with more buff or light gray on the dorsal (back) parts (USFWS, 2013a).

Each year red knots make one of the longest distance migrations known in the animal kingdom, traveling up to 19,000 mi annually. This migration occurs between the red knot's breeding grounds in the Canadian Arctic and several wintering areas, including the Southeast United States, the Northeast Gulf of Mexico, northern Brazil, and Tierra del Fuego at the southern tip of South America ("Winter" is used to refer to the nonbreeding period of the red knot life cycle when the birds are not undertaking migratory movements.). During both the northbound (spring) and southbound (fall) migrations, red knots use key staging and stopover areas to rest and feed. Southbound red knots tend to be less concentrated than during either their northbound migrations and in their wintering areas (USFWS, 2013a).

Red knots undertake long flights that may span thousands of miles without stopping. As red knots prepare to depart on long migratory flights, they undergo several physiological changes. Before takeoff, the birds accumulate and store large amounts of fat to fuel migration and undergo substantial changes in metabolic rates. In addition, leg muscles, gizzard, stomach, intestines, and liver all decrease in size, while pectoral muscles and heart increase in size. Due to these physiological changes, red knots arriving from lengthy migrations are not able to feed maximally until their digestive systems regenerate, a process that may take several days. Because stopovers are time-constrained, red knots require stopovers rich in easily digested food to achieve adequate weight gain (USFWS, 2013a).

Red knots generally nest in dry, slightly elevated tundra locations, often on windswept slopes with little vegetation. Breeding areas are located inland, but near arctic coasts. Nests may be scraped into patches of mountain avens (*Dryas octopetala*) plants, or in low spreading vegetation on hummocky ground containing lichens, leaves, and moss. Female red knots lay only one clutch (group of eggs) per season, and, as far as is known, do not lay a replacement clutch if the first is lost. The usual clutch size is four eggs, though three-egg clutches have been recorded. The incubation period lasts approximately 22 days from the last egg laid to the last egg hatched, and both sexes participate equally in egg incubation. After the eggs hatch, red knot chicks and adults quickly move away from high nesting terrain to lower, wetland habitats. Young are precocial, leaving the nest within 24 hours of hatching and foraging for themselves. Females are thought to leave the breeding grounds and start moving south soon after the chicks hatch in mid-July. Thereafter, parental care is provided solely by the males, but about 25 days later (around August 10) they also abandon the newly fledged juveniles and move south. Not long after, they are followed by the juveniles (USFWS, 2013a).

Red knots are a specialized molluscivore, eating hard-shelled mollusks, sometimes supplemented with easily accessed softer invertebrate prey, such as shrimp and crab-like organisms, marine worms, and horseshoe crab eggs. Red knots do not necessarily prefer hard-shelled mollusks (in fact they do not, when given the choice), but they are specialized in finding and processing such prey. Due to this specialization, red knots have less ability to find the actively crawling soft-bodied worms and small crustaceans on which other sandpiper species specialize. Foraging activity is largely dictated by tidal conditions, as red knots rarely wade in water more than 0.8 to 1.2 in deep. Due to bill morphology, red knots are limited to foraging on only shallow-buried prey, within the top 0.8 to 1.2 in of sediment. Red knots and other shorebirds that are long-distance migrants must take advantage of seasonally abundant food resources at migration stopovers to build up fat reserves for the next non-stop, long-distance flight. During the migration period, although foraging red knots can be found widely distributed in small numbers within suitable habitats, birds tend to concentrate in those areas where abundant food resources are consistently available from year to year. A prominent departure from typical prey items occurs each spring when red knots feed on the eggs of horseshoe crabs, particularly during the key migration stopover within the Delaware Bay of New Jersey and Delaware. The Delaware Bay serves as the principal spring migration staging area for the red knot because of the abundance and availability of horseshoe crab eggs. Horseshoe crab eggs are a superabundant source of easily digestible food. Horseshoe crabs occur along the Atlantic coast from Maine to Florida, along Florida's Gulf coast, and along Mexico's Yucatan Peninsula. Within this geographic range, horseshoe crabs are most abundant between Virginia and New Jersey, with the largest population occurring in Delaware Bay. Each spring, adult horseshoe crabs migrate from deep bay waters and the Atlantic continental shelf to spawn on intertidal sandy beaches. Beaches within estuaries are preferred spawning areas because they are low energy environments and are protected from the surf. Horseshoe crab spawning generally occurs from March through July, with the peak spawning activity occurring around the evening new and full moon high tides in May and June. Horseshoe crabs and surface egg availability are not found in similar densities in other areas on the Atlantic coast, which may explain why shorebirds concentrate in the Delaware Bay. Besides supporting red knots, Delaware Bay supports high numbers of other shorebird species, and ranks among the 10 largest shorebird migration staging sites in the Western

Hemisphere. Outside of Delaware Bay, horseshoe crab eggs are eaten opportunistically when available in nonbreeding habitats but are not considered a primary food resource for red knots in these areas. Delaware Bay provides the final Atlantic coast stopover for a significant majority (50 to 80 percent) of the red knot population making its way to the arctic breeding grounds each spring. Red knots stopping in Delaware Bay depend on horseshoe crab eggs to achieve remarkable rates of weight gain. No single stopover area is more important for the red knot than the Delaware Bay because the nutritive yield of the bay is so high. The timing of the arrival of red knots and other shorebirds in Delaware Bay typically coincides with the annual peak of the horseshoe crab spawning period. Red knots in Delaware Bay rely almost entirely on horseshoe crab eggs to support their very high rates of weight gain. Research has provided strong evidence that a majority of red knots stop at the Delaware Bay during the spring migration, and that these birds are highly reliant on a superabundance of horseshoe crab eggs to gain weight during their stopover period. On the breeding grounds, the red knot's diet consists mostly of terrestrial invertebrates, though early in the season, before insects and other macroinvertebrates are active and accessible, red knots will eat grass shoots, seeds, and other vegetable matter (USFWS, 2013a).

Red knots are restricted to ocean coasts during winter, and occur primarily along the coasts during migration. Habitats used by red knots in migration and wintering areas are similar in character, generally coastal marine and estuarine (partially enclosed tidal area where fresh and salt water mixes) habitats with large areas of exposed intertidal sediments. In North America, red knots are commonly found along sandy, gravel, or cobble beaches, tidal mudflats, salt marshes, shallow coastal impoundments and lagoons, and peat banks. In the southeastern U.S., red knots forage along sandy beaches during spring and fall migration from Maryland through Florida. In addition to the sandy beaches, red knots also forage along peat banks and tidal mudflats during migration. Along the Atlantic coast, dynamic and ephemeral features are important red knot habitats, including sand spits, islets, shoals, and sandbars, often associated with inlets. From South Carolina to Florida, red knots are found in significantly higher numbers at inlets than at other coastal sites (USFWS, 2013a).

Red knots occupy all known wintering areas from December to February, but may be present in some wintering areas as early as September or as late as May. Wintering areas for the red knot include the Atlantic coasts of Argentina and Chile (particularly the island of Tierra del Fuego that spans both countries), the north coast of Brazil (particularly in the State of Maranhão), the Northwest Gulf of Mexico (discussed below) from the Mexican State of Tamaulipas through Texas (particularly at Laguna Madre) to Louisiana, and the Southeast United States from Florida (particularly the central Gulf coast) to North Carolina. Smaller numbers of knots winter in the Caribbean, and along the central Gulf coast (Alabama, Mississippi), the mid-Atlantic, and the Northeast United States. The core of the Southeast wintering area (i.e., that portion of this large region supporting the majority of birds) is thought to shift from year to year among Florida (particularly the central Gulf coast), Georgia, and South Carolina. However, the geographic limits of this wintering region are poorly defined. Although only small numbers are known, wintering knots extend along the Atlantic coast as far north as Virginia, Maryland, and New Jersey. Still smaller numbers of red knots have been reported between December and February from Long Island, New York, through Massachusetts and as far north as Nova Scotia, Canada. Small numbers of red knots also winter along the central Gulf coast (Florida Panhandle, Alabama, Mississippi, and eastern Louisiana). Red knots occupy the southernmost wintering areas, in Tierra del Fuego, from late October to February, with some birds arriving as early as late September. Birds wintering in the Caribbean or the United States typically stay later, through March or even May. Birds wintering in the Southeast seem to arrive in November, while birds wintering in Texas seem to arrive much earlier, in late July or August. Major spring stopover areas along the Atlantic coast include Río Gallegos, Península Valdés, and San Antonio Oeste (Patagonia, Argentina); Lagoa do Peixe (eastern Brazil, State of Rio Grande do Sul); Maranhão (northern Brazil); the Virginia barrier islands; and Delaware Bay. However, large and small groups of red knots, sometimes numbering in the thousands, may occur in suitable habitats all along the Atlantic and Gulf coasts from Argentina to Massachusetts (USFWS, 2013a).

Some red knots from the Southeast-Caribbean wintering area, and from South American wintering areas, utilize spring stopovers along the Southeast United States, from Florida to North Carolina. The length of stopover at these locations is generally believed to be brief; although data exist showing that some stopovers last for several weeks. Red knots typically use mid-Atlantic stopovers from late April through late May or early June. The stopover time in Delaware Bay is about 10 to 14 days. From Delaware Bay and other mid-Atlantic stopovers, birds tend to fly overland directly northwest to the central Canadian breeding grounds, with many stopping briefly along the shores of James and Hudson Bays. Knots that winter in Tierra del Fuego tend to work their way up the South America Atlantic coast, using stopover sites in Argentina and Uruguay before departing from Brazil (USFWS, 2013a).

Important fall stopover sites include southwest Hudson Bay (including the Nelson River delta), James Bay, the north shore of the St. Lawrence River, the Mingan Archipelago, and the Bay of Fundy in Canada; the coasts of Massachusetts and New Jersey and the mouth of the Altamaha River in Georgia; the Caribbean (especially Puerto Rico and the Lesser Antilles); and the northern coast of South America from Brazil to Guyana. However, birds can occur all along the coasts in suitable habitat. In the mid-Atlantic, southbound red knots start arriving in July. Numbers of adults peak in mid-August and most depart by late September, although data shows that some birds stay through November. Migrant juveniles begin to appear along the U.S. Atlantic coast in mid-August, occurring in much lower numbers and scattered over a much wider area than adults. Several studies suggest that adult red knots fly directly to South America from the eastern seaboard of the United States, arriving in northern South America in August (USFWS, 2013a).

The primary threats to the red knot are loss of both breeding and non-breeding habitat; reduced prey availability throughout the non-breeding range; potential for disruption of natural predator cycles on the breeding grounds; and increasing frequency and severity of asynchronies (i.e., mismatches) in the timing of their annual migratory cycle relative to favorable food and weather conditions (USFWS, 2013b).

The red knot is a regular visitor along the South Carolina coast during both the spring and fall migrations. Flocks of over 1000 birds have been observed in the spring with lesser numbers being observed in the fall. The red knot also uses the South Carolina coast as a wintering area. Public reporting of red knot activity in the Garden City/Surfside area of South Carolina has been sparse (ebird.org, 2016).

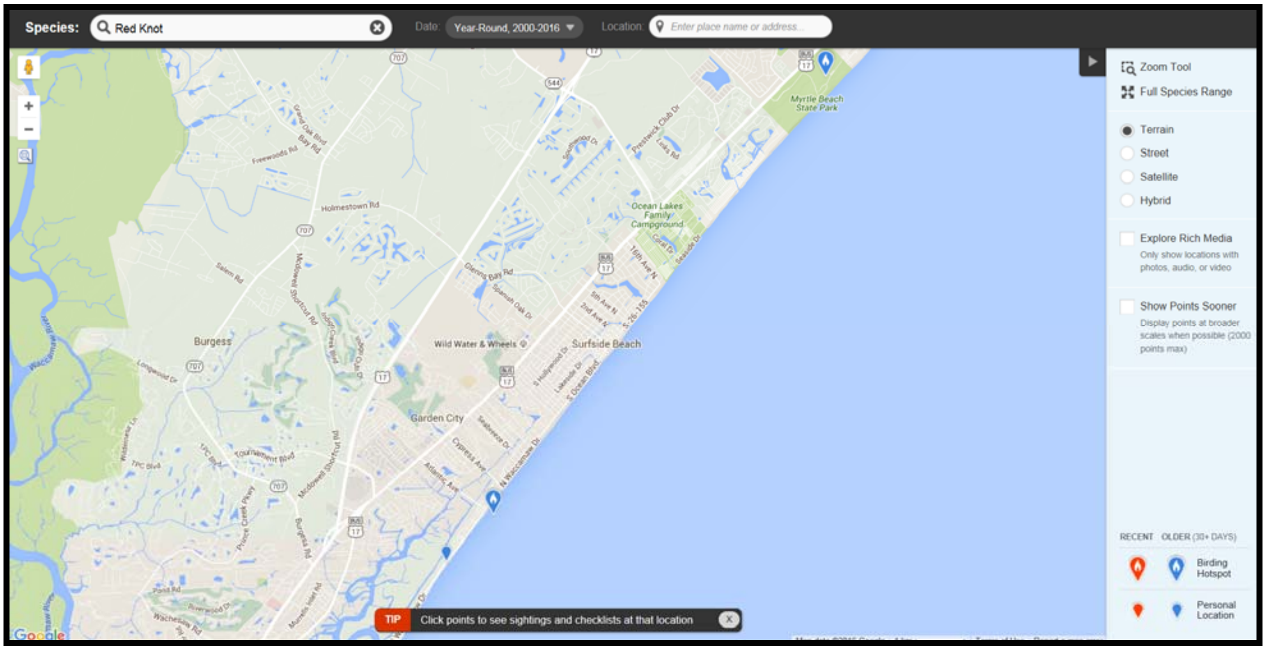

Figure 10. Red knot reported sightings on ebird.org

Effect Determination

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

6.6 Blue (NOAA Fisheries list), finback, humpback, right, sei, and sperm whales

The blue whale reaches lengths of up to 100 feet. Blue whales have weighed up to 160 tons. They feed on small shrimp-like crustaceans. The whales consume up to eight tons of these animals a day during their feeding period. A blue whale produced the loudest sound ever recorded from an animal, and some scientists have speculated that they may be able to remain in touch with each other over hundreds of miles. The number of blue whales in the southern hemisphere was severely depleted by whaling. Due to commercial whaling the size of the population is less than ten percent of what it was.

The finback whale is the second largest whale, reaching lengths of up to 88 feet and weighs up to 76 tons. The finback whale because of its crescent-shaped dorsal fin, and obvious characteristic, is easily seen at sea. Depending on where they live, finback whales eat both fish and small pelagic crustaceans, and squids. It sometimes leaps clear of the water surface, yet it is also a deeper diver than some of the other baleen whales. The finback's range is in the Atlantic from the Arctic Circle to the Greater Antilles, including the Gulf of Mexico. In the Pacific Ocean the Finback ranges from the Bering Sea to Cape San Lucas, Baja California.

The humpback whale reaches a maximum length of about 50 feet long and a maximum weight of about 37.5 tons. They are mostly black, but the belly is sometimes white. Flippers and undersides of the flukes are nearly all white. They are migratory. They eat krill and schooling fish. In the Atlantic they migrate from Northern Iceland and Western Greenland south to the West Indies, including the Northern and Eastern Gulf of Mexico. In the Pacific Ocean they migrate from the Bering Sea to Southern Mexico. The humpback is one of the most popular whales for whale watching on both the east and west coasts. Scientists estimate that there are 10,000 humpbacks worldwide, only about 8% of its estimated initial population.

The sei whale is one of the largest whales. It can reach a length of 60 feet and a weight of 32 tons. They feed primarily on krill and other small crustaceans, but also feed at times on small fish. The sei whale is the fastest of the baleen whales and can reach speeds of more than 20 miles per hour. In the Atlantic Ocean the Sei whale ranges from the Arctic Circle to the Gulf of Mexico. In the Pacific Ocean the Sei whale may range from the Bering Sea to Southern Mexico. The Sei whale is endangered due to past commercial whaling.

Unlike the other great whales on the endangered species list, the sperm whale is a toothed whale. It is the largest of the toothed whales reaching a length of 60 feet in males and 40 feet in females. Sperm whales are noted for their dives that can last up to an hour and a half and go as deep as 2 miles under the surface. It is the most abundant of all the endangered whales, with an estimated population of two million. Sperm whales feed mainly on squid, including the giant squid. They range in the Atlantic Ocean from the Arctic Circle to the Gulf of Mexico. In the Pacific Ocean the sperm whale ranges from the Bering Sea to Southern Mexico. The sperm whale was almost hunted to extinction for its oil (spermaceti). This oil was used in the manufacture of ointments, cosmetics, and candles. The sperm whales usually inhabit the offshore waters.

