US Army Corps
of Engineers ®
Wilmington District

General Re-evaluation Report and Environmental Assessment
Surf City, Onslow and Pender Counties, North Carolina
Coastal Storm Risk Management Project

Appendix K: US Fish and Wildlife Service

Section 7 (a)(2) of the Endangered Species Act

and Coordination Act

Final

January 2025

Biological Opinion

Surf City Coastal Storm Risk Management Project
U.S. Army Corps of Engineers

USFWS Project Code: 2024-0048393

Prepared by:

U.S. Fish and Wildlife Service
Raleigh Ecological Services
3916 Sunset Ridge Road
Raleigh, NC 27607

JENNIFER ARCHAMBAULT Digitally signed by JENNIFER ARCHAMBAULT Date: 2024.12.03 16:19:46 -05'00'

December 3, 2024

for Pete Benjamin, Field Supervisor

Date

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CONSULTATION HISTORY

The Service has coordinated at various times over the past 25 or more years on the Corps' Civil Works activities on Topsail Island. Previous points of contact on this project include:

March 2001: The Service provided scoping comments to the Corps.

September 9, 2003: The Service provided a Planning Aid Letter to the Corps.

June 2008: The Service provided a draft Fish and Wildlife Coordination Act (FWCA) Report.

March 2010: The Department of Interior (DOI) provided comments on the draft Integrated Feasibility Report and Environmental Impact Statement (EIS).

May 2010: The Service provided a final FWCA Report.

December 2010: The Corps issued the final Integrated Feasibility Report and EIS.

March 2014: The Service provided comments to the July 2013 Supplemental EA for the West Onslow Beach and New River Inlet (Topsail Beach) and Surf City and North Topsail Beach Coastal Storm Damage Reduction (CSDR) projects.

April 2014: The Corps issued a Finding of No Significant Impact (FONSI) for the West Onslow Beach and New River Inlet (Topsail Beach) and Surf City and North Topsail Beach CSDRs.

Key events and correspondence during the course of this consultation are listed below. A complete administrative record of this consultation is on file in the Service's Raleigh Field Office.

June 15, 2020: The Corps held a virtual scoping meeting with the Service and other resource agencies, to discuss the Corps proposed work window and solicit input. The Corps sent a scoping letter to the Service on May 26, 2020. The Service recommended formal consultation for the project.

April 2021 to August 2024: The Service participated by phone in meetings with the Corps to discuss various aspects of the project, and documentation needed for formal consultation.

August 30, 2024: The Corps issued a notice of availability of the draft General Re-evaluation Report (GRR) and EA for the proposed project and requested initiation of formal consultation. The Service provided comments to the notice of availability by letter dated October 25, 2024.

October 4, 2024: The Corps provided an updated Biological Assessment (BA) for the project. The Service initiated formal consultation by letter dated October 29, 2024.

October 29, 2024: By email, the Service provided the draft Incidental Take Statement (ITS) of the BO to the Corps, including draft RPMs and T&C.

November 6, 2024: By email, the Corps informed the Service that it could comply with the RPMs and T&Cs.

BIOLOGICAL OPINION

1. INTRODUCTION

A biological opinion (BO) is the document that states the opinion of the U.S. Fish and Wildlife Service (Service) under the Endangered Species Act of 1973, as amended (ESA), as to whether a Federal action is likely to:

- jeopardize the continued existence of species listed as endangered or threatened; or
- result in the destruction or adverse modification of designated critical habitat.

The Federal action addressed in this BO is the U.S. Army Corps of Engineers' (Corps) implementation of the Surf City Coastal Storm Risk Management (CSRM) project, in Onslow and Pender Counties, North Carolina (the Action). This BO considers the effects of the Action on piping plover, red knot, seabeach amaranth, Kemp's ridley sea turtle, the North Atlantic Ocean Distinct Population Segment (DPS) of the green sea turtle, the Northwest Atlantic Ocean DPS of the loggerhead sea turtle, and terrestrial critical habitat for the loggerhead sea turtle.

The Corps determined that the Action is not likely to adversely affect the following species, and requested Service concurrence: West Indian manatee, green sea turtle, leatherback sea turtle, hawksbill sea turtle, Kemp's ridley sea turtle, piping plover, red knot, and seabeach amaranth. The Service concurred with the findings for West Indian manatee, leatherback sea turtle, and hawksbill sea turtle in a letter dated October 25, 2024. The Service does not concur with the findings for green sea turtle, Kemp's ridley sea turtle, piping plover, red knot, or seabeach amaranth. We provided our basis for the concurrence decision in the October 25, 2024 letter. This concurrence fulfills the requirements applicable to the Action for completing consultation with respect to West Indian manatee, leatherback sea turtle, and hawksbill sea turtle.

A BO evaluates the effects of a Federal action along with those resulting from interrelated and interdependent actions, and from non-Federal actions unrelated to the proposed Action (cumulative effects), relative to the status of listed species and the status of designated critical habitat. A Service opinion that concludes a proposed Federal action is *not* likely to jeopardize species and is *not* likely to destroy or adversely modify critical habitat fulfills the Federal agency's responsibilities under §7(a)(2) of the ESA.

"*Jeopardize the continued existence*" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR §402.02). "*Destruction or adverse modification*" means a direct or indirect alteration that appreciably diminishes the value of designated critical habitat for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features (50 CFR §402.02).

This BO uses hierarchical numeric section headings. Primary (level-1) sections are labeled sequentially with a single digit (e.g., 2. PROPOSED ACTION). Secondary (level-2) sections within each primary section are labeled with two digits (e.g., 2.1. Action Area), and so on for level-3 sections. The basis of our opinion for each listed species and each designated critical habitat identified in the first paragraph of this introduction is wholly contained in a separate level-1 section that addresses its status, environmental baseline, effects of the Action, cumulative effects, and conclusion.

2. PROPOSED ACTION

According to the Draft General Re-evaluation Report and Environmental Assessment (GRR/EA) and Biological Assessment (BA) for the proposed Action, the purpose of the Corps' project is to reduce the impacts and risks associated with erosion, flooding, storm surge and wave attack created by severe coastal storms and sea level rise for the Town of Surf City, North Carolina. Construction of the Surf City Coastal Storm Risk Management (CSRM) project was authorized by Section 7002(3) of the Water Resources Reform and Development Act (WRRDA) of 2014. Project construction was funded by Public Law 116-20, the Additional Supplemental Appropriations Disaster Relief Act, 2019 (DRA 19). The Pre-construction, Engineering and Design phase of the project was completed in 2014 with the Towns of Surf City and North Topsail Beach (NTB) as non-Federal Sponsors. However, in July of 2021 the Town of NTB announced its intention to pull out of the construction phase of the project due to financial reasons. The Town of Surf City maintained its support for a federal project and asked the Corps to examine Coastal Storm risk reduction alternatives within its town limits.

The Bureau of Ocean Energy Management (BOEM) is a cooperating agency under the National Environmental Policy Act (NEPA) for this project due to the potential use of Outer Continental Shelf (OCS) sand resources. BOEM will also serve as a cooperating agency for consultation requirements related to ESA Section 7 (50 CFR 402).

Sediment is proposed to be dredged from one or more of 13 borrow areas offshore Topsail Island and placed on the Surf City shoreline. The recommended plan is a berm and dune system measuring approximately 33,300 feet (ft) long, or approximately 6 miles (mi) of shoreline, with a dune constructed to an elevation of 14 feet (NAVD 88) and fronted by a 6-foot (NAVD 88) (50 ft wide) beach berm restricted by the town limits of Surf City. The alternative would include a 1000-ft transition berm in northern end of the project from the town limits of Surf City into the town limits of NTB. Other features of the alternative would include dune vegetation and 40 public walkover structures.

The proposed plan is to complete initial construction any time of year. Initial construction would result in one disturbance event, lasting approximately 16 months, from the dredges and all other required equipment in the water and on the beach. Subsequent maintenance events would occur during the winter work window of November 16 to April 30. The periodic nourishment intervals would be every six years with a total of seven nourishment events over the 50-year project life (2024-2073).

2.1. Action Area

For purposes of consultation under ESA §7, the Action area is defined as “all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action” (50 CFR §402.02). The “Action Area” for this consultation includes the ocean shoreline within the corporate limits of Surf City on Topsail Island, in Onslow and Pender Counties, North Carolina (**Figure 2-1**). The Action Area includes approximately 33,300 lf (6 mi) of beach shoreline in the Town of Surf City. The Action Area for direct impacts includes those sections of shoreline where sediment disposal and earthen manipulation will occur – approximately 33,300 lf of ocean and shoreline within the construction footprint, extending landward from the shoreline approximately 500 feet. The Action Area for indirect impacts, however, is much larger.

Because sea turtles, piping plovers, and red knots are highly mobile species, animals influenced by direct project impacts may move great distances from the actual project site. The range of these movements produced by the project constitutes the Action Area for indirect impacts. Piping plovers that have been documented in the project area and are known to nest, overwinter, or migrate through the inlets on the north and south ends of Topsail Island. Therefore, the Service defines the Action Area for this opinion to include the entire length of shoreline from the southern inlet shoulder of New Topsail Inlet to the southern inlet shoulder of New River Inlet, encompassing the northern end of Lea-Hutaff Island and all of Topsail Island (**Figure 2-2**).

The waters in the Action Area are classified as both SA waters and Outstanding Resource Waters (ORWs). Class SA waters are surface waters suitable for shellfishing for market purposes. Waters designated as Class SA have specific water quality standards that must be met, as well as the water quality standards assigned to both Class SB and SC waters. ORWs include waters of exceptional water quality.

2.2. Sand Placement and Related Activities

Sand placement is proposed along 33,300 lf of beach, extending from Onslow County near the road intersection of Island Drive and Scotch Bonnet Drive, south to near the road intersection of South Shore Drive and Hispaniola Lane in Pender County.

Sand Placement, Grading, and Redistribution

The total required sediment volume for initial construction and nourishment events over the 50-year project life is approximately 21.8 million cubic yards (mcy). It’s anticipated that initial construction will require approximately 8.0 mcy of sand. Sand will be dredged by hopper dredge or hydraulic cutterhead pipeline systems. Although it’s anticipated that a hopper dredge will be used for the Surf City CSRM project due to the location of the offshore borrow areas, any type of dredge plant may be used for construction or periodic nourishments.

Placement of beach quality sand will be accomplished by pumping a mixture of beach quality sand and water through a pipeline leading to the recipient beach. The placement operations typically employ a spreader that is attached to the discharge end of the pipeline. Spreaders are designed to slow the velocity of the discharge to prevent erosion and to facilitate sediment settling. Temporary shore-parallel containment dikes are constructed in front of the onshore beach discharge points to facilitate sediment settling and to reduce turbidity in the nearshore environment. As placement activities progress, the onshore pipeline is extended along the beach by adding new sections of pipe. Pipeline placement is typically on the upper beach, but seaward of the dunes and any upper beach vegetation. Booster pumps may be required along the pipelines as they are extended along the beach. The location where the pipeline emerges onto the subaerial beach may also shift incrementally as construction progresses along the beach. Throughout the construction process, front-end loaders or other heavy equipment are used to transport and position the onshore pipeline sections.

Bulldozers and other heavy equipment, such as backhoes, front-end loaders, and tractors are used to redistribute and grade the discharged sediment as it falls out of suspension. A variety of supporting vehicles, such as pick-up trucks and all-terrain vehicles, are typically used to transport equipment and personnel along the beach throughout the construction process. Grade stakes are placed throughout the beach fill template to facilitate the construction of berms and dunes to design specifications. To maintain separation between the public and potentially hazardous operations, the active construction area, consisting of a ~500-ft zone on either side of the beach fill discharge point, is typically fenced. Sand placement operations are generally conducted around-the-clock, thus requiring appropriate nighttime lighting in accordance with Corps' and Occupational Safety and Health Administration safety regulations. The Corps' Safety and Health Requirements Manual (EM 385-1-1) specifies a minimum luminance of three lumens per square foot for outdoor construction zones.

Regulations also require front and back lighting on all transport vehicles and heavy equipment during nighttime operations. Post-construction tilling and/or escarpment leveling may be conducted as needed based on North Carolina Wildlife Resources Commission (NCWRC) recommendations. Tilling and leveling are accomplished by heavy equipment similar to that employed in redistribution and grading operations.

Compacted beach fill areas between the toe of the dune and the mean high water (MHW) line are typically tilled to a depth of 24 inches using a series of overlapping passes to ensure thorough decompaction. Chain-linked fencing or a similar apparatus may be dragged over the tilled areas as necessary to eliminate any ruts and furrows created by the tilling process. Escarpments are regraded according to the original berm design specifications.

Staging Areas and Beach Access

Staging areas for equipment and pipes are generally located off the beach to the extent practicable. When necessary, staging areas on the beach are generally positioned as far landward as possible without impacting established vegetation on the upper beach or the frontal dune system. Beach access for construction equipment is typically provided by existing public beach access points. Pedestrian and emergency vehicle access is generally maintained during the construction process. Sand ramps or walkovers are constructed over pipeline sections at the access points to provide access for pedestrians and construction equipment.

Construction Lighting

According to the Corps' Safety and Health Requirements Manual (EM 385-1-1), a minimum of 3 lm/ft^2 is required for general outdoor work or construction areas. Ample lighting of work areas at night is a major human safety consideration. To meet these safety standards, appropriate lighting must be provided at night during specific components of the project site (i.e. disposal site, dredge, staging area, etc.). While project construction typically occurs around-the-clock to make efficient use of equipment, most of the equipment staging, mobilization, and demobilization of pipeline are performed during daylight hours. However, nighttime work is conducted if there is a small construction window, and the work schedule is tight. For projects where lighting is a concern for sensitive organisms, ample lighting can be obtained without impacting a large area by using light shields and appropriate angling of lights. In addition to lighting in the construction area, the vehicles used for transport and the bulldozers moving sediment will have lights on the front and back of the equipment. Features within the active placement area, including the "dump shack" and equipment storage may also have lighting associated with them.

Conservation Measures

The Corps has proposed the following conservation measures:

1. Due to the high number of sea turtle nests annually on Topsail Island, nourishment events (every 6 years), will be done between November 16 and April 30 to the maximum extent practicable to avoid sea turtle nesting season.
2. If non-beach quality material from the borrow areas is placed on the beaches, a screen will be installed on the inflow and outflow pipes to prevent further placement of large shells, clay balls, or rocks. These screens, which shall be onsite during construction, will have a 3/4 inch to 1-inch screen to prevent larger material from being placed on the beach. If non-beach quality material is placed on the beach, dredging will cease until this material is removed.
3. Post-construction tilling and/or escarpment leveling may be conducted as needed based on NCWRC recommendations.
4. Staging areas for equipment and pipes are generally located off the beach to the extent practicable. When necessary, staging areas on the beach are generally positioned as far landward as possible without impacting established vegetation on the upper beach or the frontal dune system. Beach access for construction equipment is typically provided by existing public beach access points.
5. For projects where lighting is a concern for sensitive organisms, ample lighting can be obtained without impacting a large area by using light shields and appropriate angling of lights.
6. Sand placement after 30 April would employ conservation measures to minimize the duration of direct effects on benthic invertebrate communities and potential nesting piping plovers; including the use of beach-quality sand and the delineation and avoidance of shorebird nesting areas.
7. All beach activities during the nesting season will require monitoring for sea turtle nesting activity throughout the construction area, including the discharge area and pipeline routes. Monitoring for nest activity 24 hours/day starting 1 May will be required

so that nests laid in a potential construction zone can be relocated outside of the construction zone prior to project commencement to avoid potential losses.

8. Because construction activities likely will occur throughout the nesting season, 24 hour/day monitoring will be required starting 1 May to document all nests laid within the project area, as well as false crawls and false nesting. A Sea Turtle Monitoring and Nest Relocation Plan will be developed and implemented to clearly direct monitors regarding actions to take when a turtle or nest is encountered. All nests within the project area will be relocated outside of the construction area within 24 hours of nesting. This will ensure the highest success rate of hatching.
9. Throughout the period of sea turtle nesting and hatching, construction pipe that is placed on the beach parallel to the shoreline will 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 will be located off the beach to the maximum extent practicable. If placement on the beach is necessary, it will be done in a manner that impacts 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.
10. The goal of the Sea Turtle Monitoring Nest Relocation Plan will be to identify and remove any turtle nests from dangers of the project area as quickly as possible. This will include the entire length of the pipeline route to the farthest extent of the beachfill limits.
11. Use of heavy equipment along the pipeline route at night will be limited to the maximum extent practicable. A minimum of two nighttime monitors will traverse the length of the pipeline to identify any turtles coming ashore to nest. False crawls, false nests and successful nests will be documented. If proper monitoring and relocation are carried out, all turtle nests should avoid being buried or crushed and thus hatchlings will be safeguarded while emerging.
12. All lighting associated with nighttime project construction including lighting aboard dredges and associated vessels, barges, etc. operating near sea turtle nesting beaches, will be minimized to the maximum extent practicable while maintaining compliance with EM 385-1-1 and all other Corps, U.S. Coast Guard, and OSHA safety requirements. Direct lighting of the beach and nearshore waters will be limited to the immediate construction area(s). To reduce illumination of the adjacent beach and nearshore waters, to the extent practicable, lighting on offshore or onshore equipment will be minimized through reduced wattage, shielding, lowering, and/or use of low-pressure sodium lights.
13. Shielded low-pressure sodium vapor lights have been identified by the Florida Fish and Wildlife Conservation Commission as the best available technology for balancing human safety and security, roadway illumination, and endangered species protection. They provide the most energy efficient, monochromatic, long-wavelength, dark sky friendly, environmentally sensitive light of the commercially available streetlights and will be highly recommended for all lights on the beach or on offshore equipment.
14. Management techniques will be implemented to reduce the impact of escarpment formations. For completed sections of beach during sand placement operations, and for subsequent years following, as the beach profile approaches a more natural profile, visual surveys for escarpments will be performed. Escarpments that are identified that interfere with sea turtle nesting (exceed 18 inches in height for a distance of 100 ft.) will 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 should be directed by the Service or NCWRC.

15. If sea turtle nest relocation is implemented, the proper protocol established by the Service will be adhered to in order to avoid the potential adverse impacts outlined above. Considering the increased risk of finding and relocating nests, additional relocation requirements will be implemented (i.e. nighttime monitoring and relocation) to assure that nests are not missed.

2.3. Other Activities Caused by the Proposed Action

A BO evaluates all consequences to species or critical habitat caused by the proposed Federal Action, including the consequences of other activities caused by the proposed Action, that are reasonably certain to occur (see definition of "effects of the Action" at 50 CFR §402.02). Additional regulations at 50 CFR §402.17(a) identify factors to consider when determining whether activities caused by the proposed Action (but not part of the proposed Action) are reasonably certain to occur. These factors include, but are not limited to:

(1) past experiences with activities that have resulted from actions that are similar in scope, nature, and magnitude to the proposed Action;
(2) existing plans for the activity; and
(3) any remaining economic, administrative, and legal requirements necessary for the activity to go forward.

In its request for consultation, the Corps did not describe, and the Service is not aware of, any other activities caused by the proposed Action. Therefore, this BO does not further address the topic of interrelated or interdependent actions.

2.4. Tables for the Proposed Action

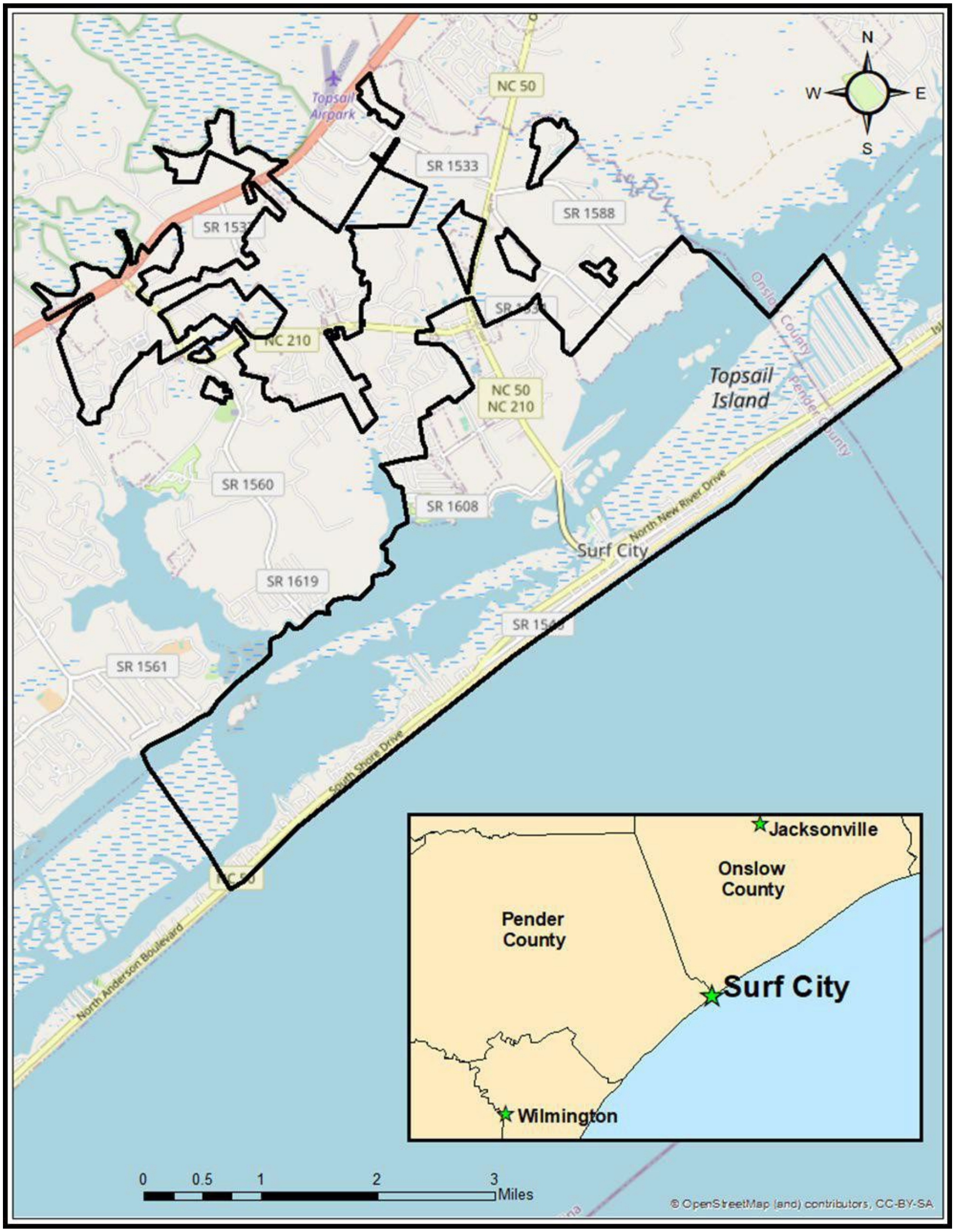

Figure 2-1. Surf City CSRM Project Location Map from the BA.

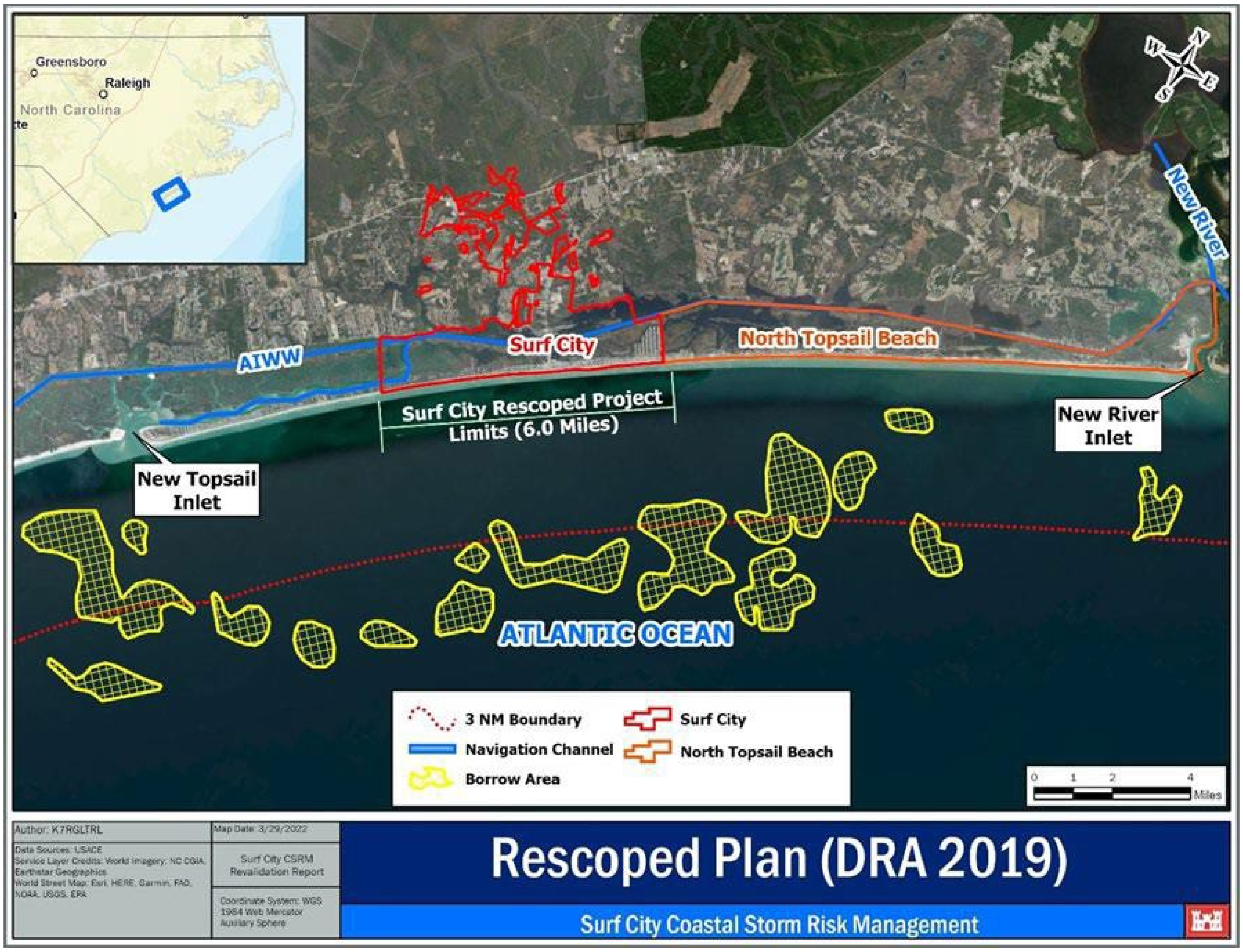

Figure 2-2. Action Area for this Biological Opinion. The Action Area stretches from New Topsail Inlet to New River Inlet. From the BA.

3. SOURCES OF CUMULATIVE EFFECTS

A BO must predict the consequences to species caused by future non-Federal activities within the Action Area, *i.e.,* cumulative effects. "Cumulative effects are those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the Action Area of the Federal action subject to consultation" (50 CFR §402.02). Additional regulations at 50 CFR §402.17(a) identify factors to consider when determining whether activities are reasonably certain to occur. These factors include but are not limited to: existing plans for the activity; and any remaining economic, administrative, and legal requirements necessary for the activity to go forward.

In its request for consultation, the Corps did not describe, and the Service is not aware of, any future non-Federal activities that are reasonably certain to occur within the Action Area. Therefore, we anticipate no cumulative effects that we must consider in formulating our opinion for the Action.

4. LOGGERHEAD, GREEN, AND KEMP'S RIDLEY SEA TURTLES

4.1. Status of Sea Turtle Species

The Service and National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NOAA Fisheries) share Federal jurisdiction for sea turtles under the ESA. The Service has responsibility for sea turtles on the nesting beach. NOAA Fisheries 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. NOAA Fisheries 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. This BO addresses nesting sea turtles, their nests and eggs, and hatchlings as they emerge from the nest and crawl to the sea.

This section summarizes best available data about the biology and current condition of the Kemp's ridley (*Lepidochelys kempii*) sea turtle, the North Atlantic Ocean Distinct Population Segment (DPS) of the green sea turtle (*Chelonia mydas*), and the Northwest Atlantic (NWA) Ocean DPS of the loggerhead sea turtle (*Caretta caretta*), throughout the ranges that are relevant to formulating an opinion about the Action.

4.1.1. Description of Sea Turtle Species

4.1.1.1. **Description – Loggerhead Sea Turtle**

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 DPSs listed as either threatened or endangered (79 FR 39755).

Loggerheads were named for their relatively large heads, which support powerful jaws and enable them to feed on hard-shelled prey, such as whelks and conch. The carapace (top shell) is slightly heart-shaped and reddish-brown in adults and sub-adults, while the plastron (bottom shell) is generally a pale yellowish color. The neck and flippers are usually dull brown to reddish brown on top and medium to pale yellow on the sides and bottom. Hatchlings are a dull brown color. Mean straight carapace length of adults in the southeastern U.S. is approximately 36 inches (in), and mean weight is about 250 lbs.

Critical habitat for the NWA Ocean DPS of the loggerhead sea turtle is addressed in **Section 5**.

4.1.1.2. **Description - Green Sea Turtle**

The green sea turtle was federally listed on July 28, 1978 (43 FR 32800). On April 6, 2016, the NMFS and Service issued a final rule to list 11 DPSs of the green sea turtle. Three of the DPSs are endangered species (Central South Pacific, Central West Pacific, and Mediterranean Sea), and eight are threatened species (81 FR 20058). In North Carolina, the green sea turtle is part of the North Atlantic Ocean DPS and is listed as threatened. The green sea turtle has a worldwide distribution in tropical and subtropical waters.

The green sea turtle grows to a maximum size of about 4 feet (ft) and a weight of 440 pounds. It has a heart-shaped shell, small head, and single-clawed flippers. The carapace is smooth and colored gray, green, brown, and black. Hatchlings are black on top and white on the bottom (NMFS 2009). Hatchling green turtles eat a variety of plants and animals, but adults feed almost exclusively on seagrasses and marine algae.

Critical habitat for the green sea turtle has been designated for the waters surrounding Culebra Island, Puerto Rico, and its outlying keys. There is no designated critical habitat in North Carolina.

4.1.1.3. **Description – Kemp's Ridley Sea Turtle**

The Kemp's ridley sea turtle was federally listed as endangered on December 2, 1970 (35 FR 18320). The Kemp's ridley has one of the most geographically restricted distributions of any sea turtle species. The range of the Kemp's ridley includes the Gulf coasts of Mexico and the U.S., and the Atlantic coast of North America as far north as Nova Scotia and Newfoundland.

Adult Kemp's ridleys and olive ridleys are the smallest sea turtles in the world. The weight of an adult Kemp's ridley is generally between 70 to 108 pounds with a carapace measuring approximately 24 to 26 in in length (Heppell et al. 2005). The carapace is almost as wide as it is long. The species' coloration changes significantly during development from the grey-black dorsum and plastron of hatchlings, a grey-black dorsum with a yellowish-white plastron as post-pelagic juveniles and then to the lighter grey-olive carapace and cream-white or yellowish plastron of adults. Their diet consists mainly of crabs, but may also include fish, jellyfish, and an array of mollusks.

No critical habitat has been designated for the Kemp's ridley sea turtle.

4.1.2. Life History of Sea Turtle Species

Sea turtles 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 sea turtles live are the:

1. Terrestrial zone (supralittoral) - the nesting beach where both 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 ft. 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 ft.

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

Maximum intrinsic growth rates of sea turtles are limited by the extremely long duration of the juvenile stage and fecundity. Sea turtles require high survival rates in the juvenile and adult stages, 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).

4.1.2.1. **Life history – Loggerhead Sea Turtle**

Table 4-1 summarizes key life history characteristics for loggerheads nesting in the U.S. 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 (nesting beaches), nearshore, and open ocean habitats. The loggerhead feeds on mollusks, crustaceans, fish, and other marine animals. The species is found hundreds of miles offshore, and in near-shore 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.

Nesting

For the NWA Ocean DPS, most 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 along the coasts of North America, Central America, northern South America, the Antilles, Bahamas, and Bermuda, but is concentrated in the southeastern United States and the Yucatán Peninsula of Mexico (Sternberg 1981; Ehrhart 1989; Ehrhart *et al*. 2003; NMFS and USFWS 2008).

Loggerheads nest on ocean beaches and occasionally on estuarine shorelines with suitable sand. Females dig nests typically between the high-tide line and the dune front (Routa 1968, 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).

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 of sufficient duration and standardized methods provides a valuable indicator of changes in the adult female population (Meylan 1982; Gerrodette and Brandon 2000; Reina *et al*. 2002).

Early Development

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 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, 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 (Limpus 1971; Salmon *et al.* 1992; Witherington and Martin 1996; Witherington 1997; Stewart and Wyneken 2004).

4.1.2.2. **Life history - Green Sea Turtle**

Green sea turtles deposit from one to nine clutches within a nesting season, but the overall average is about 3.3 nests. The interval between nesting events within a season varies around a mean of about 13 days (Hirth 1997). Mean clutch size varies widely among populations. Clutch size varies from 75 to 200 eggs with incubation requiring 48 to 70 days, depending on incubation temperatures. Only occasionally do females produce clutches in successive years. Usually, two or more years intervene between breeding seasons (NMFS and Service 1991). Age at sexual maturity is believed to be 20 to 50 years (Hirth 1997).

4.1.2.3. **Life history – Kemp's Ridley Sea Turtle**

Nesting occurs primarily from April into July. Nesting often occurs in synchronized emergences, known as “arribadas” or “arribazones,” which may be triggered by high wind speeds, especially north winds, and changes in barometric pressure (Jimenez et al. 2005). Nesting occurs primarily during daylight hours. Clutch size averages 100 eggs and eggs typically take 45 to 58 days to hatch depending on incubation conditions, especially temperatures (Marquez-Millan 1994; Rostal 2007).

Females lay an average of 2.5 clutches within a season (TEWG 1998) and inter-nesting interval generally ranges from 14 to 28 days (Miller 1997; Donna Shaver, Padre Island National Seashore, pers. comm., 2007 as cited in NMFS et al. 2011). Juvenile Kemp's ridleys spend on average 2 years in the oceanic zone (NMFS SEFSC unpublished preliminary analysis, July 2004, as cited in NMFS et al. 2011) where they likely live and feed among floating algal communities. They remain here until they reach about 7.9 in in length (approximately 2 years of age), at which size they enter coastal shallow water habitats (Ogren 1989); however, the time spent in the oceanic zone may vary from 1 to 4 years or perhaps more (Turtle Expert Working Group (TEWG) 2000; Baker and Higgins 2003; Dodge et al. 2003). The mean remigration interval for adult females is 2 years, although intervals of 1 and 3 years are not uncommon (Marquez et al. 1982; TEWG 1998; 2000). Males may not be reproductively active on an annual basis (Wibbels et al. 1991). Age at sexual maturity is believed to be between 10 to 17 years (Snover et al. 2007).

4.1.3. Numbers, Reproduction, and Distribution of Sea Turtle Species

4.1.3.1. **Numbers, Reproduction, and Distribution – Loggerhead Sea Turtle**

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): South 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.

The major nesting concentrations in the U.S. are found in South Florida. However, loggerheads nest from Texas to Virginia. Since 2000, the annual number of loggerhead nests in NC has fluctuated between 333 in 2004 to 1,622 in 2016 (Godfrey, unpublished data; www.seaturtle.org (accessed August 30, 2018). Total estimated nesting in Florida, where 90 percent of nesting occurs, has fluctuated between 52,374 and 122,707 nests per year from 2009-2016 (FWC 2018; http://myfwc.com/media/4326434/loggerheadnestingdata12-16.pdf). 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.

<u>Range-wide Trend</u>: 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 Service 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. Within the U.S., four terrestrial recovery units have been designated for the NWA Ocean DPS of the loggerhead sea turtle: the Northern Recovery Unit (NRU), Peninsular Florida Recovery Unit (PFRU), Dry Tortugas Recovery Unit (DTRU), and

Northern Gulf of Mexico Recovery Unit (NGMRU). North Carolina is located within the NRU, which is defined as loggerheads originating from nesting beaches from the Florida-Georgia border through southern Virginia (the northern extent of the nesting range). The mtDNA analyses show that there is limited exchange of females among recovery units (Ehrhart 1989; Foote et al. 2000; NMFS 2001; Hawkes et al. 2005). 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 produce a relatively high percentage of males, and the more southern nesting beaches produce a relatively high percentage of females (e.g., Hanson et al. 1998; NMFS 2001; Mrosovsky and Provancha 1989). The NRU and the 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 (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 the 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 NWA Ocean DPS. Annual nest totals from northern beaches averaged 5446 nests from 2006 to 2011, representing approximately 1,328 nesting females per year (4.1 nests per female, Murphy and Hopkins 1984) (NMFS and Service 2008). Overall, there is strong statistical data to suggest the NRU has experienced a long-term decline (NMFS and Service 2008). Currently, however, nesting for the NRU is showing possible signs of stabilizing (76 FR 58868, September 22, 2011).

<u>Recovery Criteria for the NRU (only the Demographic Recovery Criteria are presented below; for the Listing Factor Recovery Criteria, see NMFS and Service 2008)</u>

1. Number of Nests and Number of Nesting Females
   a) 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
   b) 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.

4.1.3.2. **Numbers, Reproduction, and Distribution - Green Sea Turtle**

There are an estimated 150,000 green sea turtle females that nest each year in 46 sites throughout the world (NMFS and Service 2007). Within the U.S., green turtles nest in small numbers in the U.S. Virgin Islands and Puerto Rico, and in larger numbers along the east coast of Florida, particularly in Brevard, Indian River, St. Lucie, Martin, Palm Beach, and Broward Counties (NMFS and Service 1991). Nests have been documented, in smaller numbers, north of these counties in Florida, as well as in Georgia, South Carolina, North Carolina, and as far north as Delaware in 2011. Years of coordinated conservation efforts, including protection of nesting beaches, reduction of bycatch in fisheries, and prohibitions on the direct harvest of sea turtles, have led to increasing numbers of turtles nesting in Florida and along the Pacific coast of Mexico. On April 6, 2016, NMFS and the Service reclassified the status of the two segments that include those breeding populations (North Atlantic Ocean DPS and East Pacific Ocean DPS) from endangered to threatened (81 FR 20058). In North Carolina, between 4 and 44 green sea turtle nests are laid annually (Godfrey, unpublished data). In the U.S. Pacific, over 90 percent of nesting throughout the Hawaiian archipelago occurs at the French Frigate Shoals, where about 200 to 700 females nest each year (NMFS and Service 1998). Elsewhere in the U.S. Pacific, nesting takes place at scattered locations in the Commonwealth of the Northern Marianas, Guam, and American Samoa. In the western Pacific, the largest green turtle nesting aggregation in the world occurs on Raine Island, Australia, where thousands of females nest nightly in an average nesting season (Limpus et al. 1993). In the Indian Ocean, major nesting beaches occur in Oman where 30,000 females are reported to nest annually (Ross and Barwani 1995).

<u>Range-wide Trend</u>: Eleven DPSs have been listed for the green sea turtle (81FR20058). Three of the DPSs are listed as endangered, while eight are listed as threatened, including the North Atlantic Ocean DPS, which is included in the Action Area. The range of the DPS extends from the boundary of South and Central America, north along the coast to include Panama, Costa Rica, Nicaragua, Honduras, Belize, Mexico, and the United States, then due east across the Atlantic Ocean to the Islamic Republic of Mauritania on the African continent. It then extends west to the Caribbean basin, then due south and west to the boundary of South and Central America. It includes Puerto Rico, the Bahamas, Cuba, Turks and Caicos Islands, Republic of Haiti, Dominican Republic, Cayman Islands, and Jamaica. The North Atlantic DPS includes the Florida breeding population, which was originally listed as endangered under the ESA (43 FR 32800, July 28, 1978).

The North Atlantic Ocean DPS currently exhibits high nesting abundance, with an estimated total nester abundance of 167,424 females at 73 nesting sites. More than 100,000 females nest at Tortuguero, Costa Rica, and more than 10,000 females nest at Quintana Roo, Mexico. Nesting data indicate long-term increases at all major nesting sites. There is little genetic substructure within the DPS, and turtles from multiple nesting beaches share common foraging areas. Nesting is geographically widespread and occurs at a diversity of mainland and insular sites (81 FR 20058). Annual nest totals documented as part of the Florida SNBS program from 1989-2010 have ranged from 435 nests laid in 1993 to 13,225 in 2010. Nesting occurs in 26 counties with a peak along the east coast, from Volusia through Broward Counties. Green sea turtle nesting in Florida is increasing based on 22 years (1989-2010) of INBS data from throughout the state (FWC/FWRI 2010b). The increase in nesting in Florida is likely a result of several factors, including: (1) a Florida statute enacted in the early 1970s that prohibited the killing of green turtles in Florida; (2) the species listing under the ESA afforded complete protection to eggs, juveniles, and adults in all U.S. waters; (3) the passage of Florida's constitutional net ban amendment in 1994 and its subsequent enactment, making it illegal to use any gillnets or other entangling nets in State waters; (4) the likelihood that the majority of Florida green turtles reside within Florida waters where they are fully protected; (5) the protections afforded Florida green turtles while they inhabit the waters of other nations that have enacted strong sea turtle conservation measures (e.g., Bermuda); and (6) the listing of the species on Appendix I of Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), which stopped international trade and reduced incentives for illegal trade from the U.S (NMFS and Service 2007a).

Recovery Criteria

The U.S. Atlantic population of green sea turtles can be considered for delisting if, over a period of 25 years, the following conditions are met:

1. The level of nesting in Florida has increased to an average of 5,000 nests per year for at least six years. Nesting data must be based on standardized surveys;
2. At least 25 percent (65 mi) of all available nesting beaches (260 mi) is in public ownership and encompasses at least 50 percent of the nesting activity;
3. A reduction in stage class mortality is reflected in higher counts of individuals on foraging grounds; and
4. All priority one tasks identified in the recovery plan have been successfully implemented.

The Recovery Plan for U.S. Population of Atlantic Green Turtle was signed in 1991 (NMFS and Service 1991), and the Recovery Plan for U.S. Pacific Populations of the East Pacific Green Turtle was signed in 1998 (NMFS and Service 1998).

4.1.3.3. **Numbers, Reproduction, and Distribution – Kemp's Ridley Sea Turtle**

The Kemp's ridley has a restricted distribution. Most Kemp's ridleys nest on the beaches of the western Gulf of Mexico, primarily in Tamaulipas, Mexico. Nesting also occurs in Veracruz and Campeche, Mexico, although a small number of Kemp's ridleys nest consistently along the

Texas coast (NMFS et al. 2011). In addition, rare nesting events have been reported in Alabama, Florida, Georgia, South Carolina, and North Carolina. Historical information indicates that tens of thousands of ridleys nested near Rancho Nuevo, Mexico, during the late 1940s (Hildebrand 1963). The Kemp's ridley population experienced a devastating decline between the late 1940s and the mid-1980s. The total number of nests per nesting season at Rancho Nuevo remained below 1,000 throughout the 1980s, but gradually began to increase in the 1990s. In 2009, 16,273 nests were documented along the 18.6 mi of coastline patrolled at Rancho Nuevo, and the total number of nests documented for all the monitored beaches in Mexico was 21,144 (USFWS 2010). In 2011, a total of 20,570 nests were documented in Mexico, 81 percent of these nests were documented in the Rancho Nuevo beach (Burchfield and Peña 2011). In addition, 153 and 199 nests were recorded during 2010 and 2011, respectively, in the U.S., primarily in Texas. Between 2009 and 2017 in North Carolina, there were typically one or two Kemp's ridley nests each year, and there were four in 2016.

Today, under strict protection, the population appears to be in the early stages of recovery. The recent nesting increase can be attributed to full protection of nesting females and their nests in Mexico resulting from a bi-national effort between Mexico and the U.S. to prevent the extinction of the Kemp's ridley, and the requirement to use Turtle Excluder Devices (TEDs) in shrimp trawls both in the U.S. and Mexico.
The Mexico government also prohibits harvesting and is working to increase the population through more intensive law enforcement, by fencing nest areas to diminish natural predation, and by relocating most nests into corrals to prevent poaching and predation. While relocation of nests into corrals is currently a necessary management measure, this relocation and concentration of eggs into a "safe" area is of concern since it can reduce egg viability.

Recovery Criteria (only the Demographic Recovery Criteria are presented below; for the Listing Factor Recovery Criteria, see NMFS et al. 2011)
The current recovery goal is for the species to be reduced from endangered to threatened status. The Recovery Team members feel that the criteria for a complete removal of this species from the endangered species list need not be considered now, but rather left for future revisions of the plan. Complete removal from the federal list would certainly necessitate that some other instrument of protection, similar to the MMPA, be in place and be international in scope. Kemp's ridley can be considered for reclassification to threatened status when the following four criteria are met:

1. Continuation of complete and active protection of the known nesting habitat and the waters adjacent to the nesting beach (concentrating on the Rancho Nuevo area) and continuation of the bi-national protection project;
2. Elimination of mortality from incidental catch in commercial shrimping in the U.S. and Mexico through the use of TEDs and achievement of full compliance with the regulations requiring TED use;
3. Attainment of a population of at least 10,000 females nesting in a season; and
4. Successful implementation of all priority one recovery tasks in the recovery plan.

The Recovery Plan for the Kemp's Ridley Sea Turtle was signed in 1992 (USFWS and NMFS 1992). Significant new information on the biology and population status of Kemp's ridley has become available since 1992. Consequently, a full revision of the recovery plan has been completed by the Service and NMFS. The Bi-National Recovery Plan for the Kemp's Ridley Sea turtle (2011) provides updated species biology and population status information, objective and measurable recovery criteria, and updated and prioritized recovery actions.

4.1.4. Conservation Needs of and Threats to Sea Turtle Species

Reason for Listing: All sea turtle species are listed for similar reasons. There are many threats to sea turtles, including nest destruction from natural events, such as tidal surges and hurricanes, or eggs lost to predation by raccoons, foxes, ghost-crabs, and other animals. However, human activity has significantly contributed to the decline of sea turtle populations along the Atlantic Coast and in the Gulf of Mexico (NRC 1990). These factors include the modification, degradation, or loss of nesting habitat by coastal development, artificial lighting, beach driving, and marine pollution and debris. Furthermore, the overharvest of eggs for food, intentional killing of adults and immature turtles for their shells and skin, and accidental drowning in commercial fishing gear are primarily responsible for the worldwide decline in sea turtle populations.

Barrier islands and inlets are complex and dynamic coastal systems that are continually responding to sediment supply, waves, and fluctuations in sea level. The location and shape of the beaches of barrier islands perpetually adjusts to these physical forces. Waves that strike a barrier island at an angle, for instance, generate a longshore current that carries sediment along the shoreline. Cross-shore currents carry sediment perpendicular to the shoreline. Wind moves sediment across the dry beach, dunes and island interior. During storm events, overwash may breach the island at dune gaps or other weak spots, depositing sediments on the interior and back sides of islands, increasing island elevation and accreting the soundside shoreline.

Tidal inlets play a vital role in the dynamics and processes of barrier islands. Sediment is transferred across inlets from island to island via the tidal shoals or deltas. The longshore sediment transport often causes barrier spits to accrete, shifting inlets towards the neighboring island. Flood tidal shoals that are left behind by the migrating inlet are typically incorporated into the soundside shoreline and marshes of the island, widening it considerably. Many inlets have a cycle of inlet migration, breaching of the barrier spit during a storm, and closure of the old inlet with the new breach becoming the new inlet. Barrier spits tend to be low in elevation, sparse in vegetation, and repeatedly submerged by high and storm tides.

<u>Threats to Sea Turtle Species</u>

Coastal Development

Loss of sea turtle 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 (NRC 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.

Hurricanes and Storms

Hurricanes and other large storms 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 and large storms 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. 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 (Philibosian 1976; Mann 1977; Witherington and Martin 1996). 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). 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).

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 (DOI) requires agencies under its direction to consider potential climate change effects as part of their long-range planning activities (USFWS 2007a).

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 2006). As the level of information increases relative to the effects of global climate change on sea turtles and their 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. 2008).

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 (NRC 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

Human presence on or adjacent to the beach at night during the nesting season, particularly recreational activities, 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. In 2018, a dead female Kemp's ridley sea turtle washed up Near Fort Morgan Alabama, entangled in a beach chair (USA Today 2018).

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 sea turtle 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). Beach compaction and unnatural beach profiles resulting from beach nourishment activities could negatively impact sea turtles regardless of the timing of projects. 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). The placement of rocky material may have similar effects. These impacts can be minimized by using suitable sand.

A change in sediment color on a beach could change the natural incubation temperatures of sea turtle 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.

During project construction, predators of eggs and nestlings may be attracted to the Action Area due to food waste from the construction crew.

Sand fencing

Sand fencing captures windblown sand, bolstering dunes and altering the beach profile (Rice 2017). When fences are installed seaward of houses, the sand fencing displaces the dune crest farther seaward than would naturally occur (Nordstrom and McCluskey 1985). The installation of sand fencing in overwash areas hastens the conversion of these flat, bare areas to elevated, vegetated dune habitat. Sand fencing may impede the movement of sea turtles. Between 2012 and early 2016, 62.69 mi (19%) of sandy beach habitat in North Carolina was modified by sand fencing.

In-water and Shoreline Alterations

Many navigable mainland or barrier island tidal inlets 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 designed to trap sand that would otherwise be transported by longshore currents. These in-water structures can cause downdrift erosion and cause 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 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 sea turtle nesting. 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.

4.1.5. Tables for Status of Sea Turtle Species

Table 4-1. Typical values of life history parameters for loggerheads nesting in the U.S. (NMFS and Service 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 in 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 Caldwell (1962), Dodd (1988).
9 Richardson et al. (1978); Bjorndal et al. (1983).
10 Snover (2005).
11 Dahlen et al. (2000).

4.2. Environmental Baseline for Loggerhead, Green, and Kemp's Ridley Sea Turtles

This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the three sea turtle species, respectively, sea turtle terrestrial habitat, and the ecosystem within the Action Area. The environmental baseline is a "snapshot" of the species' health in the Action Area at the time of the consultation and does not include the effects of the Action under review.

4.2.1. Action Area Numbers, Reproduction, and Distribution of Sea Turtles

The loggerhead sea turtle nesting and hatching season for North Carolina beaches extends from May 1 through November 15. Incubation ranges from about 45 to 95 days. See **Table 4-2** for data on observed loggerhead and green sea turtle nests on Topsail Island. Data was provided www.seaturtle.org (accessed on October 15, 2024). No data was provided by the Corps for the project footprint.

The green sea turtle nesting and hatching season on North Carolina beaches extends from May 15 through November 15. Incubation ranges from about 45 to 75 days. Since 2009, 29 green sea turtle nests have been documented on Topsail Island (**Table 4-2**), as recently as 2023.

The Kemp's ridley sea turtle nesting and hatchling season on North Carolina beaches appears to be similar to other species. Incubation ranges from 45 to 58 days. One Kemp's ridley nest was reported on Topsail Island in 2016 and one in 2022.

4.2.2. Action Area Conservation Needs of and Threats to Sea Turtles

According to the Town of Surf City's website (accessed October 15, 2024), the town began as a small fishing village. Development began in 1947, and today Surf City is the largest town on Topsail Island. The Town was incorporated in 1949. Prior to World War II, the only access to Topsail Island was by boat. During the war, large temporary Anti-aircraft training base was developed at nearby Holly Ridge, and a floating bridge was built to the island in order to develop training facilities. After the war, the Navy used Topsail Island for development of a guided missile program. After the program ended, the island was returned to the original owners, but the roads and bridge remained. A large portion of the Action Area is presently lined with structures, including motels, restaurants, and gift shops, along with residences. Recreational use in the Action Area is quite high from residents and tourists.

A wide range of recent and on-going activities have altered the proposed Action Area and, to a greater extent, the North Carolina coastline, and many more are proposed along the coastline for the near future. **Table 4-3** lists projects that have been completed since 2011, though the list is not comprehensive.

Nourishment activities: Surf City beaches have been nourished several times in the past 6 years. Nourishment activities included dune repair/restoration utilizing sand trucked from upland mines or bulldozed from the beach shoreline, as well as utilizing sand dredged from permitted channels adjacent to Topsail Island. In 2019, sand trucked from an upland and mine was found to contain large amounts of gravel. After discovery, the town limited the amount of gravel placed on the beach by screening the material before placement.

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).

With regard to indirect loss of eggs and hatchlings, on most beaches, nesting success typically declines for the first year or two following sand placement, even though more nesting habitat is available for turtles (Trindell et al. 1998; Ernest and Martin 1999; Herren 1999). Reduced nesting success on constructed beaches has been attributed to increased sand compaction, escarpment formation, and changes in beach profile (Nelson et al. 1987; Crain et al. 1995; Lutcavage et al. 1997; Steinitz et al. 1998; Ernest and Martin 1999; Rumbold et al. 2001). In addition, even though constructed beaches are wider, nests deposited there may experience higher rates of wash out than those on relatively narrow, steeply sloped beaches (Ernest and Martin 1999). This occurs because nests on constructed beaches are more broadly distributed than those on natural beaches, where they tend to be clustered near the base of the dune. Nests laid closest to the waterline on constructed beaches may be lost during the first year or two following construction as the beach undergoes an equilibration process during which seaward portions of the beach are lost to erosion. As a result, the project may be anticipated to result in decreased nesting and loss of nests that are laid within the Action Area for two subsequent nesting seasons following the completion of the proposed sand placement. However, it is unknown whether nests that would have been laid in an Action Area during the two subsequent nesting seasons 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). Thus, even if the majority of the eggs and hatchlings that would have been produced on the project beach are not realized for up to 2 years following project completion, 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 a sand placement project. A variety of natural and unknown factors negatively affect incubating egg clutches, including tidal inundation, storm events, and predation, accretion of sand, and erosional processes. The loss of all life stages of sea turtles including eggs are considered "take" and minimization measures are required to avoid and minimize all life stages.

Inlet dredging activities: Dredging of New Topsail Inlet has been conducted on a regular basis for decades. Congressional authorization for dredging of New Topsail Inlet began as a modification to authorizations for the AIWW in 1966 (USACE 2015). The Corps conducted maintenance dredging of the shallow-draft channel two or three times per year in many years, typically using a side-cast dredge. New River Inlet and associated channels have been dredged by the Corps at least twice in the past 6 years, with placement of the compatible material on NTB.

Beach raking: Man-made beach cleaning and raking machines effectively remove seaweed, fish, glass, syringes, plastic, cans, cigarettes, shells, stone, wood, and virtually any unwanted debris (Barber Beach Cleaning Equipment 2009). Removal of wrack also eliminates a beach's natural sand-trapping abilities, further destabilizing the beach. In addition, sand adhering to seaweed and trapped in the cracks and crevices of wrack is removed from the beach. Although the amount of sand lost due to single sweeping actions may be small, it adds up considerably over a period of years (Nordstrom et al. 2006; Neal et al. 2007). Beach cleaning or grooming can result in abnormally broad unvegetated zones that are inhospitable to dune formation or plant colonization, thereby enhancing the likelihood of erosion (Defreo et al. 2009). The Town of NTB conducted significant rock-picking activities during the 2015 beach nourishment project, due to large amounts of rock and gravel. Rock-picking activities continued within the NTB project area annually until at least 2018, to remove larger material that continued to erode onto the beach from the dune and/or berm. The Town of Surf City expressed interest in 2024 in conducting a beach cleaning event using a "Bebot" (sponsored by Keep New Hanover County Beautiful). The Bebot is assumed to be less impactful than other beach rakes, but the potential impacts of use during the sea turtle nesting season have not been studied.

Beach scraping or bulldozing: Beach scraping or bulldozing has been frequent on North Carolina beaches in recent years, in response to storms and the continuing retreat of the shoreline with rising sea level. Surf City has conducted beach bulldozing activities in the past 5 years.

Sandbags and revetments: There are two existing rock revetments along the coast of North Carolina: one at Fort Fisher (approximately 3,040 lf), and another along Carolina Beach (approximately 2,050 lf). A sandbag revetment at least 1,800 lf long (with a geotube in front of a portion) was constructed in 2015 at the north end of NTB, and more sandbags were recently added to protect a parking lot north of the revetment. In 2000 and 2001, sandbag revetments were installed on the north end of Figure Eight Island along Surf Court, Inlet Hook Road, and Comber Road.

Pedestrian Use of the Beach: There are a number of potential sources of pedestrians and pets, including those individuals originating from beachfront and nearby residences.

Beach Driving: The Town of Surf City allows vehicles on the beach between October 1 and March 15 in limited circumstances. A permit is required for access. In recent years, driving has generally been prohibited due to unsafe conditions on the beach. See **section 4.1.4** for discussion of the impacts of beach driving. Gibson et al. (2018) estimated the mean number of vehicles per km surveyed during winter and spring piping plover surveys. By far, Topsail Beach had the

highest number of vehicles observed per km of any other site in the study (including Georgia, South Carolina, and North Carolina sites), with almost one vehicle every 2 km.
Sand fencing: There are a few stretches of sand fencing along the shoreline on Surf City.

4.2.3. Tables for Environmental Baseline for Sea Turtles

Table 4-2. Number of loggerhead nests observed between 2009 and 2023 on Topsail. Data from the BA and from www.seaturtle.org (accessed October 15, 2024).

Year	Number of Loggerhead Nests	Number of Green Sea Turtle Nests
2009	59	
2010	104	
2011	110	
2012	84	1
2013	132	4
2014	53	2
2015	67	4
2016	165	
2017	94	
2018	53	1
2019	176	2
2020	99	8
2021	100	3
2022	111	
2023	104	4

Table 4-3. Actions that have occurred on Topsail Island since 2011. This list is not comprehensive.

Year	Species Impacted	Project Type	Anticipated Take
Various and ongoing, since the mid-1900s or earlier	Loggerhead, green, and Kemp's ridley sea turtle, piping plover, red knot, seabeach amaranth	Federal Navigation Projects in New Topsail Inlet and associated channels, some events with sand placement on Topsail Island	Typically 2,500 lf of shoreline, if sand is placed on beach
2011, 2012, 2015, 2019, 2023	Loggerhead, green, and Kemp's ridley sea turtle, piping plover, red knot, seabeach amaranth	Dredging of Topsail Creek, Banks Channel, Connector Channel, AIWW, with sand placement on Topsail Island	24,700 lf of shoreline (unknown length in 2019 when Surf City also placed sand).
Ongoing	Loggerhead, green, and Kemp's ridley sea turtle, piping plover, red knot, seabeach amaranth	Shallow-draft Inlet dredging, sometimes with placement on Topsail Beach	Up to 23,900 lf of shoreline
2013	Loggerhead, green, and Kemp's ridley sea turtle, piping plover, red knot, seabeach amaranth	Beach nourishment of NTB Phase 1	7,500 lf of shoreline
2014	Loggerhead, green, and Kemp's ridley sea turtle, piping plover, red knot, seabeach amaranth	Beach nourishment of NTB Phase 5 utilizing sand from offshore borrow sites	20,300 lf of shoreline
2015	Loggerhead, green, and Kemp's ridley sea turtle, piping plover, red knot, seabeach amaranth	Installation of sandbag revetments on NTB	Approximately 2,000 lf of shoreline
2018, 2019, 2023, 2024	Loggerhead, green, and Kemp's ridley sea turtle, piping plover, red knot, seabeach amaranth	Beach nourishment or dune repair (beach bulldozing and/or truck-hauled sand) on NTB or Surf City Beaches	At least 1,000 lf of shoreline during each event

4.3. Effects of the Action on Loggerhead, Green, and Kemp's Ridley Sea Turtles

This section analyzes the direct and indirect effects of the Action on the three sea turtle species, including the direct and indirect effects of interrelated and interdependent actions. Direct effects are caused by the Action and occur at the same time and place. Indirect effects are caused by the Action, but are later in time and reasonably certain to occur. Our analyses are organized according to the description of the Action in **Section 2** of this BO.

As discussed in **Section 4.1**, the Service and the NMFS share Federal jurisdiction for sea turtles under the ESA. The Service has responsibility for sea turtles on the nesting beach. NMFS has jurisdiction for sea turtles in the marine environment. Therefore, this BO will not consider effects of dredging on sea turtles within the marine environment.

4.3.1. Effects of Sand Placement on Sea Turtle Species

Applicable Science and Pathways of Response

Direct Effects: Potential adverse effects during the project construction phase include disturbance of existing nests, which may have been missed by surveyors and thus not marked for avoidance, disturbance of females attempting to nest, and disorientation of emerging hatchlings. In addition, heavy equipment will be required to re-distribute the sand to the original natural beach template. This equipment will have to traverse the beach portion of the Action Area, which could result in harm to nesting sea turtles, their nests, and emerging hatchlings.