The right whale is the most endangered species of whale off of the U.S. coasts. The right whale got its name because it was the "right" whale to hunt. It was slow moving and floated after being killed. Current estimates indicate that presently no more than a few hundred exist. Right whales can reach a length of 60 feet and a weight of 100 tons. Although the species has been internationally protected since 1937, it has failed to show any signs of recovery.

Right whales have been observed along the eastern coast of North America from the Florida Keys north to the Gulf of St. Lawrence in Canada. They are found in relatively large numbers around Massachusetts and near Georges Bank in the spring, and then they migrate to two areas in Canadian waters by mid-summer. Most cows that give birth in any given year travel in the winter to the coastal waters of Georgia and Florida to calve and raise their young for the first three months. The Bay of

Fundy, between Maine and Nova Scotia, appears to serve as the primary summer and fall nursery hosting mothers and their first-year calves. The calf will stay with its mother through the first year and it is believed that weaning occurs sometime in the fall. Calves become sexually mature in about 8 years. Females are believed to calve about every three to four years. Sightings of right whales and their occurrence in the inshore waters of the State, although very rare, are generally assumed to represent individuals seen during this migration.

Right whales feed primarily on copepods and euphausids. They swim very close to the shoreline, often noted only a few hundred meters offshore. Because of their habit of traveling near the coast, there is concern over impacts resulting from collisions with boats and ships. Some right whales have been observed to bear propeller scars on their backs resulting from collisions with boats (NMFS, 1984). Destruction or pollution of right whale habitat is not known to be a problem in the project area.

Critical Habitat.

The proposed action area falls within a small portion of the critical calving habitat for NARWs. NMFS defines in the rule (81 FR 4837) the physical features that are essential to the conservation of the NARW as being: "(1) Sea surface conditions associated with Force 4 or less on the Beaufort Scale; (2) Sea surface temperatures of 7°C to 17°C; and (3) Water depths of 6 to 28 meters, where these features simultaneously co-occur over contiguous areas of at least 231 km^2 of ocean waters during the months of November through April." NMFS notes that the critical habitat was designated based in part on 2 models that predict calving habitat, and that the habitat extends from New Smyrna, FL to Cape Fear, NC between 10 and 50 km from shore (Figure 11). NMFS also notes that the essential features of NARW calving habitat may require special management considerations because of: offshore energy development, large-scale offshore aquaculture operations, and global climate change. The concern with the first two of these is more in fragmenting habitat than any changes to the 3 PCE's. Infrastructure that could limit the availability of essential features such that NARWs are not able to move about could have a negative impact on calving critical habitat. NMFS also identified 5 categories of activities that have the potential to affect essential features. One of these is USACE maintenance dredging or permitting of dredging and disposal activities under the Clean Water Act.

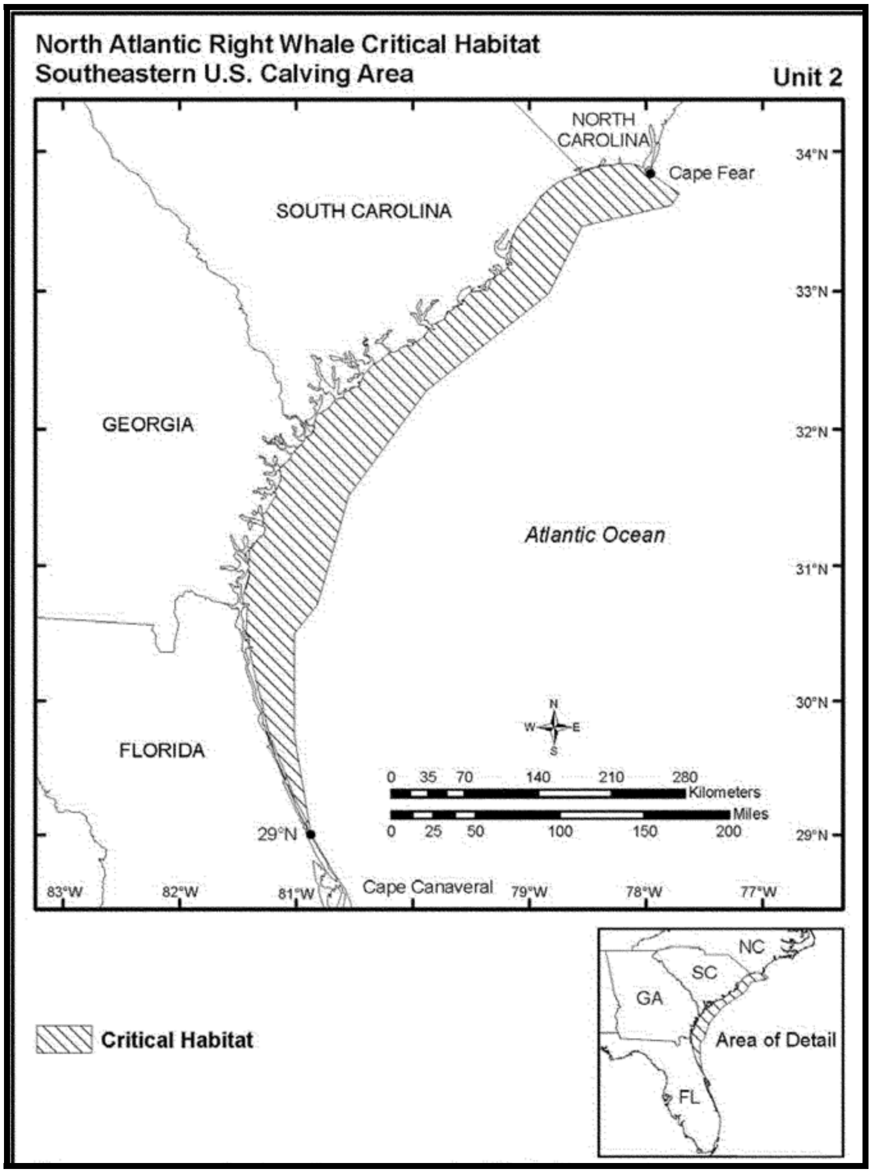

Figure 11. North Atlantic right whale (NARW) critical habitat area for the southeastern calving whales (81 FR 4837 / NOAA-NMFS-2016-01633)

The proposed project consists of the dredging and placement of material for beach placement; however, this activity is unlikely to adversely affect essential habitat features of the right whale calving area. Excavation and disposal of dredge material does not affect water temperature or sea surface roughness. Water depth would only be slightly modified by the dredging of borrow areas and disposal of dredge material at designated sites. The proposed action would occur only in relatively small areas of the overall critical habitat. Changes in water depth within entrance channels, offshore disposal sites, or borrow areas are not likely to affect the selectability of calving habitat features by right whales, nor will the actions significantly alter the PCEs or create an impediment to migration through the calving grounds. USACE and BOEM have evaluated the rule for NARW critical habitat and have determined that the proposed action will have discountable effects on the new NARW designated critical habitat. USACE and BOEM are currently consulting with NMFS on this designation on a regional level and no consultation is needed for this BA.

Effect Determination

Of these six species of whales being considered, only the right whale would normally be expected to occur within the project area during the construction period; therefore the other species of whales are not likely to be affected. The majority of right whale sightings occur from December through February. Since the proposed work is expected to occur during this time period, the dredge will be required to have endangered species observers standing watch on the bridge of the dredge to look for whales during construction. The presence of a hydraulic cutter-head pipeline or hopper dredge in this area should pose no direct impacts to the right whale, however, when relocating, the dredge and any supporting vessels are required to alter course and stop if necessary to avoid approaching whales. If whales are spotted during the day within 10 miles of the dredging operation, then the dredge is required to reduce transit speed at night, should it need to relocate during that time period. Corps contract specifications expressly require avoidance of right whales. For these reasons, it has been determined that the project as proposed is **not likely to adversely affect the right whale**. (The 29 October 1997 "National Marine Fisheries Service, Regional Biological Opinion on Hopper Dredging along the South Atlantic Coast" has jurisdiction on right whale effects)

7.0 SUMMARY OF PROTECTIVE MEASURES

West Indian Manatee

When work occurs during the manatee migration period, personnel will be advised that there are civil and criminal penalties for harming, harassing, or killing manatees. The Contractor may be held responsible for any manatee harmed, harassed, or killed as a result of vessel collisions or construction activities. Failure of the Contractor to follow these specifications is a violation of the Endangered Species Act and could result in prosecution of the Contractor under the Endangered Species Act or the Marine Mammals Protection Act. The standard manatee conditions will be implemented from 15 April to 31 October, if construction takes place during these months. The Contractor will be instructed to take necessary precautions to avoid any contact with manatees. If manatees are sighted within 100 yards of the dredging area, all appropriate precautions will be implemented to insure protection of the manatee. The Contractor will stop, alter course, or maneuver as necessary to avoid operating moving equipment (including watercraft) any closer than 100 yards of the manatee. Operation of equipment closer than 50 feet to a manatee will necessitate immediate shutdown of that equipment.

North Atlantic Right Whale

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

Sea Turtles

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

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

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

8.0 SUMMARY EFFECT DETERMINATION

This assessment has examined the potential impacts of the proposed project on designated habitat and listed species of plants and animals that are, or have been, present in the project area. Both primary and secondary impacts to habitat have been considered. Based on the analysis provided by this document, the following determinations have been made.

- It has been determined that the proposed project is not likely to adversely affect the manatee.
- It has been determined that the proposed project is not likely to adversely affect Kemp's ridley, leatherback, or hawksbill sea turtles.

- It has been determined that the proposed project will have no effect on the shortnose sturgeon.
- It has been determined that the proposed project will not adversely affect the Atlantic sturgeon.
- It has been determined that the proposed project is not likely to adversely affect the piping plover.
- It has been determined that the proposed project is not likely to adversely affect the rufa red knot.
- It has been determined that the proposed project is not likely to adversely affect seabeach amaranth.
- It has been determined that the proposed project will have no effect on critical habitat for the wintering piping plover.
- It has been determined that the proposed project may adversely affect the nesting loggerhead and green sea turtle and any resulting hatchlings.
- It has been determined that the proposed project will have no effect on critical habitat for the loggerhead sea turtle.
- It has been determined that the proposed project will not adversely modify critical habitat for the North Atlantic right whale.

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
176 Croghan Spur Road, Suite 200
Charleston, South Carolina 29407

June 7, 2017

Lt. Colonel Matthew W. Luzzatto
District Engineer
U.S. Army Corps of Engineers
69A Hagood Avenue
Charleston, S.C. 29403-5107

Attn: Mark Messersmith and Jesse Helton

Re: Myrtle Beach Storm Damage Reduction Project, Reaches 1 and 3
Horry County, South Carolina
FWS Log No. 04ES1000-2016-F-0409-R01

Dear Colonel Luzzatto:

This document is the U.S. Fish and Wildlife Service's (Service) revised Biological Opinion (BO) based on our review of the addition of Reach One to the Myrtle Beach Storm Damage Reduction Project, which includes beach renourishment in Horry County, South Carolina. This BO addresses effects on the green sea turtle (*Chelonia mydas*), leatherback sea turtle (*Dermochelys coriacea*), Northwest Atlantic population of the loggerhead sea turtle (*Caretta caretta*), piping plover (*Charadrius melodus*) and its critical habitat, red knot (*Calidris canutus rufa*), seabeach amaranth (*Amaranthus pumilus*), and West Indian manatee (*Trichechus manatus*) per section 7 of the Endangered Species Act of 1973, as amended (16 United States Code [U.S.C.] 1531 *et seq.*) (ESA).

Formal consultation was initiated on April 1, 2016, for Reach Three of the Myrtle Beach Storm Damage Reduction Project. Formal consultation was reinitiated on March 23, 2017, to include an additional reach, Reach One, of the Myrtle Beach Storm Damage Reduction Project. This BO is based on information provided in the draft Environmental Assessment (EA) received on April 1, 2016, and the draft EA received on March 23, 2017, respectively for the above-referenced projects and further communication with related parties. A complete administrative record of this consultation is on file at the South Carolina Ecological Services Field Office (SCFO), 176 Croghan Spur Road, Suite 200, Charleston, South Carolina 29407. The Service has assigned FWS Log No. 04ES1000-2016-F-0409-R01 to the Myrtle Beach Storm Damage Reduction Project for this revised consultation.

It is the Service's opinion that this project is not likely to adversely affect (NLAA) the following species and their habitat: the green sea turtle, leatherback sea turtle, piping plover and its designated critical habitat, red knot, seabeach amaranth, and West Indian manatee based on the following information (**Table 1**).

Table 1. Species and Critical Habitat Evaluated for Effects from the Proposed Action but not discussed further in this Biological Opinion.

SPECIES OR CRITICAL HABITAT	PRESENT IN ACTION AREA	PRESENT IN ACTION AREA BUT "NOT LIKELY TO BE ADVERSELY AFFECTED" BASED ON
Green sea turtle	Yes, but rare. Green sea turtle nests have been documented in low numbers on North Myrtle Beach, Surfside, and Waites Island beaches.	Protection measures in place for the loggerhead sea turtle.
Leatherback sea turtle	Possible, but rare. No Leatherback sea turtle nests have been documented on North Myrtle Beach, Surfside, or Waites Island beaches in the past 7 years.	Protection measures in place for the loggerhead sea turtle.
Red knot	Possible, but not present or in very low numbers.	No long term adverse impacts to the species' primary prey item *Donax* sp., which use exposed intertidal flats, are anticipated.
Piping plover	Possible, but present in very low numbers during fall and spring migration.	Infrequent use in low numbers during migration, current habitat conditions, and location of sand placement on the island is outside of preferred wintering habitat.
Piping plover critical habitat unit SC-2: Waites Island - South	Yes, but not within the project footprint	Located on adjacent island outside of the construction footprint. No adverse impacts are anticipated.
Seabeach amaranth	Possible, within southernmost part of historical range.	Absence of documentation of viable plants or seed sources.
West Indian manatee	Possible if water temperatures are >68°F.	Implementation of Standard Manatee Construction Conditions (**Appendix A**).

CONSULTATION HISTORY

April 1, 2016 – The Service received the U.S. Army Corps of Engineers' (Corps) draft Environmental Assessment (EA) for Reach Three of the Myrtle Beach Storm Damage Reduction Project.

April 28, 2016 – The Service sent a letter to the Corps acknowledging receipt of all information necessary to initiate the consultation.

May 10, 2016 – The Service received a letter from the Corps announcing the availability of the draft EA for the Myrtle Beach Storm Damage Reduction Project.

March 23, 2017 – The Service received the Corps' request to reinitiate formal consultation on the Myrtle Beach Storm Damage Reduction Project to include Reach One.

March 31, 2017 – The Service sent a letter to the Corps acknowledging receipt of all information necessary to reinitiate the consultation.

BIOLOGICAL OPINION

DESCRIPTION OF THE PROPOSED ACTION

Myrtle Beach Storm Damage Reduction Project, Reaches 1 and 3

The proposed action consists of constructing a protective storm berm and an advanced nourishment construction berm. The length of the dune and beachfill for Reach One is approximately 17,424 feet and 40,300 feet for Reach Three, respectively. The entire length of Reach One (45,500 feet) is not included in the proposed project. Only three hotspots that have extreme damage will receive beachfill within Reach One. The protective storm berm has a top elevation of 6.0 NAVD 88 and a crest width of 10 feet. The fore slope of the protective berm is 1 vertical to 20 horizontal down to natural ground. The advanced nourishment berm will be adjacent to the protective storm berm. The advance nourishment berm has a top elevation of 6.0 NAVD 88. The fore slope of the advance nourishment is 1 vertical to 5 horizontal down to elevation 2.0 NAVD 88 then a fore slope of 1 vertical to 20 horizontal down to the bottom. The project is anticipated to be constructed with a hopper dredge, booster pump, and land based heavy equipment and is anticipated to occur July 2017 through June 2018 lasting for approximately 10-11 months (**Figures 1 and 2**).

Figure 1. North Myrtle Beach (Reach 1) Project Footprint for Three Hotspots (Corps 2017)

Figure 2. Surfside Beach (Reach 3) Project Footprint (Corps 2016).

Conservation Measures

The Corps proposed the following conservation measures to minimize impacts to nesting sea turtles if the projects extend into nesting season **(Corps 2016, 2017)**

- If any construction of the project occurs during the period between May 1 and September 15, the dredging contractor will provide nighttime monitoring along the beach where construction is taking place to ensure the safety of female turtles attempting to nest. Cease construction activities if a sea turtle is sighted on an area of beach scheduled for fill until the turtle returns to the ocean. A buffer zone around the female will be imposed in the event of an attempt to nest.

- If any construction of the project occurs during the period between May 1 and September 15, daily nesting surveys will be conducted starting either May 1 or 65 days prior to the start of construction, whichever is later. These surveys will be performed between sunrise and 9:00 A.M. and will continue until the end of the project, or September 15, whichever is earlier. Any nests found in the area that will be impacted by construction activities will be moved to a safe location. The nesting surveys and nest relocations will only be performed by people with a valid South Carolina Department of Natural Resources (SCDNR) license.

- For construction activities occurring during the period May 1 through October 31, staging areas for equipment and supplies will be located off of the beach to the maximum extent possible.

- For construction activities occurring during the period May 1 through October 31, use of heavy equipment will be limited to the area undergoing placement of material.

- For construction activities occurring during the period May 1 through October 31, all on-beach lighting associated with the project will be limited to the minimum amount necessary around active construction areas to satisfy Occupational Safety and Health Administration (OSHA) requirements.

- For construction activities occurring during the period May 1 through October 31, use predator proof trash receptacles to minimize presence of species that prey upon hatchlings.

- The Corps will adhere to all terms and conditions of the South Atlantic Regional Biological Opinion which evaluates in-water impacts on sea turtles, sturgeon and large whales.

- The Service and SCDNR will be notified immediately if a sea turtle, nest, or hatchlings are impacted by the construction.

- Immediately after completion of the project, the Corps will perform tilling to a depth of at least 24 inches in order to reduce compaction associated with newly placed sand. Visual surveys for escarpments along the project area will be made immediately after completion of the project and prior to May 1 for 3 subsequent years, if needed. Results of the surveys will be submitted to the Service prior to any action being taken. The Service will be contacted immediately if subsequent reformation of escarpments exceeding 18 inches in height for a distance of 100 feet occurs during nesting and hatching season. This coordination will determine what appropriate action must be taken. An annual summary of escarpment surveys and action taken will be submitted to the Service.

Refer to the Reasonable and Prudent Measures and Terms and Conditions (p. 34) to see how these proposed conservation measures have been modified.

Action Area

The "action area" is defined in 50 CFR 402.02 Interagency Cooperation as all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action. The Service has described the action area to include Garden City Beach, Surfside Beach, and Myrtle Beach, and North Myrtle Beach, and Waites Island for reasons explained and discussed beginning on page 29 in the "Status of the species within the action area" section of this consultation (**Figure 3**).

Figure 3. Reaches One and Three of the Myrtle Beach Storm Damage Reduction Project Action Area.

Loggerhead Sea Turtle

The Service and National Marine Fisheries Service (NMFS) share Federal jurisdiction for sea turtles under the ESA. The Service has responsibility for sea turtles on the nesting beach. The NMFS has jurisdiction for sea turtles in the marine environment. In accordance with the ESA, the Service completes consultations with all Federal agencies for actions that may adversely affect sea turtles on the nesting beach. The Service's analysis only addresses activities that may impact nesting sea turtles, their nests and eggs, and hatchlings as they emerge from the nest and crawl to the sea. NMFS assesses and consults with Federal agencies concerning potential impacts to sea turtles in the marine environment, including updrift and downdrift nearshore areas affected by sand placement projects on the beach.

STATUS OF THE SPECIES/CRITICAL HABITAT

Listing

The loggerhead sea turtle, which occurs throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans, was federally listed worldwide as a threatened species on July 28, 1978 (43 Federal Register (FR) 32800). On September 22, 2011, the loggerhead sea turtle's listing under the ESA was revised from a single threatened species to nine distinct population segments (DPS) listed as either threatened or endangered.

The nine DPSs and their statuses are:

Northwest Atlantic Ocean DPS – threatened
Northeast Atlantic Ocean – endangered
Mediterranean Sea DPS – endangered
South Atlantic Ocean DPS – threatened
North Pacific Ocean DPS – endangered
South Pacific Ocean DPS – endangered
North Indian Ocean DPS – endangered
Southwest Indian Ocean – threatened
Southeast Indo-Pacific Ocean DPS – threatened

The loggerhead sea turtle grows to an average weight of about 200 pounds and is characterized by a large head with blunt jaws. Adults and subadults have a reddish-brown carapace. Scales on the top of the head and top of the flippers are also reddish-brown with yellow on the borders. Hatchlings are a dull brown color (NMFS 2009). The loggerhead feeds on mollusks, crustaceans, fish, and other marine animals.

The loggerhead may be found hundreds of miles out to sea, as well as in inshore areas such as bays, lagoons, salt marshes, creeks, ship channels, and the mouths of large rivers. Coral reefs, rocky places, and shipwrecks are often used as feeding areas. Within the Northwest Atlantic, the majority of nesting activity occurs from April through September, with a peak in June and July (Williams-Walls *et al.* 1983, Dodd 1988, Weishampel *et al.* 2006). Nesting occurs within the Northwest Atlantic along the coasts of North America, Central America, northern South America, the Antilles, Bahamas, and Bermuda, but is concentrated in the southeastern U.S. and on the Yucatán Peninsula in Mexico on open beaches or along narrow bays having suitable sand (Sternberg 1981, Ehrhart 1989, Ehrhart *et al.* 2003, NMFS and USFWS 2008).

Designated Critical Habitat

On July 10, 2014, the Service published the final rule to designate critical habitat in the terrestrial environment for the Northwest Atlantic Ocean Distinct Population Segment of the loggerhead sea turtle (79 FR 39755). In total, 1,102.1 kilometers (km) (684.8 miles) of loggerhead sea turtle nesting beaches have been designated as critical habitat in the terrestrial environment in the States of North Carolina, South Carolina, Georgia, Florida, Alabama, and Mississippi.

Critical Habitat Physical or Biological Features (PBFs)

In accordance with section 3(5)(A)(i) and 4(b)(1)(A) of the ESA and regulations at 50 CFR 424.12, in determining which areas within the geographical area occupied by the species at the time of listing to designate as critical habitat, the Service considers the physical or biological features (PBFs) that are essential to the conservation of the species and which may require special management considerations or protection.
These include, but are not limited to:

(1) Space for individual and population growth and for normal behavior;
(2) Food, water, air, light, minerals, or other nutritional or physiological requirements;
(3) Cover or shelter;
(4) Sites for breeding, reproduction, or rearing (or development) of offspring; and
(5) Habitats that are protected from disturbance or are representative of the historical, geographic, and ecological distributions of a species.

The Service derived the specific physical or biological features essential for the loggerhead sea turtle from studies of this species' habitat, ecology, and life history based on the following methods. Shaffer and Stein (2000) identify a methodology for conserving imperiled species known as the "three Rs": representation, resiliency, and redundancy. Representation, or preserving some of everything, means conserving not just a species but its associated habitats. Resiliency means ensuring that the habitat is adequate for a species and its representative components. Redundancy ensures an adequate number of sites and individuals. Together, resiliency and redundancy ensures that species can survive into the future. This methodology has been widely accepted as a reasonable conservation strategy (Tear *et al.* 2005). In applying this strategy to terrestrial critical habitat for loggerheads, we have determined that it is important to conserve: (1) Beaches that have the highest nesting densities (representation); (2) beaches that have a good geographic spatial distribution to ensure protection of genetic diversity (resiliency and redundancy); (3) beaches that collectively provide a good representation of total nesting (representation); and (4) beaches adjacent to the high density nesting beaches that can serve as expansion areas and provide sufficient habitat to accommodate and provide a rescue effect for nesting females whose primary nesting beach has been lost (resiliency and redundancy). Therefore, we have determined that the following physical or biological features are essential for the loggerhead sea turtle (79 FR 39755):

PBF 1 – Sites for Breeding, Reproduction, or Rearing (or Development) of Offspring

PBF 2 – Habitats Protected From Disturbance or Representative of the Historical, Geographic, and Ecological Distributions of the Species

Critical Habitat Primary Constituent Elements (PCEs)

Under the ESA and its implementing regulations, the Service is required to identify the physical or biological features essential to the conservation of the loggerhead sea turtle in areas occupied at the time of listing, focusing on the features' primary constituent elements (PCEs). We consider primary constituent elements to be those specific elements of the physical or biological features that provide for a species' life-history processes and are essential to the conservation of the species.

Based on our current knowledge of the physical or biological features and habitat characteristics required to sustain the species' life-history processes, we determine that the terrestrial primary constituent elements specific to the Northwest Atlantic Ocean DPS of the loggerhead sea turtle are:

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

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

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

PCE 4 – Natural coastal processes or artificially created or maintained habitat mimicking natural conditions.

Life history

Loggerheads are long-lived, slow-growing animals that use multiple habitats across entire ocean basins throughout their life history. This complex life history encompasses terrestrial, nearshore, and open ocean habitats. The three basic ecosystems in which loggerheads live are the:

1. Terrestrial zone (supralittoral) - the nesting beach where oviposition (egg laying) and embryonic development and hatching occur.

2. Neritic zone - the inshore marine environment (from the surface to the sea floor) where water depths do not exceed 656 feet. The neritic zone generally includes the continental shelf, but in areas where the continental shelf is very narrow or nonexistent, the neritic zone conventionally extends to areas where water depths are less than 656 feet.

3. Oceanic zone - the vast open ocean environment (from the surface to the sea floor) where water depths are greater than 656 feet.

Maximum intrinsic growth rates of sea turtles are limited by the extremely long duration of the juvenile stage and fecundity. Loggerheads require high survival rates in the juvenile and adult stages, which are common constraints critical to maintaining long-lived, slow-growing species, to achieve positive or stable long-term population growth (Congdon *et al.* 1993, Heppell 1998, Crouse 1999, Heppell *et al.* 1999, 2003, Musick 1999).

The generalized life history of Atlantic loggerheads is shown in **Figure 4** (from Bolten 2003).

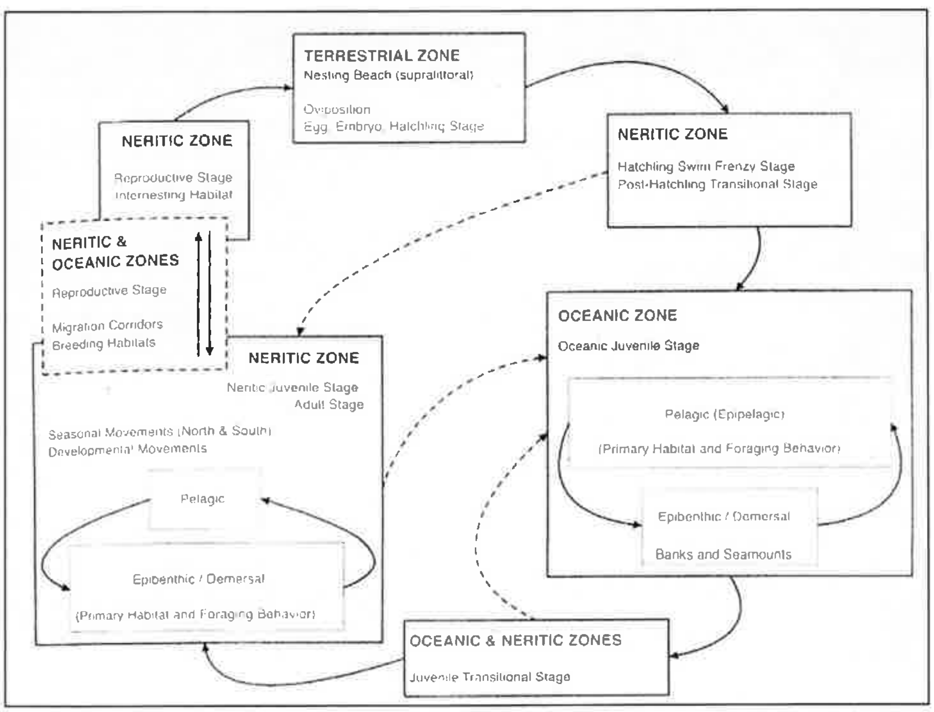

Figure 4. Life history stages of a loggerhead turtle. The boxes represent life stages and the corresponding ecosystems, solid lines represent movements between life stages and ecosystems, and dotted lines are speculative (Bolten 2003).

Numbers of nests and nesting females are often highly variable from year to year due to a number of factors including environmental stochasticity, periodicity in ocean conditions, anthropogenic effects, and density-dependent and density-independent factors affecting survival, somatic growth, and reproduction (Meylan 1982, Hays 2000, Chaloupka 2001, Solow *et al.* 2002). Despite these sources of variation, and because female turtles exhibit strong nest site fidelity, a nesting beach survey can provide a valuable assessment of changes in the adult female population, provided that the study is sufficiently long and effort and methods are standardized (Meylan 1982, Gerrodette and Brandon 2000, Reina *et al.* 2002). **Table 2** summarizes key life history characteristics for loggerheads nesting in the U.S.

Table 2. Typical values of life history parameters for loggerheads nesting in the U.S. (NMFS and USFWS 2008).

Life History Trait	Data
Clutch size (mean)	100-126 eggs[1]
Incubation duration (varies depending on time of year and latitude)	Range = 42-75 days[2,3]
Pivotal temperature (incubation temperature that produces an equal number of males and females)	84°F[5]
Nest productivity (emerged hatchlings/total eggs) x 100 (varies depending on site specific factors)	45-70 percent[2,6]
Clutch frequency (number of nests/female/season)	3-4 nests[7]
Internesting interval (number of days between successive nests within a season)	12-15 days[8]
Juvenile (<34 inches Curved Carapace Length) sex ratio	65-70 percent female[4]
Remigration interval (number of years between successive nesting migrations)	2.5-3.7 years[9]
Nesting season	late April-early September
Hatching season	late June-early November
Age at sexual maturity	32-35 years[10]
Life span	>57 years[11]

1 Dodd (1988).
2 Dodd and Mackinnon (1999, 2000, 2001, 2002, 2003, 2004).
3 Witherington (2006) (information based on nests monitored throughout Florida beaches in 2005, n = 865).
4 NMFS (2001); Foley (2005).
5 Mrosovsky (1988).
6 Witherington (2006) (information based on nests monitored throughout Florida beaches in 2005, n = 1,680).
7 Murphy and Hopkins (1984); Frazer and Richardson (1985); Hawkes *et al.* 2005; Scott 2006.
8 Dodd (1988).
9 Richardson *et al.* (1978); Bjorndal *et al.* (1983).
10 Snover (2005).
11 Dahlen *et al.* (2000).

Loggerheads nest on ocean beaches and occasionally on estuarine shorelines with suitable sand. Nests are typically laid between the high tide line and the dune front (Routa 1968, Witherington 1986, Hailman and Elowson 1992). Wood and Bjorndal (2000) evaluated four environmental factors (slope, temperature, moisture, and salinity) and found that slope had the greatest influence on loggerhead nest-site selection on a beach in Florida. Loggerheads appear to prefer relatively narrow, steeply sloped, coarse-grained beaches, although nearshore contours may also play a role in nesting beach site selection (Provancha and Ehrhart 1987).

The warmer the sand surrounding the egg chamber, the faster the embryos develop (Mrosovsky and Yntema 1980). Sand temperatures prevailing during the middle third of the incubation period also determine the sex of hatchling sea turtles (Mrosovsky and Yntema 1980). Incubation temperatures near the upper end of the tolerable range produce only female hatchlings while incubation temperatures near the lower end of the tolerable range produce only male hatchlings.

Loggerhead hatchlings pip and escape from their eggs over a 1- to 3-day interval and move upward and out of the nest over a 2- to 4-day interval (Christens 1990). The time from pipping to emergence ranges from 4 to 7 days with an average of 4.1 days (Godfrey and Mrosovsky 1997). Hatchlings emerge from their nests en masse almost exclusively at night, and presumably using decreasing sand temperature as a cue (Hendrickson 1958, Mrosovsky 1968, Witherington *et al.* 1990). Moran *et al.* (1999) concluded that a lowering of sand temperatures below a critical threshold, which most typically occurs after nightfall, is the most probable trigger for hatchling emergence from a nest. After an initial emergence, there may be secondary emergences on subsequent nights (Carr and Ogren 1960, Witherington 1986, Ernest and Martin 1993, Houghton and Hays 2001).