Placement of sand on a beach in and of itself may not provide suitable nesting habitat for sea turtles. Although sand placement activities may increase the potential nesting area, significant negative impacts to sea turtles may result if protective measures are not incorporated during project construction. Sand placement activities during the nesting season can cause increased loss of eggs and hatchlings and, along with other mortality sources, may significantly impact the long-term survival of the species. For instance, projects conducted during the nesting and hatching season could result in the loss of sea turtles through disruption of adult nesting activity and by burial or crushing of nests or 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. In addition, nests may be destroyed by operations at night prior to beach patrols being performed. Even under the best of conditions, about 7 percent of the nests can be misidentified as false crawls by experienced sea turtle nest surveyors (Schroeder 1994).

a. Equipment during construction

The use of heavy machinery on beaches during a construction project may have adverse effects on sea turtles. Equipment left on the nesting beach overnight can create barriers to nesting females emerging from the surf and crawling up the beach, causing a higher incidence of false crawls and unnecessary energy expenditure.

The operation of motor vehicles or equipment on the beach to complete the project work at night affects sea turtle nesting by: interrupting or colliding with a nesting turtle on the beach, headlights disorienting or misorienting emergent hatchlings, vehicles running over hatchlings attempting to reach the ocean, and vehicle ruts on the beach interfering with hatchlings crawling to the ocean. Apparently, hatchlings become diverted not because they cannot physically climb out of a 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 ruts may increase the susceptibility of hatchlings to dehydration and depredation during migration to the ocean (Hosier et al. 1981). 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).

The physical changes and loss of plant cover caused by vehicles on vegetated areas or dunes can lead to various degrees of instability and cause dune migration. As vehicles move over the sand, sand is displaced downward, lowering the substrate. Since the vehicles also inhibit plant growth, and open the area to wind erosion, the beach and dunes may become unstable. Vehicular traffic on the beach or through dune breaches or low dunes may cause acceleration of overwash and erosion (Godfrey et al. 1978). Driving along the beachfront should be between the low and high tide water lines. To minimize the impacts to the beach, dunes, and dune vegetation, transport and access to the construction sites should be from the road to the maximum extent possible. However, if vehicular access to the beach is necessary, the areas for vehicle and equipment usage should be designated and marked.

b. Artificial lighting as a result of an unnatural beach slope on the adjacent beach

Visual cues are the primary sea-finding mechanism for hatchling sea turtles (Mrosovsky and Carr 1967; Mrosovsky and Shettleworth 1968; Dickerson and Nelson 1989; Witherington and Bjorndal 1991). When artificial lighting is present on or near the beach, it can misdirect hatchlings once they emerge from their nests and prevent them from reaching the ocean (Philibosian 1976; Mann 1977; FWC 2007). For example, in July 2018 in Atlantic Beach, NC, more than 80 hatchlings from an unmarked loggerhead sea turtle nest were rescued from the road, parking lots, and dunes after they were disoriented by artificial lights (Godfrey 2018, pers. comm.). At least one hatchling was crushed by a car on the road.

A significant reduction in sea turtle nesting activity has also been documented on beaches illuminated with artificial lights (Witherington 1992). Construction lights along a project beach and on the dredging vessel may deter females from coming ashore to nest, misdirect females trying to return to the surf after a nesting event, and misdirect emergent hatchlings from adjacent non-project beaches.

The unnatural sloped beach adjacent to the structure exposes sea turtles and their nests to lights that were less visible, or not visible, from nesting areas before the sand placement activity, leading to a higher mortality of hatchlings. Review of over 10 years of empirical information from beach nourishment projects indicates that the number of sea turtles impacted by lights increases on the post-construction berm. A review of selected nourished beaches in Florida (South Brevard, North Brevard, Captiva Island, Ocean Ridge, Boca Raton, Town of Palm Beach, Longboat Key, and Bonita Beach) indicated disorientation reporting increased by approximately 300 percent the first nesting season after project construction and up to 542 percent the second year compared to pre-nourishment reports (Trindell et al. 2005).

Specific examples of increased lighting disorientations after a sand placement project include a sand placement project in Brevard County, Florida, completed in 2002. After the project, there was an increase of 130 percent in disorientations in the nourished area. Disorientations on beaches in the County that were not nourished remained constant (Trindell 2007). This same result was also documented in 2003 when another beach in Brevard County was nourished and the disorientations increased by 480 percent (Trindell 2007). Installing appropriate beachfront lighting is the most effective method to decrease the number of disorientations on any developed beach including nourished beaches.

c. Nest relocation

Besides the potential for missing nests during surveys and a nest relocation program, there is a potential for eggs to be damaged by nest movement or relocation, particularly if eggs are not relocated within 12 hours of deposition (Limpus et al. 1979). Nest relocation can have adverse impacts on incubation temperature (and hence sex ratios), gas exchange parameters, hydric environment of nests, hatching success, and hatchling emergence (Limpus et al. 1979; Ackerman 1980; Parmenter 1980; Spotila et al. 1983; McGehee 1990). Relocating nests 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).

In a 1994 Florida study comparing loggerhead hatching and emerging success of relocated nests with nests left in their original location, Moody (1998) found that hatching success was lower in relocated nests at nine of 12 beaches evaluated. In addition, emerging success was lower in relocated nests at 10 of 12 beaches surveyed in 1993 and 1994.

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

a. Changes in the physical environment

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).

Beach compaction and unnatural beach profiles resulting from beach nourishment activities could negatively impact sea turtles regardless of the timing of project. 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). These impacts can be minimized by using suitable sand.

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.

b. Escarpment formation

On nourished beaches, steep escarpments may develop along their water line interface as they adjust from an unnatural construction profile to a more natural beach profile (Coastal Engineering Research Center 1984; Nelson et al. 1987). Escarpments can hamper or prevent access to nesting sites (Nelson and Blihovde 1998). Researchers have shown that female sea turtles coming ashore to nest can be discouraged by the formation of an escarpment, leading to situations where they choose marginal or unsuitable nesting areas to deposit eggs (e.g., in front of the escarpments, which often results in failure of nests due to prolonged tidal inundation). This impact can be minimized by leveling any escarpments prior to the nesting season.

c. 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).

d. Increased beachfront development

Pilkey and Dixon (1996) stated that beach replenishment frequently leads to more development in greater density within shorefront communities that are then left with a future of further replenishment or more drastic stabilization measures. Dean (1999) also noted that the very existence of a beach nourishment project can encourage more development in coastal areas. Following completion of a beach nourishment project in Miami during 1982, investment in new and updated facilities substantially increased tourism there (NRC 1995). Increased building density immediately adjacent to the beach often resulted as much larger buildings that accommodated more beach users replaced older buildings. Overall, shoreline management creates an upward spiral of initial protective measures resulting in more expensive development that leads to the need for more and larger protective measures. Increased shoreline development may adversely affect sea turtle nesting success. Greater development may support larger populations of mammalian predators, such as foxes and raccoons, than undeveloped areas (NRC 1990a), and can also result in greater adverse effects due to artificial lighting, as discussed above.

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.

Responses and Interpretation of Effects

Sand placement activities may impact nesting and hatchling sea turtles and sea turtle nests occurring along up to 33,300 lf of shoreline in Surf City. Sand placement activities would occur within and adjacent to nesting habitat for sea turtles and dune habitats that ensure the stability and integrity of the nesting beach. Specifically, the project would potentially impact loggerhead, green, and Kemp's ridley nesting females, their nests, and hatchling sea turtles. The Service expects the proposed construction activities could directly and indirectly affect the availability of habitat for nesting and hatchling sea turtles. The timing of the sand placement activities could directly and indirectly impact nesting females, their nests, and hatchling sea turtles when conducted between May 1 and November 15. The Corps proposes to conduct the initial event within the sea turtle nesting season, though maintenance events (every six years) are proposed to be scheduled outside of the sea turtle nesting season.

The effects of sand placement activities may change the nesting behavior of adult female sea turtles, diminish nesting success, and cause reduced hatching and emerging success. Sand placement can also change the incubation conditions within the nest. Any decrease in productivity and/or survival rates would contribute to the vulnerability of the sea turtles nesting in the southeastern U.S.

During the first post-construction year, nests on nourished beaches are deposited significantly seaward of the toe of the dune and significantly landward of the tide line than nests on natural beaches. More nests are washed out on the wide, flat beaches of the nourished treatments than on the narrower steeply sloped natural beaches. This phenomenon may persist through the second post-construction year monitoring and result from the placement of nests near the seaward edge of the beach berm where dramatic profile changes, caused by erosion and scarping, occur as the beach equilibrates to a more natural contour.

The principal effect of beach nourishment on sea turtle reproduction is a reduction in nesting success during the first year following project construction. Although most studies have attributed this phenomenon to an increase in beach compaction and escarpment formation, Ernest and Martin (1999) indicated that changes in beach profile may be more important. Regardless, as a nourished beach is reworked by natural processes in subsequent years and adjusts from an unnatural construction profile to a natural beach profile, beach compaction and the frequency of escarpment formation decline, and nesting and nesting success return to levels found on natural beaches.

The sand placement activity is a recurring activity. The initial activity is anticipated to take up to 16 months to complete. No estimated duration is provided for the maintenance events. Indirect effects from the activity may continue to impact nesting and hatchling sea turtles and sea turtle nests in subsequent nesting seasons.

For this and other sand placement BOs, the Service typically uses a surrogate to estimate the extent of take. The amount of take is directly proportional to the spatial/temporal extent of occupied habitat that the Action affects and exceeding this extent would represent a taking that is not anticipated in this BO. 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, nest mark and avoidance, or egg relocation program (2) the total number of hatchlings per undiscovered nest is unknown; (3) the reduction in percent hatching and emerging success per relocated nest over the natural nest site is unknown; (4) an unknown number of females may avoid the project beach and be forced to nest in a less than optimal area; (5) lights may misdirect an unknown number of hatchlings and cause death; and (6) escarpments may form and prevent an unknown number of females from accessing a suitable nesting site.

However, the level of take of these species can be anticipated by the sand placement activities on suitable turtle nesting beach habitat because: (1) turtles nest within the Action Area; (2) the nourishment project will modify the incubation substrate, beach slope, and sand compaction; and (3) artificial lighting will deter and/or misdirect nesting hatchling turtles.

4.4. Cumulative Effects on Loggerhead, Green, and Kemp's Ridley Sea Turtles

For purposes of consultation under ESA §7, cumulative effects are those caused by future state, tribal, local, or private actions that are reasonably certain to occur in the Action Area. Future Federal actions that are unrelated to the proposed action are not considered, because they require separate consultation under §7 of the ESA. The Service is unaware of any future non-Federal Actions in the Action area that may affect sea turtles. Therefore, cumulative effects are not relevant to formulating our opinion for the Action.

4.5. Conclusion for Sea Turtle Species

In this section, we summarize and interpret the findings of the previous sections for loggerhead, green, and Kemp's ridley sea turtles (status, baseline, effects, and cumulative effects) relative to the purpose of a BO under §7(a)(2) of the ESA, which is to determine whether a Federal action is likely to:

a) jeopardize the continued existence of species listed as endangered or threatened; or
b) result in the destruction or adverse modification of designated critical habitat.

<u>Status</u>

All three sea turtle species may nest or attempt to nest in the Action Area. Between 2009 and 2023, the annual number of recorded loggerhead turtle nests on Topsail Island has fluctuated from 53 in 2014 and 2018 to 176 in 2019. Twenty-nine green sea turtle nests have been documented on Topsail Island since 2009, as well as two Kemp's ridley sea turtle nests.

There are many threats to sea turtles, including nest destruction from natural events, such as tidal surges and hurricanes, or eggs lost to predation by raccoons, foxes, ghost-crabs, and other animals. However, human activity has significantly contributed to the decline of sea turtle populations along the Atlantic Coast and in the Gulf of Mexico (NRC 1990). These factors include the modification, degradation, or loss of nesting habitat by coastal development, artificial lighting, beach driving, and marine pollution and debris. Furthermore, the overharvest of eggs for food, intentional killing of adults and immature turtles for their shells and skin, and accidental drowning in commercial fishing gear are primarily responsible for the worldwide decline in sea turtle populations.

<u>Baseline</u>

The Action Area has become quite developed. According to the Town of Surf City's website (accessed October 15, 2024), the town began as a small fishing village. Development began in 1947, and today Surf City is the largest town on Topsail Island. A large portion of the Action Area is presently lined with structures, including motels, restaurants, and gift shops, along with residences. Recreational use in the Action Area is quite high from residents and tourists, including vehicular driving in the winter months.

A wide range of recent and on-going activities have altered the proposed Action Area and, to a greater extent, the North Carolina coastline, and many more are proposed along the coastline for the near future. **Table 4-3** lists projects that have been completed since 2011, though the list is not comprehensive.

Effects

Sand placement activities may impact nesting and hatchling sea turtles and sea turtle nests occurring along up to 33,300 lf of shoreline in Surf City. Sand placement activities would occur within and adjacent to nesting habitat for sea turtles and dune habitats that ensure the stability and integrity of the nesting beach. The project would potentially impact loggerhead, green, and Kemp's ridley nesting females, their nests, and hatchling sea turtles. The Service expects the proposed construction activities could directly and indirectly affect the availability of habitat for nesting and hatchling sea turtles. The timing of the sand placement activities could directly and indirectly impact nesting females, their nests, and hatchling sea turtles when conducted between May 1 and November 15.

The Service determined there is a potential for long-term adverse effects on sea turtles as a result of sand placement. However, the Service acknowledges the potential benefits of the sand placement project, since it provides additional sea turtle nesting habitat. Nonetheless, an increase in sandy beach may not necessarily equate to an increase in suitable sea turtle nesting habitat.

After reviewing the current status of the nesting sea turtle species, the environmental baseline for the Action Area, the effects of the proposed activities, the proposed Conservation Measures, and the cumulative effects, it is the Service's biological opinion that the placement of sand is not likely to jeopardize the continued existence of the loggerhead sea turtle, green sea turtle, and Kemp's ridley sea turtle.

5. CRITICAL HABITAT FOR THE NORTHWEST ATLANTIC (NWA) POPULATION OF LOGGERHEAD SEA TURTLES

5.1. Status of Loggerhead Terrestrial Critical Habitat

This section summarizes best available data about the current condition of all designated units of critical habitat for the NWA population of the loggerhead sea turtle (*Caretta caretta*) that are relevant to formulating an opinion about the Action. On July 10, 2014, the Service designated portions North Carolina beaches as critical habitat for the NWA population of loggerhead sea turtles (79 FR 39756). Topsail Island is located within critical habitat Unit LOGG-T-NC-03 (Topsail Island, Pender County). From the Federal Register (FR) Notice (see http://www.regulations.gov/#!documentDetail;D=FWS-R4-ES-2012-0103-0001), this unit consists of 35.0 km (21.8 mi) of island shoreline along the Atlantic Ocean and extends from New River inlet to New Topsail Inlet.

5.1.1. Description of Loggerhead Terrestrial Critical Habitat

The designated units include terrestrial habitats that support nesting of the loggerhead sea turtle. In total, 1,189.9 kilometers (km) (739.3 mi) of loggerhead sea turtle nesting beaches are designated critical habitat in the States of North Carolina, South Carolina, Georgia, Florida, Alabama, and Mississippi. These beaches account for 48 percent of an estimated 2,464 km (1,531 mi) of coastal beach shoreline, and account for approximately 84 percent of the documented nesting (numbers of nests) within these six States. The designated critical habitat has been identified by the recovery unit in which they are located.

Critical habitat designation for the NWA population of the loggerhead sea turtle used the term "primary constituent elements" (PCEs) to identify the key components of critical habitat that are essential to its conservation and may require special management considerations or protection. Revisions to the critical habitat regulations in 2016 (81 FR 7214, 50 CFR §4.24) discontinue use of the term PCEs and rely exclusively on the term "physical and biological features" (PBFs) to refer to these key components, because the latter term is the one used in the statute. This shift in terminology does not change how the Service conducts a "destruction or adverse modification" analysis. In this BO, we use the term PBFs to label the key components of critical habitat that provide for the conservation of the loggerhead sea turtle that were identified in its critical habitat designation rule as PCEs.

The PBFs of the NWA population of the loggerhead sea turtle critical habitat are (79 FR 39756):

(1) **PBF 1**—Sites for Breeding, Reproduction, or Rearing (or Development) of Offspring.
To be successful, reproduction must occur when environmental conditions support adult activity (e.g., sufficient quality and quantity of food in the foraging area, suitable beach structure for digging, nearby inter-nesting habitat) (Georges et al. 1993). The environmental conditions of the nesting beach must favor embryonic development and survival (i.e., modest temperature fluctuation, low salinity, high humidity, well drained, well aerated) (Mortimer 1982; Mortimer 1990). Additionally, the hatchlings must emerge to onshore and offshore conditions that enhance their chances of survival (e.g., less than 100 percent depredation, appropriate offshore currents for dispersal) (Georges et al. 1993).

(2) **PBF 2**—Habitats Protected from Disturbance or Representative of the Historical, Geographic, and Ecological Distributions of the Species.

Sea turtle nesting habitat is part of the highly dynamic and continually shifting coastal system, which includes oceanfront beaches, barrier islands, and inlets. These geologically dynamic coastal regions are controlled by natural coastal processes or activities that mimic these natural processes, including littoral or longshore drift (the process by which sediments move along the shoreline), onshore and offshore sand transport (natural erosion or accretion cycle), and tides and storm surge. The integrity of the habitat components depends upon daily tidal events; these processes are associated with the formation and movement of barrier islands, inlets, and other coastal landforms throughout the landscape.

5.1.2. Conservation Value of Loggerhead Terrestrial Critical Habitat

The most recent comprehensive review of loggerhead terrestrial critical habitat conditions is the 2013 proposed designation of critical habitat for the NWA population of loggerhead sea turtles (78 FR 18000-18082). We summarize in this section key points from these documents that are relevant to this BO. Please refer to that document for further details.

Characterizing the current conservation value of loggerhead terrestrial critical habitat is difficult, due to the multi-state scale of the designation and to the dynamic or ephemeral nature of its PBFs. Waves, tides, currents, storms, terrestrial runoff, and biological communities interacting with sediments at the land/sea interface form and maintain loggerhead terrestrial habitats. Various human activities at the land/sea interface (construction, dredging, sand mining, sand placement, inlet stabilization/relocation/closure, seawalls, revetments, beach cleaning) disrupt these processes and reduce or degrade the PBFs. Therefore, a common and practical approach to describing the status of loggerhead terrestrial critical habitat is to quantify the extent of human alteration of features or PBFs that are easily measured at large scales.

At the time of designation, the entire designated critical habitat is occupied, and all of the designated critical habitat contains, to different degrees, the PBFs essential to the conservation of the species in the terrestrial environment. The high-density nesting beaches designated as critical habitat units have the highest nesting densities within the each of the four recovery units and have a good geographic spatial distribution that will help ensure the protection of genetic diversity. The critical habitat units next to the primary high-density nesting units currently support loggerhead nesting and can serve as expansion areas should the high-density nesting beaches be significantly degraded or temporarily or permanently lost.

Threats to loggerhead sea turtle terrestrial habitat

Most of the threats listed below are discussed in more detail in **Section 4.1.2**, above, and in the March 25, 2013, proposed designation (78 FR 18000-18082).

Recreational beach use: beach cleaning (including rock-picking), human presence (e.g., dog beach, special events, piers, and recreational beach equipment). Beach cleaning is increasing in the southeastern U.S., especially in Florida. Beach cleaning also occurs in a few locations in South Carolina, North Carolina, and Alabama. Human presence on the beach at night during the nesting season may reduce the quality of nesting habitat by deterring or disturbing nesting sea turtles and causing them to avoid otherwise suitable habitat. Recreational beach equipment, such as lounge chairs and umbrellas, left 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 false crawls at these obstacles is becoming increasingly common as more recreational beach equipment is left on the beach at night.

Beach driving: essential and nonessential off-road vehicles, all-terrain vehicles, and recreational access and use. Beach driving has been found to reduce the quality of loggerhead nesting habitat in several ways. In the southeastern U.S., vehicle ruts on the beach have been found to prevent or impede hatchlings from reaching the ocean following emergence from the nest (Hosier et al. 1981; Cox et al. 1994; Hughes and Caine 1994). Sand compaction by vehicles has been found to hinder nest construction and hatchling emergence from nests (Mann 1977). Vehicle lights and vehicle movement on the beach after dark results in reduced habitat suitability, which can deter females from nesting and disorient hatchlings. If driving occurs at night, sea turtles could be run over and injured. Additionally, vehicle traffic on nesting beaches contributes to erosion, especially during high tides or on narrow beaches where driving is concentrated on the high beach and foredune.

Predation: depredation of eggs and hatchlings by native and nonnative predators. Predation of sea turtle eggs and hatchlings by native and nonnative species occurs on almost all nesting beaches. Predation by a variety of predators can considerably decrease sea turtle nest hatching success. In addition, nesting turtles harassed by predators (e.g., coyotes, red foxes) on the beach may abort nesting attempts (Hope 2012, pers. comm.). Thus, the presence of predators can affect the suitability of nesting habitat.

Beach sand placement activities: beach nourishment, beach restoration, inlet sand bypassing, dredge material disposal, dune construction, emergency sand placement after natural disaster, berm construction, and dune and berm planting. Substantial amounts of sand are deposited along Gulf of Mexico and Atlantic Ocean beaches to protect coastal properties in anticipation of preventing erosion and what otherwise would be considered natural processes of overwash and island migration. Constructed beaches tend to differ from natural beaches in several important ways for sea turtles. They are typically wider, flatter, and more compact, and the sediments are moister than those on natural beaches (Nelson et al. 1987; Ackerman et al. 1991; Ernest and Martin 1999). On severely eroded sections of beach, where little or no suitable nesting habitat previously existed, sand placement can result in increased nesting (Ernest and Martin 1999). There are important ephemeral impacts associated with beach sand placement activities. In most cases, a significantly larger proportion of turtles emerging on engineered beaches abandon their nesting attempts than turtles emerging on natural or pre-nourished beaches, even though more nesting habitat is available (Trindell et al. 1998; Ernest and Martin 1999; Herren 1999), with nesting success approximately 10 to 34 percent lower on nourished beaches than on control beaches during the first year post-nourishment. This reduction in nesting success is most pronounced during the first year following project construction and is most likely the result of changes in physical beach characteristics (beach profile, sediment grain size, beach compaction, frequency and extent of escarpments) associated with the nourishment project (Ernest and Martin 1999). During the first post-construction year, the time required for turtles to excavate an egg chamber on untilled, hard-packed sands increases significantly relative to natural beach conditions. Also, during the first post-construction year, nests on nourished beaches are deposited significantly more seaward of the toe of the dune than nests on natural beaches. More nests are washed out on the wide, flat beaches of the nourished treatments than on the narrower steeply sloped natural beaches.

In-water and shoreline alterations: artificial in-water and shoreline stabilization measures (e.g., in-water erosion control structures, such as groins, breakwaters, jetties), inlet relocation, inlet dredging, nearshore dredging, and dredging and deepening channels. Many navigable mainland or barrier island tidal inlets along the Atlantic and Gulf of Mexico coasts are stabilized with jetties or groins. 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 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. 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.

Coastal development: residential and commercial development and associated activities including beach armoring (e.g., sea walls, geotextile tubes, rock revetments, sandbags, emergency temporary armoring); and activities associated with construction, repair, and maintenance of upland structures, stormwater outfalls, and piers. Coastal development not only causes the loss and degradation of suitable nesting habitat but can result in the disruption of powerful coastal processes accelerating erosion and interrupting the natural shoreline migration. This may in turn cause the need to protect upland structures and infrastructure by armoring, which causes changes in additional loss of, or impact to the remaining sea turtle habitat. In the southeastern U.S., numerous armoring or erosion control structures (e.g., bulkheads, seawalls, soil retaining walls, rock revetments, sandbags, geotextile tubes) that create barriers to nesting have been constructed to protect upland residential and commercial development. Armoring is any rigid structure placed parallel to the shoreline on the upper beach to prevent both landward retreat of the shoreline and inundation or loss of upland property by flooding and wave action (Kraus and McDougal 1996). Although armoring structures may provide short-term protection to beachfront property, they do little to promote or maintain sandy beaches used by loggerhead sea turtles for nesting. These structures influence natural shoreline processes and the physical beach environment, but the effects are not well understood. However, it is clear that armoring structures prevent long-term recovery of the beach and dune system by physically prohibiting dune formation from wave uprush and wind-blown sand movement.

In addition to coastal armoring, there are a variety of other coastal construction activities that may affect sea turtles and their nesting habitat. These include construction, repair, and maintenance of upland structures and dune crossovers; installation of utility cables; installation and repair of public infrastructure (such as coastal highways and emergency evacuation routes); and construction equipment and lighting associated with any of these activities. Many of these activities alter nesting habitat, as well as directly harm adults, nests, and hatchlings. Most direct construction-related impacts can be avoided by requiring that nonemergency activities be performed outside of the nesting and hatching season.

Artificial lighting: direct and indirect lighting, skyglow, and bonfires. Coastal development contributes to habitat degradation by increasing light pollution (Witherington and Martin 1996). Experimental studies have shown that artificial lighting deters adult female turtles from emerging from the ocean to nest (Witherington 1992). Witherington (1986) also found that loggerheads aborted nesting attempts at a greater frequency in lighted areas. In addition, because adult females rely on visual brightness cues to find their way back to the ocean after nesting, those turtles that nest on lighted beaches may become disoriented by artificial lighting and have difficulty finding their way back to the ocean. Hatchlings, unable to find the ocean or delayed in reaching it, are likely to incur high mortality from dehydration, exhaustion, or predation (Carr and Ogren 1960; Ehrhart and Witherington 1987; Witherington and Martin 1996). Based on hatchling orientation index surveys at nests located at 23 representative beaches in six counties around Florida in 1993 and 1994, Witherington et al. (1996) found that, by county, approximately 10 to 30 percent of nests showed evidence of hatchlings disoriented by lighting. Mortality of disoriented hatchlings is likely very high (NMFS and USFWS 2008).

Beach erosion: erosion due to aperiodic, short-term weather-related erosion events, such as atmospheric fronts, northeasters, tropical storms, and hurricanes. Natural beach erosion events may influence the quality of nesting habitat. Short-term erosion events (e.g., atmospheric fronts, northeasters, tropical storms, and hurricanes) are common phenomena throughout the NWA loggerhead nesting range and may vary considerably from year to year. Although these erosion events may affect loggerhead hatchling production, the results are generally localized, and they rarely result in whole-scale losses over multiple nesting seasons. The negative effects of hurricanes on low-lying and developed shorelines used for nesting by loggerheads may be longer-lasting and a greater threat overall. Hurricanes and other storm events 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 affect sea turtles by causing the loss of nesting habitat. Depending on their frequency, storms can affect sea turtles on either a short- or long-term basis. 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. When combined with the effects of sea level rise (see the threat category for climate change below for additional information), there may be increased cumulative impacts from future storms.

Climate change: including sea level rise. Climate change has the potential to impact loggerhead sea turtles in the Northwest Atlantic. The decline in loggerhead nesting in Florida from 1998 to 2007, as well as the recent increase, appears to be tied to climatic conditions (Van Houtan and Halley 2011). Global sea level during the 20th century rose at an estimated rate of about 1.7 millimeters (mm) (0.7 in) per year or an estimated 17 centimeter (cm) (6.7 in) over the entire 100-year period, a rate that is an order of magnitude greater than that seen during the several millennia that followed the end of the last ice age (Bindoff et al. 2007). Potential impacts of climate change to NWA loggerheads include beach erosion from rising sea levels, repeated inundation of nests, skewed hatchling sex ratios from rising incubation temperatures, and abrupt disruption of ocean currents used for natural dispersal during the complex life cycle (Fish et al. 2005; Hawkes et al. 2009). 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 loggerhead nesting habitat and nesting females and their eggs. The loss of habitat as a result of climate change could be accelerated due to a combination of other environmental and oceanographic changes such as an increase in the intensity of storms and/ or changes in prevailing currents, both of which could lead to increased beach loss via erosion (Kennedy et al. 2002; Meehl et al. 2007).

Habitat obstructions: tree stumps, fallen trees, and other debris on the beach; nearshore sand bars; and ponding along beachfront seaward of dry beach. Both natural and anthropogenic features can act as barriers or deterrents to adult females attempting to access a beach. In addition, hatchlings often must navigate through a variety of obstacles before reaching the ocean. These include natural and human-made debris. Research has shown that travel times of hatchlings from the nest to the water may be extended when traversing areas of heavy foot traffic or vehicular ruts (Hosier et al. 1981); the same is true of debris on the beach. Hatchlings may be upended and spend both time and energy in righting themselves. Some beach debris may have the potential to trap hatchlings and prevent them from successfully reaching the ocean. In addition, debris over the tops of nests may impede or prevent hatchling emergence.

Human-caused disasters and response to natural and human-caused disasters: oil spills, oil spill response including beach cleaning and berm construction, and debris cleanup after natural disasters. Oil spills threaten loggerhead sea turtles in the Northwest Atlantic. Oil spills in the vicinity of nesting beaches just prior to or during the nesting season place nesting females, incubating egg clutches, and hatchlings at significant risk from direct exposure to contaminants (Fritts and McGehee 1982; Lutcavage et al. 1997; Witherington 1999), as well as negative impacts on nesting habitat. Oil cleanup activities can also be harmful. Earth-moving equipment can dissuade females from nesting and destroy nests, containment booms can entrap hatchlings, and lighting from nighttime activities can misdirect turtles (Witherington 1999)

Military testing and training activities: troop presence, pyrotechnics and nighttime lighting, vehicles and amphibious watercraft usage on the beach, helicopter drops and extractions, live fire exercises, and placement and removal of objects on the beach. The presence of soldiers and other personnel on the beach, particularly at night during nesting and hatching season, could result in harm or death to individual nesting turtles or hatchlings, as well as deter females from nesting. Training exercises require concentration and often involve inherently dangerous activities. A nesting sea turtle or emerging hatchling could be overlooked and injured or killed by training activities on the beach. Training activities also may require the use of pyrotechnics and lighting, and both nesting and hatchling sea turtles are adversely affected by the presence of artificial lighting on or near the beach (Witherington and Martin 1996). The use of vehicles for amphibious assault training, troop transport, helicopter landing drops and extraction, search and rescue, and unmanned aerial vehicle use all have the potential to injure or kill nesting females and emerging hatchlings. In addition, heavy vehicles have the potential to compact sand that may affect the ability of hatchlings to climb out of nests or create ruts that entrap hatchlings after emergence. Live fire exercises are inherently dangerous and spent ammunition could injure or kill sea turtles and hatchlings, particularly at night. A nesting sea turtle or emerging hatchling could approach the beach area during an exercise and be harmed or killed. Digging into the sand to place or remove objects (e.g., mine placement and extraction) could result in direct mortality of developing embryos in nests within the training area for those nests that are missed during daily nesting surveys and thus not marked for avoidance.