Hatchlings use a progression of orientation cues to guide their movement from the nest to the marine environments where they spend their early years (Lohmann and Lohmann 2003). Hatchlings first use light cues to find the ocean. On naturally lighted beaches without artificial lighting, ambient light from the open sky creates a relatively bright horizon compared to the dark silhouette of the dune and vegetation landward of the nest. This contrast guides the hatchlings to the ocean (Daniel and Smith 1947, Limpus 1971, Salmon *et al.* 1992, Witherington and Martin 1996, Witherington 1997, Stewart and Wyneken 2004).

Loggerheads in the Northwest Atlantic display complex population structure based on life history stages. Based on mitochondrial deoxyribonucleic acid (mtDNA), oceanic juveniles show no structure, neritic juveniles show moderate structure, and nesting colonies show strong structure (Bowen *et al.* 2005). In contrast, a survey using microsatellite (nuclear) markers showed no significant population structure among nesting populations (Bowen *et al.* 2005), indicating that while females exhibit strong philopatry, males may provide an avenue of gene flow between nesting colonies in this region.

Population dynamics

The loggerhead occurs throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian Oceans (Dodd 1988). However, the majority of loggerhead nesting is at the western rims of the Atlantic and Indian Oceans. The most recent reviews show that only two loggerhead nesting beaches have greater than 10,000 females nesting per year (Baldwin *et al.* 2003, Ehrhart *et al.* 2003, Kamezaki *et al.* 2003, Limpus and Limpus 2003, Margaritoulis *et al.* 2003): Peninsular Florida (U.S.) and Masirah (Oman). Those beaches with 1,000 to 9,999 females nesting each year are Georgia through North Carolina (U.S.), Quintana Roo and Yucatán (Mexico), Cape Verde Islands (Cape Verde, eastern Atlantic off Africa), and Western Australia (Australia). Smaller nesting aggregations with 100 to 999 nesting females annually occur in the Northern Gulf of Mexico (U.S.), Dry Tortugas (U.S.), Cay Sal Bank (Bahamas), Sergipe and Northern Bahia (Brazil), Southern Bahia to Rio de Janerio (Brazil), Tongaland (South Africa), Mozambique, Arabian Sea Coast (Oman), Halaniyat Islands (Oman), Cyprus, Peloponnesus (Greece), Island of Zakynthos (Greece), Turkey, Queensland (Australia), and Japan.

The loggerhead is commonly found throughout the North Atlantic including the Gulf of Mexico, the northern Caribbean, the Bahamas archipelago, and eastward to West Africa, the western Mediterranean, and the west coast of Europe.

The major nesting concentrations in the U.S. are found in South Florida. However, loggerheads nest from Texas to Virginia. Total estimated nesting in the U.S. has fluctuated between 49,000 and 90,000 nests per year from 1999-2010 (NMFS and Service 2008, FWC/FWRI 2010). About 80 percent of loggerhead nesting in the southeast U.S. occurs in six Florida counties (Brevard, Indian River, St. Lucie, Martin, Palm Beach, and Broward Counties). Adult loggerheads are known to make considerable migrations between foraging areas and nesting beaches (Schroeder *et al.* 2003, Foley *et al.* 2008). During non-nesting years, adult females from U.S. beaches are distributed in waters off the eastern U.S. and throughout the Gulf of Mexico, Bahamas, Greater Antilles, and Yucatán.

From a global perspective, the U.S. nesting aggregation is of paramount importance to the survival of the species as is the population that nests on islands in the Arabian Sea off Oman (Ross 1982, Ehrhart 1989, Baldwin *et al.* 2003). Based on standardized daily surveys of the highest nesting beaches and weekly surveys on all remaining island nesting beaches, approximately 50,000, 67,600, and 62,400 nests, were estimated in 2008, 2009, and 2010, respectively (Conant *et al.* 2009). The status of the Oman loggerhead nesting population, reported to be the largest in the world (Ross 1979), is uncertain because of the lack of long-term standardized nesting or foraging ground surveys and its vulnerability to increasing development pressures near major nesting beaches and threats from fisheries interaction on foraging grounds and migration routes (Possardt 2005). The loggerhead nesting aggregations in Oman and the U.S. account for the majority of nesting worldwide.

Status and distribution

Five recovery units have been identified in the Northwest Atlantic based on genetic differences and a combination of geographic distribution of nesting densities, geographic separation, and geopolitical boundaries (NMFS and USFWS 2008). Recovery units are subunits of a listed species that are geographically or otherwise identifiable and essential to the recovery of the species. Recovery units are individually necessary to conserve genetic robustness, demographic robustness, important life history stages, or some other feature necessary for long-term sustainability of the species. The five recovery units identified in the Northwest Atlantic are:

1. Northern Recovery Unit (NRU) - defined as loggerheads originating from nesting beaches from the Florida-Georgia border through southern Virginia (the northern extent of the nesting range);

2. Peninsula Florida Recovery Unit (PFRU) - defined as loggerheads originating from nesting beaches from the Florida-Georgia border through Pinellas County on the west coast of Florida, excluding the islands west of Key West, Florida;

3. Dry Tortugas Recovery Unit (DTRU) - defined as loggerheads originating from nesting beaches throughout the islands located west of Key West, Florida;

4. Northern Gulf of Mexico Recovery Unit (NGMRU) - defined as loggerheads originating from nesting beaches from Franklin County on the northwest Gulf coast of Florida through Texas; and

5. Greater Caribbean Recovery Unit (GCRU) - composed of loggerheads originating from all other nesting assemblages within the Greater Caribbean (Mexico through French Guiana, The Bahamas, Lesser Antilles, and Greater Antilles).

The mtDNA analyses show that there is limited exchange of females among these recovery units (Ehrhart 1989, Foote *et al.* 2000, NMFS 2001, Hawkes *et al.* 2005). Based on the number of haplotypes, the highest level of loggerhead mtDNA genetic diversity in the Northwest Atlantic has been observed in females of the GCRU that nest at Quintana Roo, Mexico (Encalada *et al.* 1999, Nielsen 2010).

Nuclear DNA analyses show that there are no substantial subdivisions across the loggerhead nesting colonies in the southeastern U.S. Male-mediated gene flow appears to be keeping the subpopulations genetically similar on a nuclear DNA level (Francisco-Pearce 2001).

Historically, the literature has suggested that the northern U.S. nesting beaches (NRU and NGMRU) produce a relatively high percentage of males and the more southern nesting beaches (PFRU, DTRU, and GCRU) a relatively high percentage of females (e.g., Hanson *et al.* 1998, NMFS 2001, Mrosovsky and Provancha 1989). The NRU and NGMRU were believed to play an important role in providing males to mate with females from the more female-dominated subpopulations to the south. However, in 2002 and 2003, researchers studied loggerhead sex ratios for two of the U.S. nesting subpopulations, the northern and southern subpopulations (NGU and PFRU, respectively) (Blair 2005, Wyneken *et al.* 2005). The study produced interesting results. In 2002, the northern beaches produced more females and the southern beaches produced more males than previously believed. However, the opposite was true in 2003 with the northern beaches producing more males and the southern beaches producing more females in keeping with prior literature. Wyneken *et al.* (2005) speculated that the 2002 result may have been anomalous; however, the study did point out the potential for males to be produced on the southern beaches. Although this study revealed that more males may be produced on southern recovery unit beaches than previously believed, the Service maintains that the NRU and NGMRU play an important role in the production of males to mate with females from the more southern recovery units.

The NRU is the second largest loggerhead recovery unit within the Northwest Atlantic Ocean DPS. Annual nest totals from northern beaches averaged 5,215 nests from 1989-2008, a period of near-complete surveys of NRU nesting beaches, representing approximately 1,272 nesting females per year (4.1 nests per female, Murphy and Hopkins 1984) (NMFS and USFWS 2008). Nesting in Georgia reached a new record in 2011 (2,004) followed by another record in 2012 (2,245 nests). South Carolina had the two highest years of nesting in the 2000s in 2011 (4,024 nests) and 2012 (4,628 nests). North Carolina had 967 nests in 2011 and 1103 nests in 2012, which is above the average of 715. The Georgia, South Carolina, and North Carolina nesting data come from the seaturtle.org Sea Turtle Nest Monitoring System, which is populated with data input by the State agencies. The loggerhead nesting trend from daily beach surveys was declining significantly at 1.3 percent annually from 1983 to 2007 (NMFS and Service 2008). Nest totals from aerial surveys conducted by the SCDNR showed a 1.9 percent annual decline in nesting in South Carolina from 1980-2007. Overall, there is strong statistical data to suggest the NRU has experienced a long-term decline (NMFS and USFWS 2008). Currently, however, nesting for the NRU is showing possible signs of stabilizing (76 FR 58868, September 22, 2011).

The PFRU is the largest loggerhead recovery unit within the Northwest Atlantic Ocean DPS and represents approximately 87 percent of all nesting effort in the DPS (Ehrhart *et al.* 2003). A near-complete nest census of the PFRU undertaken from 1989 to 2007 revealed a mean of 64,513 loggerhead nests per year representing approximately 15,735 females nesting per year (4.1 nests per female, Murphy and Hopkins 1984) (FWC 2008, NMFS and USFWS 2008). This near-complete census provides the best statewide estimate of total abundance, but because of variable survey effort, these numbers cannot be used to assess trends. Loggerhead nesting trends are best assessed using standardized nest counts made at Index Nesting Beach Survey (INBS) sites surveyed with constant effort over time. In 1979, the Statewide Nesting Beach Survey (SNBS) program was initiated to document the total distribution, seasonality, and abundance of sea turtle nesting in Florida. In 1989, the INBS program was initiated in Florida to measure seasonal productivity, allowing comparisons between beaches and between years (FWC 2009). Of the 190 SNBS surveyed areas, 33 participate in the INBS program (representing 30 percent of the SNBS beach length). Using INBS nest counts, a significant declining trend was documented for the Peninsular Florida Recovery Unit, where nesting declined 26 percent over the 20-year period from 1989–2008, and declined 41 percent over the period 1998-2008 (NMFS and USFWS 2008, Witherington *et al.* 2009). However, with the addition of nesting data through 2010, the nesting trend for the PFRU did not show a nesting decline statistically different from zero (76 FR 58868, September 22, 2011).

The NGMRU is the third largest nesting assemblage among the four U.S. recovery units. Nesting surveys conducted on approximately 186 miles of beach within the NGMRU (Alabama and Florida only) were undertaken between 1995 and 2007 (statewide surveys in Alabama began in 2002). The mean nest count during this 13-year period was 906 nests per year, which equates to about 221 females nesting per year (4.1 nests per female, Murphy and Hopkins 1984, FWC 2008, NMFS and USFWS 2008). Evaluation of long-term nesting trends for the NGMRU is difficult because of changed and expanded beach coverage. Loggerhead nesting trends are best assessed using standardized nest counts made at INBS sites surveyed with constant effort over time. Using Florida INBS data for the NGMRU (FWC 2008), a log-linear regression showed a significant declining trend of 4.7 percent annually from 1997-2008 (NMFS and USFWS 2008).

The DTRU, located west of the Florida Keys, is the smallest of the identified recovery units. A near-complete nest census of the DTRU was undertaken from 1995 to 2004, excluding 2002, (9 years surveyed) revealed a mean of 246 nests per year, which equates to about 60 females nesting per year (4.1 nests per female, Murphy and Hopkins 1984, FWC 2008, NMFS and USFWS 2008). The nesting trend data for the DTRU are from beaches that are not part of the INBS program, but are part of the SNBS program. A simple linear regression of 1995-2004 nesting data, accounting for temporal autocorrelation, revealed no trend in nesting numbers. Because of the annual variability in nest totals, it was determined that a longer time series is needed to detect a trend (NMFS and USFWS 2008).

The GCRU is composed of all other nesting assemblages of loggerheads within the Greater Caribbean and is the third largest recovery unit within the Northwest Atlantic Ocean DPS, with the majority of nesting at Quintana Roo, Mexico. Statistically valid analyses of long-term nesting trends for the entire GCRU are not available because there are few long-term standardized nesting surveys representative of the region. Additionally, changing survey effort at monitored beaches and scattered and low-level nesting by loggerheads at many locations currently precludes comprehensive analyses. The most complete data are from Quintana Roo and Yucatán, Mexico, where an increasing trend was reported over a 15-year period from 1987-2001 (Zurita *et al.* 2003). However, TEWG (2009) reported a greater than 5 percent annual decline in loggerhead nesting from 1995-2006 at Quintana Roo.

Threats to the Loggerhead Sea Turtle

Anthropogenic (human) factors that impact hatchlings and adult female turtles on land, or the success of nesting and hatching include: beach erosion, armoring and nourishment; artificial lighting; beach cleaning; increased human presence; recreational beach equipment; beach driving; coastal construction and fishing piers; exotic dune and beach vegetation; and poaching. An increased human presence at some nesting beaches or close to nesting beaches has led to secondary threats such as the introduction of exotic fire ants, feral hogs, dogs, and an increased presence of native species (*e.g.*, raccoons, armadillos, and opossums), which raid and feed on turtle eggs. Although sea turtle nesting beaches are protected along large expanses of the western North Atlantic coast, other areas along these coasts have limited or no protection.

Loggerhead turtles are affected by a completely different set of anthropogenic threats in the marine environment. These include oil and gas exploration and transportation; marine pollution; underwater explosions; hopper dredging, offshore artificial lighting; power plant entrainment and/or impingement; entanglement in debris; ingestion of marine debris; marina and dock construction and operation; boat collisions; poaching, and fishery interactions. In the oceanic environment, loggerheads are exposed to a series of longline fisheries that include the U.S. Atlantic tuna and swordfish longline fisheries, an Azorean longline fleet, a Spanish longline fleet, and various fleets in the Mediterranean Sea (Aguilar *et al.* 1995; Bolten *et al.* 1994; Crouse 1999). There is particular concern about the extensive incidental take of juvenile loggerheads in the eastern Atlantic by longline fishing vessels. In the neritic environment in waters off the coastal U.S., loggerheads are exposed to a suite of fisheries in Federal and State waters including trawl, purse seine, hook and line, gillnet, pound net, longline, dredge, and trap fisheries (NMFS and USFWS 2007).

Coastal Development

Loss of nesting habitat related to coastal development has had the greatest impact on nesting sea turtles. Beachfront development not only causes the loss of suitable nesting habitat, but can result in the disruption of powerful coastal processes accelerating erosion and interrupting the natural shoreline migration (National Research Council 1990b). This may in turn cause the need to protect upland structures and infrastructure by armoring, groin placement, beach emergency berm construction and repair, and beach nourishment, all of which cause changes in, additional loss of, or impact to the remaining sea turtle habitat. Rice (2012b) identified that approximately 856 miles (40%) of sandy beaches from North Carolina to Texas have been developed (**Table 3**).

Table 3. The lengths and percentages of sandy oceanfront beach in each state that are developed, undeveloped, and preserved as of December 2011 (Rice 2012b).

State	Approximate Shoreline Beach Length (miles)	Approximate Miles of Beach Developed (percent of total shoreline length)	Approximate Miles of Beach Undeveloped (percent of total shoreline length)[a]	Approximate Miles of Beach Preserved (percent of total shoreline length)[b]
North Carolina	326	159 (49%)	167 (51%)	178.7 (55%)
South Carolina	182	93 (51%)	89 (49%)	84 (46%)
Georgia	90	15 (17%)	75 (83%)	68.6 (76%)
Florida	809	459 (57%)	351 (43%)	297.5 (37%)
-Atlantic	*372*	*236 (63%)*	*136 (37%)*	*132.4 (36%)*
-Gulf	*437*	*223 (51%)*	*215 (49%)*	*168.0. (38%)*
Alabama	46	25 (55%)	21 (45%)	11.2 (24%)
Mississippi barrier island coast	27	0 (0%)	27 (100%)	27 (100%)
Mississippi mainland coast	51[c]	41 (80%)	10 (20%)	12.6 (25%)
Louisiana	218	13 (6%)	205 (94%)	66.3 (30%)
Texas	370	51 (14%)	319 (86%)	152.7 (41%)
TOTAL	**2,119**	**856 (40%)**	**1,264 (60%)**	**901.5 (43%)**

[a] Beaches classified as "undeveloped" occasionally include a few scattered structures.

[b] Preserved beaches include public ownership, ownership by non-governmental conservation organizations, and conservation easements. The miles of shoreline that have been preserved generally overlap with the miles of undeveloped beach but may also include some areas (e.g., in North Carolina) that have been developed with recreational facilities or by private inholdings.

[c] The mainland Mississippi coast along Mississippi Sound includes 51.3 miles of sandy beach as of 2010-2011, out of approximately 80.7 total shoreline miles (the remaining portion is non-sandy, either marsh or armored coastline with no sand). See Rice 2012b for details.

Hurricanes

Hurricanes were probably responsible for maintaining coastal beach habitat upon which sea turtles depend through repeated cycles of destruction, alteration, and recovery of beach and dune habitat. Hurricanes generally produce damaging winds, storm tides and surges, and rain, which can result in severe erosion of the beach and dune systems. Overwash and blowouts are common on barrier islands. Hurricanes and other storms can result in the direct loss of sea turtle nests, either by erosion or washing away of the nests by wave action and inundation or "drowning" of the eggs or pre-emergent hatchlings within the nest, or indirectly by causing the loss of nesting habitat. Depending on their frequency, storms can affect sea turtles on either a short-term basis (nests lost for one season and/or temporary loss of nesting habitat) or long-term, if frequent (habitat unable to recover). The manner in which hurricanes affect sea turtle nesting also depends on their characteristics (winds, storm surge, rainfall), the time of year (within or outside of the nesting season), and where the northeast edge of the hurricane crosses land.

Because of the limited remaining nesting habitat in a natural state with no immediate development landward of the sandy beach, frequent or successive severe weather events could threaten the ability of certain sea turtle populations to survive and recover. Sea turtles evolved under natural coastal environmental events such as hurricanes. The extensive amount of predevelopment coastal beach and dune habitat allowed sea turtles to survive even the most severe hurricane events. It is only within the last 20 to 30 years that the combination of habitat loss to beachfront development and destruction of remaining habitat by hurricanes has increased the threat to sea turtle survival and recovery. On developed beaches, typically little space remains for sandy beaches to become reestablished after periodic storms. While the beach itself moves landward during such storms, reconstruction or persistence of structures at their pre-storm locations can result in a loss of nesting habitat.

Erosion

A critically eroded area is a segment of shoreline where natural processes or human activity have caused or contributed to erosion and recession of the beach or dune system to such a degree that upland development, recreational interests, wildlife habitat, or important cultural resources are threatened or lost. Critically eroded areas may also include peripheral segments or gaps between identified critically eroded areas because, although they may be stable or slightly erosional now, their inclusion is necessary for continuity of management of the coastal system or for the design integrity of adjacent beach management projects (FDEP 2009). It is important to note that for an erosion problem area to be critical there must be an existing threat to or loss of one of four specific interests – upland development, recreation, wildlife habitat, or important cultural resources.

Beachfront Lighting

Artificial lights along a beach can deter females from coming ashore to nest or misdirect females trying to return to the surf after a nesting event. A significant reduction in sea turtle nesting activity has been documented on beaches illuminated with artificial lights (Witherington 1992). Artificial beachfront lighting may also cause disorientation (loss of bearings) and misorientation (incorrect orientation) of sea turtle hatchlings. Visual signs are the primary sea-finding mechanism for hatchlings (Mrosovsky and Carr 1967, Mrosovsky and Shettleworth 1968, Dickerson and Nelson 1989, Witherington and Bjorndal 1991). Artificial beachfront lighting is a documented cause of hatchling disorientation and misorientation on nesting beaches (Philibosian 1976, Mann 1977, Witherington and Martin

1996). The emergence from the nest and crawl to the sea is one of the most critical periods of a sea turtle's life. Hatchlings that do not make it to the sea quickly become food for ghost crabs, birds, and other predators, or become dehydrated and may never reach the sea. In addition, research has documented significant reduction in sea turtle nesting activity on beaches illuminated with artificial lights (Witherington 1992). During the 2010 sea turtle nesting season in Florida, over 47,000 turtle hatchlings were documented as being disoriented (FWC/FWRI 2011).

Predation

Predation of sea turtle eggs and hatchlings by native and introduced species occurs on almost all nesting beaches. Predation by a variety of predators can considerably decrease sea turtle nest hatching success. The most common predators in the southeastern U.S. are ghost crabs (*Ocypode quadrata*), raccoons (*Procyon lotor*), feral hogs (*Sus scrofa*), foxes (*Urocyon cinereoargenteus* and *Vulpes vulpes*), coyotes (*Canis latrans*), armadillos (*Dasypus novemcinctus*), and fire ants (*Solenopsis invicta*) (Dodd 1988, Stancyk 1995). In the absence of nest protection programs in a number of locations throughout the southeast U.S., raccoons may depredate up to 96 percent of all nests deposited on a beach (Davis and Whiting 1977, Hopkins and Murphy 1980, Stancyk *et al.* 1980, Talbert *et al.* 1980, Schroeder 1981, Labisky *et al.* 1986).

Beach Driving

The operation of motor vehicles on the beach affects sea turtle nesting by interrupting or striking a female turtle on the beach, headlights disorienting or misorienting emergent hatchlings, vehicles running over hatchlings attempting to reach the ocean, and vehicle tracks traversing the beach that interfere with hatchlings crawling to the ocean. Hatchlings appear to become diverted not because they cannot physically climb out of the rut (Hughes and Caine 1994), but because the sides of the track cast a shadow and the hatchlings lose their line of sight to the ocean horizon (Mann 1977). The extended period of travel required to negotiate tire tracks and ruts may increase the susceptibility of hatchlings to dehydration and depredation during migration to the ocean (Hosier *et al.* 1981).

Driving on the beach can cause sand compaction, which may result in adverse impacts on nest site selection, digging behavior, clutch viability, and emergence by hatchlings, decreasing nest success and directly killing pre-emergent hatchlings (Mann 1977, Nelson and Dickerson 1987, Nelson 1988).

Additionally, the physical changes and loss of plant cover caused by vehicles on dunes can lead to various degrees of instability, and therefore encourage dune migration. As vehicles move either up or down a slope, sand is displaced downward, lowering the trail. Since the vehicles also inhibit plant growth, and open the area to wind erosion, dunes may become unstable, and begin to migrate. Unvegetated sand dunes may continue to migrate across stable areas as long as vehicle traffic continues. Vehicular traffic through dune breaches or low dunes on an eroding beach may cause an accelerated rate of overwash and beach erosion (Godfrey *et al.* 1978). If driving is required, the area where the least amount of impact occurs is the beach between the low and high tide water lines. Vegetation on the dunes can quickly reestablish provided the mechanical impact is removed.

Climate Change

The varying and dynamic elements of climate science are inherently long term, complex, and interrelated. Regardless of the underlying causes of climate change, glacial melting and expansion of warming oceans are causing sea level rise, although its extent or rate cannot as yet be predicted with certainty. At present, the science is not exact enough to precisely predict when and where climate impacts will occur. Although we may know the direction of change, it may not be possible to predict its precise timing or magnitude. These impacts may take place gradually or episodically in major leaps.

Climate change is evident from observations of increases in average global air and ocean temperatures, widespread melting of snow and ice, and rising sea level, according to the Intergovernmental Panel on Climate Change Report (IPCC 2007a). The IPCC Report (2007a) describes changes in natural ecosystems with potential widespread effects on many organisms, including marine mammals and migratory birds. The potential for rapid climate change poses a significant challenge for fish and wildlife conservation. Species' abundance and distribution are dynamic, relative to a variety of factors, including climate. As climate changes, the abundance, and distribution of fish and wildlife will also change. Highly specialized or endemic species are likely to be most susceptible to the stresses of changing climate. Based on these findings and other similar studies, the U.S. Department of the Interior requires agencies under its direction to consider potential climate change effects as part of their long-range planning activities (USFWS 2007c).

In the southeastern U.S., climatic change could amplify current land management challenges involving habitat fragmentation, urbanization, invasive species, disease, parasites, and water management. Global warming will be a particular challenge for endangered, threatened, and other "at risk" species. It is difficult to estimate, with any degree of precision, which species will be affected by climate change or exactly how they will be affected. The Service will use Strategic Habitat Conservation planning, an adaptive science-driven process that begins with explicit trust resource population objectives, as the framework for adjusting our management strategies in response to climate change (USFWS 2006b). As the level of information increases relative to the effects of global climate change on sea turtles and its designated critical habitat, the Service will have a better basis to address the nature and magnitude of this potential threat and will more effectively evaluate these effects to the range-wide status of sea turtles.

Temperatures are predicted to rise from 1.6°F to 9°F for North America by the end of this century (IPCC 2007a, b). Alterations of thermal sand characteristics could result in highly female-biased sex ratios because sea turtles exhibit temperature dependent sex determination (e.g., Glen and Mrosovsky 2004, Hawkes *et al.* 2007).

Along developed coastlines, and especially in areas where shoreline protection structures have been constructed to limit shoreline movement, rising sea levels will cause severe effects on nesting females and their eggs. Erosion control structures can result in the permanent loss of dry nesting beach or deter nesting females from reaching suitable nesting sites (National Research Council 1990a). Nesting females may deposit eggs seaward of the erosion control structures potentially subjecting them to repeated tidal inundation or washout by waves and tidal action.

Based on the present level of available information concerning the effects of global climate change on the status of sea turtles and their designated critical habitat, the Service acknowledges the potential for changes to occur in the action area, but presently has no basis to evaluate if or how these changes are affecting sea turtles or their designated critical habitat. Nor does our present knowledge allow the Service to project what the future effects from global climate change may be or the magnitude of these potential effects.

Recreational Beach Use

There is increasing popularity in the southeastern U.S., especially in Florida, for beach communities to carry out beach cleaning operations to improve the appearance of beaches for visitors and residents. Beach cleaning occurs on private beaches and on some municipal or county beaches that are used for nesting by loggerhead sea turtles. Beach cleaning activities effectively remove "seaweed, fish, glass, syringes, plastic, cans, cigarettes, shells, stone, wood, and virtually any unwanted debris" (Barber and Sons 2012). Removal of wrack material (organic material that is washed up onto the beach by surf, tides, and wind) reduces the natural sand-trapping abilities of beaches and contributes to their destabilization. As beach cleaning vehicles and equipment move over the sand, sand is displaced downward, lowering the substrate. Although the amount of sand lost due to single sweeping actions may be small, it adds up considerably over a period of years (Neal *et al.* 2007). In addition, since the beach cleaning vehicles and equipment also inhibit plant growth and open the area to wind erosion, the beach and dunes may become unstable. Beach cleaning "can result in abnormally broad unvegetated zones that are inhospitable to dune formation or plant colonization, thereby enhancing the likelihood of erosion" (Defeo *et al.* 2009). This is also a concern because dunes and vegetation play an important role in minimizing the impacts of artificial beachfront lighting, which causes disorientation of sea turtle hatchlings and nesting turtles, by creating a barrier that prevents residential and commercial business lighting from being visible on the beach.

Human presence on the beach at night during the nesting season can reduce the quality of nesting habitat by deterring or disturbing and causing nesting turtles to avoid otherwise suitable habitat. In addition, human foot traffic can make a beach less suitable for nesting and hatchling emergence by increasing sand compaction and creating obstacles to hatchlings attempting to reach the ocean (Hosier *et al.* 1981).

The use and storage of lounge chairs, cabanas, umbrellas, catamarans, and other types of recreational equipment on the beach at night can also make otherwise suitable nesting habitat unsuitable by hampering or deterring nesting by adult females and trapping or impeding hatchlings during their nest to sea migration. The documentation of non-nesting emergences (also referred to as false crawls) at these obstacles is becoming increasingly common as more recreational beach equipment is left on the beach at night. Sobel (2002) describes nesting turtles being deterred by wooden lounge chairs that prevented access to the upper beach.

Sand Placement

Sand placement projects may result in changes in sand density (compaction), beach shear resistance (hardness), beach moisture content, beach slope, sand color, sand grain size, sand grain shape, and sand grain mineral content if the placed sand is dissimilar from the original beach sand (Nelson and Dickerson 1988a). These changes could result in adverse impacts on nest site selection, digging behavior, clutch viability, and hatchling emergence (Nelson and Dickerson 1987, Nelson 1988).

Beach nourishment projects create an elevated, wider, and unnatural flat slope berm. Sea turtles nest closer to the water the first few years after nourishment because of the altered profile (and perhaps unnatural sediment grain size distribution) (Ernest and Martin 1999, Trindell 2005) Rice (2012b) identified that approximately 32% of sandy shorelines from North Carolina to Texas have been modified by sand placement projects (**Table 4**).

Table 4. Approximate shoreline miles of sandy beach that have been modified by sand placement activities for each state in the U.S. continental wintering range of the piping plover as of December 2011. These totals are minimum numbers, given missing data for some areas (Rice 2012b).

State	Known Approximate Miles of Beach Receiving Sand	Proportion of Modified Sandy Beach Shoreline
North Carolina	91.3	28%
South Carolina	67.6	37%
Georgia	5.5	6%
Florida Atlantic coast	189.7	51%
Florida Gulf coast	189.9	43%
Alabama	7.5	16%
Mississippi barrier island coast	1.1	4%
Mississippi mainland coast	43.5	85%
Louisiana	60.4	28%
Texas	28.3	8%
TOTAL	**684.8+**	**32%**

Beach compaction and unnatural beach profiles resulting from beach nourishment activities could negatively impact sea turtles regardless of the timing of projects. Very fine sand or the use of heavy machinery can cause sand compaction on nourished beaches (Nelson *et al.* 1987, Nelson and Dickerson 1988a). Significant reductions in nesting success (*i.e.*, false crawls occurred more frequently) have been documented on severely compacted nourished beaches (Fletemeyer 1980, Raymond 1984, Nelson and Dickerson 1987, Nelson *et al.* 1987), and increased false crawls may result in increased physiological stress to nesting females. Sand compaction may increase the length of time required for female sea turtles to excavate nests and cause increased physiological stress to the animals (Nelson and Dickerson 1988b). Nelson and Dickerson (1988c) concluded that, in general, beaches nourished from offshore borrow sites are harder than natural beaches, and while some may soften over time through erosion and accretion of sand, others may remain hard for 10 years or more.

These impacts can be minimized by using suitable sand and by tilling (minimum depth of 36 inches) compacted sand after project completion. The level of compaction of a beach can be assessed by measuring sand compaction using a cone penetrometer (Nelson 1987). Tilling of a nourished beach with a root rake may reduce the sand compaction to levels comparable to unnourished beaches. However, a pilot study by Nelson and Dickerson (1988c) showed that a tilled nourished beach will remain uncompacted for only up to 1 year. Thus, multi-year beach compaction monitoring and, if necessary, tilling would help to ensure that project impacts on sea turtles are minimized.

A change in sediment color on a beach could change the natural incubation temperatures of nests in an area, which, in turn, could alter natural sex ratios. To provide the most suitable sediment for nesting sea turtles, the color of the nourished sediments should resemble the natural beach sand in the area. Natural reworking of sediments and bleaching from exposure to the sun would help to lighten dark nourishment sediments; however, the timeframe for sediment mixing and bleaching to occur could be critical to a successful sea turtle nesting season.

In-water and Shoreline Alterations

Many navigable mainland or barrier island tidal inlets or beaches along the Atlantic and Gulf of Mexico coasts are stabilized with jetties or groins. Jetties are built perpendicular to the shoreline and extend through the entire nearshore zone and past the breaker zone to prevent or decrease sand deposition in the channel (Kaufman and Pilkey 1979). Groins are also shore-perpendicular structures that are designed to trap sand that would otherwise be transported by longshore currents and can cause downdrift erosion (Kaufman and Pilkey 1979).

These in-water structures have profound effects on adjacent beaches (Kaufman and Pilkey 1979). Jetties and groins placed to stabilize a beach or inlet prevent normal sand transport, resulting in accretion of sand on updrift beaches and acceleration of beach erosion downdrift of the structures (Komar 1983, Pilkey *et al.* 1984). Witherington *et al.* (2005) found a significant negative relationship between loggerhead nesting density and distance from the nearest of 17 ocean inlets on the Atlantic coast of Florida. The effect of inlets in lowering nesting density was observed both updrift and downdrift of the inlets, leading researchers to propose that beach instability from both erosion and accretion may discourage loggerhead nesting. Rice (2012a) identified over half of inlets from North Carolina to Texas have been modified by some type of structure (**Table 5**).