5.1.3. Conservation Needs for Loggerhead Terrestrial Critical Habitat

Under the definition of critical habitat in the ESA, PBFs are both “essential to the conservation of the species” and “may require special management considerations or protection” (ESA §3(5)(A)(i)).

Within the designated critical habitat units for the NWA population of the loggerhead sea turtle, sites for breeding and reproduction of offspring (PBF 1) are managed or protected in many states. Some beach communities, local governments, and State and Federal lands have management plans, agreements, or ordinances that prohibit beach driving during the nesting season, and also address recreational equipment on the beach to minimize impacts to nesting and hatchling loggerhead sea turtles. It is more difficult to maintain protected habitats from disturbance or habitats representative of the historical, geographic, and ecological distributions of the species (PBF 2) on a large scale. Across the southeastern U.S., areas where natural coastal processes are allowed to occur are almost exclusively located on protected state and federal lands; however, even these areas are subject to increasing pressure to nourish beaches and allow beach driving or other forms of increased recreational access.

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. Beach sand placement projects conducted under the Service’s Statewide Programmatic Biological Opinion for the Corps’ planning and regulatory sand placement activities (including post-disaster sand placement activities) in Florida and North Carolina, and other individual biological opinions throughout the loggerhead’s nesting range include required terms and conditions that minimize incidental take of turtles and protect sand quality and compatibility for nesting sea turtles.

Efforts are underway to reduce light pollution on sea turtle nesting beaches. In the southeastern U.S., the effects of light pollution on sea turtles are most extensive in Florida due to dense coastal development. Enforcement of mandatory lighting ordinances in Florida and other States has increased.

The Service consults with the Department of Defense under section 7 of the ESA on their Integrated Natural Resources Management Plans, military mission, testing, and training activities that may affect nesting and hatchling sea turtles, sea turtle nests, and sea turtle nesting habitat. Efforts to minimize the effects of these activities including natural resource management have focused on adjusting the activity timing to minimize encounters with loggerheads and adjusting locations of activities to reduce overlap with sea turtle habitats.

The Service acknowledges that we cannot fully address the significant, long-term threat of natural beach erosion, climate change, or natural disasters to loggerhead sea turtles. However, we can determine how we respond to the threats by providing protection to the known nesting sites. We can also identify measures to protect nesting habitat from the actions undertaken to respond to those natural changes. Likewise, coastal development is difficult to manage with respect to sea turtle protection and is likely to result in long-term or recurrent impacts to sea turtle nesting habitat from increased threats in almost all of the threat categories.

5.2. Environmental Baseline for Loggerhead Terrestrial Critical Habitat

This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of designated critical habitat for loggerhead sea turtles within the Action Area. The environmental baseline is a "snapshot" of the condition of the PBFs that are essential to the conservation of the species within designated critical of the Action Area at the time of the consultation and does not include the effects of the Action under review.

5.2.1. Action Area Conservation Value of Loggerhead Terrestrial Critical Habitat

For the NRU, the Service has designated 393.7 km (244.7 mi) of Atlantic Ocean shoreline in North Carolina, South Carolina, and Georgia, encompassing approximately 86 percent of the documented number of nests within the recovery unit. The eight critical habitat units in North Carolina total 96.1 mi (154.6 km) of beach. 15.1 mi (24.3 km) are located within state-owned lands, while 81 mi (130.3 km) are on land owned by private parties or others, such as counties and municipalities.

Surf City is located within critical habitat Unit LOGG-T-NC-03. This unit has high-density nesting by loggerhead sea turtles in North Carolina. This critical habitat unit is one of 38 designated critical habitat units for the Northern Recovery Unit of the NWA Ocean DPS. Up to a quarter of this acreage has been affected recently by activities such as beach nourishment and sandbag revetment construction or is proposed for such activities. However, with the exception of beach nourishment activities, sandbags, groin construction, and recreational activities, most of the critical habitat units in North Carolina remain relatively unaffected by development.

The units in North Carolina contain both of the PBFs, although some have more stressors than others. The critical habitat unit in the Action Area provides important nesting habitat in the northern portion of the loggerheads breeding range, and due to cooler sand temperatures, may provide greater numbers of male hatchlings than beaches to the south. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, beach sand placement activities, in-water and shoreline alterations, climate change, beach erosion, artificial lighting, human-caused disasters, and response to disasters.

5.2.2. Action Area Conservation Needs for and Threats to Loggerhead Terrestrial Critical Habitat

The Action Area is developed and most of it is under private ownership that may support new coastal development. Residential and commercial development began in the late 1940s. Large portions of the Action Area are presently lined with structures. Recreational use in the Action Area is quite high from residents and tourists. The Action Area and adjacent beaches are managed in order to protect sea turtle nesting habitat by prohibiting beach driving within the nesting season, and local ordinances requiring the removal of beach equipment and chairs after sundown. A local volunteer organization conducts daily monitoring of sea turtle nests during the nesting season.

A wide range of recent and on-going beach disturbance activities have altered the proposed Action Area and, to a greater extent, the North Carolina coastline, and many more are proposed along the coastline for the near future. **Table 4-3** lists the most recent projects, since 2011. The threats to loggerhead terrestrial critical habitat in the Action Area are the same as those to sea turtles in general. See **Section 4.2.2** for threats within the Action Area.

5.3. Effects of the Action on Loggerhead Terrestrial Critical Habitat

This section analyzes the direct and indirect effects of the Action on critical habitat for loggerhead sea turtles, which includes the direct and indirect effects of interrelated and interdependent actions. Direct effects are caused by the Action and occur at the same time and place. Indirect effects are caused by the Action but are later in time and reasonably certain to occur.

5.3.1. Effects of Sand Placement on Loggerhead Terrestrial Critical Habitat

Sand placement activities may impact loggerhead terrestrial critical habitat along up to 33,300 lf of shoreline in Surf City. Sand placement activities would occur within designated critical habitat.

The sand placement activity is a recurring activity. The initial sand placement event is expected to take up to 16 months to complete. No duration was provided for maintenance events. Indirect effects from the activity may continue to loggerhead terrestrial critical habitat in subsequent nesting seasons after each event.

Applicable Science and Pathways of Response

Direct Effects: Potential adverse effects to loggerhead terrestrial critical habitat include many of the indirect effects to sea turtle species, discussed in **Section 4.3.1**. Placement of sand on a beach may adversely affect PBFs 1 and 2. Driving on the beach can also cause sand compaction, which may result in adverse impacts on nest site selection, digging behavior, clutch viability, and emergence by hatchlings (Mann 1977; Nelson and Dickerson 1987; Nelson 1988).

The physical changes and loss of plant cover caused by vehicles on vegetated areas or dunes can lead to various degrees of instability and cause dune migration, potentially adversely affecting PBFs 1 and 2. As vehicles move over the sand, sand is displaced downward, lowering the substrate. Since the vehicles also inhibit plant growth, and open the area to wind erosion, the beach and dunes may become unstable. Vehicular traffic on the beach or through dune breaches or low dunes may cause acceleration of overwash and erosion (Godfrey et al. 1978).

Artificial lighting as a result of an unnatural beach slope may adversely affect PBFs 1 and 2. The unnatural sloped beach adjacent to the structure exposes sea turtles and their nests to lights that were less visible, or not visible, from nesting areas before the sand placement activity, leading to a higher mortality of hatchlings.

Changes in the physical environment as a result of the project may adversely affect PBF 2. Beach nourishment projects create an elevated, wider, and unnatural flat slope berm, and may result in an unnatural sediment grain size distribution (Ernest and Martin 1999; Trindell 2005).

Incompatible sediment and unnatural beach profiles resulting from beach nourishment activities could negatively impact PBFs 1 and 2. Very fine sand or the use of heavy machinery can cause sand compaction on nourished beaches (Nelson et al. 1987; Nelson and Dickerson 1988a). Large amounts of rock or gravel can also cause issues for females attempting to construct a nest and hatchlings attempting to egress a nest. 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 and sediment grain size 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.

Escarpment formation may adversely affect PBFs 1 and 2. On nourished beaches, steep escarpments may develop along their water line interface as they adjust from an unnatural construction profile to a more natural beach profile (Coastal Engineering Research Center 1984; Nelson et al. 1987). Escarpments can hamper or prevent access to nesting sites (Nelson and Blihovde 1998). This impact can be minimized by leveling any escarpments prior to the nesting season.

Increased beachfront development may adversely affect PBF 2. Shoreline management creates an upward spiral of initial protective measures resulting in more expensive development that leads to the need for more and larger protective measures.

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.

5.4. Cumulative Effects on Loggerhead Terrestrial Critical Habitat

For purposes of consultation under ESA §7, cumulative effects are those caused by future state, tribal, local, or private actions that are reasonably certain to occur in the Action Area. Future Federal actions that are unrelated to the proposed action are not considered, because they require separate consultation under §7 of the ESA. The Service is unaware of any future non-Federal Actions in the Action area that may affect loggerhead critical habitat. Therefore, cumulative effects are not relevant to formulating our opinion for the Action.

5.5. Conclusion for Loggerhead Terrestrial Critical Habitat

In this section, we summarize and interpret the findings of the previous sections for loggerhead sea turtle critical habitat (status, baseline, effects, and cumulative effects) relative to the purpose of a BO under §7(a)(2) of the ESA, which is to determine whether a Federal action is likely to:

a) jeopardize the continued existence of species listed as endangered or threatened; or
b) result in the destruction or adverse modification of designated critical habitat.

"*Destruction or adverse modification*" means a direct or indirect alteration that appreciably diminishes the value of designated critical habitat for the conservation of a listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features (50 CFR §402.02).

Status

The entire designated critical habitat for the NWA Population of the loggerhead sea turtle is occupied, and all of the designated critical habitat contains the PBFs essential to the conservation of the species in the terrestrial environment. The high-density nesting beaches designated as critical habitat units have the highest nesting densities within the each of the four recovery units and have a good geographic spatial distribution that will help ensure the protection of genetic diversity. The critical habitat units next to the primary high-density nesting units currently support loggerhead nesting and can serve as expansion areas should the high-density nesting beaches be significantly degraded or temporarily or permanently lost.

Baseline

This critical habitat unit (LOGG-T-NC-03; Topsail Island) is one of 38 designated critical habitat units for the Northern Recovery Unit of the NWA Ocean DPS. In North Carolina, 96.1 shoreline mi (154.6 km) of critical habitat for nesting loggerhead sea turtles was designated. Some of this acreage has been affected recently by activities such as beach nourishment and sandbag revetment construction. However, with the exception of beach nourishment activities, sandbags, and recreational activities, most of the critical habitat units in North Carolina remain relatively unaffected by development.

The units in North Carolina contain both of the PBFs, and all function relatively well. The CH units in the Action Area provide important nesting habitat in the northern portion of the loggerheads breeding range, and due to cooler sand temperatures, may provide greater numbers of male hatchlings than beaches to the south.

Effects

Within the six-mile Action Area, PBF 1 and PBF 2 may be adversely affected by the use of heavy equipment on the beach, artificial lighting (resulting from an unnatural beach slope), changes in the physical environment, including placement of incompatible sediment, unnatural beach profiles, changes in sediment color, escarpment formation, and increased beachfront development. The placement of sand on a beach with reduced dry foredune habitat may also have a beneficial effect if the sand is highly compatible. These adverse impacts are limited to the Action Area.

After reviewing the current status of the critical habitat, the environmental baseline for the Action Area, the effects of the Action, and the cumulative effects, it is the Service's biological opinion that the Action is not likely to destroy or adversely modify designated critical habitat for the NWA Ocean DPS of the loggerhead sea turtle.

6. PIPING PLOVER

6.1. Status of Piping Plover

This section summarizes best available data about the biology and current condition of piping plover (*Charadrius melodus*) throughout its range that are relevant to formulating an opinion about the Action. On January 10, 1986, the piping plover was listed as endangered in the Great Lakes watershed and threatened elsewhere within its range, including migratory routes outside of the Great Lakes watershed and wintering grounds (USFWS 1985).

Multiple recovery plans and 5-year reviews have been developed for the three piping plover populations since listing, including a 1988 recovery plan and 1994 revised draft recovery plan for the Great Lakes and Northern Great Plains populations (USFWS 1998; USFWS 1994), a 1996 revised recovery plan for the Atlantic Coast breeding population (USFWS 1996a), a 2003 recovery plan for the Great Lakes population (USFWS 2003a), a document outlining the comprehensive conservation strategy (CCS) for the piping plover in its coastal migration and wintering range (USFWS 2012), and a 2016 recovery plan for the Northern Great Plains piping plover (USFWS 2015), which incorporates an updated CCS.

Our most recent 5-year status review of the species recommended retaining the current ESA classification (USFWS 2009c). The status review also summarized data that would support classifying the piping plover for ESA purposes as two subspecies, *C. m. melodus* (Atlantic Coast breeding population), and *C. m. circumcinctus.* Additional data would support classifying the latter as two discrete breeding populations: (a) the Northern Great Plains of the U.S. and Canada, and (b) the Great Lakes watershed of the U.S. and Canada. However, the review concludes that revising the classification accordingly would have little regulatory or conservation effect, because the current classification appropriately represents the status of the three breeding populations.

6.1.1. Description of Piping Plover

Three separate breeding populations have been identified, each with its own recovery criteria: the northern Great Plains (threatened), the Great Lakes (endangered), and the Atlantic Coast (threatened). Piping plovers that breed on the Atlantic Coast of the U.S. and Canada belong to the subspecies *C. m. melodus*. The second subspecies, *C. m. circumcinctus*, is comprised of two Distinct Population Segments (DPSs). One DPS breeds on the Northern Great Plains of the U.S. and Canada, while the other breeds on the Great Lakes. Each of these three entities is demographically independent. The piping plover winters in coastal areas of the U.S. from North Carolina to Texas, and along the coast of eastern Mexico and on Caribbean islands from Barbados to Cuba and the Bahamas (Haig and Elliott-Smith 2004).

North Carolina is one of the only states where piping plovers' breeding and wintering ranges overlap, and the birds are present year-round. Piping plovers in the Action Area may include individuals from all three breeding populations. Piping plover subspecies are phenotypically indistinguishable, and most studies in the nonbreeding range report results without regard to breeding origin. Although a 2012 analysis shows strong patterns in the wintering distribution of piping plovers from different breeding populations (Gratto-Trevor et al. 2012), partitioning is not complete and major information gaps persist.

Wintering critical habitat has been designated for the piping plover. Designated critical habitat is on the south end of Topsail Island, but no critical habitat is present in the Action Area.

6.1.2. Life History of Piping Plover

Named for its melodic mating call, the piping plover is a pale-colored shorebird about the size of a robin. Length is 17–18 cm; weight is 43–63 g. Plumage, bill, and leg coloration are slightly different between the breeding season and winter, between juveniles and adults, and between males and females. Cryptic coloration is a primary defense mechanism for piping plovers where nests, adults, and chicks all blend in with their typical beach surroundings.

Piping plovers live an average of 5 years, although studies have documented birds as old as 11 (Wilcox 1959) and 15 years (Audubon Society 2017). Plovers are known to begin breeding as early as one year of age (MacIvor 1990; Haig 1992). In studies with large numbers of marked interior breeding piping plovers, Saunders et al. (2014) found that 56 percent of female Great Lakes piping plovers mated in their first season post-hatch, while 68 percent of female yearlings mated in Saskatchewan in 2001-2006 (Gratto-Trevor et al. 2010). Both studies found that probability of breeding in the first year was lower for males than females, but Great Lakes males that had not bred earlier were more likely than females to recruit into the breeding population in years two and three. Virtually all surviving Great Lakes piping plovers began breeding by year three (Saunders et al. 2014). Piping plover breeding activity begins in mid-March when birds begin returning to their nesting areas (Coutu et al. 1990; Cross 1990; Goldin et al. 1990; MacIvor 1990; Hake 1993). Piping plovers generally fledge only a single brood per season but may re-nest several times if previous nests are lost. The reduction in suitable nesting habitat due to a number of factors is a major threat to the species, likely limiting reproductive success and future recruitment into the population (USFWS 2009a).

Plovers depart their breeding grounds for their wintering grounds between July and late August, but southward migration extends through November. More information about the three breeding populations of piping plovers can be found in the following documents:

a. Piping Plover, Atlantic Coast Population: 1996 Revised Recovery Plan (USFWS 1996a);
b. 2009 Piping Plover (*Charadrius melodus*) 5-Year Review: Summary and Evaluation (USFWS 2009a);

c. 2003 Recovery Plan for the Great Lakes Piping Plover (*Charadrius melodus*) (USFWS 2003a);
d. Questions and Answers about the Northern Great Plains population of Piping Plover (USFWS 2002).
e. 2016 Draft Revised Recovery Plan for the Northern Great Plains population of Piping Plover (USFWS 2015).

Atlantic Coast plovers nest on coastal beaches, sand flats at the ends of sand spits and barrier islands, gently-sloped foredunes, sparsely-vegetated dunes, and washover areas cut into or between dunes. The species requires broad, open, sand flats for feeding, and undisturbed flats with low dunes and sparse dune grasses for nesting. Plovers arrive on the breeding grounds from mid-March through mid-May and remain for three to four months per year; the Atlantic Coast plover breeding activities begin in March in North Carolina with courtship and territorial establishment (Coutu et al. 1990; McConnaughey et al. 1990). Following establishment of nesting territories and courtship rituals, the pair forms a depression in the sand, where the female lays her eggs. Egg-laying begins around mid-April with nesting and brood rearing activities continuing through July. They lay three to four eggs in shallow, scraped depressions lined with light colored pebbles and shell fragments. The eggs are well camouflaged and blend extremely well with their surroundings. Chicks are precocial, often leaving the nest within hours of hatching, but are tended by adults who lead the chicks to and from feeding areas, shelter them from harsh weather, and protect the young from perceived predators. Chicks remain together with one or both parents until they fledge (are able to fly) at 25 to 35 days of age. By early September both adults and young depart for their wintering areas.

Breeding and wintering plovers feed on exposed wet sand in swash zones; intertidal ocean beach; wrack lines; washover passes; mud, sand, and algal flats; and shorelines of streams, ephemeral ponds, lagoons, and salt marshes by probing for invertebrates at or just below the surface (Coutu et al. 1990; USFWS 1996a). Behavioral observations of piping plovers on the wintering grounds suggest that they spend the majority of their time foraging and roosting (Nicholls and Baldassarre 1990; Drake 1999a; 1999b; Maddock et al. 2009). Feeding activities may occur during all hours of the day and night (Staine and Burger 1994; Zonick 1997), and at all stages in the tidal cycle (Goldin 1993; Hoopes 1993). Wintering plovers primarily feed on invertebrates such as polychaete marine worms, various crustaceans, fly larvae, beetles, and occasionally bivalve mollusks found on top of the soil or just beneath the surface (Bent 1929; Cairns 1977; Nicholls 1989; Zonick and Ryan 1996). They use beaches adjacent to foraging areas for roosting and preening. Small sand dunes, debris, and sparse vegetation within adjacent beaches provide shelter from wind and extreme temperatures.

Piping plovers from the federally endangered Great Lakes population as well birds from the threatened populations of the Atlantic Coast and Northern Great Plains overwinter on North Carolina beaches. Piping plovers migrate through and winter in coastal areas of the U.S. from North Carolina to Texas and in portions of Mexico and the Caribbean. Data based on four rangewide mid-winter (late January to early February) population surveys, conducted at 5-year intervals starting in 1991, show that total numbers have fluctuated over time, with some areas experiencing increases and others decreases. Regional and local fluctuations may reflect the quantity and quality of suitable foraging and roosting habitat, which vary over time in response to natural coastal formation processes as well as anthropogenic habitat changes (e.g., inlet relocation, dredging of shoals and spits). Fluctuations may also represent localized weather conditions (especially wind) during surveys, or unequal survey coverage. Changes in wintering numbers may also be influenced by growth or decline in the particular breeding populations that concentrate their wintering distribution in a given area.

Piping plovers exhibit a high degree of intra- and interannual wintering site fidelity (Nicholls and Baldassarre 1990b; Drake et al. 2001; Noel and Chandler 2008; Stucker and Cuthbert 2006; Gibson et al. 2017). However, local movements during winter are more common. In South Carolina, Maddock et al. (2009) documented many cross-inlet movements by wintering banded piping plovers as well as occasional movements of up to 11.2 mi by approximately 10 percent of the banded population. Larger movements within South Carolina were seen during fall and spring migration.

6.1.3. Numbers, Reproduction, and Distribution of Piping Plover

The International Piping Plover Breeding Census is conducted throughout the breeding grounds every 5 years by the Great Lakes/Northern Great Plains Recovery Team of the U.S. Geological Survey (USGS). Although there are shortcomings in the census method, it is the largest known, complete avian species census. The 2011 survey documented 2,391 breeding pairs, with a total of 5,723 birds throughout Canada and the U.S. (Elliot-Smith et al. 2015).

The most consistent finding in the various population viability analyses conducted for piping plovers (Ryan et al. 1993; Melvin and Gibbs 1996; Plissner and Haig 2000; Amirault et al. 2005; Calvert et al. 2006; Brault 2007; Gibson et al. 2018) indicates even small declines in adult and juvenile survival rates will cause increases in extinction risk. A banding study conducted between 1998 and 2004 in Atlantic Canada concluded lower return rates of juvenile (first year) birds to the breeding grounds than was documented for Massachusetts (Melvin and Gibbs 1996), Maryland (Loegering 1992), and Virginia (Cross 1996) breeding populations in the mid-1980s and very early 1990s. This is consistent with failure of the Atlantic Canada population to increase in abundance despite high productivity (relative to other breeding populations) and extremely low rates of dispersal to the U.S. over the last 15 plus years (Amirault et al. 2005). This suggests maximizing productivity does not ensure population increases. However, Drake et al. (2001) observed no mortality among 49 radio-marked piping plovers (total of 2,704 transmitter-days) in Texas in the 1990s. Cohen et al. (2008) also reported no mortality among a small sample (n=7) of radio-marked piping plovers at Oregon Inlet, North Carolina in 2005-2006.

<u>Northern Great Plains Population</u>

The Northern Great Plains plover breeds from Alberta to Manitoba, Canada and south to Nebraska, although some nesting has occurred in Oklahoma (Boyd 1991). Currently the most westerly breeding piping plovers in the U.S. occur in Montana and Colorado.

The Northern Great Plains breeding population is geographically widespread, with many birds in very remote places, especially in the U.S. and Canadian alkali lakes. The decline of piping plovers on rivers in the Northern Great Plains has been largely attributed to the loss of sandbar island habitat and forage base due to dam construction and operation. Nesting occurs on sand flats or bare shorelines of rivers and lakes, including sandbar islands in the upper Missouri River system, and patches of sand, gravel, or pebbly-mud on the alkali lakes of the northern Great Plains. Population declines in alkali wetlands are attributed to wetland drainage, contaminants, and predation.

Every fifth year since 1991, the USGS has coordinated a range wide International Piping Plover Census (IPPC) on both the species' wintering and breeding grounds. Results from the most recent census in 2016 are not yet published. The IPPC numbers indicate that the Northern Great Plains breeding population (including Canada) declined from 1991 through 2001, and then increased dramatically in 2006. This increase corresponded with a multi-year drought in the Missouri River basin that exposed a great deal of nesting habitat, suggesting that the population can respond fairly rapidly to changes in habitat quantity and quality. Despite this improvement, we do not consider the elements of the population recovery criteria achieved.

In the 2009 status review, the Service concluded that the Northern Great Plains breeding population remains vulnerable, especially due to management of river systems throughout the breeding range (USFWS 2009a). Many of the threats identified in the 1988 recovery plan, including those affecting Northern Great Plains breeding population during the two-thirds of its annual cycle spent in the wintering range, remain today or have intensified.

Great Lakes Breeding Population

The Great Lakes plovers once nested on Great Lakes beaches in Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania, Wisconsin, and Ontario. Great Lakes piping plovers nest on wide, flat, open, sandy or cobble shoreline with very little grass or other vegetation. Reproduction is adversely affected by human disturbance of nesting areas and predation by foxes, gulls, crows and other avian species. Shoreline development, such as the construction of marinas, breakwaters, and other navigation structures, has adversely affected nesting and brood rearing.

The Recovery Plan (USFWS 2003a) sets a population goal of at least 150 pairs (300 individuals), for at least 5 consecutive years, with at least 100 breeding pairs (200 individuals) in Michigan and 50 breeding pairs (100 individuals) distributed among sites in other Great Lakes states. The Great Lakes breeding population, which has been traditionally represented as the number of breeding pairs, has slowly increased after the completion of the recovery plan between 2003 and 2016 (Cuthbert and Roche 2007; Cuthbert and Roche 2006; Westbrock et al. 2005; Stucker and Cuthbert 2004; Stucker et al. 2003; Cuthbert and Saunders 2013). The Great Lakes piping plover recovery plan documents the 2002 population at 51 breeding pairs (USFWS 2003a), and in 2016, 75 breeding pairs were estimated (Cavalieri pers. comm. 2016a). The total of 75 breeding pairs represents 50% of the current recovery goal of 150 breeding pairs for the Great Lakes breeding population. Productivity goals, as specified in the 2003 recovery plan, have been met over the past 5 years. During this time period the average annual fledging rate has varied, but averages about 1.7, well above the 1.5 fledglings per breeding pair recovery goal (Cavalieri pers. comm. 2016d). The total estimated population in 2016, including breeding pairs, non-breeding adults, and 2016 chicks, was approximately 330 individuals. Approximately 130 of those were 2016 chicks. However, that number is expected to have declined quickly over the winter months with the expected mortality of some hatch-year and after-hatch year adults (Cavalieri pers. comm. 2016b). It is the productivity rate, or recruitment rate, that has continued to increase the overall population, despite considerable decreases in adult survival rates. Continued population growth will require the long-term maintenance of productivity goals concurrent with measures to sustain or improve important vital rates.

The Great Lakes annual monitoring program is an intensive survey effort with nearly daily monitoring of active breeding locations. Virtually all of the Great Lakes individuals are banded, unlike individuals from the Atlantic Coast or Northern Great Plains breeding populations. The probability of detection of adults during the breeding season is near perfect (95-97%). Several years of population growth is evidence of the effectiveness of the ongoing Great Lakes piping plover recovery program. However, the average annual growth of just less than 2.3% in this small population typically results in only 3 or 4 additional surviving individuals each year (Catlin pers. comm. 2016a).

Survival rates in general for Great Lakes piping plovers have declined over 20 percent since 1994 (Saunders pers. comm. 2016). The estimated annual survival rates in 1994 for males in the Great Lakes breeding population was 0.878 (or almost 88%), while the survival rate for females was a bit lower at 0.87. The survival rates have fallen steadily since then, and by 2012, the survival rate was 0.667 for males and 0.650 for females (Saunders pers. comm. 2016). During this time, adult predation by merlins increased as a result of a general increase in merlin population numbers and a range expansion that began in the 1980s (Haas 2011; Cava et al. 2014). Management of merlin predation on the breeding grounds appears to have allowed the survival rate to stabilize (Roche et al. 2010a; Saunders pers. comm. 2016). Fluctuations in the number of breeding pairs between 2009 and 2016 may have been caused by weather conditions or merlin predation (Elliott-Smith et al. 2015).

In the 2009 status review, the Service concluded that the Great Lakes breeding population remains at considerable risk of extinction due to its small size, limited distribution and vulnerability to stochastic events, such as disease outbreak (USFWS 2009a). In addition, the factors that led to the piping plover’s 1986 listing remain present.

Atlantic Coast Population

The Atlantic Coast piping plover breeds on coastal beaches from Newfoundland and southeastern Quebec to North Carolina. Historical population trends for the Atlantic Coast piping plover have been reconstructed from scattered, largely qualitative records. Nineteenth-century naturalists, such as Audubon and Wilson, described the piping plover as a common summer resident on Atlantic Coast beaches (Haig and Oring 1987). However, by the beginning of the 20th century, egg collecting and uncontrolled hunting, primarily for the millinery trade, had greatly reduced the population, and in some areas along the Atlantic Coast, the piping plover was close to extirpation. Following passage of the Migratory Bird Treaty Act (MBTA) (40 Stat. 775; 16 U.S.C. 703-712) in 1918, and changes in the fashion industry that no longer exploited wild birds for feathers, piping plover numbers recovered to some extent (Haig and Oring 1985).

Substantial population growth, from approximately 790 pairs in 1986 to an estimated 1,870 pairs in 2015, has decreased the Atlantic Coast piping plover's vulnerability to extinction since ESA listing. Thus, considerable progress has been made towards the overall goal of 2,000 breeding pairs. However, the overall security of the Atlantic Coast piping plover is fundamentally dependent on even distribution of population growth, as specified in subpopulation targets, to protect a sparsely-distributed species with strict biological requirements from environmental variation (including catastrophes) and increase the likelihood of interchange among subpopulations. Population growth has been tempered by geographic and temporal variability. By far, the largest net population increase between 1989 and 2015 occurred in New England (445 percent). Net growth in the southern recovery unit population was over 182 percent between 1989 and 2015, but the subpopulation recovery target has not yet been attained. Preliminary estimates indicate abundance in the New York-New Jersey recovery unit experienced a net increase of 129 percent between 1989 and 2015. However, the population declined sharply from a peak of 586 pairs in 2007 and has still not recovered, with only 411 pairs in 2015. In Eastern Canada, where increases have often been quickly eroded in subsequent years, the population posted a 25-percent decline between 1989 and 2015.

Twenty years of relatively steady population growth, driven by productivity gains, evidences the efficacy of the ongoing Atlantic Coast piping plover recovery program. However, all of the major threats identified in the 1986 ESA listing and 1996 revised recovery plan remain persistent and pervasive along the Atlantic Coast. Expensive labor-intensive management to minimize the effects of these continuing threats, as specified in recovery plan tasks, are implemented every year by a network of dedicated governmental and private cooperators. Because threats to Atlantic Coast piping plovers remain or have increased since listing, reversal of gains in abundance and productivity would quickly follow diminishment of current protection efforts. In the 2009 status review, the Service concluded that the Atlantic Coast piping plover remains vulnerable to low numbers in the Southern and Eastern Canada Recovery Units (USFWS 2009a).

Non-breeding Range

Piping plovers spend up to 10 months of their life cycle on their migration and winter grounds, generally July 15 through as late as May 15. Piping plover migration routes and habitats overlap breeding and wintering habitats, and, unless banded, migrants passing through a site usually are indistinguishable from breeding or wintering piping plovers. Coastal migration stopovers by banded piping plovers from the Great Lakes region have been documented in New Jersey, Maryland, Virginia, North Carolina, South Carolina, and Georgia (Stucker et al. 2010). Migrating birds from eastern Canada have been observed in Massachusetts, New Jersey, New York, and North Carolina (Amirault et al. 2005). Piping plovers banded in the Bahamas have been sighted during migration in nine Atlantic Coast states and provinces between Florida and Nova Scotia (Gratto-Trevor pers. comm. 2012a). In general, the distance between stopover locations and the duration of stopovers throughout the coastal migration range remain poorly understood (USFWS 2015).

Piping plovers migrate through and winter in coastal areas of the U.S. from North Carolina to Texas and in portions of Mexico and the Caribbean. Gratto-Trevor et al. (2009) reported that six of 259 banded piping plovers observed more than once per winter moved across boundaries of the seven U.S. regions. This species exhibits a high degree of intra- and inter-annual wintering site fidelity (Noel and Chandler 2008; Cohen and Gratto-Trevor 2011; Gratto-Trevor et al. 2016; Drake et al. 2001; Noel et al. 2005; Stucker and Cuthbert 2006), even when encountering a high level of environmental disturbance (Gibson et al. 2017; 2018). Of 216 birds observed in different years, only eight changed regions between years, and several of these shifts were associated with late summer or early spring migration periods (Gratto-Trevor et al. 2009). In the years following the 2010 Deepwater Horizon oil spill, Gibson et al. (2017) found that, in spite of significant environmental disturbance, most individuals returned to and persisted at the same wintering site.

Local movements are more common. In South Carolina, Maddock et al. (2009) documented many cross-inlet movements by wintering banded piping plovers as well as occasional movements of up to 18 km by approximately 10% of the banded population; larger movements within South Carolina were seen during fall and spring migration. Similarly, eight banded piping plovers that were observed in two locations during 2006-2007 surveys in Louisiana and Texas were all in close proximity to their original location, such as on the bay and ocean side of the same island or on adjoining islands (Maddock 2008). In Cape Lookout National Seashore, wintering banded birds were surveyed along Shackleford Banks. Individual birds were always observed in the same general area over multiple seasons, indicating that the wintering birds are very site-specific and return to the same area in consecutive years (NPS 2003).

Seventy-nine percent of 57 piping plovers banded in the Bahamas in 2010 were reported breeding on the Atlantic Coast; one was resighted in the Northern Great Plains (Catlin pers. comm. 2012a). Furthermore, consistent with patterns observed in other parts of the wintering range, a few individuals banded in the Great Lakes and Northern Great Plains breeding populations have been observed in the Bahamas (Gratto-Trevor pers. comm. 2012; Catlin pers. comm. 2012a). Collectively, these studies demonstrate an intermediate level of connectivity between breeding and wintering areas. Specific breeding populations will be disproportionately affected by habitat and threats occurring where they are most concentrated in the winter (USFWS 2015).

Five rangewide mid-winter IPPCs are summarized in **Table 6-1.** Total numbers have fluctuated over time, with some areas experiencing increases and others decreases. Regional and local fluctuations may reflect the quantity and quality of suitable foraging and roosting habitat, which vary over time in response to natural coastal formation processes as well as anthropogenic habitat changes (e.g., inlet relocation, dredging of shoals and spits). Fluctuations may also represent localized weather conditions (especially wind) during surveys, or unequal survey coverage. Changes in wintering numbers may also be influenced by growth or decline in the particular breeding populations that concentrate their wintering distribution in a given area.

IPPC surveys may substantially underestimate the abundance of nonbreeding piping plovers using a site or region during other months. In late September 2007, 104 piping plovers were counted at the south end of Ocracoke Island, North Carolina (NPS 2007), where none were seen during the 2006 International Piping Plover January Winter Census (Elliott-Smith et al. 2009). Noel et al. (2007) observed up to 100 piping plovers during peak migration at Little St. Simons Island, Georgia, where approximately 40 piping plovers wintered in 2003–2005. Differences among fall, winter, and spring counts in South Carolina were less pronounced, but inter-year fluctuations (e.g., 108 piping plovers in spring 2007 versus 174 piping plovers in spring 2008) at 28 sites were striking (Maddock et al. 2009).

6.1.4. Conservation Needs of and Threats to Piping Plover

Reason for Listing

Piping plovers were listed principally because of habitat destruction and degradation, predation, and human disturbance. Hunting during the 19th and early 20th centuries likely led to initial declines in the species; however, shooting piping plovers has been prohibited since 1918 pursuant to the provisions of the MBTA. Other human activities, such as habitat loss and degradation, disturbance from recreational pressure, contaminants, and predation are likely responsible for continued declines. The final rule also stated, in addition to extensive breeding area problems, the loss and modification of wintering habitat was a significant threat to the piping plover.

Recovery Criteria

Delisting of the three piping plover populations may be considered when the following criteria are met:

Northern Great Plains Breeding Population (USFWS 1988, 1994)

1. Increase the number of birds in the U.S. Northern Great Plains states to 2,300 pairs (Service 1994).
2. Increase the number of birds in the prairie region of Canada to 2,500 adult piping plovers (Service 1988).
3. Secure long-term protection of essential breeding and wintering habitat (Service 1994).

In 2016, the Service drafted new recovery criteria for the Northern Great Plains breeding population. The new criteria are expected to be finalized in the near future.

Great Lakes Breeding Population (USFWS 2003a)

1. At least 150 pairs (300 individuals), for at least 5 consecutive years, with at least 100 breeding pairs (200 individuals) in Michigan and 50 breeding pairs (100 individuals) distributed among sites in other Great Lakes states.
2. Five-year average fecundity within the range of 1.5-2.0 fledglings per pair, per year, across the breeding distribution, and ten-year population projections indicate the population is stable or continuing to grow above the recovery goal.
3. Protection and long-term maintenance of essential breeding and wintering habitat is ensured, sufficient in quantity, quality, and distribution to support the recovery goal of 150 pairs (300 individuals).
4. Genetic diversity within the population is deemed adequate for population persistence and can be maintained over the long-term.

5. Agreements and funding mechanisms are in place for long-term protection and management activities in essential breeding and wintering habitat.

Atlantic Coast Breeding Population (USFWS 1996a)

1. Increase and maintain for 5 years a total of 2,000 breeding pairs, distributed among 4 recovery units.

Recovery Unit	*Minimum Subpopulation*
Atlantic (eastern) Canada	*400 pairs*
New England	*625 pairs*
New York-New Jersey	*575 pairs*
Southern (DE-MD-VA-NC)	*400 pairs*

2. Verify the adequacy of a 2,000 pair population of piping plovers to maintain heterozygosity and allelic diversity over the long term.
3. Achieve a 5-year average productivity of 1.5 fledged chicks per pair in each of the 4 recovery units described in criterion 1, based on data from sites that collectively support at least 90% of the recovery unit's population.
4. Institute long-term agreements to assure protection and management sufficient to maintain the population targets and average productivity in each recovery unit.
5. Ensure long-term maintenance of wintering habitat, sufficient in quantity, quality, and distribution to maintain survival rates for a 2,000-pair population.

Conservation Recommendations

Nonbreeding Plovers from All Three Breeding Populations (USFWS 2012)

1. Maintain natural coastal processes that perpetuate wintering and coastal migration habitat.
2. Protect wintering and migrating piping plovers and their habitat from human disturbance.
3. Monitor nonbreeding plovers and their habitat.
4. Protect nonbreeding plovers and their habitats from contamination and degradation from oil or other chemical contaminants.
5. Assess predation as a potential limiting factor for piping plovers on wintering and migration sites.
6. Improve application or regulatory tools.
7. Develop mechanisms to provide long-term protection of nonbreeding plovers and their habitat.
8. Conduct scientific investigations to refine knowledge and inform conservation of migrating and wintering piping plovers.

Atlantic and Gulf Coast studies highlighted the importance of inlets for nonbreeding piping plovers. Almost 90% of observations of roosting piping plovers at ten coastal sites in southwest Florida were on inlet shorelines (Lott et al. 2009b). However, piping plovers may be present along ocean-facing shorelines.

Threats to Piping Plovers

The three recovery plans state that shoreline development throughout the wintering range poses a threat to all populations of piping plovers. The plans further state that beach maintenance and nourishment, inlet dredging, and artificial structures, such as jetties, groins, and revetments, could eliminate wintering areas and alter sedimentation patterns leading to the loss of nearby habitat. Unregulated motorized and pedestrian recreational use, inlet and shoreline stabilization projects, beach maintenance and nourishment, and pollution affect most winter and migration areas. Data from studies at Hilton Head, Kiawah Island, and other locations in South Carolina and Georgia demonstrate that impacts from poor winter habitat conditions can be seen the following year on the breeding grounds (Saunders et al. 2014; Gibson et al. 2016). Piping plovers wintering at areas with fewer anthropogenic disturbances had higher survival, recruitment, and population growth rates than areas with greater disturbance.

Important components of ecologically sound barrier beach management include perpetuation of natural dynamic coastal formation processes. Structural development along the shoreline or manipulation of natural inlets upsets the dynamic processes and results in habitat loss or degradation (Melvin et al. 1991). Throughout the range of migrating and wintering piping plovers, inlet and shoreline stabilization, inlet dredging, beach maintenance and nourishment activities, and seawall installations continue to constrain natural coastal processes. As discussed in more detail below, all these efforts result in loss of piping plover habitat. These threats are exacerbated by accelerating sea level rise, which increases erosion and habitat loss where existing development and hardened stabilization structures prevent the natural migration of the beach and/or barrier island. Construction during months when piping plovers are present also causes disturbance that disrupts the birds' foraging efficiency and hinders their ability to build fat reserves over the winter and in preparation for migration, as well as their recuperation from migratory flights. In addition, up to 24 shorebird species migrate or winter along the Atlantic Coast and almost 40 species of shorebirds are present during migration and wintering periods in the Gulf of Mexico region (Helmers 1992). Continual degradation and loss of habitats used by wintering and migrating shorebirds may cause an increase in intra-specific and inter-specific competition for remaining food supplies and roosting habitats. The shrinking extent of shoreline that supports natural coastal formation processes concentrates foraging and roosting opportunities for all shorebird species and forces some individuals into suboptimal habitats. Thus, intra- and inter-specific competition most likely exacerbates threats from habitat loss and degradation.

Loss, modification, and degradation of habitat

The wide, flat, sparsely vegetated barrier beaches, spits, sandbars, and bayside flats preferred by piping plovers in the U.S. are formed and maintained by natural forces and are thus susceptible to degradation caused by development and shoreline stabilization efforts.

Development and Construction

Development and associated construction threaten the piping plover in its migration and wintering range by degrading, fragmenting, and eliminating habitat. Constructing buildings and infrastructure adjacent to the beach can eliminate roosting and loafing habitat within the development's footprint and degrade adjacent habitat by replacing sparsely vegetated dunes or back-barrier beach areas with landscaping, pools, fences, etc. In addition, bayside development can replace foraging habitat with finger canals, bulkheads, docks and lawns. High-value plover habitat becomes fragmented as lots are developed or coastal roads are built between oceanside and bayside habitats.

There are approximately 2,119 mi of sandy beaches within the U.S. continental wintering range of the piping plover (Rice 2012b). Approximately 40% (856 mi) of these sandy beaches are developed, with mainland Mississippi (80%), Florida (57%), Alabama (55%), South Carolina (51%), and North Carolina (49%) comprising the most developed coasts (Rice 2012b). Developed beaches are highly vulnerable to further habitat loss because they cannot migrate in response to sea level rise.

Rice (2012b) has identified over 900 mi (43%) of sandy beaches in the wintering range that are currently "preserved" through public ownership, ownership by non-governmental conservation organizations, or conservation easements. This means that the remaining 17% of shoreline habitat (that which is currently undeveloped but not preserved) is susceptible to future loss to development and the attendant threats from shoreline stabilization activities and sea level rise. These preserved beaches may be subject to some erosion as they migrate in response to sea level rise or if sediment is removed from the coastal system, and they are vulnerable to recreational disturbance. However, they are the areas most likely to maintain the geomorphic characteristics of suitable piping plover habitat.

Inlet Dredging and Sand Mining

The dredging and mining of sediment from inlet complexes threatens the piping plover on its wintering grounds through habitat loss and degradation. The maintenance of navigation channels by dredging, especially deep shipping channels such as those in Alabama and Mississippi can significantly alter the natural coastal processes on inlet shorelines of nearby barrier islands, as described by Otvos (2006), Morton (2008), Otvos and Carter (2008), and Stockdon et al. (2010). Inlet shoals consist of ebb shoals, formed by wave action interacting with the ebb tidal flow, and flood shoals, formed through supply and deposition from the littoral system into the bay during flood tide. Sediment initially is deposited in the near-field flood zone, closest to the inlet entrance. A far-field zone forms through the spreading of sediment from the near-field zone farther into the bay (Carr de Betts, 1999). Cialone and Stauble (1998) describe the impacts of mining ebb shoals within inlets as a source of beach fill material at eight locations and provide a recommended monitoring protocol for future mining events; Dabees and Kraus (2008) also describe the impacts of ebb shoal mining in southwest Florida. There are very few studies on the impacts of flood shoal mining.

Forty-four percent of the tidal inlets within the U.S. wintering range of the piping plover have been or continue to be dredged, primarily for navigational purposes. States where more than two-thirds of inlets have been dredged include Alabama (three of four), Mississippi (four of six), North Carolina (16 of 20), and Texas (13 of 18), and 16 of 21 along the Florida Atlantic coast. The dredging of navigation channels or relocation of inlet channels for erosion-control purposes contributes to the cumulative effects of inlet habitat modification by removing or redistributing the local and regional sediment supply; the maintenance dredging of deep shipping channels can convert a natural inlet that normally bypasses sediment from one shoreline to the other into a sediment sink, where sediment no longer bypasses the inlet.

Among the dredged inlets identified in Rice (2012a), dredging efforts began as early as the 1800s and continue to the present, generating long-term and even permanent effects on inlet habitat; at least 11 inlets were first dredged in the 19th century, with the Cape Fear River (North Carolina) being dredged as early as 1826 and Mobile Pass (Alabama) in 1857. Dredging can occur on a schedule ranging from quarterly to every two to three years, resulting in continual perturbations and modifications to inlet and adjacent shoreline habitat. The volumes of sediment removed in the larger projects can be significant, with 2.2 million cubic yards of sediment removed on average every 1.9 years from the Galveston Bay Entrance (Texas) and 3.6 mcy of sediment removed from Sabine Pass (Texas) on average every 1.4 years (USACE 1992).

Inlets associated with ports and other high-traffic areas typically have maintenance dredging conducted annually, if not more often. At five shallow-draft inlets (Bogue, Topsail, Carolina Beach, and Lockwoods Folly) the Corps has typically dredged the inlet on a quarterly basis and maintained inlet crossings and connecting channels every 1-2 years (NCDENR, 2015). Local governments have received authorization to also conduct maintenance dredging of these inlets on the same general schedule, with beach disposal during the winter work window. Inlets that are mined for Coastal Storm Damage Reduction (CSDR) projects (conducted by the Corps or local governments) are typically dredged on three-year intervals, with placement of the sand on the adjacent shoreline. Dredging may remove intertidal shoals and unvegetated sandy habitat on inlet shoulders. These types of activities are typically conducted during the winter work window to avoid impacts to nesting sea turtles but may have significant impacts to migrating and overwintering piping plovers.

As sand sources for beach nourishment projects have become more limited, the mining of ebb tidal shoals for sediment has increased (Cialone and Stauble 1998). This is a problem because exposed ebb and flood tidal shoals and sandbars are prime roosting and foraging habitats for piping plovers. In general, such areas are only accessible by boat; and as a result, they tend to receive less human recreational use than nearby mainland beaches. Rice (2012a) found that the ebb shoal complexes of at least 20 inlets within the wintering range of the piping plover have been mined for beach fill. Ebb shoals are especially important because they act as “sand bridges” that connect beaches and islands by transporting sediment via longshore transport from one side (updrift) to the other (downdrift) side of an inlet. The mining of sediment from these shoals upsets the inlet system equilibrium and can lead to increased erosion of the adjacent inlet shorelines (Cialone and Stauble 1998). Rice (2012a) noted that this mining of material from inlet shoals for use as beach fill is not equivalent to the natural sediment bypassing that occurs at unmodified inlets for several reasons, most notably for the massive volumes involved that are “transported” virtually instantaneously instead of gradually and continuously and for the placement of the material outside of the immediate inlet vicinity, where it would naturally bypass. The mining of inlet shoals can remove massive amounts of sediment, with 1.98 mcy mined for beach fill from Longboat Pass (Florida) in 1998, 1.7 mcy from Shallotte Inlet (North Carolina) in 2001 and 1.6 mcy from Redfish Pass (Florida) in 1988 (Cialone and Stauble 1998, USACE 2004). Cialone and Stauble (1998) found that monitoring of the impacts of ebb shoal mining has been insufficient, and in one case the mining pit was only 66% recovered after five years; they conclude that the larger the volume of sediment mined from the shoals, the larger the perturbation to the system and the longer the recovery period.

Compared to ebb shoals, flood shoals have received much less attention and study, perhaps because flood shoals are often more complex (particularly where the source of sediment may be oceanic as well as riverine) and are modified by dredging of navigation channels (Carr de Betts 1999; Militello and Kraus 2001). The mined or channelized portions of these flood channels would experience greater sediment deposition as compared to the existing condition because the deeper water would reduce the speed of the current within. When examining a proposal to mine the sand from the flood shoal in Shinnecock Bay, Militello and Kraus (2001) determined that the flood shoal could take a decade or longer to regenerate.

Inlet Stabilization and Relocation

Many navigable tidal inlets along the Atlantic and Gulf coasts are stabilized with hard structures. A description of the different types of stabilization structures typically constructed at or adjacent to inlets – jetties, terminal groins, groins, seawalls, breakwaters and revetments – can be found in the *Manual for Coastal Hazard Mitigation* (Herrington 2003) and in *Living by the Rules of the Sea* (Bush et al. 1996).

The adverse direct and indirect impacts of hard stabilization structures at inlets and inlet relocations can be significant. The impacts of jetties on inlet and adjacent shoreline habitat have been described by Cleary and Marden (1999), Bush et al. (1996), Wamsley and Kraus (2005), USFWS (2009a), Thomas et al. (2011), and many others. The relocation of inlets or the creation of new inlets often leads to immediate widening of the new inlet and loss of adjacent habitat, among other impacts, as described by Mason and Sorenson (1971), Masterson et al. (1973), USACE (1992), Cleary and Marden (1999), Cleary and Fitzgerald (2003), Erickson et al. (2003), Kraus et al. (2003), Wamsley and Kraus (2005), and Kraus (2007).

Rice (2012a) found that, as of 2011, an estimated 54% of 221 mainland or barrier island tidal inlets in the U.S continental wintering range of the piping plover had been modified by some form of hardened structure, dredging, relocation, mining, or artificial opening or closure. On the Atlantic Coast, 43% of the inlets have been stabilized with hard structures, whereas 37% were stabilized on the Gulf Coast. The Atlantic coast of Florida has 17 stabilized inlets adjacent to each other, extending between the St. John's River in Duval County and Norris Cut in Miami-Dade County, a distance of 341 mi. A shorebird would have to fly nearly 344 mi between unstabilized inlets along this stretch of coast.

Unstabilized inlets naturally migrate, reforming important habitat components over time, particularly during a period of rising sea level. Inlet stabilization with rock jetties and revetments alters the dynamics of longshore sediment transport and the natural movement and formation of inlet habitats such as shoals, unvegetated spits and flats. Once a barrier island becomes "stabilized" with hard structures at inlets, natural overwash and beach dynamics are restricted, allowing encroachment of new vegetation on the bayside that replaces the unvegetated (open) foraging and roosting habitats that plovers prefer. Rice (2012a) found that 40% (89 out of 221) of the inlets open in 2011 have been stabilized in some way, contributing to habitat loss and degradation throughout the wintering range. Accelerated erosion may compound future habitat loss, depending on the degree of sea level rise (Titus et al. 2009). Relocation of tidal inlets also can cause loss and/or degradation of piping plover habitat. Although less permanent than construction of hard structures, the effects of inlet relocation can persist for years.

Groins

In 2024, there are 35 groins along the North Carolina coast (Rice 2016). Groins pose an ongoing threat to piping plover beach habitat within the continental wintering range. Groins are hard structures built perpendicular to the shoreline, designed to trap sediment traveling in the littoral drift and to slow erosion on a particular stretch of beach or near an inlet. “Leaky” groins, also known as permeable or porous groins, are low-crested structures built like typical groins, but which allow some fraction of the littoral drift or longshore sediment transport to pass through the groin. They have been used as terminal groins near inlets or to hold beach fill in place for longer durations. Although groins can be individual structures, they are often clustered along the shoreline in “groin fields.” Because they intentionally act as barriers to longshore sand transport, groins cause downdrift erosion, which degrades and fragments sandy beach habitat for the piping plover and other wildlife. The resulting beach typically becomes scalloped in shape, thereby fragmenting plover habitat over time.

Seawalls and Revetments

Seawalls and revetments are hard vertical structures built parallel to the beach in front of buildings, roads, and other facilities. Although they are intended to protect human infrastructure from erosion, these armoring structures often accelerate erosion by causing scouring both in front of and downdrift from the structure, which can eliminate intertidal plover foraging and adjacent roosting habitat. Physical characteristics that determine microhabitats and biological communities can be altered after installation of a seawall or revetment, thereby depleting or changing composition of benthic communities that serve as the prey base for piping plovers. Dugan and Hubbard (2006) found in a California study that intertidal zones were narrower and fewer in the presence of armoring, armored beaches had significantly less macrophyte wrack, and shorebirds responded with significantly lower abundance (more than three times lower) and species richness (2.3 times lower) than on adjacent unarmored beaches. As sea level rises, seawalls will prevent the coastline from moving inland, causing loss of intertidal foraging habitat (Galbraith et al. 2002; Defeo et al. 2009). Geotubes (long cylindrical bags made of high-strength permeable fabric and filled with sand) are less permanent alternatives, but they prevent overwash and thus the natural production of sparsely vegetated habitat.

Although North Carolina has prohibited the use of hard erosion-control structures or armoring since 1985 (with the exception of the six terminal groins recently legislated), the “temporary” installation of sandbag revetments is allowed. As a result, the precise length of armored sandy beaches in North Carolina is unknown, but at least 350 sandbag revetments have been constructed (Rice 2012b). South Carolina also limits the installation of some types of new armoring but already has 24 mi (27% of the developed shoreline or 13% of the entire shoreline) armored with some form of shore-parallel erosion-control structure (SC DHEC 2010).

The repair of existing armoring structures and installation of new structures continues to degrade, destroy, and fragment beachfront plover habitat throughout its continental wintering range. As sea level rises at an accelerating rate, the threat of habitat loss, fragmentation and degradation from hard erosion-control structures is likely to increase as communities and property owners seek to protect their beachfront development. As coastal roads become threatened by rising sea level and increasing storm damage, additional lengths of beachfront habitat may be modified by riprap, revetments, and seawalls.

Sand Placement Projects

Sand placement projects threaten the piping plover and its habitat by altering the natural, dynamic coastal processes that create and maintain beach strand and bayside habitats, including the habitat components that piping plovers rely upon. Although specific impacts vary depending on a range of factors, so-called "soft stabilization" projects may directly degrade or destroy roosting and foraging habitat in several ways. Beach habitat may be converted to an artificial berm that is densely planted in grass, which can in turn reduce the availability of roosting habitat. Over time, if the beach narrows due to erosion, additional roosting habitat between the berm and the water can be lost. Berms can also prevent or reduce the natural overwash that creates and maintains sparsely vegetated roosting habitats. The growth of vegetation resulting from impeding the natural overwash can also reduce the availability of bayside intertidal feeding habitats.

Overwash is an essential process, necessary to maintain the integrity of many barrier islands and to create new habitat (Donnelly et al. 2006). In a study on the Outer Banks of North Carolina, Smith et al. (2008) found that human "modifications to the barrier island, such as construction of barrier dune ridges, planting of stabilizing vegetation, and urban development, can curtail or even eliminate the natural, self-sustaining processes of overwash and inlet dynamics." They also found that such modifications led to island narrowing from both oceanside and bayside erosion. Lott et al. (2009b) found a strong negative correlation between ocean shoreline sand placement projects and the presence of piping and snowy plovers in the Panhandle and southwest Gulf Coast regions of Florida.

Sand placement projects threaten migration and wintering habitat of the piping plover in every state throughout the range (Rice 2012b). At least 684.8 mi (32%) of sandy beach habitat in the continental wintering range of the piping plover have received artificial sand placement via dredge disposal activities, beach nourishment or restoration, dune restoration, emergency berms, inlet bypassing, inlet closure and relocation, and road reconstruction projects, including over 91 mi in North Carolina. In most areas, sand placement projects are in developed areas or adjacent to shoreline or inlet hard stabilization structures in order to address erosion, reduce storm damages, or ameliorate sediment deficits caused by inlet dredging and stabilization activities.

Wintering and migrating piping plovers depend on the availability and abundance of macroinvertebrates as an important food item. Polychaete worms comprise the majority of the shorebird diet (Kalejta 1992; Mercier and McNeil 1994; Tsipoura and Burger 1999; Verkuil et al. 2006) and of the piping plover diet in particular (Hoopes 1993; Nicholls 1989; Zonick and Ryan 1996). The quality and quantity of the macroinvertebrate prey base is threatened by shoreline stabilization activities, including the approximately 685 mi of beaches that have received sand placement of various types. The addition of dredged sediment can temporarily affect the benthic fauna of intertidal systems. Invertebrates may be crushed or buried during project construction. Although some benthic species can burrow through a thin layer of additional sediment (38-89 cm for different species), thicker layers (i.e., >1 meter (m)) are likely to smother these sensitive benthic organisms (Greene 2002). Numerous studies of such effects indicate that the recovery of benthic fauna after beach nourishment or sediment placement projects can take anywhere from six months to two years, and possibly longer in extreme cases (Thrush et al. 1996; Peterson et al. 2000; Zajac and Whitlatch 2003; Bishop et al. 2006; Peterson et al. 2006).

Delayed recovery of the benthic prey base or changes in their communities due to physical habitat changes may affect the quality of piping plover foraging habitat. The duration of the impact can adversely affect piping plovers because of their high site fidelity. Uncertainty persists about the impacts of various projects to invertebrate communities and how these impacts affect shorebirds, particularly the piping plover.

Both the number and the size of sand projects along the Atlantic and Gulf coasts are increasing (Trembanis et al. 1999), and these projects are increasingly being chosen as a means to combat sea level rise and related beach erosion problems (Klein et al. 2001). Throughout the plover migration and wintering range, the number of sand placement events has increased every decade for which records are available, with at least 710 occurring between 1939 and 2007, and more than 75% occurring since 1980 (Trembanis et al. 1999). The cumulative volume of sand placed on East Coast beaches has risen exponentially since the 1920s (Trembanis et al. 1999). As a result, sand placement projects increasingly pose threats to plover habitat.

Invasive Vegetation

The spread of invasive plants into suitable wintering piping plover habitat is a relatively recently identified threat (USFWS 2009a). Such plants tend to reproduce and spread quickly and to exhibit dense growth habits, often outcompeting native plants. Uncontrolled invasive plants can shift habitat from open or sparsely vegetated sand to dense vegetation, resulting in the loss or degradation of piping plover roosting habitat, which is especially important during high tides and migration periods. The propensity of invasive species to spread, and their tenacity once established, make them a persistent threat that is only partially countered by increasing landowner awareness and willingness to undertake eradication activities. Many invasive species are either currently affecting or have the potential to affect coastal beaches and thus plover habitat, including beach vitex (*Vitex rotundifolia*), crowfootgrass (*Dactyloctenium aegyptium*), Australian pine (*Casuarina equisetifolia*), and Japanese sedge *(Carex kobomugi)*. Defeo et al. (2009) cite biological invasions of both plants and animals as global threats to sandy beaches, with the potential to alter the food web, nutrient cycling and invertebrate assemblages. Although the extent of the threat is uncertain, this may be due to poor survey coverage more than an absence of invasions.

Wrack Removal and Beach Cleaning

Wrack on beaches and baysides provides important foraging and roosting habitat for piping plovers (Drake 1999a; Smith 2007; Maddock et al. 2009; Lott et al. 2009b) and for many other shorebirds. Because shorebird numbers are positively correlated both with wrack cover and the biomass of their invertebrate prey that feed on wrack (Tarr and Tarr 1987; Hubbard and Dugan 2003; Dugan et al. 2003), beach grooming has been shown to decrease bird numbers (Defeo et al. 2009).

Although beach cleaning and raking machines effectively remove human-made debris, they also remove accumulated wrack, topographic depressions, emergent foredunes and hummocks, and sparse vegetation nodes used by roosting and foraging piping plovers (Nordstrom 2000; Dugan and Hubbard 2010). Removal of wrack also reduces or eliminates natural sand-trapping, further destabilizing the beach. Furthermore, the sand adhering to seaweed and trapped in the cracks and crevices of wrack also is lost to the beach when the wrack is removed. Although the amount of sand lost during a single sweeping activity may be small, over a period of years this loss could be significant (Neal et al. 2007).

Accelerating sea level rise and other climate change impacts

Accelerating sea level rise poses a threat to piping plovers during the migration and wintering portions of their life cycle. As noted in the previous section, threats from sea level rise are tightly intertwined with artificial coastal stabilization activities that modify and degrade habitat. If climate change increases the frequency or magnitude of extreme temperatures, piping plover survival rates may be affected.

Numerous studies have documented accelerating rise in sea levels worldwide (Rahmstorf et al. 2007; Douglas et al. 2001 as cited in Hopkinson et al. 2008; CCSP 2009; Pilkey and Young 2009; Vermeer and Rahmstorf 2009). Potential effects of sea level rise on piping plover roosting and foraging habitats may vary regionally due to subsidence or uplift, the geological character of the coast and nearshore, and the influence of management measures such as beach nourishment, jetties, groins, and seawalls (CCSP 2009; Galbraith et al. 2002; Gutierrez et al. 2011). Gutierrez et al. (2011) found that along the Atlantic coast, the central and southern Florida coast is the most likely Atlantic portion of the wintering and migration range to experience moderate to severe erosion with sea level rise.