Table 5. The number of open tidal inlets, inlet modifications, and artificially closed inlets in each state as of December 2011 (Rice 2012a).

State	Existing Inlets							Artificially closed
	Number of Inlets	Total Number of Modified Inlets	Habitat Modification Type					
			structures[a]	dredged	relocated	mined	artificially opened	
North Carolina	20	17 (85%)	7	16	3	4	2	11
South Carolina	47	21 (45%)	17	11	2	3	0	1
Georgia	23	6 (26%)	5	3	0	1	0	0
Florida *-Atlantic*	21	19 (90%)	19	16	0	3	10	0
Florida *-Gulf*	48	24 (50%)	20	22	0	6	7	1
Alabama	4	4 (100%)	4	3	0	0	0	2
Mississippi	6	4 (67%)	0	4	0	0	0	0
Louisiana	34	10 (29%)	7	9	1	2	0	46
Texas	18	14 (78%)	10	13	2	1	11	3
TOTAL	221	119 (54%)	89 (40%)	97 (44%)	8 (4%)	20 (9%)	30 (14%)	64 (N/A)

[a] Structures include jetties, terminal groins, groin fields, rock or sandbag revetments, seawalls, and offshore breakwaters.

Following construction, the presence of groins and jetties may interfere with nesting turtle access to the beach, result in a change in beach profile and width (downdrift erosion, loss of sandy berms, and escarpment formation), trap hatchlings, and concentrate predatory fishes, resulting in higher probabilities of hatchling predation. In addition to decreasing nesting habitat suitability, construction or repair of groins and jetties during the nesting season may result in the destruction of nests, disturbance of females attempting to nest, and disorientation of emerging hatchlings from project lighting.

Recovery Criteria (only the Demographic Recovery Criteria are presented below; for the Listing Factor Recovery Criteria, see NMFS and USFWS 2008)

1. Number of Nests and Number of Nesting Females
   a. NRU
      i. There is statistical confidence (95 percent) that the annual rate of increase over a generation time of 50 years is 2 percent or greater resulting in a total annual number of nests of 14,000 or greater for this recovery unit (approximate distribution of nests is North Carolina =14 percent [2,000

nests], South Carolina =66 percent [9,200 nests], and Georgia =20 percent [2,800 nests]); and

   ii. This increase in number of nests must be a result of corresponding increases in number of nesting females (estimated from nests, clutch frequency, and remigration interval).

b. PFRU
   i. There is statistical confidence (95 percent) that the annual rate of increase over a generation time of 50 years is statistically detectable (one percent) resulting in a total annual number of nests of 106,100 or greater for this recovery unit; and
   ii. This increase in number of nests must be a result of corresponding increases in number of nesting females (estimated from nests, clutch frequency, and remigration interval).

c. DTRU
   i. There is statistical confidence (95 percent) that the annual rate of increase over a generation time of 50 years is three percent or greater resulting in a total annual number of nests of 1,100 or greater for this recovery unit; and
   ii. This increase in number of nests must be a result of corresponding increases in number of nesting females (estimated from nests, clutch frequency, and remigration interval).

d. NGMRU
   i. There is statistical confidence (95 percent) that the annual rate of increase over a generation time of 50 years is three percent or greater resulting in a total annual number of nests of 4,000 or greater for this recovery unit (approximate distribution of nests (2002-2007) is Florida= 92 percent [3,700 nests] and Alabama =8 percent [300 nests]); and
   ii. This increase in number of nests must be a result of corresponding increases in number of nesting females (estimated from nests, clutch frequency, and remigration interval).

e. GCRU
   i. The total annual number of nests at a minimum of three nesting assemblages, averaging greater than 100 nests annually (e.g., Yucatán, Mexico; Cay Sal Bank, Bahamas) has increased over a generation time of 50 years; and
   ii. This increase in number of nests must be a result of corresponding increases in number of nesting females (estimated from nests, clutch frequency, and remigration interval).

2. Trends in Abundance on Foraging Grounds
   A network of in-water sites, both oceanic and neritic across the foraging range is established and monitoring is implemented to measure abundance. There is statistical confidence (95 percent) that a composite estimate of relative abundance from these sites is increasing for at least one generation.

3. Trends in Neritic Strandings Relative to In-water Abundance
   Stranding trends are not increasing at a rate greater than the trends in in-water relative abundance for similar age classes for at least one generation.

Analysis of the species/critical habitat likely to be affected

The proposed action has the potential to adversely affect nests and hatchlings on the beach. The effects of the proposed action on the loggerhead sea turtle will be considered further in the remaining sections of this BO.

Potential effects include destruction of nests deposited within the boundaries of the proposed project that are not found and relocated out of the project area the nesting season prior to construction. Impacts to nesting females are not expected since the project construction will occur after the egg laying portion of the nesting season. Impacts to hatchlings are not expected since the construction is limited to daylight hours.

Some individuals in a population are more "valuable" than others in terms of the number of offspring they are expected to produce. An individual's potential for contributing offspring to future generations is its reproductive value. Because of delayed sexual maturity, reproductive longevity, and low survivorship in early life stages, nesting females are of high value to a population. The loss of a nesting female in a small recovery unit would represent a significant loss to the recovery unit. The reproductive value for a nesting female has been estimated to be approximately 253 times greater than an egg or a hatchling (NMFS and USFWS 2008). However, the proposed action includes avoidance and minimization measures that reduce the possibility of mortality of a nesting female on the beach as a result of the project. Therefore, we do not anticipate the loss of any nesting females on the beach as a result of the project.

During project construction, direct mortality of the developing embryos in nests within the project area may occur for nests that are missed and not relocated. The exact number of these missed nests is not known. However, in two separate monitoring programs on the east coast of Florida where hand digging was performed to confirm the presence of nests and thus reduce the chance of missing nests through misinterpretation, trained observers still missed about 6 to 8 percent of the nests because of natural elements (Martin 1992, Ernest and Martin 1993). This must be considered a conservative number, because missed nests are not always accounted for. In another study, Schroeder (1994) found that even under the best of conditions, about 7 percent of nests can be misidentified as false crawls by highly experienced sea turtle nest surveyors. Missed nests are usually identified by signs of hatchling emergences in areas where no nest was previously documented. Signs of hatchling emergence are very easily obliterated by the same elements that interfere with detection of

nests.
However, it is important to note that it is unknown whether nests that would have been laid in a project area had the project not occurred are actually lost from the population or if nesting is simply displaced to adjacent beaches. Regardless, eggs and hatchlings have a low reproductive value; each egg or hatchling has been estimated to have only 0.004 percent of the value of a nesting female (NMFS and USFWS 2008). The Service would not expect this loss to have a significant effect on the recovery and survival of the species, for the following reasons: 1) some nesting is likely just displaced to adjacent non-project beaches, 2) not all eggs will produce hatchlings, and 3) destruction and/or failure of nests will not always result from the construction project. A variety of natural and unknown factors negatively affect incubating egg clutches, including tidal inundation, storm events, and predation.

ENVIRONMENTAL BASELINE

South Carolina barrier beaches are part of a complex and dynamic coastal system that continually respond to inlets, tides, waves, erosion and deposition, longshore sediment transport, and depletion, fluctuations in sea level, and weather events. The location and shape of the coastline perpetually adjusts to these physical forces. Winds move sediment across the dry beach forming dunes and the island interior landscape. The natural communities contain plants and animals that are subject to shoreline erosion and deposition, salt spray, wind, drought conditions, and sandy soils. Vegetative communities include foredunes, primary, and secondary dunes, interdunal swales, sand pine scrub, and maritime forests. However, the protection or persistence of these important natural land forms, processes, and wildlife resources is often in conflict with long-term beach stabilization projects and their indirect effects, i.e., increases in residential development, infrastructure, and public recreational uses.

South Carolina has approximately 182 miles of coastline and approximately 51% (93/182 miles) of the coastline is developed (SC DHEC 2010). Approximately 37% (67.6/182 miles) of the state's coastline has received sand placement via beach nourishment or dredge disposal placement (Rice 2012b). South Carolina currently has 47 tidal inlets open and 36% (17/47 inlets) have been stabilized with some type of hard structure(s) along at least one shoreline (Rice 2012a).

Status of the species within the action area

One of the five recovery units, the NRU, occurs within the proposed action area. The loggerhead sea turtle nesting and hatching season for South Carolina extends from May 1 through October 31. Incubation ranges from about 50 to 60 days.

Garden City Beach and Surfside Beach have low numbers of nesting sea turtles compared to beaches in coastal counties south of Horry County (**Table 6**). These islands have nest protection projects under South Carolina United Turtle Enthusiasts (S.C.U.T.E.), which is permitted through SCDNR to conduct daily nesting surveys, nest relocations, predator control measures, and nest inventories.

If project construction occurs during the sea turtle nesting season, nesting females may avoid Surfside Beach and North Myrtle Beach and nest on adjacent beaches. Garden City Beach is the next beach south of Surfside Beach and Myrtle Beach is the next beach north of Surfside Beach (**Figure 3, p. 7**). Waites Island is the next island north and North Myrtle Beach and Myrtle Beach is the next beach south of North Myrtle Beach (**Figure 3, p. 7**). Therefore, Garden City Beach, Myrtle Beach, and Waites Island are considered to be part of the action area.

Table 6. Sea turtle nests on Surfside Beach and North Myrtle Beach from 2009 through 2016 (SCDNR unpublished data on seaturtle.org).

Year	Surfside Beach	North Myrtle Beach
2009	1	2
2010	2	10
2011	5	21
2012	7	9
2013	1	6
2014	0	6
2015	1	8
2016	4	8

Factors affecting the species environment within the action area

Sea turtle nests within the action area are subject to severe erosion, tidal inundation, predation by fox, raccoon, coyote, ghost crabs, and disorientations from artificial beachfront lighting. All islands within the action areas provide nesting habitat and volunteers carry out nest monitoring and protection efforts, which are overseen by SCDNR.

EFFECTS OF THE ACTION

This section is an analysis of the beneficial, direct, and indirect effects of the proposed action on nonbreeding piping plovers, nesting sea turtles, nests, eggs, and hatchling sea turtles within the action area. The analysis includes effects interrelated and interdependent of the project activities. An interrelated activity is an activity that is part of a proposed action and depends on the proposed activity. An interdependent activity is an activity that has no independent utility apart from the action.

Factors to be considered

The proposed project will occur within sea turtle nesting habitat and construction will overlap the sea turtle nesting season. Short-term and temporary impacts to sea turtle nesting activities may result from project work occurring on the nesting beach during the nesting season.

Proximity of action: The project will occur within nesting habitat for sea turtles and may potentially impact loggerhead nesting females, nests, and hatchling sea turtles.

Distribution: The project may impact hatchling sea turtles and sea turtle nests that would occur within the project area by discouraging nesting females to nest on the beach due to construction activity or relocating nests that would otherwise be left *in situ* to prevent loss due to burial by construction activities.

Timing: The timing of the project construction may directly and indirectly impact nesting females, nests, and hatchling sea turtles during the nesting season that overlaps with the construction.

Nature of the effect: The effects of the project are not anticipated to result in adverse effects since all nests laid within the vicinity of the project area will be relocated before project construction.

Duration: The projects will take up to eleven months to complete. Thus, the direct effects would be expected to occur during one nesting season.

Disturbance frequency: Sea turtle nests within the project area that are not found and relocated may experience decreased nesting success, hatching success, and hatchling emergence success that could result from the construction activities being conducted during one nesting season.

Disturbance intensity and severity: Project construction will occur during the nesting season. Conservation measures have been incorporated into the project description to minimize impacts.

Analyses for effects of the action

The effects of the sand placement project include impacts associated with project construction within the action area.

Beneficial Effects

The placement of sand on a beach with reduced dry foredune habitat may increase sea turtle nesting habitat if the placed sand is highly compatible (*i.e.*, grain size, shape, color, etc.) with naturally occurring beach sediments in the area, and compaction and escarpment remediation measures are incorporated into the project. In addition, a nourished beach that is designed and constructed to mimic a natural beach system may benefit sea turtles more than an eroding beach it replaces.

Adverse Effects

Through many years of research, it has been documented that shoreline stabilization projects can have adverse effects on nesting and hatchling sea turtles and sea turtle nests. Results of monitoring sea turtle nesting provide additional information on how sea turtles respond to the these projects, minimization measures, and other factors that influence nesting, hatching, and emerging success.

Direct Effects

The equipment to relocate the inlet will have to traverse the beach portion of the action area, which could result in harm sea turtles nests and emerging hatchlings. While a nest monitoring and egg relocation program would reduce these impacts, nests may be inadvertently missed (when crawls are obscured by rainfall, wind, or tides) or misidentified as false crawls during daily patrols. Even under the best of conditions, about seven percent of the nests can be misidentified as false crawls by experienced sea turtle nest surveyors (Schroeder 1994).

Potential Direct Effects Associated With Project Construction

1. Nest relocation

Besides the potential for missing nests during surveys, there is a potential for eggs to be damaged by nest relocation, particularly if eggs are not relocated within 12 hours of deposition (Limpus *et al.* 1979). Relocated nests can incubate at different temperatures than nests left to incubate in place (*in situ*) (Mrosovosky and Yntema 1980, Hoekert *et al.* 1998, Başkale and Kaska 2005, Tuttle 2007, Bimbi 2009, Tuttle and Rostal 2010, Pintus *et al.* 2009) and cause skewed sex ratios (Morreale *et al.* 1982, Godfrey *et al.* 1997). Relocated nests can also have higher or lower hatch success and hatchling emergence than *in situ* nests (Wyneken *et al.* 1988, Hoekert *et al.* 1998, García *et al.* 2003, Moody 2000, Kornaraki *et al.* 2006, Tuttle 2007, McElroy 2009, Pintus *et al.* 2009) depending on relocation technique and environmental conditions.

Nest relocation can have adverse impacts on gas exchange parameters and the hydric environment of nests (Limpus *et al.* 1979, Ackerman 1980, Parmenter 1980, Spotila *et al.* 1983, McGehee 1990). Nests relocated into sands deficient in oxygen or moisture can result in mortality, morbidity, and reduced behavioral competence of hatchlings. Water availability is known to influence the incubation environment of the embryos and hatchlings of turtles with flexible-shelled eggs, which has been shown to affect nitrogen excretion (Packard *et al.* 1984), mobilization of calcium (Packard and Packard 1986), mobilization of yolk nutrients (Packard *et al.* 1985), hatchling size (Packard *et al.* 1981, McGehee 1990), energy reserves in the yolk at hatching (Packard *et al.* 1988), and locomotory ability of hatchlings (Miller *et al.* 1987).

2. Equipment during construction

The use of heavy machinery on beaches during a construction project may also have adverse effects on sea turtles. Driving directly above or over incubating egg clutches or on the beach can cause sand compaction, which may result in adverse impacts on nest site selection, digging behavior, clutch viability, and emergence by hatchlings, as well as directly kill pre-emergent hatchlings (Mann 1977, Nelson and Dickerson 1987, Nelson 1988).

Indirect Effects

Many of the direct effects of shoreline stabilization projects may persist over time and become indirect impacts. These indirect effects include increased susceptibility of relocated nests to catastrophic events, the consequences of potential increased beachfront development, changes in the physical characteristics of the beach, the formation of escarpments, and future sand migration.

Increased susceptibility to catastrophic events

Nest relocation within a nesting season may concentrate eggs in an area making them more susceptible to catastrophic events. Hatchlings released from concentrated areas also may be subject to greater predation rates from both land and marine predators, because the predators learn where to concentrate their efforts (Glenn 1998, Wyneken *et al.* 1998).

Species' response to the proposed action

The Service expects a minimal response to the proposed action due to the minimization measures in place and the short duration of project construction. Although the project may be permitted to occur more than once during the life of the permit, the same construction window and minimization measures would apply.

CUMULATIVE EFFECTS

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this BO. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA. The Service is not aware of any cumulative effects in the project area at this time.

CONCLUSION

After reviewing the current status of the loggerhead sea turtle, the environmental baseline for the action area, the effects of the proposed inlet relocation, the cumulative effects, and the proposed conservation measures, it is the Service's biological opinion that the project as proposed, is not likely to jeopardize the continued existence of the loggerhead sea turtle and is not likely to destroy or adversely modify designated critical habitat.