Inundation of piping plover habitat by rising seas could lead to permanent loss of habitat, especially if those shorelines are armored with hardened structures (Brown and McLachlan 2002; Dugan and Hubbard 2006; Defeo et al. 2009). Overwash and sand migration are impeded on the developed portions of sandy ocean beaches (Smith et al. 2008) that comprise 40% of the U.S. nonbreeding range (Rice 2012b). As the sea level rises, the ocean-facing beaches erode and attempt to migrate inland. Buildings and artificial sand dunes then prevent sand from washing back toward the lagoons (i.e., bayside), and the lagoon side becomes increasingly submerged during extreme high tides (Scavia et al. 2002). Barrier beach shorebird habitat and natural features that protect mainland developments are both diminished as a result.

Modeling by Galbraith et al. (2002) for three sea level rise scenarios at five important U.S. shorebird staging and wintering sites predicted aggregate loss of 20-70% of current intertidal foraging habitat. The most severe losses were projected at sites where the coastline is unable to move inland due to steep topography or seawalls. Although habitat losses in some areas are likely to be offset by gains in other locations, Galbraith et al. (2002) noted that time lags between these losses and the creation of replacement habitat elsewhere may have serious adverse effects on shorebird populations. Furthermore, even if piping plovers are able to move their wintering locations in response to accelerated habitat changes, there could be adverse effects on the birds' survival rates or subsequent productivity.

Storm Events

Storms are an integral part of the natural processes that form coastal habitats used by migrating and wintering piping plovers, and positive effects of storm-induced overwash and vegetation removal have been noted in portions of the wintering range. For example, biologists reported piping plover use of newly created habitats at Gulf Islands National Seashore in Florida within six months of overwash events that occurred during the 2004 and 2005 hurricane seasons (Nicholas pers. comm. 2005). Hurricane Katrina created a new inlet and improved habitat conditions on some areas of Dauphin Island, Alabama, but subsequent localized storms contributed to habitat loss there (LeBlanc pers. comm. 2009) and the inlet was subsequently closed with a rock dike as part of Deepwater Horizon oil spill response efforts (Rice 2012a).

Adverse effects attributed to storms alone are sometimes actually due to a combination of storms and other environmental changes or human use patterns. Storm-induced adverse effects include post-storm acceleration of human activities such as beach nourishment, sand scraping, closure of new inlets, and berm and seawall construction. Such stabilization activities can result in the loss and degradation of feeding and resting habitats. Land managers sometimes face public pressure after big storm events to plant vegetation, install sandfences, and bulldoze artificial "dunes." Storms also can cause widespread deposition of debris along beaches. Subsequent removal of this debris often requires large machinery that in turn can cause extensive disturbance and adversely affect habitat elements such as wrack. Challenges associated with management of public use can grow when storms increase access (Gibson et. al. 2009; LeBlanc pers. comm. 2009).

Severe Cold Weather

Several sources suggest the potential for adverse effects of severe winter cold on survival of piping plovers. The Atlantic Coast piping plover recovery plan mentioned high mortality of coastal birds and a drop from approximately 30-40 to 15 piping plovers following an intense 1989 snowstorm along the North Carolina coast (Fussell 1990). A preliminary analysis of survival rates for Great Lakes piping plovers found that the highest variability in survival occurred in spring and correlated positively with minimum daily temperature (weighted mean based on proportion of the population wintering near five weather stations) during the preceding winter (Roche pers. comm. 2010; 2012). Catlin (pers. comm. 2012b) reported that the average mass of ten piping plovers captured in Georgia during unusually cold weather in December 2010 was 5.7 grams (g) less than the average for nine birds captured in October of the same year (46.6 g and 52.4 g, respectively; p = 0.003).

Disturbance from recreation activities

Increasing human disturbance is a major threat to piping plovers in their coastal migration and wintering range (USFWS 2009a). Intense human disturbance in shorebird winter habitat can be functionally equivalent to habitat loss if the disturbance prevents birds from using an area (Goss-Custard et al. 1996). Nicholls and Baldassarre (1990a) found less people and off-road vehicles at sites where nonbreeding piping plovers were present than at sites without piping plovers. Pfister et al. (1992) and Gibson et al. (2018) implicate anthropogenic disturbance as a factor in the long-term decline of migrating shorebirds at staging areas and overwintering areas. Disturbance can cause shorebirds to spend less time roosting or foraging and more time in alert postures or fleeing from the disturbances (Burger 1991; 1994; Elliott and Teas 1996; Lafferty 2001a, 2001b; Thomas et al. 2003). Shorebirds that are repeatedly flushed in response to disturbance expend energy on costly short flights (Nudds and Bryant 2000).

Shorebirds are more likely to flush from the presence of dogs than people, and breeding and nonbreeding shorebirds react to dogs from farther distances than people (Lafferty 2001a, 2001b; Lord et al. 2001; Thomas et al. 2003). Off-road vehicles can disrupt piping plover's normal behavior patterns. The density of off-road vehicles negatively correlated with abundance of piping plovers on the ocean beach in Texas (Zonick 2000). Cohen et al. (2008) found that radio-tagged wintering piping plovers using ocean beach habitat at Oregon Inlet in North Carolina were far less likely to use the north side of the inlet where off-road vehicle use was allowed. Ninety-six percent of piping plover detections occurred on the south side of the inlet even though it was more than four times farther away from foraging sites, prompting a recommendation that controlled management experiments be conducted to determine if recreational disturbance drives roost site selection (Cohen et al. 2008).

Recreational activities, especially off-road vehicles, may degrade piping plover habitat. Tires that crush wrack into the sand render it unavailable as a roosting habitat or foraging substrate (Goldin 1993; Hoopes 1993). Off-road vehicles significantly lessened densities of invertebrates on intertidal flats on the Cape Cod National Seashore in Massachusetts (Wheeler 1979).

Oil spills

Piping plovers may accumulate contaminants from point and non-point sources at migratory and wintering sites. Depending on the type and degree of contact, contaminants can have lethal and sub-lethal effects on birds, including behavioral impairment, deformities, and impaired reproduction (Rand and Petrocelli 1985; Gilbertson et al. 1991; Hoffman et al. 1996). Contaminants have both the potential to cause direct toxicity to individual birds and to negatively impact their invertebrate prey base (Chapman 1984; Rattner and Ackerson 2008). Piping plovers' extensive use of the intertidal zone puts them in constant contact with coastal habitats likely to be contaminated by water-borne spills. Negative impacts can also occur during rehabilitation of oiled birds. Frink et al. (1996) describe how standard treatment protocols were modified to reflect the extreme susceptibility of piping plovers to handling and other stressors.

Efforts to prevent shoreline oiling and cleanup response activities can disturb piping plovers and their habitat. Although most piping plovers were on their breeding grounds in May, June, and early July when the Deepwater well was discharging oil, oil was still washing onto Gulf beaches when the plovers began arriving back on the Gulf in mid-July. Ninety percent of piping plovers detected during the prior four years of surveys in Louisiana were in the Deepwater Horizon oil spill impact zone, and Louisiana's Department of Wildlife and Fisheries reported significant disturbance to birds and their habitat from response activities. Surface oil collection methods in these areas involved rakes, shovels, boats, all-terrain-vehicles, mechanical raking, chain raking, and surface sifters. Sub-surface collection methods from some beaches and vegetated coastlines involved auguring and digging pits/trenches using various beach-cleaning machines, excavators, track hoes, and wheeled/tracked vehicles. Responders deployed barriers to oil movement along beaches and vegetated coastlines. Using boats, pumps, walkways, and hoses, responders flushed oil from vegetated coastlines. Front-end loaders facilitated oil washing from beaches by surf action. In some segments, responders modified habitat features to prevent or reduce the impacts of oiling. Potential long-term adverse effects stem from the construction of sand berms and closing of at least 32 inlets (Rice 2012a). A study by Gibson et al. (2017) found that piping plover demographics did not appear to be negatively influenced by the magnitude of oil observed in impacted areas. Also, piping plovers that were observed to be oiled did not appear to have lower survival probabilities following the oil spill relative to non-oiled individuals from the same winter population.

Subtler but cumulatively damaging sources of oil and other contaminants are leaking vessels, offshore oil rigs and undersea pipelines in the Gulf of Mexico, pipelines buried under the bay bottoms, and onshore facilities such as petroleum refineries and petrochemical plants. In Louisiana, about 2,500-3,000 oil spills are reported in the Gulf region each year, ranging in size from very small to thousands of barrels (Carver pers. comm. 2011). The oil from these smaller leaks and seeps, if they occur far enough from land, will tend to wash ashore as tar balls.

Pesticides and Other Contaminants

A piping plover was found among dead shorebirds discovered on a sandbar near Marco Island, Florida following the county's aerial application of the organophosphate pesticide Fenthion for mosquito control in 1997 (Pittman 2001; Williams 2001). Subsequent to further investigations of bird mortalities associated with pesticide applications and to a lawsuit being filed against the Environmental Protection Agency in 2002, the manufacturer withdrew Fenthion from the market, and Environmental Protection Agency banned all use after November 30, 2004 (American Bird Conservancy 2007). Absent identification of contaminated substrates or observation of direct mortality of shorebirds on a site used by migrating and wintering piping plovers, detection of contaminants threats is most likely to occur through analysis of unhatched eggs. Contaminants in eggs can originate from any point in the bird's annual cycle, and considerable effort may be required to ascertain where in the annual cycle exposure occurred (see, for example, Dickerson et al. 2011 characterizing contaminant exposure of mountain plovers).

There has been limited opportunistic testing of piping plover eggs. Polychlorinated biphenyl (PCB) concentrations in several composites of Great Lakes piping plover eggs tested in the

1990s had potential to cause reproductive harm. Analysis of prey available to piping plovers at representative Michigan breeding sites indicated that breeding areas along the upper Great Lakes region were not likely the major source of contaminants to this population (Best pers. comm. 1999 in USFWS 2003a). Relatively high levels of PCB, dichloro diphenyl dichloroethylene (DDE), and polybrominated diphenyl ether (PBDE) were detected in one of two clutches of Ontario piping plover eggs analyzed in 2009 (Cavalieri pers. comm. 2011). Results of opportunistic egg analyses to date from Atlantic Coast piping plovers did not warrant follow-up investigation (Mierzykowski 2009; 2010; 2012; Mierzykowski pers. comm. 2012). No recent testing has been conducted for contaminants in the Northern Great Plains piping plover population.

Predation

The extent of predation on migrating or wintering piping plovers remains largely unknown and is difficult to document. Avian and mammalian predators are common throughout the species' wintering range. Human activities affect the types, numbers, and activity patterns of some predators, thereby exacerbating natural predation on breeding piping plovers (USFWS 1996). One incident involving a cat observed stalking piping plovers was reported in Texas (NY Times 2007). It has been estimated that free-roaming cats kill over one billion birds every year in the U.S., representing one of the largest single sources of human-influenced mortality for small native wildlife (Sax and Gaines 2008, Loss et al. 2012).

Predatory birds, including peregrine falcons (*F. peregrinus)*, merlin, and harriers, are present in the nonbreeding range. Newstead (pers. comm. 2012b) reported two cases of suspected avian depredation of piping plovers in a Texas telemetry study, but he also noted that red tide may have compromised the health of these plovers. It has been noted, however, that the behavioral response of crouching when in the presence of avian predators may minimize avian predation on piping plovers (Morrier and McNeil 1991; Drake 1999a; Drake et al. 2001). Drake (1999a) theorized that this piping plover behavior enhances concealment associated with roosting in depressions and debris in Texas.

Nonbreeding piping plovers may reap some collateral benefits from predator management conducted for the primary benefit of other species. Florida Keys Refuges National Wildlife Refuge (USFWS 2011a), for example, released a draft integrated predator management plan that targets predators, including cats, for the benefit of native fauna and flora. Other predator control programs are ongoing in North Carolina, South Carolina, Florida, and Texas beach ecosystems (USFWS 2009a).

Military operations

Five of the eleven coastal military bases located in the U.S. continental range of nonbreeding piping plovers have consulted with the USFWS about potential effects of military activities on plovers and their habitat (USFWS 2009a; USFWS 2010b). Formal consultation under section 7 of the ESA with Camp Lejeune, North Carolina in 2002 provided for year-round piping plover surveys, but restrictions on activities on Onslow Beach only pertain to the plover breeding season (Hammond pers. comm. 2012). Informal consultations with three Florida bases (Naval

Station Mayport, Eglin Air Force Base, and Tyndall Air Force Base) addressed training activities that included beach exercises and occasional use of motorized equipment on beaches and bayside habitats. Eglin Air Force Base conducts twice-monthly surveys for piping plovers, and habitats consistently used by piping plovers are posted with avoidance requirements to minimize direct disturbance from troop activities. Operations at Tyndall Air Force Base and Naval Station Mayport were determined to occur outside optimal piping plover habitats. A 2001 consultation with the Navy for one-time training operations on Peveto Beach in Louisiana concluded informally (USFWS 2010b). Current threats to wintering and migrating piping plovers posed by military activities appear minimal.

Disease

No instances of disease have been documented in piping plovers outside the breeding range. The 2009 5-Year Review concluded that West Nile virus and avian influenza remain minor threats to piping plovers on their wintering and migration grounds.

Conservation Efforts

The 2012 CCS (USFWS 2012; 2015) synthesizes conservation needs across the shared coastal migration and wintering ranges of the three piping plover populations and presents recommended conservation actions for protection of nonbreeding piping plovers that are contained in the approved recovery plans (USFWS 1988b, 1996, 2003) and recommendations for future action in the 2009 5-Year Review (USFWS 2009a). Implementation of actions described in the CCS will support attainment of relevant reclassification and delisting criteria (USFWS 1996; 2003).

Conservation efforts on behalf of piping plovers in their non-breeding range have increased since the species listing and further accelerated since the early 2000s. Diverse conservation tools are selectively used to address protection needs across federal, state, municipal, and private land ownership.

6.1.5. Tables for Status of Piping Plover

Table 6-1. Results of the 1991, 1996, 2001, 2006, and 2011 International Piping Plover Winter Censuses (Haig and Plissner 1993; Plissner and Haig 2000; Ferland and Haig 2002; Haig et al. 2005; Elliott-Smith et al. 2009; Elliott-Smith et al. 2015).

Location	**1991**	**1996**	**2001**	**2006**	**2011**
Virginia	not surveyed (ns)	ns	ns	1	1
North Carolina	**20**	**50**	**87**	**84**	**43**
South Carolina	51	78	78	100	86
Georgia	37	124	111	212	63
Florida	551	375	416	454	306
-Atlantic	*70*	*31*	*111*	*133*	*83*

-Gulf	*481*	*344*	*305*	*321*	*223*
Alabama	12	31	30	29	38
Mississippi	59	27	18	78	88
Louisiana	750	398	511	226	86
Texas	1,904	1,333	1,042	2,090	2,145
Puerto Rico	0	0	6	2	2
U.S. Total	**3,384**	**2,416**	**2,299**	**3,357**	**2,858**
Mexico	27	16	ns	76	30
Bahamas	29	17	35	417	1,066
Cuba	11	66	55	89	19
Other Caribbean Islands	0	0	0	28	ns
GRAND TOTAL	**3,451**	**2,515**	**2,389**	**3,884**	**3,973**
Percent of Total International Piping Plover Breeding Census	62.9%	42.4%	40.2%	48.2%	69.4%

6.2. Environmental Baseline for Piping Plover

This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the piping plover, its habitat, and ecosystem within the Action Area. The environmental baseline is a "snapshot" of the species' health in the Action Area at the time of the consultation and does not include the effects of the Action under review.

6.2.1. Action Area Numbers, Reproduction, and Distribution of Piping Plover

Nonbreeding Piping Plovers

It is unclear if piping plover surveys have been conducted in the Action Area. Due to the proximity to optimal piping plover habitat on New Topsail Inlet and New River Inlet, piping plovers may be present in the Action Area. Surveys by multiple groups have documented many piping plovers during the breeding, migration, and overwintering season at New Topsail Inlet, south of the Action Area. The migrant population is larger than the winter population and breeding population. Reports from the National Seashores, and unpublished data from NCWRC's PAWS database (www.ncpaws.org) and Audubon North Carolina provide banded piping plover data for most coastal areas of North Carolina. Banded piping plovers from all three breeding populations have been recorded on the National Seashores and south to Masonboro Inlet. This region of North Carolina, from Cape Lookout to Masonboro Inlet, is extremely important to the survival and recovery of the piping plover, particularly the Great Lakes piping plover.

According to the Audubon North Carolina data, since 2006, 43 individual piping plovers from the Great Lakes population have been recorded at New Topsail Inlet, along with three banded individuals from the Northern Great Plains population and nine banded individuals from the Atlantic Coast breeding population.

6.2.2. Action Area Conservation Needs of and Threats to Piping Plover

The Action Area is developed, mainly with residences. Residential and commercial development began in the 1950s. Large portions of the Action Area are presently lined with structures. Recreational use in the Action Area is quite high from residents and tourists. A wide range of recent and on-going activities have altered the proposed Action Area and, to a greater extent, the North Carolina coastline, and many more are proposed along the coastline for the near future. **Table 4-3** lists projects that have been completed since 2011, though the list is not comprehensive.

Inlet dredging and sand mining: New Topsail Inlet has been dredged by the Corps typically two to three times a year, while the inlet crossings and connecting channels have been typically dredged every 1-2 years (NCDENR, 2015). The Town of Topsail Beach has received authorization to also conduct maintenance dredging of this inlet on the same general schedule, with beach disposal during the winter work window. New River Inlet and associated channels have been dredged by the Corps at least twice in the past 6 years, with placement of the compatible material on NTB.

Nourishment activities widen beaches, change their sedimentology and stratigraphy, alter coastal processes and often plug dune gaps and remove overwash areas. Surf City beaches have been nourished several times in the past 6 years. Nourishment activities included dune repair/restoration utilizing sand trucked from upland mines or bulldozed from the beach shoreline, as well as utilizing sand dredged from permitted channels adjacent to Topsail Island.

Beach scraping can artificially steepen beaches, stabilize dune scarps, plug dune gaps, and redistribute sediment distribution patterns. Artificial dune building, often a product of beach scraping, removes low-lying overwash areas and dune gaps. As chronic erosion catches up to structures throughout the Action Area, artificial dune systems are constructed and maintained to protect beachfront structures either by sand fencing or fill placement. Beach scraping or bulldozing has become more frequent on North Carolina beaches in the past 20 years, in response to storms and the continuing retreat of the shoreline with rising sea level. These activities primarily occur during the winter months. Artificial dune or berm systems have been constructed and maintained in several areas. These dunes make the artificial dune ridge function like a seawall that blocks natural beach retreat, evolution, and overwash.

Beach raking and rock-picking: Man-made beach cleaning and raking machines effectively remove seaweed, fish, glass, syringes, plastic, cans, cigarettes, shells, stone, wood, and virtually any unwanted debris (Barber Beach Cleaning Equipment 2009). These efforts may remove accumulated wrack, topographic depressions, and sparse vegetation nodes used by roosting and foraging piping plovers. Removal of wrack also eliminates a beach's natural sand-trapping abilities, further destabilizing the beach. In addition, sand adhering to seaweed and trapped in the cracks and crevices of wrack is removed from the beach. Although the amount of sand lost due to single sweeping actions may be small, it adds up considerably over a period of years (Nordstrom et al. 2006; Neal et al. 2007). Beach cleaning or grooming can result in abnormally broad unvegetated zones that are inhospitable to dune formation or plant colonization, thereby enhancing the likelihood of erosion (Defreo et al. 2009). The Town of NTB conducted significant rock-picking activities during the 2015 beach nourishment project, due to large amounts of rock and gravel. Rock-picking activities continued within the NTB project area annually until at least 2018, to remove larger material that continued to erode onto the beach from the dune and/or berm. The Town of Surf City expressed interest in 2024 in conducting a beach cleaning event using a "Bebot" (sponsored by Keep New Hanover County Beautiful). The Bebot is assumed to be less impactful than other beach rakes, but still has the potential to remove wrack and vegetation.

Pedestrian Use of the Beach: There are a number of potential sources of pedestrians and pets, including those individuals originating from boats, beachfront, and nearby residences.

Beach Driving: The Town of Surf City allows vehicles on the beach between October 1 and March 15 in limited circumstances. A permit is required for access. In recent years, driving has generally been prohibited due to unsafe conditions on the beach. Impacts to piping plovers and piping plover habitat are discussed at length in **Section 6.1.4.** By far, Topsail Beach had the highest number of vehicles observed per km of any other site in Gibson et al. (2018), with almost one vehicle every 2 km.

Shoreline stabilization: Sandbags and revetments are vertical structures built parallel to the beach in front of buildings, roads, and other facilities to protect them from erosion. However, these structures often accelerate erosion by causing scouring in front of and downdrift from the structure (Hayes and Michel 2008), which can eliminate piping plover habitat. Sand geotubes and sandbag revetments are softer alternatives, but act as barriers by preventing overwash. There are two existing rock revetments along the coast of North Carolina: one at Fort Fisher (approximately 3,040 lf), and another along Carolina Beach (approximately 2,050 lf). A sandbag revetment at least 1,800 lf long (with a geotube in front of a portion) was constructed in 2015 at the north end of NTB, and more sandbags were recently added to protect a parking lot north of the revetment. In 2000 and 2001, sandbag revetments were installed on the north end of Figure Eight Island along Surf Court, Inlet Hook Road, and Comber Road.

Sand fencing: There are a few stretches of sand fencing along the shoreline in Surf City.

6.3. Effects of the Action on Piping Plover

This section analyzes the direct and indirect effects of the Action on the Piping Plover, which includes the direct and indirect effects of interrelated and interdependent actions. Direct effects are caused by the Action and occur at the same time and place. Indirect effects are caused by the Action but are later in time and reasonably certain to occur.

6.3.1. Effects of Sand Placement on Piping Plover

The proposed action has the potential to adversely affect wintering and migrating piping plovers and their habitat from all breeding populations that may use the Action Area. The Atlantic Coast breeding population of piping plover is listed as threatened, while the Great Lakes breeding population is listed as endangered. Potential effects to piping plover include direct loss of foraging and roosting habitat in the Action Area and attraction of predators due to food waste from the construction crew. Plovers face predation by avian and mammalian predators that are present year-round on the wintering and nesting grounds.

Applicable Science and Response Pathways

Direct effects:

Heavy machinery and equipment (e.g., dredges, trucks and bulldozers operating in Action Area) may adversely affect piping plovers in the Action Area by disturbance and disruption of normal activities such as roosting and foraging, and possibly forcing birds to expend valuable energy reserves to seek available habitat elsewhere. In addition, piping plovers may face increased predation from avian and mammalian predators attracted to the Action Area by food waste from the construction crew.

Indirect effects:

The Service expects there may be morphological changes to adjacent piping plover habitat, including roosting and foraging habitat. Activities that affect or alter the use of optimal habitat or increase disturbance to the species may decrease the survival and recovery potential of the piping plover.

Indirect effects include reducing the potential for the formation of optimal habitats. Overwash is an essential process, necessary to maintain the integrity of many barrier islands and to create new habitat (Donnelly et al. 2006). In a study on the Outer Banks of North Carolina, Smith et al. (2008) found that human "modifications to the barrier island, such as construction of barrier dune ridges, planting of stabilizing vegetation, and urban development, can curtail or even eliminate the natural, self-sustaining processes of overwash and inlet dynamics." The proposed project may limit overwash and the creation of optimal foraging and roosting habitat and may increase the attractiveness of these beaches for recreation increasing recreational pressures within the Action Area. Recreational activities that potentially adversely affect plovers include disturbance by unleashed pets and increased use by beach drivers and pedestrians.

The Service anticipates potential adverse effects throughout the Action Area by limiting proximity to roosting and foraging habitat, and degrading occupied foraging habitat.
Elliott and Teas (1996) found a significant difference in actions between piping plovers encountering pedestrians and those not encountering pedestrians. Piping plovers encountering pedestrians spend proportionately more time in non-foraging behavior. This study suggests that interactions with pedestrians on beaches cause birds to shift their activities from calorie acquisition to calorie expenditure. In winter and migration sites, human disturbance continues to

decrease the amount of undisturbed habitat and appears to limit local piping plover abundance (Zonick and Ryan 1996).

Disturbance also reduces the time migrating shorebirds spend foraging (Burger 1991). Pfister et al. (1992) implicate disturbance as a factor in the long-term decline of migrating shorebirds at staging areas. While piping plover migration patterns and needs remain poorly understood and occupancy of a particular habitat may involve shorter periods relative to wintering, information about the energetics of avian migration indicates that this might be a particularly critical time in the species' life cycle.

Long-term and permanent impacts could preclude the creation of new habitat and increase recreational disturbance. Short-term and temporary impacts to piping plovers could result from project work disturbing roosting plovers and degrading currently occupied adjacent foraging areas. The effects of the project construction include a long-term reduction in foraging habitat and a long-term decreased rate of change in coastal dynamics (e.g. sand movement that forms shoals and other intertidal habitats) that may preclude habitat creation. A decrease in the survival of piping plovers on the migration and winter grounds due to the lack of optimal habitat may contribute to decreased survival rates, decreased productivity on the breeding grounds, and increased vulnerability to the three populations.

The addition of dredged sediment can temporarily affect the benthic fauna of intertidal systems. Burial, crushing, and suffocation of invertebrate species will occur during the sand placement, and will affect up to 33,300 lf of shoreline. Although some benthic species can burrow through a thin layer of additional sediment (38-89 cm for different species), thicker layers (i.e., >1 meter) are likely to smother these sensitive benthic organisms (Greene 2002). Numerous studies of such effects indicate that the recovery of benthic fauna after beach nourishment or sediment placement projects can take anywhere from six months to two years, and possibly longer in extreme cases (Thrush et al. 1996; Peterson et al. 2000; Zajac and Whitlatch 2003; Bishop et al. 2006; Peterson et al. 2006). Sand placement projects bury the natural beach with up to millions of cubic yards of new sediment and grade the new beach and intertidal zone with heavy equipment to conform to a predetermined topographic profile. If the material used in a sand placement project does not closely match the native material on the beach, the sediment incompatibility may result in modifications to the macroinvertebrate community structure, because several species are sensitive to grain size and composition (Rakocinski et al. 1996; Peterson et al. 2000; 2006; Peterson and Bishop 2005; Colosio et al. 2007; Defeo et al. 2009).

Delayed recovery of the benthic prey base or changes in their communities due to physical habitat changes may affect the quality of piping plover foraging habitat. The duration of the impact can adversely affect piping plovers because of their high site fidelity. Although recovery of invertebrate communities has been documented in many studies, sampling designs have typically been inadequate and have only been able to detect large-magnitude changes (Schoeman et al. 2000; Peterson and Bishop 2005). Therefore, uncertainty persists about the impacts of various projects to invertebrate communities and how these impacts affect shorebirds, particularly the piping plover.

Beneficial effects:

For some highly eroded beaches, sand placement will have a beneficial effect on the habitat's ability to support wintering piping plovers. Narrow beaches that do not support a productive wrack line may see an improvement in foraging habitat available to piping plovers following sand placement. The addition of sand to the sediment budget may also increase a sand-starved beach's likelihood of developing habitat features valued by piping plovers, including washover fans and emergent nearshore sand bars.

Responses and Interpretation of Effects

Sand placement activities widen beaches, change their sedimentology and stratigraphy, alter coastal processes and often plug dune gaps and remove overwash areas.

The proposed placement of sand on 33,300 lf of beach will occur within habitat for migrating and wintering piping plovers and construction will occur during a portion of the nesting, migration, and winter seasons. Piping plovers may be present year-round in the Action Area; however, the location of project activities will occur outside of piping plover optimal habitat. Sand nourishment under this authorization is expected to be a recurring event. The initial sand placement event is expected to take up to 16 months to complete. The Service expects the Action will result in direct and indirect, long-term effects to piping plovers. However, the Action Area has been developed for decades, with regular nourishment activities and a high level of recreational activity for over 10 years.

For this and other sand placement BOs, the Service typically uses a surrogate to estimate the extent of take. The amount of take is directly proportional to the spatial/temporal extent of occupied habitat that the Action affects and exceeding this extent would represent a taking that is not anticipated in this BO. It is difficult for the Service to estimate the exact number of piping plovers that could be migrating through or wintering within the Action Area at any point in time and place during and after project construction and maintenance events. Disturbance to suitable habitat resulting from placement of sand would affect the ability of an undetermined number of piping plovers to find suitable foraging and roosting habitat during construction and maintenance for an unknown length of time after construction. Incidental take of piping plovers will be difficult to detect for the following reasons:

(1) harassment to the level of harm may only be apparent on the breeding grounds the following year; and
(2) dead plovers may be carried away by waves or predators.

However, the level of take of this species can be anticipated by the proposed activities because:

(1) piping plovers breed, migrate through, and winter in the Action Area;
(2) the placement of the constructed beach is expected to affect the coastal morphology and prevent early successional stages, thereby precluding the maintenance and creation of additional recovery habitat;
(3) increased levels of pedestrian and vehicular disturbance may be expected; and
(4) a temporary reduction of food base will occur.

6.4. Cumulative Effects on Piping Plover

For purposes of consultation under ESA §7, cumulative effects are those caused by future state, tribal, local, or private actions that are reasonably certain to occur in the Action Area. Future Federal actions that are unrelated to the proposed action are not considered, because they require separate consultation under §7 of the ESA. It is reasonable to expect continued shoreline stabilization and beach renourishment projects in this area in the future since erosion and sea-level rise increases would impact the existing beachfront development. Potential cumulative effects are unknown at this time. Therefore, cumulative effects are not relevant to formulating our opinion for the Action.

6.5. Conclusion for Piping Plover

In this section, we summarize and interpret the findings of the previous sections for the piping plover (status, baseline, effects, and cumulative effects) relative to the purpose of a BO under §7(a)(2) of the ESA, which is to determine whether a Federal action is likely to:

a) jeopardize the continued existence of species listed as endangered or threatened; or
b) result in the destruction or adverse modification of designated critical habitat.

<u>Status</u>

North Carolina is the only state where the piping plover's breeding and wintering ranges overlap, and the birds are present year-round. Piping plovers in the Action Area may include individuals from all three breeding populations. Piping plovers migrate through and winter in coastal areas of the U.S. from North Carolina to Texas and in portions of Mexico and the Caribbean.

Since its 1986 listing under the ESA, the Atlantic Coast population estimate has increased 234%, from approximately 790 pairs to an estimated 1,849 pairs in 2008, and the U.S. portion of the population has almost tripled, from approximately 550 pairs to an estimated 1,596 pairs.