The conservation of the five loggerhead recovery units in the Northwest Atlantic is essential to the recovery of the loggerhead sea turtle. Each individual recovery unit is necessary to conserve genetic and demographic robustness, or other features necessary for long-term sustainability of the entire population. Thus, maintenance of viable nesting in each recovery unit contributes to the overall population. One of the five loggerhead recovery units in the Northwest Atlantic, the NRU, occurs within the action area. Of the available nesting habitat within the NRU, project construction will occur and/or will likely have an effect on approximately 58,000 linear feet of shoreline.

Take of sea turtles will be minimized by implementation of the Reasonable and Prudent Measures, and Terms and Conditions outlined below. These measures have been shown to help minimize adverse impacts to sea turtles.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered or threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, carrying out an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited under the ESA provided that such taking is in compliance with the terms and conditions of this incidental take statement.

The measures described below are non-discretionary, and must be implemented by the Corps and/or their contractors so that they become binding conditions of any grant or permit issued, as appropriate, for the exemption in section 7(o)(2) to apply. The Corps has a continuing duty to regulate the activity covered by this incidental take statement. If the Corps and/or their contractors (1) fail(s) to assume and implement the terms and conditions or (2) fail(s) to require the applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the Corps must report the progress of the action and its impacts on the species to the SCFO as specified in the incidental take statement [50 CFR 402.14(i)(3)].

AMOUNT OR EXTENT OF TAKE ANTICIPATED

The Service anticipates 58,000 linear feet of nesting beach habitat could be taken as a result of this proposed action. The take is expected to be in the form of destruction of all nests that may be constructed and eggs that may be deposited and missed by a nest survey and nest relocation program (May 1 – October 31) within the boundaries of the proposed project.

Incidental take is anticipated for only the 58,000 linear feet of beach that have been identified. The Service anticipates incidental take of sea turtles will be difficult to detect for the following reasons: (1) The turtles nest primarily at night and all nests are not found because [a] natural factors, such as rainfall, wind, and tides may obscure crawls and [b] human-caused factors, such as pedestrian and vehicular traffic, may obscure crawls, and result in nests being destroyed because they were missed during a nesting survey and nest mark and avoidance program, (2) The total number of hatchlings per undiscovered nest is unknown.

EFFECT OF THE TAKE

In the accompanying BO, the Service determined that this level of anticipated take is not likely to result in jeopardy to the species. Critical habitat has not been designated in the project area; therefore, the project will not result in destruction or adverse modification of critical habitat. Incidental take of nesting and hatchling sea turtles is anticipated to occur during project construction and during the life of the project. Take will occur on nesting habitat on 58,000 feet of shoreline.

REASONABLE AND PRUDENT MEASURES

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize take of the loggerhead sea turtle.

1. Conservation Measures included in the permit application/project plans must be implemented (unless revised below in the Terms and Conditions) in the proposed project.

2. Beach quality sand will be used for sand placement.

3. All derelict concrete, metal, coastal armoring material or other debris will be removed from the beach prior to any material placement.

4. During the sea turtle nesting season (May 1 – October 31) immediately prior to project construction, surveys for nesting sea turtles must be conducted within the project area if work will occur during a portion of the nesting season. If nests are constructed in the project footprint, the eggs must be relocated to minimize sea turtle nest burial, crushing of eggs, or nest excavation. Nest relocation will be on a selected area of beach that is not expected to experience daily inundation by high tides or known to routinely experience severe erosion and egg loss, predation, or subject to

artificial lighting.

5. Construction equipment and materials for project construction must be stored in a manner that will minimize impacts to hatchling sea turtles to the maximum extent practicable.

6. Predator-proof trash receptacles must be installed and maintained at all beach access points used for project construction to minimize the potential for attracting predators of sea turtles.

7. The Corps must take actions to minimize sea turtle misorientation/disorientations on the beach caused by the projects' construction-related lighting during the nesting season from May 1 through October 31. The project sponsors must take actions to minimize sea turtle misorientation/disorientations due to artificial lighting associated with oceanfront development adjacent to the project area and within the project limits during the nesting season from May 1 through October 31.

8. Prior to the beginning of the project, the Corps must submit a lighting plan for the dredge that will be used in this project. The plan must include a description of each light source that will be visible from the beach and the measures implemented to minimize this lighting.

9. The Corps must hire monitors with sea turtle experience to patrol the beach at night in the project area if nighttime construction activities and equipment occur during the nesting season.

10. The Corps must monitor compliance with construction related lighting during the sea turtle hatching season (July 15 - October 15).

11. During the sea turtle nesting season, the contractor must not extend the beach fill more than 500 feet along the shoreline and must confine work activities within this area between dusk and the following day's nesting survey unless nighttime monitors patrol the beach to reduce the impacts to emerging sea turtles and burial of new nests.

12. Sand compaction must be monitored and tilling (non-vegetated areas) must be conducted if needed immediately after completion of the sand placement work and prior to the next three nesting seasons to reduce the likelihood of impacting sea turtle nesting and hatching activities.

13. Escarpment formation will be monitored and leveling will be conducted if needed immediately after completion of the sand placement project and prior to the next three nesting seasons to reduce the likelihood of impacting nesting and hatchling sea turtles.

14. The Corps must complete post construction surveys of all artificial lighting visible from the project beach.

15. During the portion of the nesting season that overlaps with the construction window, on-beach access to the construction site will be restricted to the wet sand below mean high water (MHW).

16. The SCFO and SCDNR must be notified if a sea turtle adult, hatchling, or egg is harmed or destroyed as a direct or indirect result of the project.

17. A meeting/conference call between representatives of the contractor, the SCFO, SCDNR, and the permitted sea turtle and shorebird surveyor(s) must be held prior to the commencement of work on this project.

18. A report describing the actions taken to implement the terms and conditions of this incidental take statement must be submitted to the SCFO following completion of the proposed work.

19. Existing vegetated habitat at each of the beach access points must be protected to the maximum extent practicable and must be delineated by post and rope or other suitable material to ensure vehicles and equipment transport stay within the access corridor. Any vegetated areas impacted must be restored to pre-construction conditions. New beach access locations created for the project work must be approved by the SCFO and SCDNR.

20. Expanded or newly created beach access points must be restored to dune habitat within three months following project completion. The habitat restoration must consist of restoring the dune topography and planting with appropriate native dune vegetation (i.e., native to coastal dunes in South Carolina). The Corps must consult with the Service prior to implementation of their conservation measure to plant Sea-beach amaranth.

TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the ESA, the Corps will include the following terms and conditions, which implement the reasonable and prudent measures, (RPM) described above and outline required reporting/monitoring requirements. These terms and conditions (T&Cs) are non-discretionary.

1. Conservation Measures included in the permit application/project plans must be implemented in the proposed project.

2. Daily early morning surveys for sea turtle nests will be required if construction coincides with the sea turtle nesting season. Nesting surveys must be conducted May 1–October 31 in the project area if work will begin before October 31. If nests are constructed in areas where they may be affected by construction activities, the nests must be relocated per the following requirements.

a. Nesting surveys and nest relocation will only be conducted by personnel with prior experience and training in nesting survey and nest marking procedures. Surveyors must have a valid SCDNR permit. Nesting surveys must be conducted daily between sunrise and 9:00 AM.

b. Only those nests that may be affected by sand placement activities will be relocated. Nests requiring relocation will be moved no later than 9:00 AM the morning following deposition to a nearby self-release beach site in a secure setting where artificial lighting will not interfere with hatchling orientation. Relocated nests will not be placed in organized groupings. Relocated nests will be randomly staggered along the length and width of the beach in settings that are not expected to experience daily inundation by high tides or known to routinely experience severe erosion and egg loss, or subject to artificial lighting. Nest relocations in association with construction activities must cease when construction activities no longer threaten nests.

c. Nests deposited within areas where construction activities have ceased or will not occur for 75 days or nests laid in the nourished berm prior to tilling must be marked and left in situ unless other factors threaten the success of the nest. The turtle permit holder will install an on-beach marker at the nest site or a secondary marker at a point as far landward as possible to assure that future location of the nest will be possible should the on-beach marker be lost. No activity will occur within this area nor will any activities occur which could result in impacts to the nest. Nest sites will be inspected daily to assure nest markers remain in place and the nest has not been disturbed by the project activity.

3. During the sea turtle nesting season, nighttime storage of construction equipment not in use must be off the beach to minimize disturbance to sea turtle hatching activities.

4. Staging areas for construction equipment must be located off the beach. Nighttime storage of construction equipment not in use must be off the beach to minimize disturbance to sea turtle nesting and hatching activities. In addition, all construction pipes placed on the beach must be located as far landward as possible without compromising the integrity of the dune system. Pipes placed parallel to the dune must be 5 to 10 feet away from the toe of the dune if the width of the beach allows. Temporary storage of pipes must be off the beach to the maximum extent possible. If the pipes are stored on the beach, they must be placed in a manner that will minimize the impact to nesting habitat and must not compromise the integrity of the dune systems.

5. Two post-construction surveys must be conducted of all lighting visible from the beach placement area using standard techniques for such a survey (**Appendix B**). The timing of these surveys will be coordinated with the SCFO prior to commencement of the work. Summary reports of both surveys will be provided to the SCFO. The summary report from the post-construction surveys (including the following information: methodology of the survey, a map showing the position of the lights visible from the beach, a description

of each light source visible from the beach, recommendations for remediation, and any actions taken) will be provided to the SCFO within 3 months after the survey is conducted. After the report is completed, a meeting must be set up with the Corps, the project sponsors, SCDNR, and the Service to discuss the survey report, as well as any documented sea turtle disorientations in or adjacent to the project area. Any action related to artificial beachfront lighting will be addressed by the appropriate project sponsor, as mentioned in RPM #7. If the project is completed during the nesting season and prior to May 1, the lighting surveys may be conducted during the year of construction.

6. Sand compaction must be monitored in the area of sand placement immediately after completion of the project and prior to May 1 for three subsequent years. If tilling is needed, the area must be tilled to a depth of 24 inches. Each pass of the tilling equipment must be overlapped to allow more thorough and even tilling. All tilling activity must be completed at least once prior to nesting season. An electronic copy of the results of the compaction monitoring must be submitted to the SCFO prior to any tilling actions being taken or if a request not to till is made based on compaction results. The requirement for compaction monitoring can be eliminated if the decision is made to till regardless of post construction compaction levels. Additionally, out-year compaction monitoring and remediation are not required if placed material no longer remains on the dry beach.

7. Compaction sampling stations must be located at 500-foot intervals along the sand placement template. One station must be at the seaward edge of the dune/bulkhead line (when material is placed in this area), and one station must be midway between the dune line and the high water line (normal wrack line).

8. At each station, the cone penetrometer must be pushed to a depth of 6, 12, and 18 inches three times (three replicates). Material may be removed from the hole if necessary to ensure accurate readings of successive levels of sediment. The penetrometer may need to be reset between pushes, especially if sediment layering exists. Layers of highly compact material may lie over less compact layers. Replicates must be located as close to each other as possible, without interacting with the previous hole or disturbed sediments. The three replicate compaction values for each depth must be averaged to produce final values for each depth at each station. Reports will include all 18 values for each transect line, and the final six averaged compaction values.

9. If the average value for any depth exceeds 500 pounds per square inch (psi) for any two or more adjacent stations, then that area must be tilled immediately prior to May 1.

10. If values exceeding 500 psi are distributed throughout the project area but in no case do those values exist at two adjacent stations at the same depth, then consultation with the SCFO will be required to determine if tilling is required. If a few values exceeding 500 psi are present randomly within the project area, tilling will not be required.

11. Tilling must occur landward of the wrack line and avoid all vegetated areas three square feet or greater with a three square foot buffer around the vegetated areas.

12. Visual surveys for escarpments along the project area must be made immediately after completion of the sand placement and within 30 days prior to May 1 for three subsequent years if sand in the project area still remains on the dry beach. Escarpments that interfere with sea turtle nesting or that exceed 18 inches in height for a distance of 100 feet must be leveled and the beach profile must be reconfigured to minimize scarp formation by the dates listed above. Any escarpment removal must be reported by location. If the project is completed during the early part of the sea turtle nesting and hatching season, escarpments may be required to be leveled immediately, while protecting nests that have been relocated or left in place. The SCFO must be contacted immediately if subsequent reformation of escarpments that interfere with sea turtle nesting or that exceed 18 inches in height for a distance of 100 feet occurs during the nesting and hatching season to determine the appropriate action to be taken. If it is determined that escarpment leveling is required during the nesting or hatching season, the SCFO will provide a brief written authorization within 30 days that describes methods to be used to reduce the likelihood of impacting existing nests. An annual summary of escarpment surveys and actions taken must be submitted to the SCFO.

13. Prior to the beginning of the project, the Corps must submit a lighting plan for the dredge that will be used in the project. The plan must include a description of each light source that will be visible from the beach and the measures implemented to minimize this lighting. This plan must be reviewed and approved by the SCFO.

14. Direct lighting of the beach and nearshore waters must be limited to the immediate construction area during nesting season and must comply with safety requirements. Lighting on all equipment must be minimized through reduction, shielding, lowering, and appropriate placement to avoid excessive illumination of the water's surface and nesting beach while meeting all Coast Guard, Corps EM 385-1-1, and OSHA requirements. Light intensity of lighting equipment must be reduced to the minimum standard required by OSHA for General Construction areas, in order not to misdirect sea turtles. Shields must be affixed to the light housing and be large enough to block light from all on-beach lamps from being transmitted outside the construction area or to the adjacent sea turtle nesting beach (**Figure 5**).

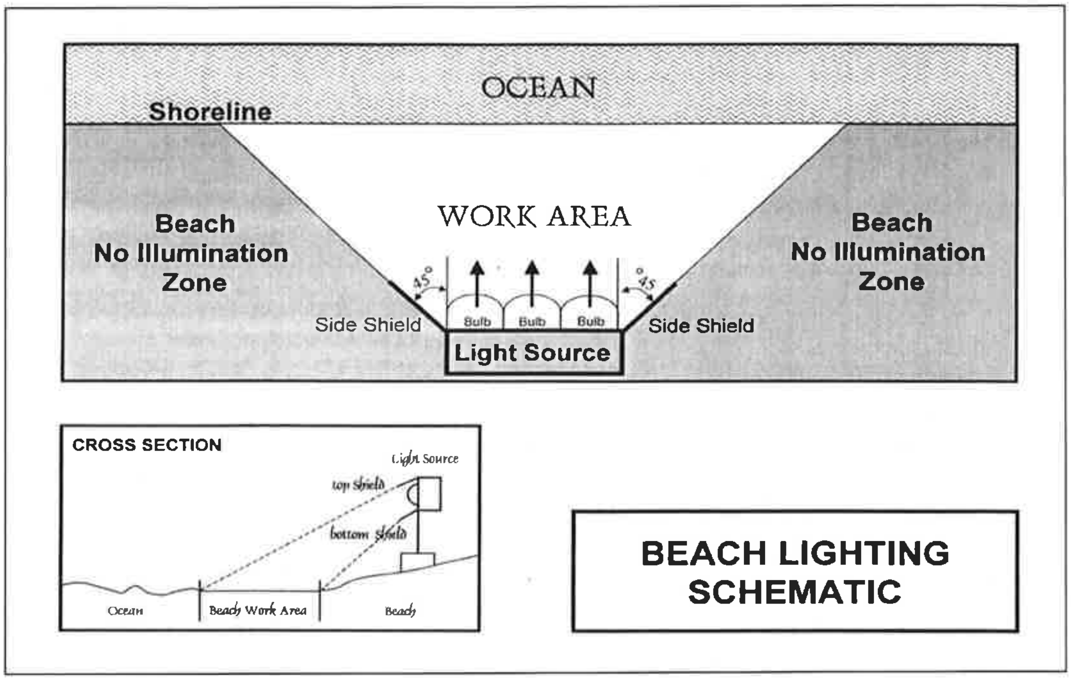

Figure 5. Beach lighting schematic.