Overall, it appears that the Northern Great Plains breeding population (including Canada) declined from 1991 through 2001, increased dramatically in 2006, and then declined again in 2011. The 2011 breeding census count was substantially lower than the count in 2006 (over 4,500 birds in 2006 and 2,249 in 2011) (Elliott-Smith et al. 2015).

The Great Lakes population has shown significant growth, from approximately 17 pairs at the time of listing in 1986, to 75 pairs in 2016 (Cavalieri pers. comm. 2016a). The total of 75 breeding pairs represents 50% of the current recovery goal of 150 breeding pairs for the Great Lakes population.

Baseline

Within the Action Area, wintering, migrating, and breeding piping plovers are documented every year. There have been as many as 15 documented piping plovers on one day during the winter and migration seasons, and typically one breeding pair during the breeding season on Topsail Island. However, the Action Area is not located in optimal piping plover habitat.

Effects

The Service anticipates potential adverse effects throughout the Action Area by limiting proximity to roosting and foraging habitat and removing or degrading foraging habitat.

Threats on the wintering grounds may impact piping plovers' breeding success if they start migration or arrive at the breeding grounds with a poor body condition. Even small declines in adult and juvenile survival rates will cause increases in extinction risk (Ryan et al. 1993; Melvin and Gibbs 1996; Plissner and Haig 2000; Amirault et al. 2005; Calvert et al. 2006; Brault 2007; Gibson et al. 2018). Disturbance also reduces the time migrating shorebirds spend foraging (Burger 1991). Pfister et al. (1992) implicate disturbance as a factor in the long-term decline of migrating shorebirds at staging areas. While piping plover migration patterns and needs remain poorly understood and occupancy of a particular habitat may involve shorter periods relative to wintering, information about the energetics of avian migration indicates that this might be a particularly critical time in the species' life cycle.

Sand placement activities widen beaches, change their sedimentology and stratigraphy, alter coastal processes and often plug dune gaps and remove overwash areas. The proposed placement of sand on 33,300 lf of beach will occur within habitat for piping plovers. Piping plovers may be present year-round in the Action Area; however, the location of project activities is outside of optimal piping plover habitat.

After reviewing the current status of the species, the environmental baseline for the Action Area, the effects of the Action and the cumulative effects, it is the Service's biological opinion that the Action is not likely to jeopardize the continued existence of the piping plover.

7. RED KNOT

7.1. Status of Red Knot

This section summarizes best available data about the biology and current condition of red knot (*Calidris canutus rufa*) throughout its range that are relevant to formulating an opinion about the Action. The Service published its decision to list the rufa red knot as threatened on December 11, 2014 (79 FR 73706

7.1.1. Description of Red Knot

The rufa red knot is a medium-sized, highly migratory shorebird that ranges across nearly the full latitude gradient of the Western Hemisphere. This subspecies is among the longest-distance migrants in the animal kingdom, and among the best-studied shorebirds in the world. The red knot migrates annually between its breeding grounds in the Canadian Arctic and several wintering regions, including the Southeast U.S. (Southeast), the Northeast Gulf of Mexico, northern Brazil, and Tierra del Fuego at the southern tip of South America. During both the northbound (spring) and southbound (fall) migrations, red knots use key staging and stopover areas to rest and feed. Red knots migrate through and overwinter in North Carolina. The term "winter" is used to refer to the nonbreeding period of the red knot life cycle when the birds are not undertaking migratory movements. Red knots are most common in North Carolina during the migration seasons (mid-April through May and July to mid-October) and may be present in the state throughout the year (Fussell 1994; Potter et al. 1980). Wintering areas for the red knot include the Atlantic coasts of Argentina and Chile, the north coast of Brazil, the Northwest Gulf of Mexico from the Mexican State of Tamaulipas through Texas to Louisiana, and the Southeast U.S. from Florida to North Carolina (Newstead et al. 2013; Niles et al. 2008). Smaller numbers of knots winter in the Caribbean, and along the central Gulf coast, the mid-Atlantic, and the Northeast U.S. Little information exists on where juvenile red knots spend the winter months (USFWS and Conserve Wildlife Foundation 2012), and there may be at least partial segregation of juvenile and adult red knots on the wintering grounds. Critical habitat has been proposed for red knot There is no designation of critical habitat for red knot.

7.1.2. Life History of Red Knot

Each year red knots make one of the longest distance migrations known in the animal kingdom, traveling up to 19,000 mi (30,000 km) annually between breeding grounds in the Arctic Circle and wintering grounds. Red knots undertake long flights that may span thousands of miles without stopping. As they 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 (a muscular organ used for grinding food), stomach, intestines, and liver all decrease in size, while pectoral (chest) 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 (Niles et al. 2008; van Gils et al. 2005a; van Gils et al. 2005b; Piersma et al. 1999) that fuels the next migratory flight and, upon arrival in the Arctic, fuels a body transformation to breeding condition (Morrison 2006). Red knots from different wintering areas appear to employ different migration strategies, including differences in timing, routes, and stopover areas. However, full segregation of migration strategies, routes, or stopover areas does not occur among red knots from different wintering areas.

During both the northbound (spring) and southbound (fall) migrations, rufa red knots rely on key staging areas and other stopover areas to rest and feed. The single most important spring staging area is along the shores of Delaware Bay in Delaware and New Jersey, where rufa red knots achieve very high rates of weight gain feeding on the eggs of spawning horseshoe crabs (*Limulus polyphemus*). Large and small groups of rufa red knots, sometimes numbering in the thousands, may occur in suitable habitats from the southern tip of South America to Central Canada during the spring and fall migration seasons.

Habitats used by red knots in migration and wintering areas are similar in character, generally coastal marine and estuarine 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 (Cohen et al. 2010; Cohen et al. 2009; Niles et al. 2008; Harrington 2001; Truitt et al. 2001). The supra-tidal sandy habitats of inlets provide important areas for roosting, especially at higher tides when intertidal habitats are inundated (Harrington 2008).

The red knot is 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 (Piersma and van Gils 2011; Harrington 2001). Mollusk prey are swallowed whole and crushed in the gizzard (Piersma and van Gils 2011). Foraging activity is largely dictated by tidal conditions, as red knots rarely wade in water more than 0.8 to 1.2 in (2 to 3 cm) deep (Harrington 2001). Due to bill morphology, the red knot is limited to foraging on only shallow-buried prey, within the top 0.8 to 1.2 in (2 to 3 cm) of sediment (Gerasimov 2009; Zwarts and Blomert 1992).

The primary prey of the rufa red knot in non-breeding habitats include blue mussel (*Mytilus edulis*) spat; *Donax* and *Darina* clams; snails and other mollusks, with polychaete worms, insect larvae, and crustaceans also eaten in some locations. Red knots also prey on horseshoe crab eggs when available.

Red knots and other shorebirds that are long-distance migrants must take advantage of seasonally abundant food resources at intermediate stopovers to build up fat reserves for the next non-stop, long-distance flight (Clark et al. 1993). Although foraging red knots can be found widely distributed in small numbers within suitable habitats during the migration period, birds tend to concentrate in those areas where abundant food resources are consistently available from year to year.

7.1.3. Numbers, Reproduction, and Distribution of Red Knot

The Service has determined that the rufa red knot is threatened due to loss of both breeding and nonbreeding habitat; potential for disruption of natural predator cycles on the breeding grounds; reduced prey availability throughout the nonbreeding range; and increasing frequency and severity of asynchronies in the timing of the birds' annual migratory cycle relative to favorable food and weather conditions.

In the U.S., red knot populations declined sharply in the late 1800s and early 1900s due to excessive sport and market hunting, followed by hunting restrictions and signs of population recovery by the mid-1900s (Urner and Storer 1949; Stone 1937; Bent 1927). However, it is unclear whether the red knot population fully recovered its historical numbers (Harrington 2001) following the period of unregulated hunting. More recently, long-term survey data from two key areas (Tierra del Fuego wintering area and Delaware Bay spring stopover site) both show a roughly 75 percent decline in red knot numbers since the 1980s (Dey et al. 2011; Clark et al. 2009; Morrison et al. 2004; Morrison and Ross 1989; Kochenberger 1983; Dunne et al. 1982; Wander and Dunne 1982).

Counts on the wintering grounds are particularly useful in estimating rufa red knot populations and trends because the birds generally remain within a given wintering area for a longer period of time compared to migration stopover areas. This reduces errors associated with turnover or double counting that can occur during migration counts (Service 2014, p. 85). Thus, although abundance estimates are available for certain stopover areas and are important for their management, we focus on estimates from the wintering areas to assess population trends. Aerial surveys of Tierra del Fuego (Chile and Argentina) and the adjacent Patagonian coast to the north (Argentina) have been conducted since 2000, and previously in the early 1980s, by the same observers using consistent methodology. This is the best available long-term data set for a wintering region. Rufa red knot counts in this Southern wintering region have been markedly lower in recent years.

Population sizes and trends for the other three wintering regions are far less certain. Based on best available information, the North Coast of South America wintering population was most recently estimated at about 31,000 birds (Mizrahi 2020), the Southeast United States/Caribbean population at about 15,500 birds including about 5,100 in the Caribbean (Lyons et al. 2017), and the Western Gulf of Mexico/Central America/Pacific population at about 6,000 birds (a rough estimate of 2,000 to 4,000 in Texas and Northern Mexico and at least 2,500 in Louisiana, with no quantitative estimates available for Central America or the Pacific coast of South America (Newstead pers. comm. 2019, 2020). We have no evidence that the Southeast United States/Caribbean population has declined, and earlier regional abundance estimates suggest this population has been roughly stable since the 1980s (Service 2014). All of these estimates are associated with lower certainty due to sporadic and inconsistent survey and modeling efforts, but the estimate for the Western Gulf of Mexico/Central America/Pacific is particularly uncertain. Adding up the 4 regional estimates, and noting the various uncertainties, we estimate the current total abundance of rufa red knot at approximately 64,700.

7.1.4. Conservation Needs of and Threats to Red Knot

A Recovery Plan for the red knot was completed in 2023.

Threats to the Red Knot

In the final listing rule, the Service determined that the rufa red knot is threatened under the ESA due to the following primary threats: loss of breeding and nonbreeding habitat (including sea level rise, coastal engineering/stabilization, coastal development, and arctic ecosystem change); likely effects related to disruption of natural predator cycles on the breeding grounds; reduced prey availability throughout the nonbreeding range; and increasing frequency and severity of asynchronies (mismatches) in the timing of the birds' annual migratory cycle relative to favorable food and weather conditions. The Service also evaluated other, secondary factors that likely cause additive rufa red knot mortality. Individually the secondary factors are not expected to have effects at the level of the listed taxon. Cumulatively, however, these factors are expected to exacerbate the effects of the primary threats, as they further reduce the subspecies' resiliency and possibly representation and redundancy. These secondary factors include hunting; predation in nonbreeding areas; harmful algal blooms; and human disturbance, oil spills, and wind energy development especially near the coasts.

7.2. Environmental Baseline for Red Knot

This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of the Red Knot, its habitat, and ecosystem within the Action Area. The environmental baseline is a "snapshot" of the species' health in the Action Area at the time of the consultation and does not include the effects of the Action under review.

7.2.1. Action Area Numbers, Reproduction, and Distribution of Red Knot

Migrating and overwintering hatch-year and adult red knots may utilize the Action Area. Red knots may be present any month of the year, although they are less likely to be present during the height of the breeding season (July). Spring migration peaks in North Carolina in May-June, while fall migration peaks between mid-August and early September, though many individuals stay until November, and small flocks may stay for the entire winter (nc.audubon.org).

It is unclear if any surveys have been conducted in the Action Area. Surveys conducted on the north end of Topsail Island (New River Inlet, south side) documented red knots in 2017, 2021, and 2022 (ncpaws.org, accessed October 15, 2024). Gilbert Grant observed 128 red knots on the north end of Topsail Island in May 2022.

7.2.2. Action Area Conservation Needs of and Threats to Red Knot

The Action Area is developed, mainly with residences. Residential and commercial development began in the 1950s. Large portions of the Action Area are presently lined with structures. Recreational use in the Action Area is quite high from residents and tourists. In recent years, piping plover nests on the south end of Topsail Beach have been protected during the breeding season, using posts and rope. These roped off areas may also provide areas for red knots to be free from human disturbance for a small portion of the year.

A wide range of recent and on-going beach disturbance activities have altered the proposed Action Area and, to a greater extent, the North Carolina coastline, and many more are proposed along the coastline for the near future. **Table 4-3** lists projects that have been completed since 2011, though the list is not comprehensive.

<u>Nourishment activities:</u> Surf City beaches have been nourished several times in the past 6 years. Nourishment activities included dune repair/restoration utilizing sand trucked from upland mines or bulldozed from the beach shoreline, as well as utilizing sand dredged from permitted channels adjacent to Topsail Island.

Beach scraping: Beach scraping or bulldozing has become more frequent on North Carolina beaches in the past 20 years, in response to storms and the continuing retreat of the shoreline with rising sea level. These activities primarily occur during the winter months. Artificial dune or berm systems have been constructed and maintained in several areas. These dunes make the artificial dune ridge function like a seawall that blocks natural beach retreat, evolution, and overwash.

Beach raking: The Town of NTB conducted significant rock-picking activities during the 2015 beach nourishment project, due to large amounts of rock and gravel. Rock-picking activities continued within the NTB project area annually until at least 2018, in order to remove larger material that continued to wash onto the beach as the dune and/or berm eroded. The Town of Surf City has recently expressed interest in conducting a beach cleaning event using a "Bebot" (sponsored by Keep New Hanover County Beautiful).

Pedestrian use of the beach: There are a number of potential sources of pedestrians and pets, including those individuals originating from boats, beachfront, and nearby residences. Gibson et al. (2018) rated the project area as receiving moderate levels of recreational use from boaters and beachgoers, compared to other inlets in Georgia, South Carolina, and North Carolina used by overwintering and migrating red knots. Although the mean number of people observed per km of survey area was relatively low compared to other sites (below 4), the number of dogs observed per km surveyed was the highest of all of the sites at almost three dogs per km.

Beach driving: The Town of Surf City allows vehicles on the beach between October 1 and March 15 in limited circumstances. A permit is required for access. In recent years, driving has generally been prohibited due to unsafe conditions on the beach. Impacts to red knots are similar to those of piping plover, discussed in **Section 6.1.4.** By far, Topsail Beach had the highest number of vehicles observed per km of any other site in Gibson et al. (2018), with almost one vehicle every 2 km.

Shoreline stabilization: There are two existing rock revetments along the coast of North Carolina: one at Fort Fisher (approximately 3,040 lf), and another along Carolina Beach (approximately 2,050 lf). A sandbag revetment at least 1,800 lf long (with a geotube in front of a portion) was constructed in 2015 at the north end of NTB, and more sandbags were recently added to protect a parking lot north of the revetment. In 2000 and 2001, sandbag revetments were installed on the north end of Figure Eight Island along Surf Court, Inlet Hook Road, and Comber Road. There are over a few homes on Surf City with existing sandbag structures.

Sand fencing: There are a few stretches of sand fencing along the shoreline on Surf City.

7.3. Effects of the Action on Red Knot

This section analyzes the direct and indirect effects of the Action on the red knot, which includes the direct and indirect effects of interrelated and interdependent actions. Direct effects are caused by the Action and occur at the same time and place. Indirect effects are caused by the Action but are later in time and reasonably certain to occur. Our analyses are organized according to the description of the Action in **Section 2** of this BO.

7.3.1. Effects of Sand Placement on Red Knot

The proposed action has the potential to adversely affect wintering and migrating red knots and their habitat. Potential effects to red knots include degradation of foraging habitat and destruction of the prey base from sand disposal, and attraction of predators due to food waste from the construction crew. Like the piping plover, red knots face predation by avian and mammalian predators that are present year-round on the migration and wintering grounds.

<u>Applicable Science and Response Pathways</u>

Placement of sand will occur within and adjacent to red knot roosting and foraging habitat along 33,300 lf of oceanfront shoreline. The timing of project construction could directly and indirectly impact migrating and wintering red knots. The effects of the project construction include a temporary reduction in foraging habitat, a long term decreased rate of change in coastal dynamics that may preclude habitat creation and increased recreational disturbance. A decrease in the survival of red knots on the migration and winter grounds due to the lack of optimal habitat may contribute to decreased survival rates, decreased productivity on the breeding grounds, and increased vulnerability to the population.

Dredging and beach nourishment will be a one-time activity, which will take up to four and a half months to complete. Thus, the direct effects would be expected to be short-term in duration. Indirect effects from the activity may continue to impact migrating and wintering red knots in subsequent seasons after sand placement. Disturbance from construction activities will be short term, lasting up to two years. Recreational disturbance may increase after project completion and have long-term impacts.

In addition to causing disturbance during construction, beach nourishment often increases recreational use of the widened beaches that, without careful management, can increase disturbance of red knots. Beach nourishment can also temporarily depress, and sometimes permanently alter, the invertebrate prey base on which shorebirds depend. In addition to disturbing the birds and impacting the prey base, beach nourishment can affect the quality and quantity of red knot habitat (M. Bimbi pers. comm. November 1, 2012; Greene 2002). The artificial beach created by nourishment may provide only suboptimal habitat for red knots, as a steeper beach profile is created when sand is stacked on the beach during the nourishment process. In some cases, nourishment is accompanied by the planting of dense beach grasses, which can degrade habitat, as red knots require sparse vegetation to avoid predation. By precluding overwash and Aeolian transport, especially where large artificial dunes are constructed, beach nourishment can also lead to further erosion on the bayside and promote bayside vegetation growth, both of which can degrade the red knot's preferred foraging and roosting habitats. Preclusion of overwash also impedes the formation of new red knot habitats. Beach nourishment can also encourage further development, bringing further habitat impacts, reducing future alternative management options such as a retreat from the coast, and perpetuating the developed and stabilized conditions that may ultimately lead to inundation where beaches are prevented from migrating (M. Bimbi pers. comm. November 1, 2012; Greene 2002).

The quantity and quality of red knot prey may also be affected by the placement of sediment for beach nourishment or disposal of dredged material. Invertebrates may be crushed or buried during project construction. Although some benthic species can burrow through a thin layer of additional sediment, thicker layers (over 35 in (90 cm)) smother the benthic fauna (Greene 2002). By means of this vertical burrowing, recolonization from adjacent areas, or both, the benthic faunal communities typically recover. Recovery can take as little as 2 weeks or as long as 2 years, but usually averages 2 to 7 months (Greene 2002; Peterson and Manning 2001). Although many studies have concluded that invertebrate communities recovered following sand placement, study methods have often been insufficient to detect even large changes (e.g., in abundance or species composition), due to high natural variability and small sample sizes (Peterson and Bishop 2005). Therefore, uncertainty remains about the effects of sand placement on invertebrate communities, and how these impacts may affect red knots.

Beneficial effects: For some highly eroded beaches, sand placement may have a beneficial effect on the habitat's ability to support wintering or migrating red knots. The addition of sand to the sediment budget may increase a sand-starved beach's likelihood of developing habitat features valued by red knots.

Direct effects: Direct effects are those direct or immediate effects of a project on the species or its habitat. The construction window will extend into one or more red knot migration and winter seasons. Heavy machinery and equipment (e.g., trucks and bulldozers operating on Action Area beaches, the placement of the dredge pipeline along the beach, and sand disposal) may adversely affect migrating and wintering red knots in the Action Area by disturbance and disruption of normal activities such as roosting and foraging, and possibly forcing birds to expend valuable energy reserves to seek available habitat elsewhere.

Burial and suffocation of invertebrate species will occur during each sand placement activity. Impacts will affect up to 33,300 lf of shoreline. Timeframes projected for benthic recruitment and re-establishment following beach nourishment are between 6 months to 2 years. Depending on actual recovery rates, impacts will occur even if nourishment activities occur outside the red knot migration and wintering seasons.

Indirect effects: The proposed project includes beach renourishment along up to 33,300 lf of shoreline. Indirect effects include reducing the potential for the formation of optimal roosting and foraging habitats (coastal marine and estuarine habitats with large areas of exposed intertidal sediments). The proposed project may also increase the attractiveness of these beaches for recreation increasing recreational pressures within the Action Area. Recreational activities that potentially adversely affect red knots include disturbance by unleashed pets and increased pedestrian or beach vehicle use.

Responses and Interpretation of Effects

The proposed placement of sand on 33,300 lf of beach will occur within habitat that is used by migrating and wintering red knots. Since red knots can be present on these beaches almost year-round, construction is likely to occur while this species is utilizing these beaches and associated habitats. Sand nourishment under this authorization is expected to be a one-time event, taking up to four and a half months to complete. The Service expects the Action will result in direct and indirect, long-term effects to red knot. Short-term and temporary impacts to red knot activities could result from project work occurring on the beach that flushes birds from roosting or foraging habitat. Long-term impacts could include a hindrance in the ability of migrating or wintering red knots to recuperate from their migratory flight from their breeding grounds, survive on their wintering areas, or to build fat reserves in preparation for migration. Long-term impacts may also result from changes in the physical characteristics of the beach from the placement of the sand. The area of sand placement has been developed for decades, with regular nourishment activities and a high level of recreational activity.

For this and other sand placement BOs, the Service typically uses a surrogate to estimate the extent of take. The amount of take is directly proportional to the spatial/temporal extent of occupied habitat that the Action affects and exceeding this extent would represent a taking that is not anticipated in this BO. It is difficult for the Service to estimate the exact number of red knots that could be migrating through or wintering within the Action Area at any one point in time and place during project construction. Disturbance to suitable habitat resulting from both construction and sand placement activities within the Action Area would affect the ability of an undetermined number of red knots to find suitable foraging and roosting habitat during any given year.

The Service anticipates that directly and indirectly an unspecified number of red knots along 33,300 lf of shoreline, all at some point, potentially usable by red knots, could be taken in the form of harm and harassment as a result of this proposed action. The amount of take is directly proportional to the spatial/temporal extent of occupied habitat that the Action affects and exceeding this extent would represent a taking that is not anticipated in this BO. Incidental take of red knots will be difficult to detect for the following reasons:

(1) harassment to the level of harm may only be apparent on the breeding grounds the following year; and
(2) dead red knots may be carried away by waves or predators.

The level of take of this species can be anticipated by the proposed activities because:

(1) red knots migrate through and winter in the Action Area;
(2) the placement of the constructed beach is expected to affect the coastal morphology and prevent early successional stages, thereby precluding the maintenance and creation of additional recovery habitat;
(3) increased levels of pedestrian or vehicular disturbance may be expected; and
(4) a temporary reduction of food base will occur.

7.4. Cumulative Effects on Red Knot

For purposes of consultation under ESA §7, cumulative effects are those caused by future state, tribal, local, or private actions that are reasonably certain to occur in the Action Area. Future Federal actions that are unrelated to the proposed action are not considered, because they require separate consultation under §7 of the ESA. It is reasonable to expect continued dredging, shoreline stabilization, and beach renourishment projects in this area in the future since erosion and sea-level rise increases would impact the existing beachfront development.

7.5. Conclusion for Red Knot

In this section, we summarize and interpret the findings of the previous sections for the Red Knot (status, baseline, effects, and cumulative effects) relative to the purpose of a BO under §7(a)(2) of the ESA, which is to determine whether a Federal action is likely to:

a) jeopardize the continued existence of species listed as endangered or threatened; or
b) result in the destruction or adverse modification of designated critical habitat.

"Jeopardize the continued existence" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR §402.02).

Status

The Service has determined that the rufa red knot is threatened due to loss of both breeding and nonbreeding habitat; potential for disruption of natural predator cycles on the breeding grounds; reduced prey availability throughout the nonbreeding range; and increasing frequency and severity of asynchronies in the timing of the birds' annual migratory cycle relative to favorable food and weather conditions.

Baseline

Migrating and overwintering hatch-year and adult red knots utilize the Action Area. Red knots may be present any month of the year, although they are less likely to be present during the height of the breeding season (July).

Effects

The proposed placement of sand on 33,300 lf of beach will occur within habitat that is used by migrating and wintering red knots. Since red knots can be present on these beaches almost year-round, construction is likely to occur while this species is utilizing these beaches and associated habitats. Sand nourishment under this authorization is expected to be a one-time event, taking up to four and a half months to complete. The Service expects the Action will result in direct and indirect, long-term effects to red knots. Short-term and temporary impacts to red knot activities could result from project work occurring on the beach that flushes birds from roosting or foraging habitat. Long-term impacts could include a hindrance in the ability of migrating or wintering red knots to recuperate from their migratory flight from their breeding grounds, survive on their wintering areas, or to build fat reserves in preparation for migration. Long-term impacts may also result from changes in the physical characteristics of the beach from the placement of the sand. However, the Action Area has been developed for decades, with regular nourishment activities and a high level of recreational activity. There are no optimal habitats that will be affected. Therefore, the severity of these effects to the red knot population is expected to be slight.

After reviewing the current status of the species, the environmental baseline for the Action Area, the effects of the Action and the cumulative effects, it is the Service's biological opinion that the Action is not likely to jeopardize the continued existence of the red knot.

8. SEABEACH AMARANTH

8.1. Status of Seabeach Amaranth

This section summarizes best available data about the biology and current condition of seabeach amaranth (*Amaranthus pumilus*) throughout its range that are relevant to formulating an opinion about the Action. The Service published its decision to list the seabeach amaranth as threatened on April 7, 1993 (58 FR 18035).

8.1.1. Description of Seabeach Amaranth

Seabeach amaranth is an annual plant that grows on Atlantic barrier islands and ocean beaches currently ranging from South Carolina to New York. It was listed as threatened under the ESA because of its vulnerability to human and natural impacts and the fact that it had been eliminated from two-thirds of its historic range (USFWS 1996b). Seabeach amaranth stems are fleshy and pink-red or reddish, with small, rounded leaves that are 0.5 to 1.0 in in diameter. The green leaves, with indented veins, are clustered toward the tip of the stems, and have a small notch at the rounded tip. Flowers and fruits are relatively inconspicuous, borne in clusters along the stems. Seabeach amaranth will be considered for delisting when the species exists in at least six states within its historic range and when a minimum of 75 percent of the sites with suitable habitat within each state are occupied by populations for l0 consecutive years (USFWS 1996b). The recovery plan states that mechanisms must be in place to protect the plants from destructive habitat alterations, destruction or decimation by off-road vehicles or other beach uses, and protection of populations from debilitating webworm predation. There is no designation of critical habitat for seabeach amaranth.

8.1.2. Life History of Seabeach Amaranth

Seabeach amaranth is an annual plant. Germination of seabeach amaranth seeds occurs over a relatively long period, generally from April to July. Upon germinating, this plant initially forms a small unbranched sprig, but soon begins to branch profusely into a clump. This clump often reaches one foot in diameter and consists of five to 20 branches. Occasionally, a clump may get as large as three feet or more across, with 100 or more branches. Flowering begins as soon as plants have reached sufficient size, sometimes as early as June, but more typically commencing in July and continuing until the death of the plant in late fall. Seed production begins in July or August and peaks in September during most years but continues until the death of the plant. Weather events, including rainfall, hurricanes, and temperature extremes, and predation by webworms have strong effects on the length of the reproductive season of seabeach amaranth. Because of one or more of these influences, the flowering and fruiting period can be terminated as early as June or July. Under favorable circumstances, however, the reproductive season may extend until January or sometimes later (Radford et al. 1968; Bucher and Weakley 1990; Weakley and Bucher1992).

8.1.3. Numbers, Reproduction, and Distribution of Seabeach Amaranth

The species historically occurred in nine states from Rhode Island to South Carolina (USFWS 2003c). By the late 1980s, habitat loss and other factors had reduced the range of this species to North and South Carolina. Since 1990, seabeach amaranth has reappeared in several states that had lost their populations in earlier decades. However, threats like habitat loss have not diminished, and populations are declining overall. It is currently found in New York, New Jersey, Delaware, Maryland, Virginia, North Carolina, and South Carolina. The typical habitat where this species is found includes the lower foredunes and upper beach strands on the ocean side of the primary sand dunes and overwash flats at accreting spits or ends of barrier islands. Seabeach amaranth has been and continues to be threatened by destruction or adverse alteration of its habitat. As a fugitive species dependent on a dynamic landscape and large-scale geophysical processes, it is extremely vulnerable to habitat fragmentation and isolation of small populations. Further, because this species is easily recognizable and accessible, it is vulnerable to taking, vandalism, and the incidental trampling by curiosity seekers. Seabeach amaranth is afforded legal protection in North Carolina by the General Statutes of North Carolina, Sections 106-202.15, 106- 202.19 (N.C. Gen. Stat. section 106 (Supp. 1991)), which provide for protection from intrastate trade (without a permit).

Within North Carolina and across its range, seabeach amaranth numbers vary from year to year. Data in North Carolina is available from 1987 to 2013. Recently, the number of plants across the entire state dwindled from a high of 19,978 in 2005 to 165 in 2013. This trend of decreasing numbers is seen throughout its range. 249,261 plants were found throughout the species' range in 2000. By 2013, those numbers had dwindled to 1,320 plants. In 2014, there was a slight increase in the number of plants to 2,829 (USFWS, unpublished data).

Seabeach amaranth is dependent on natural coastal processes to create and maintain habitat. However, high tides and storm surges from tropical systems can overwash, bury, or inundate seabeach amaranth plants or seeds, and seed dispersal may be affected by strong storm events. In September of 1989, Hurricane Hugo struck the Atlantic Coast near Charleston, South Carolina, causing extensive flooding and erosion north to the Cape Fear region of North Carolina, with less severe effects extending northward throughout the range of seabeach amaranth. This was followed by several severe storms that, while not as significant as Hurricane Hugo, caused substantial erosion of many barrier islands in the seabeach amaranth's range. Surveys for seabeach amaranth revealed that the effects of these climatic events were substantial (Weakley and Bucher 1992). In the Carolinas, populations of amaranth were severely reduced. In South Carolina, where the effects of Hurricane Hugo and subsequent dune reconstruction were extensive, amaranth numbers declined from 1,800 in 1988 to 188 in 1990, a reduction of 90 percent. A 74 percent reduction in amaranth numbers occurred in North Carolina, from 41,851 plants in 1988 to 10,898 in 1990. Although population numbers in New York increased in 1990, range-wide totals of seabeach amaranth were reduced 76 percent from 1988 (Weakley and Bucher 1992). The influence stochastic events have on long-term population trends of seabeach amaranth has not been assessed.