15. The Corps must hire monitors with sea turtle experience and a valid SCDNR permit to patrol the beach at night in the project area if nighttime construction activities and equipment occur during the nesting season. Monitors must patrol the length of the pipeline within the active nighttime construction area for nesting females May 1 – August 15. From July 1 - October 15, sea turtle monitors must check all nests on a nightly basis after 10 pm within 1000 feet of the active nighttime project area that have been incubating for 45 days until three nights after the first sign of emergence or the inventory of the nest contents. Light visible from the beach will be documented and the source identified. Lighting will be classified into five categories: 1) sky glow (ambient light from coastal development), 2) construction related (light coming from the active nighttime project area), 3) residential or municipal (light coming from a house, condo, pier, or street light), 4) personal use (light from a flashlight), or 5) monitoring related (light from headlights of vehicles used to conduct night monitoring). The Corps or its representative will take corrective measures to address construction and monitoring related lighting visible from nests due to hatch. Sea turtle monitors will contact the appropriate code enforcement officials for residential or municipal lighting visible from the beach.

16. During the sea turtle nesting season, the contractor must not extend the beach fill more than 500 feet (or other agreed upon length) along the shoreline between dusk and dawn and the following day until the daily nesting survey has been completed and the beach cleared for fill advancement. An exception to this may occur if there is permitted sea turtle surveyor present on-site to ensure no nesting and hatching sea

turtles are present within the extended work area. If the 500 feet is not feasible for the project, an agreed upon distance will be decided on during the preconstruction meeting. Once the beach has been cleared and the necessary nest relocations have been completed, the contractor will be allowed to proceed with the placement of fill and work activities during daylight hours until dusk at which time the 500-foot length (or other agreed upon length) limitation must apply. If any nesting turtles are sighted on the beach within the immediate construction area, activities must cease immediately until the turtle has returned to the water and the sea turtle permit holder responsible for nest monitoring has relocated the nest.

17. Predator-proof trash receptacles must be installed and maintained during construction at all beach access points used for the project construction to minimize the potential for attracting predators of sea turtle (**Appendix C**). The contractors conducting the work must provide predator-proof trash receptacles for the construction workers. All contractors and their employees must be briefed on the importance of not littering and keeping the project area trash and debris free.

18. During the nest laying and hatching season, on-beach access to the construction site will be restricted to the wet sand below MHW.

19. A meeting or conference call between representatives of the contractor, SCFO, SCDNR, and the permitted sea turtle surveyor will be held prior to the commencement of work on this project. At least ten business days advance notice will be provided prior to conducting this meeting. The meeting/conference call will provide an opportunity for explanation and/or clarification of the sea turtle protection measures as well as additional guidelines when construction occurs during the sea turtle nesting season, such as storing equipment, minimizing driving, as well as follow up meetings during construction.

20. A report with the information listed below must be submitted to the SCFO within three months of the completion of construction.

    - Project location (latitude and longitude coordinates)
    - Project description (include linear feet of beach, and access points)
    - Dates of actual construction activities
    - Names and qualifications of personnel involved in sea turtle nesting surveys and nest relocation
    - Escarpment formation
    - Remedial action

Monitoring and Reporting

21. A report describing the work conducted during the year and actions taken to implement the reasonable and prudent measures and terms and conditions of this incidental take statement must be submitted to the SCFO within 90 days of completing the proposed work.

22. Upon locating a dead or injured sea turtle adult, hatchling, egg, or piping plover that may have been harmed or destroyed as a direct or indirect result of the project, the Corps, permittee, and/or local sponsor will be responsible for notifying the SCDNR Hotline (1-800-922-5431) and the SCFO (843-727-4707). Care must be taken in handling injured sea turtles, eggs, or piping plovers to ensure effective treatment or disposition, and in handling dead specimens to preserve biological materials in the best possible state for later analysis.

CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the ESA by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

Loggerhead sea turtles

1. The Corps should schedule project construction outside of the nesting season especially when operating a hopper dredge.

2. Educational signs should be placed where appropriate at beach access points explaining the importance of the area to sea turtles and/or the life history of sea turtle species that nest in the area.

Migratory Birds

Nesting season surveys should be conducted in all potential beach-nesting bird habitats within the project boundaries that may be impacted by construction or pre-construction activities during the nesting season. Portions of the project in which there is no potential for project-related activity during the nesting season may be excluded.

If shorebird nesting activity is discovered within the project area, the Corps should establish a 300-foot wide buffer zone around any location where shorebirds have been engaged in nesting behavior, including territory defense. All construction activities, including movement of vehicles, should be prohibited in the buffer zone.

In order for the Service to be kept informed of actions minimizing or avoiding adverse effects or benefitting listed species or their habitats, the Service requests notification of the implementation of any conservation recommendations.

REINITIATION - CLOSING STATEMENT

This concludes formal consultation on the action outlined in your request for formal consultation for the proposed project. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect listed species or critical habitat in a manner or to an extent not considered in this opinion or the project has not been completed within five years of the issuance of this BO; (3) the agency action is subsequently modified in a manner, that causes an effect to the listed species or critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

Section 9 of the ESA and Federal regulation pursuant to section 4(d) of the ESA prohibit the take of endangered or threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by the Service to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the Service as intentional or negligent actions that create the likelihood of injury to listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering. Incidental take is defined as take that is incidental to, and not the purpose of, carrying out an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2) of the ESA, taking that is incidental to and not intended as part of the agency action is not considered to be prohibited under the ESA provided that such taking is in compliance with the terms and conditions of this incidental take statement.

The measures described below are non-discretionary, and must be implemented by the Corps so that they become binding conditions of any grant or permit issued to the Applicant, as appropriate, for the exemption in section 7(o)(2) to apply. The Corps has a continuing duty to regulate the activity covered by this incidental take statement. If the Corps: (1) fails to assume and implement the terms and conditions; or (2) fails to require the Applicant to adhere to the terms and conditions of the incidental take statement through enforceable terms that are added to the permit or grant document, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, the Corps must report the progress of the action and its impacts on the species to the Service as specified in the incidental take statement [50 CFR 402.14(i)(3)].

For this BO, the incidental take will be exceeded when the construction activities associated with this project exceed 58,000 linear feet of beach, which would extend activities beyond the project's authorized boundaries. This BO has exempted an undetermined number of loggerhead sea turtle eggs and hatchlings and nonbreeding piping plovers from the prohibitions of section 9 of the ESA.

The Service appreciates the cooperation of the Corps during this consultation. We would like to continue working with you and your staff regarding this project. For further coordination, please contact Ms. Melissa Bimbi at (843) 727-4707, ext. 217. In future correspondence concerning the project, please reference FWS Log Nos. 04ES1000-2016-F-0409-R01.

Sincerely,

Thomas D. McCoy
Field Supervisor

TDM/MKB

Electronic copies to:

USFWS, Atlanta, GA (Jerry Ziewitz)
USFWS, Jacksonville, FL (Ann Marie Lauritsen)
USFWS, Daphne, AL (Dianne Ingram)
NMFS, Charleston, SC (Pace Wilbur)
SCDNR, Charleston, SC (Michelle Pate)
SCDNR, Charleston, SC (Susan Davis)
SCDHEC-OCRM, Charleston, SC (Bill Eiser)

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APPENDIX A: Standard Manatee Construction Conditions

To reduce potential construction-related impacts to the manatee to discountable and insignificant levels, the Service recommends implementing the *Standard Manatee Construction Conditions* (FWC 2011), which are as follows:

The permittee will comply with the following manatee protection construction conditions:

a. The permittee will instruct all personnel associated with the project of the potential presence of manatees and the need to avoid collisions with manatees. All construction personnel are responsible for observing water-related activities for the presence of manatee(s).

b. The permittee will advise all construction personnel that there are civil and criminal penalties for harming, harassing, or killing manatees, which are protected under the Marine Mammal Protection Act of 1972, the Endangered Species Act of 1973, and the Florida Manatee Sanctuary Act.

c. Siltation barriers must be made of material in which manatees cannot become entangled, are properly secured, and are regularly monitored to avoid manatee entrapment. Barriers must not block manatee entry to or exit from essential habitat.

d. All vessels associated with the construction project must operate at "no wake/idle" speeds at all times while in the construction area and while in water where the draft of the vessel provides less than a four-foot clearance from the bottom. All vessels will follow routes of deep water whenever possible.

e. If manatee(s) are seen within 100 yards of the active daily construction/dredging operation or vessel movement, all appropriate precautions must be implemented to ensure protection of the manatee. These precautions must include the operation of all moving equipment no closer than 50 feet to a manatee. Operation of any equipment closer than 50 feet to a manatee will necessitate immediate shutdown of that equipment. Activities will not resume until the manatee(s) has departed the project area of its own volition.

f. Any collision with and/or injury to a manatee must be reported immediately to the SCDNR Hotline at 1-800-922-5431. Collision and/or injury should also be reported to the U.S. Fish and Wildlife Service (843-727-4707).

APPENDIX B

ASSESSMENTS: DISCERNING PROBLEMS CAUSED BY ARTIFICIAL LIGHTING

EXCERPT FROM:

UNDERSTANDING, ASSESSING, AND RESOLVING LIGHT-POLLUTION PROBLEMS ON SEA TURTLE NESTING BEACHES
FLORIDA WILDLIFE RESEARCH INSTITUTE TECHNICAL REPORT TR-2
REVISED 2003

LIGHTING INSPECTIONS

WHAT ARE LIGHTING INSPECTIONS?

During a lighting inspection, a complete census is made of the number, types, locations, and custodians of artificial light sources that emit light visible from the beach. The goal of lighting inspections is to locate lighting problems and to identify the property owner, manager, caretaker, or tenant who can modify the lighting or turn it off.

WHICH LIGHTS CAUSE PROBLEMS?

Although the attributes that can make a light source harmful to sea turtles are complex, a simple rule has proven to be useful in identifying problem lighting under a variety of conditions:

An artificial light source is likely to cause problems for sea turtles if light from the source can be seen by an observer standing anywhere on the nesting beach.

If light can be seen by an observer on the beach, then the light is reaching the beach and can affect sea turtles. If any glowing portion of a luminaire (including the lamp, globe, or reflector) is directly visible from the beach, then this source is likely to be a problem for sea turtles. But light may also reach the beach indirectly by reflecting off buildings or trees that are visible from the beach. Bright or numerous sources, especially those directed upward, will illuminate sea mist and low clouds, creating a distinct glow visible from the beach. This "urban skyglow" is common over brightly lighted areas. Although some indirect lighting may be perceived as nonpoint-source light pollution, contributing light sources can be readily identified and include sources that are poorly directed or are directed upward. Indirect lighting can originate far from the beach.

Although most of the light that sea turtles can detect can also be seen by humans, observers should realize that some sources, particularly those emitting near-ultraviolet and violet light (e.g., bug-zapper lights, white electric-discharge lighting) will appear brighter to sea turtles than to humans. A human is also considerably taller than a hatchling; however, an observer on the dry beach who crouches to the level of a hatchling may miss some lighting that will affect turtles. Because of the way that some lights are partially hidden by the dune, a standing observer is more likely to see light that is visible to hatchlings and nesting turtles in the swash zone.

HOW SHOULD LIGHTING INSPECTIONS BE CONDUCTED?

Lighting inspections to identify problem light sources may be conducted either under the purview of a lighting ordinance or independently. In either case, goals and methods should be similar.

GATHER BACKGROUND INFORMATION

Before walking the beach in search of lighting, it is important to identify the boundaries of the area to be inspected. For inspections that are part of lighting ordinance enforcement efforts, the jurisdictional boundaries of the sponsoring local government should be determined. It will help to have a list that includes the name, owner, and address of each property within inspection area so that custodians of problem lighting can be identified. Plat maps or aerial photographs will help surveyors orient themselves on heavily developed beaches.

PRELIMINARY DAYTIME INSPECTIONS

An advantage to conducting lighting inspections during the day is that surveyors will be better able to judge their exact location than they would be able to at night. Preliminary daytime inspections are especially important on beaches that have restricted access at night. Property owners are also more likely to be available during the day than at night to discuss strategies for dealing with problem lighting at their sites.

A disadvantage to daytime inspections is that fixtures that are not directly visible from the beach will be difficult to identify as problems. Moreover, some light sources that can be seen from the beach in daylight may be kept off at night and thus present no problems. For these reasons, daytime inspections are not a substitute for nighttime inspections. Descriptions of light sources identified during daytime inspections should be detailed enough so that anyone can locate the lighting. In addition to a general description of each luminaire (e.g., HPS floodlight directed seaward at top northeast corner of the building at 123 Ocean Street), photographs or sketches of the lighting may be necessary. Descriptions should also include an assessment of how the specific lighting problem can be resolved (e.g., needs turning off; should be redirected 90° to the east). These detailed descriptions will show property owners exactly which luminaries need what remedy.

NIGHTTIME INSPECTIONS

Surveyors orienting themselves on the beach at night will benefit from notes made during daytime surveys. During nighttime lighting inspections, a surveyor walks the length of the nesting beach looking for light from artificial sources. There are two general categories of artificial lighting that observers are likely to detect:

1. **Direct lighting**. A luminaire is considered to be direct lighting if some glowing element of the luminaire (e.g., the globe, lamp [bulb], reflector) is visible to an observer on the beach. A source not visible from one location may be visible from another farther down the beach. When direct lighting is observed, notes should be made of the number, lamp type (discernable by color), style of fixture, mounting (pole, porch, *etc.*), and location (street address, apartment number, or pole identification number) of the luminaire(s). If exact locations of problem sources were not determined during preliminary daytime surveys, this should be done during daylight soon after the nighttime survey. Photographing light sources (using long exposure times) is often helpful.

2. **Indirect lighting**. A luminaire is considered to be indirect lighting if it is not visible from the beach but illuminates an object (e.g., building, wall, tree) that is visible from the beach. Any object on the dune that appears to glow is probably being lighted by an indirect source. When possible, notes should be made of the number, lamp type, fixture style, and mounting of an indirect-lighting source. Minimally, notes should be taken that would allow a surveyor to find the

lighting during a follow-up daytime inspection (for instance, which building wall is illuminated and from what angle?).

WHEN SHOULD LIGHTING INSPECTIONS BE CONDUCTED?

Because problem lighting will be most visible on the darkest nights, lighting inspections are ideally conducted when there is no moon visible. Except for a few nights near the time of the full moon, each night of the month has periods when there is no moon visible. Early-evening lighting inspections (probably the time of night most convenient for inspectors) are best conducted during the period of two to 14 days following the full moon. Although most lighting problems will be visible on moonlit nights, some problems, especially those involving indirect lighting, will be difficult to detect on bright nights.

A set of daytime and nighttime lighting inspections before the nesting season and a minimum of three additional nighttime inspections during the nesting-hatching season are recommended. The first set of day and night inspections should take place just before nesting begins. The hope is that managers, tenants, and owners made aware of lighting problems will alter or replace lights before they can affect sea turtles. A follow-up nighttime lighting inspection should be made approximately two weeks after the first inspection so that remaining problems can be identified. During the nesting-hatching season, lighting problems that seemed to have been remedied may reappear because owners have been forgetful or because ownership has changed. For this reason, two midseason lighting inspections are recommended. The first of these should take place approximately two months after the beginning of the nesting season, which is about when hatchlings begin to emerge from nests. To verify that lighting problems have been resolved, another follow-up inspection should be conducted approximately one week after the first midseason inspection.

WHO SHOULD CONDUCT LIGHTING INSPECTIONS?

Although no specific authority is required to conduct lighting inspections, property managers, tenants, and owners are more likely to be receptive if the individual making recommendations represent a recognized conservation group, research consultant, or government agency. When local ordinances regulate beach lighting, local government code-enforcement agents should conduct lighting inspections and contact the public about resolving problems.

WHAT SHOULD BE DONE WITH INFORMATION FROM LIGHTING INSPECTIONS?

Although lighting surveys serve as a way for conservationists to assess the extent of lighting problems on a particular nesting beach, the principal goal of those conducting lighting inspections should be to ensure that lighting problems are resolved. To resolve lighting problems, property managers, tenants, and owners should be give the information they need to make proper alterations to light sources. This information should include details on the location and description of problem lights, as well as on how the lighting problem can be solved. One should also be prepared to discuss the details of how lighting affects sea turtles. Understanding the nature of the problem will motivate people more than simply being told what to do.

APPENDIX C

EXAMPLES OF PREDATOR PROOF TRASH RECEPTACLES

Example of predator proof trash receptacle at Gulf Islands National Seashore. Lid must be tight fitting and made of material heavy enough to stop animals such as raccoons.

Example of trash receptacle anchored into the ground so it is not easily turned over.

Example of predator proof trash receptacle at Perdido Key State Park. Metal trash can is stored inside. Cover must be tight fitting and made of material heavy enough to stop animals such as raccoons.