8.1.4. Conservation Needs of and Threats to Seabeach Amaranth

The most serious threats to the continued existence of seabeach amaranth are construction of beach stabilization structures, natural and man-induced beach erosion and tidal inundation, fungi (i.e., white wilt), beach raking and scraping, herbivory by insects and mammals, and off-road vehicles. Herbivory by webworms, deer, feral horses, and rabbits is a major source of mortality and lowered fecundity for seabeach amaranth. However, the extent to which herbivory affects the species as a whole is unknown.

Potential effects to seabeach amaranth from vehicle use on the beaches include vehicles running over, crushing, burying, or breaking plants, burying seeds, degrading habitat through compaction of sand and the formation of seed sinks caused by tire ruts. Seed sinks occur when blowing seeds fall into tire ruts, then a vehicle comes along and buries them further into the sand preventing germination. If seeds are capable of germinating in the tire ruts, the plants are usually destroyed before they can reproduce by other vehicles following the tire ruts. Those seeds and their reproductive potential become lost from the population.

Pedestrians also can negatively affect seabeach amaranth plants. Seabeach amaranth occurs on the upper portion of the beach which is often traversed by pedestrians walking from parking lots, hotels, or vacation property to the ocean. This is also the area where beach chairs and umbrellas are often set up and/or stored. In addition, resorts, hotels, or other vacation rental establishments may set up volleyball courts or other sporting activity areas on the upper beach at the edge of the dunes. All of these activities can result in the trampling and destruction of plants. Pedestrians walking their dogs on the upper part of the beach, or dogs running freely on the upper part of the beach, may result in the trampling and destruction of seabeach amaranth plants. The extent of the effects that dogs have on seabeach amaranth is not known.

Recovery Criteria

Seabeach amaranth will be considered for delisting when the species exists in at least six states within its historic range and when a minimum of 75 percent of the sites with suitable habitat within each state are occupied by populations for l0 consecutive years (USFWS 1996b). The recovery plan states that mechanisms must be in place to protect the plants from destructive habitat alterations, destruction or decimation by off-road vehicles or other beach uses, and protection of populations from debilitating webworm predation.

8.2. Environmental Baseline for Seabeach Amaranth

This section is an analysis of the effects of past and ongoing human and natural factors leading to the current status of seabeach amaranth, its habitat, and ecosystem within the Action Area. The environmental baseline is a “snapshot” of the species’ health in the Action Area at the time of the consultation and does not include the effects of the Action under review.

8.2.1. Action Area Numbers, Reproduction, and Distribution of Seabeach Amaranth

Since 1992, seabeach amaranth surveys have been conducted along much of the North Carolina shoreline. The numbers of seabeach amaranth vary widely from year to year. See **Table 8-1** for data from the Corps and the Service (unpublished). Seabeach amaranth numbers have been very high in the past on Topsail Island, numbering in the thousands of individuals in the 1990s and early 2000's. Over the past 10-20 years, the numbers of seabeach amaranth plants has plummeted, with only 10 plants reported in 2013, 38 reported in 2014, and 23 reported in 2018 along the entire island shoreline. Since 1992, the statewide total number of seabeach amaranth records has varied from as few as 105 plants in the year 2000 to 33,514 plants in 1995. Over the past 12 years, the numbers of seabeach amaranth have declined dramatically across the state. It is unclear what is causing the decline in numbers of plants.

8.2.2. Action Area Conservation Needs of and Threats to Seabeach Amaranth

The predominant threat to seabeach amaranth is the destruction or alteration of suitable habitat, primarily because of beach stabilization efforts and storm-related erosion (USFWS 1993). Other important threats to the plant include beach grooming and vehicular traffic, which can easily break or crush the fleshy plant and bury seeds below depths from which they can germinate, and predation by webworms (caterpillars of small moths) (USFWS 1993). Webworms feed on the leaves of the plant and can defoliate the plants to the point of either killing them or at least reducing their seed production. Beach vitex (*Vitex rotundifulia*) is another threat to seabeach amaranth, as it is an aggressive, invasive, woody plant that can occupy habitat similar to seabeach amaranth and outcompete it (Invasive Species Specialist Group (ISSG) 2010).

The Action Area is developed, mainly with residences. Residential and commercial development began in the mid-1960's. Large portions of the Action Area are presently lined with structures. Recreational use in the Action Area is quite high from residents and tourists. A wide range of recent and on-going beach disturbance activities have altered the proposed Action Area and, to a greater extent, the North Carolina coastline, and many more are proposed along the coastline for the near future. **Table 4-3** lists projects that have been completed since 2011, though the list is not comprehensive.

<u>*Nourishment activities*</u>: Surf City beaches have been nourished several times in the past 6 years. Nourishment activities included dune repair/restoration utilizing sand trucked from upland mines or bulldozed from the beach shoreline, as well as utilizing sand dredged from permitted channels adjacent to Topsail Island. In 2019, sand trucked from an upland and mine was found to contain large amounts of gravel. After discovery, the town limited the amount of gravel placed on the beach by screening the material before placement.

<u>*Beach scraping:*</u> Beach scraping or bulldozing has become more frequent on North Carolina beaches in the past 20 years, in response to storms and the continuing retreat of the shoreline with rising sea level. These activities primarily occur during the winter months. Artificial dune or berm systems have been constructed and maintained in several areas. Data concerning beach scraping is not available for Topsail Beach.

Beach raking: The Town of NTB conducted significant rock-picking activities during the 2015 beach nourishment project, due to large amounts of rock and gravel. Rock-picking activities continued within the NTB project area annually until at least 2018, in order to remove larger material that continued to wash onto the beach as the dune and/or berm eroded. The Town of Surf City expressed interest in 2024 in conducting a beach cleaning event using a "Bebot" (sponsored by Keep New Hanover County Beautiful). The Bebot is assumed to be less impactful than other beach rakes, but potential impacts from vegetation removal are still of concern.

Pedestrian Use of the Beach: There are a number of potential sources of pedestrians and pets, including those individuals originating from beachfront and nearby residences.

Beach Driving: The Town of Surf City allows vehicles on the beach between October 1 and March 15 in limited circumstances. A permit is required for access. In recent years, driving has generally been prohibited due to unsafe conditions on the beach. Impacts to seabeach amaranth are discussed in **Section 8.1.4.** By far, Topsail Beach had the highest number of vehicles observed per km of any other site in Gibson et al. (2018), with almost one vehicle every 2 km.

Shoreline stabilization: There are two existing rock revetments along the coast of North Carolina: one at Fort Fisher (approximately 3,040 lf), and another along Carolina Beach (approximately 2,050 lf). A sandbag revetment at least 1,800 lf long (with a geotube in front of a portion) was constructed in 2015 at the north end of NTB, and more sandbags were recently added to protect a parking lot north of the revetment. In 2000 and 2001, sandbag revetments were installed on the north end of Figure Eight Island along Surf Court, Inlet Hook Road, and Comber Road. There are over 30 homes on Topsail Beach with existing sandbag structures.

Sand fencing: There are a few stretches of sand fencing along Surf City.

8.2.3. Tables for Environmental Baseline for Seabeach Amaranth

Table 8-1. Annual seabeach amaranth records in North Carolina, from 1987 to 2014. Data from various sources, collated by the Service.

Year	Dare Co.	Pea I. NWR	Cape Hatteras NS	Ocracoke	Core Banks	Shackleford Banks	Bogue Banks	Hammocks Beach SP	Camp LeJeune	Topsail Island	Lea Hutaff	Figure 8	Wrightsville Beach	Wrightsville Beach and Fig 8	Masonboro	Carolina Beach/Ft. Fisher	Bald Head Island	Oak Island	Holden Beach	Ocean Isle Beach	Sunset Beach	Brunswick County	Year Totals
1987			5474	1409	58	0	0		0					0								3337	**10278**
1988			2518	13310	900	2	0		0					0								3531	**20261**
1989					0	0	0		0					0								0	**0**
1990			3082	250	339	175	0		0					0								613	**4459**
1991					0	0	467	703	0					0					0	0		0	**1170**
1992					0	10	2556	407	0	22410			416	0	2	9	1	3148	21	5		3175	**32160**
1993					1290	975	3762	73	0	2089		1344	157	0	7	35	26	6103	52	15		6286	**22214**
1994			0	0	704	948	1181	3	0	135		1309	38	0	19	103	2	4409	239	112		4762	**13964**
1995			0	1	75	1155	14776		0	1925		3965	1323	0	295	579	1	4628	59	22		4710	**33514**
1996			88	10	1	3	0		0	1000		995	289	0		93	37	1983	99	819		3038	**8455**
1997			65	6	2	51	81		0	3			22	0		1	0	599	1	7		607	**1445**
1998			265	0	125	369	3946	1000	0	110			191	0	231	1	107	5367	32	11		0	**11755**
1999			8	0	2	9	218	1	0	39			1	0	6	0	24	15	268	5		0	**596**
2000			2	0	4	13	40		0	12			5	0	3		3	9	10	4			**105**
2001			43	8	51	126	451		0	4041			64	0	9		1	66	223	5			**5088**
2002			86	7	71	261	1983	50	0	413			104	72	51		0	542	702	45			**4387**
2003			19	11	206	1354	5270	66	0	1043			735	3	207		0	1267	843	206			**11230**
2004			1	0	79	58	5292	22	1797	1722			782	656	664	2	0	11	79	49			**11214**
2005			1	1	284	671	10711		1302	3416	1011		244	772	0	1	45	174	800	545			**19978**
2006			0	0	33	30	251	2		16	39			4		1	4	462	1954	337	118		**3251**
2007			0	0	2	125	130	6	5	160	21	0	9		0	0	0	116	281	20			**875**
2008		0	0	0	0	76	313		17	432	14	0	3		0	0	2	65	574	110			**1606**
2009		0	0	0	1	100	281	71	15	80	6	0	0		0	0	8	64	123	36			**785**
2010		0	0	0	6	28	70	187	32	215	18	4	0		0	0	0	1576	434	4			**2574**
2011		0	0	0	1	18	56	0	6	136	0	17	2		0	0	0	16	116	5			**373**
2012		0	0	0	0	7	5	1	4	83	2	0	0		NS	0	NS	5	46	1			**154**
2013		0	0	0	0	0	1	0	1	10	1	31	0		0	0	NS	1	108	1	12		**166**
2014					0	0	52	0	27	38	3		0		0	0	0	1	349	20	36		**526**
Site Totals	**0**	**0**	**11652**	**15013**	**4234**	**6564**	**51893**	**2592**	**3206**	**39528**	**1115**	**7665**	**4385**	**1507**	**1494**	**825**	**261**	**30627**	**7413**	**2384**	**166**	**30059**	**222583**
																							222583

8.3. Effects of the Action on Seabeach Amaranth

This section analyzes the direct and indirect effects of the Action on seabeach amaranth, which includes the direct and indirect effects of interrelated and interdependent actions. Direct effects are caused by the Action and occur at the same time and place. Indirect effects are caused by the Action but are later in time and reasonably certain to occur.

8.3.1. Effects of Sand Placement on Seabeach Amaranth

The proposed action has the potential to adversely affect seabeach amaranth and its habitat. Potential effects include burying, trampling, or injuring plants as a result of construction operations and/or sediment disposal activities; burying seeds to a depth that would prevent future germination as a result of construction operations and/or sediment disposal activities; and destruction of plants by trampling or breaking as a result of increased recreational activities. The Corps proposes to place sand any time of year, for the initial construction phase, including during the growing season of seabeach amaranth.

Applicable Science and Response Pathways and Interpretation of Effects

Placement of sand will occur within and adjacent to seabeach amaranth habitat along 33,300 lf of oceanfront shoreline. Project construction is anticipated to be conducted during portions of the seabeach amaranth growing and flowering season. Conservation measures have been incorporated into the project to minimize impacts. The timing of project construction could directly and indirectly impact seabeach amaranth. The construction window will extend into the seabeach amaranth growing season. The effects of the project construction include burying, trampling, or injuring plants as a result of construction operations and/or sediment disposal activities; and burying seeds to a depth that would prevent future germination as a result of construction operations and/or sediment disposal activities. Direct effects would be expected to be short-term in duration.

Indirect effects include destruction of plants by trampling or breaking as a result of increased recreational activities. Future tilling or removal of incompatible material on the beach may be necessary if sediment quality hinders sea turtle nesting activities. The placement of heavy machinery or associated tilling equipment on the beach may destroy or bury existing plants.

However, the placement of beach-compatible sand may benefit this species by providing additional suitable habitat or by redistributing seed sources buried during past storm events, beach disposal activities, or natural barrier island migration. Disposal of sand may be compatible with seabeach amaranth provided the material placed on the beach is compatible with the natural sand.

8.4. Cumulative Effects on Seabeach Amaranth

For purposes of consultation under ESA §7, cumulative effects are those caused by future state, tribal, local, or private actions that are reasonably certain to occur in the Action Area. Future Federal actions that are unrelated to the proposed action are not considered, because they require separate consultation under §7 of the ESA. Potential cumulative effects are unknown at this time. It is reasonable to expect continued dredging, shoreline stabilization, and beach renourishment projects in this area in the future since erosion and sea-level rise increases would impact the existing beachfront development.

8.5. Conclusion for Seabeach Amaranth

In this section, we summarize and interpret the findings of the previous sections for seabeach amaranth (status, baseline, effects, and cumulative effects) relative to the purpose of a BO under §7(a)(2) of the ESA, which is to determine whether a Federal action is likely to:

a) jeopardize the continued existence of species listed as endangered or threatened; or
b) result in the destruction or adverse modification of designated critical habitat.

"Jeopardize the continued existence" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR §402.02).

Status

The Service has determined that seabeach amaranth is threatened due to its vulnerability to human and natural impacts and the fact that it had been eliminated from two-thirds of its historic range (USFWS 1996b).

Baseline

Within the Action Area, seabeach amaranth numbers have been very high in the past; in the thousands of individuals on Topsail Island in the 1990s and early 2000s. Over the past 10- 20 years, the numbers of seabeach amaranth plants has plummeted, with 10 plants reported in 2013 and 38 reported in 2014 along the entire Topsail Island shoreline. The Service planted seeds south of the Action Area in Topsail Beach in 2016, as a pilot project. In 2018, 23 plants were documented on Topsail Island, but none have been reported since then. It is not clear if the plants documented in 2018 were related to the seeds planted in 2016.

Effects

The proposed placement of sand on 33,300 lf of beach will occur within seabeach amaranth habitat. The placement of sand in the Action Area could bury existing plants and also bury seeds to a depth that would prevent germination. Increased traffic from recreationists, their vehicles, and their pets can also destroy existing plants by trampling or breaking the plants. It is unclear whether the placement of sand would have positive impacts on seabeach amaranth by creating additional habitat for the species, or by exposing seeds that had previously been buried.

After reviewing the current status of the species, the environmental baseline for the Action Area, the effects of the Action and the cumulative effects, it is the Service's biological opinion that the Action is not likely to jeopardize the continued existence of seabeach amaranth.

9. INCIDENTAL TAKE STATEMENT

ESA §9(a)(1) and regulations issued under §4(d) prohibit the take of endangered and threatened fish and wildlife species without special exemption. The term "take" in the ESA means "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct" (ESA §3). In regulations at 50 CFR §17.3, the Service further defines:

- "harass" as "an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering;"
- "harm" as "an act which actually kills or injures wildlife. Such act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering;" and
- "incidental take" as "any taking otherwise prohibited, if such taking is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity."

Under the terms of ESA §7(b)(4) and §7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered prohibited, provided that such taking is in compliance with the T&Cs of an ITS.

This BO evaluated effects of the Action on the threatened seabeach amaranth. ESA §7(b)(4) and §7(o)(2), which provide the authority for issuing an ITS, do not apply to listed plant species. However, ESA §9(a)(2) prohibits certain acts with respect to endangered plant species, including:

(a) remove and reduce to possession from areas under Federal jurisdiction;
(b) maliciously damage or destroy on areas under Federal jurisdiction; and
(c) remove, cut, dig up, or damage or destroy on any other area in knowing violation of any law or regulation of any State or in the course of any violation of a State criminal trespass law.

Regulations issued under ESA §4(d) extend the prohibition under (a) above to threatened plant species (50 CFR §17.71). The damage or destruction of endangered and threatened plants that is incidental to (not the purpose of) an otherwise lawful activity is not prohibited.

This BO evaluated effects of the Action on loggerhead, green, and Kemp's ridley sea turtles, piping plover, and red knot, and determined that incidental take of these species is reasonably certain to occur. The Service will not refer the incidental take of piping plover and red knot for prosecution under the Migratory Bird Treaty Act of 1918, as amended (16 U.S.C. §§ 703-712), if such take is in compliance with the T&Cs specified below.

For the exemption in ESA §7(o)(2) to apply to the Action considered in this BO, the Corps must undertake the non-discretionary measures described in this ITS, and these measures must become binding conditions of any permit, contract, or grant issued for implementing the Action.

The Corps has a continuing duty to regulate the activity covered by this ITS. The protective coverage of §7(o)(2) may lapse if the Corps fails to:

- assume and implement the T&Cs; or
- require a permittee, contractor, or grantee to adhere to the T&Cs of the ITS through enforceable terms that are added to the permit, contract, or grant document.

In order to monitor the impact of incidental take, the Corps must report the progress of the Action and its impact on the species to the Service as specified in this ITS.

9.1. Amount or Extent of Take

This section specifies the amount or extent of take of listed wildlife species that the Action is reasonably certain to cause, which we estimated in the "Effects of the Action" section(s) of this BO. We reference, but do not repeat, these analyses here. We do not anticipate take for seabeach amaranth, since the ESA does not prohibit incidental take of listed plants.

9.1.1. Sea Turtles

The Service anticipates that the Action is reasonably certain to cause incidental take of individual sea turtles consistent with the definition of harass resulting from changes to the behavior of adult female sea turtles; berm slope, escarpment formation, and sediment quality effects on the ability of the females sea turtles to access high quality nesting habitat; and wasted energy caused by increased numbers of false crawls (see **Section 4.3.1**). The Service anticipates that the Action is reasonably certain to cause incidental take of individual eggs and hatchling sea turtles consistent with the definition of harm resulting from reduced hatching and emerging success; changes to incubation conditions within the nest; an increase in the number of nests placed in areas that may wash out; and injury or death due of hatchlings due to deterrence or misdirection from artificial lighting (see **Section 4.3.1**).

For this and other sand placement BOs, the Service typically uses a surrogate to estimate the extent of take. The amount of take is directly proportional to the spatial/temporal extent of occupied habitat that the Action affects and exceeding this extent would represent a taking that is not anticipated in this BO. The Service anticipates that directly and indirectly an unspecified number of sea turtles along 33,300 lf of shoreline, all at some point potentially usable by sea turtles, could be taken in the form of harm and harassment as a result of this proposed action. 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, nest mark and avoidance, or egg relocation program (2) the total number of hatchlings per undiscovered nest is unknown; (3) the reduction in percent hatching and emerging success per relocated nest over the natural nest site is unknown; (4) an unknown number of females may avoid the project beach and be forced to nest in a less than optimal area; (5) lights may misdirect an unknown number of hatchlings and cause death; and (6) escarpments may form and prevent an unknown number of females from accessing a suitable nesting site.

However, the level of take of these species can be anticipated by the sand placement activities on suitable turtle nesting beach habitat because: (1) turtles nest within the Action Area; (2) the nourishment project will modify the incubation substrate, beach slope, and sand compaction; and (3) artificial lighting will deter and/or misdirect nesting hatchling turtles.

Anticipated Take of Loggerhead, Green, and Kemp's Ridley Sea Turtles

Amount or Extent	Life Stage	Form of Take
33,300 lf suitable breeding habitat (shoreline)	Adults	Harass
33,300 lf suitable breeding habitat (shoreline)	Eggs and Hatchlings	Harm

Due to the difficulty of detecting take of nesting sea turtles and sea turtle nests caused by the Action, the Corps will monitor the extent of taking using the surrogate measure specified in the table above, and also monitor sea turtle nesting in the project area. Instructions for monitoring and reporting take are provided in **Section 9.4**.

9.1.2. Piping Plover

The Service anticipates that the Action is reasonably certain to cause incidental take of individual piping plovers consistent with the definition of harass resulting from disturbance and disruption of normal activities such as roosting and foraging, and possibly forcing birds to expend valuable energy reserves to seek available habitat elsewhere (See **Section 6.3.2**).

For this and other sand placement BOs, the Service typically uses a surrogate to estimate the extent of take of piping plovers. The amount of take is directly proportional to the spatial/temporal extent of occupied habitat that the Action affects and exceeding this extent would represent a taking that is not anticipated in this BO. It is difficult for the Service to estimate the exact number of piping plovers that could be breeding, migrating through, or wintering within the Action Area at any point in time and place during and after project construction. Disturbance to suitable habitat resulting from placement of sand would affect the ability of an undetermined number of piping plovers to find suitable foraging and roosting habitat during construction and for an unknown length of time after construction.

The Service anticipates that directly and indirectly an unspecified amount of piping plovers along 33,300 lf of shoreline, all at some point potentially usable by piping plovers, could be taken in the form of harm and harassment as a result of this proposed action. Incidental take of piping plovers will be difficult to detect for the following reasons:

(1) harassment to the level of harm may only be apparent on the breeding grounds the following year; and
(2) dead plovers may be carried away by waves or predators.

However, the level of take of this species can be anticipated by the proposed activities because:

(1) piping plovers breed, migrate through, and winter in the Action Area;
(2) the placement of the constructed beach is expected to affect the coastal morphology and prevent early successional stages, thereby precluding the maintenance and creation of additional recovery habitat;
(3) increased levels of pedestrian and vehicular disturbance may be expected; and
(4) a temporary reduction of food base will occur.

Anticipated Take of Piping Plover

Amount or Extent	Life Stage	Form of Take
33,300 lf of Shoreline	Adults	Harass and/or Harm

Due to the difficulty of detecting take of piping plover caused by the Action, the Corps will monitor the extent of taking using the surrogate measure specified in the table above, and also monitor piping plover abundance and distribution in the Action Area. Instructions for monitoring and reporting take are provided in **Section 9.4** and the **Appendix**.

9.1.3. Red Knot

The Service anticipates that the Action is reasonably certain to cause incidental take of individual red knots consistent with the definition of harass resulting from disturbance and disruption of normal activities such as roosting and foraging, and possibly forcing birds to expend valuable energy reserves to seek available habitat elsewhere (See **Section 7.3.2**).

For this and other sand placement BOs, the Service typically uses a surrogate to estimate the extent of take for red knots. The amount of take is directly proportional to the spatial/temporal extent of occupied habitat that the Action affects and exceeding this extent would represent a taking that is not anticipated in this BO. It is difficult for the Service to estimate the exact number of red knots that could be migrating through or wintering within the Action Area at any one point in time and place during project construction. Disturbance to suitable habitat resulting from both construction and sand placement activities within the Action Area would affect the ability of an undetermined number of red knots to find suitable foraging and roosting habitat during any given year.

The Service anticipates that directly and indirectly an unspecified number of red knots along 33,300 lf of shoreline, all at some point potentially usable by red knots, could be taken in the form of harm and harassment as a result of this proposed action. Incidental take of red knots will be difficult to detect for the following reasons:

(1) harassment to the level of harm may only be apparent on the breeding grounds the following year; and
(2) dead red knots may be carried away by waves or predators.

The level of take of this species can be anticipated by the proposed activities because:

(1) red knots migrate through and winter in the Action Area;
(2) the placement of the constructed beach is expected to affect the coastal morphology and prevent early successional stages, thereby precluding the maintenance and creation of additional recovery habitat;
(3) increased levels of pedestrian or vehicular disturbance may be expected; and
(4) a temporary reduction of food base will occur.

Anticipated Take of Red Knot

Amount or Extent	Life Stage	Form of Take
33,300 lf of Shoreline	Adults	Harass and/or Harm

Due to the difficulty of detecting take of red knot caused by the Action, the Corps will monitor the extent of taking using the surrogate measure specified in the table above, and also monitor piping plover abundance and distribution in the Action Area. Instructions for monitoring and reporting take are provided in **Section 9.4** and the **Appendix**.

9.2. Reasonable and Prudent Measures

The Service believes the following RPMs are necessary or appropriate to minimize the impact of incidental take caused by the Action on listed wildlife species. The RPMs are described for each listed wildlife species in the subsections below.

9.2.1. All Species

1. The initial construction of the project is proposed to be conducted any time of year. After the initial construction of the project, all sand placement events above MHW must be conducted within the winter work window (November 16 to April 30).

2. Prior to sand placement, all derelict material, large amounts of rock, or other debris must be removed from the beach to the maximum extent possible.

3. Conservation Measures included in the permit applications/project plans must be implemented in the proposed project. If a RPM and T&C address the same requirement, the requirements of the RPM and T&C take precedence over the Conservation Measure.

4. During construction, trash and food items shall be disposed of properly either in predator-proof receptacles, or in receptacles that are emptied each night to minimize the potential for attracting predators of piping plovers, red knots, and sea turtles.

5. The pipeline route/pipeline placement must be coordinated with NCDCM, the Service, and the NCWRC.

6. A meeting between representatives of the Corps and contractor(s), the Service, the NCWRC, the permitted sea turtle surveyor(s), must be held prior to the commencement of work. Advance notice (of at least 10 business days) must be provided prior to conducting this meeting.

7. Access points for construction vehicles should be as close to the project site as possible. Construction vehicle travel down the beach should be limited to the maximum extent possible.

9.2.2. Piping Plovers and Red Knots

8. All personnel involved in the construction or sand placement process along the beach shall be aware of the potential presence of piping plovers and red knots. Before start of work each morning, a visual survey must be conducted in the area of work for that day, to determine if piping plovers and red knots are present.

9.2.3. Loggerhead, Green, and Kemp's Ridley Sea Turtles

9. Only beach quality sand suitable for sea turtle nesting, successful incubation, and hatchling emergence shall be used for sand placement.

10. During dredging operations, material placed on the beach shall be qualitatively inspected daily to ensure compatibility. If the inspection process finds that a significant amount of non-beach compatible material is on or has been placed on the beach, all work shall stop immediately and the NCDCM and the Corps will be notified by the Corps' contractors to determine the appropriate plan of action.

11. Visual surveys for escarpments along the Action Area must be made immediately after completion of sand placement, and within 30 days prior to May 1, for two subsequent years after any construction or sand placement event.

12. Sand compaction must be qualitatively evaluated at least twice after each sand placement event. Sand compaction must be inspected in the project area immediately after completion of any sand placement event and one time after project completion between October 1 and May 1.

9.3. Terms and Conditions

In order for the exemption from the take prohibitions of §9(a)(1) and of regulations issued under §4(d) of the ESA to apply to the Action, the Corps must comply with the T&Cs of this statement, provided below, which carry out the RPMs described in the previous section. These T&Cs are mandatory. As necessary and appropriate to fulfill this responsibility, the Corps must require any permittee, contractor, or grantee to implement these T&Cs through enforceable terms that are added to the permit, contract, or grant document.

9.3.1. All Species

1. The initial construction of the project is proposed to be conducted any time of year. After the initial construction of the project, all sand placement events above MHW must be conducted within the winter work window (November 16 to April 30), unless a variance is approved after additional consultation with the Service.

2. Prior to sand placement, all derelict material, large amounts of rock, or other debris must be removed from the beach to the maximum extent possible.

3. Conservation Measures included in the permit applications/project plans must be implemented in the proposed project. If a RPM and T&C address the same requirement, the requirements of the RPM and T&C take precedence over the Conservation Measure.

4. During construction, trash and food items shall be disposed of properly either in predator-proof receptacles, or in receptacles that are emptied each night to minimize the potential for attracting predators of piping plovers, red knots, and sea turtles.

5. The pipeline route/pipeline placement must be coordinated with NCDCM, the Service, and the NCWRC.

6. Access points for construction vehicles should be as close to the project site as possible. Construction vehicle travel down the beach should be limited to the maximum extent possible.

7. A meeting between representatives of the contractor(s), the Corps, the Service, the NCWRC, and NCDCM, must be held prior to the commencement of work. Advance notice (of at least 5 business days) must be provided prior to conducting this meeting. The meeting will provide an opportunity for explanation and/or clarification of the Conservation Measures and T&Cs, and will include the following:
    a) Staging locations, and storing of equipment, including fuel stations;
    b) Coordination with the surveyors on required species surveys;
    c) Pipeline placement;
    d) Minimization of driving within and around the Action Area;
    e) Follow up coordination during construction and post construction;
    f) Direction of the work including progression of sand placement along the beach;
    g) Plans for compaction monitoring;
    h) Plans for escarpment surveys and
    i) Names and qualifications of personnel involved in any required species surveys.

9.3.2. Piping Plover and Red Knot

8. All personnel involved in the construction or sand placement process along the beach shall be aware of the potential presence of piping plovers and red knots. Before start of work each morning, a visual survey must be conducted in the area of work for that day, to determine if piping plovers and red knots are present. If shorebirds are present in the

work area, careful movement of equipment in the early morning hours should allow those individuals to move out of the area. Construction operations shall be carried out at all times in a manner as to avoid negatively impacting shorebirds and allowing them to exit the area.

9.3.3. Sea Turtles

9. Only beach compatible fill shall be placed on the beach or in any associated dune system. Beach compatible fill must be sand that is similar to a native beach in the vicinity of the site that has not been affected by prior sand placement activity. Beach compatible fill must be sand comprised solely of natural sediment and shell material, containing no construction debris, toxic material, large amounts of rock, or other foreign matter. The beach compatible fill must be similar in both color and grain size distribution (sand grain frequency, mean and median grain size and sorting coefficient) to the native material in the Action Area. Beach compatible fill is material that maintains the general character and functionality of the material occurring on the beach and in the adjacent dune and coastal system.

10. During dredging operations, material placed on the beach shall be qualitatively inspected daily to ensure compatibility. If the inspection process finds that a significant amount of non-beach compatible material is on or has been placed on the beach, all work shall stop immediately, and the NCDCM, Corps, and BOEM (as appropriate) will be notified by the Corps contractors to determine the appropriate plan of action. Required actions may include immediate removal of material and/or long-term remediation activities.

11. Visual surveys for escarpments along the Action Area must be made immediately after completion of sand placement, and within 30 days prior to May 1, for two subsequent years after any construction or sand placement event. 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. The Service 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 Service or NCWRC 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 Service.

12. Sand compaction must be qualitatively evaluated at least twice after each sand placement event, once in the project area immediately after completion of any sand placement event and once after project completion between October 1 and May 1. Compaction monitoring and remediation are not required if the placed material no longer remains on the beach. Within 14 days of completion of sand placement and prior to any tilling (if needed), a field meeting shall be held with the Service, NCWRC, and the Corps to inspect the project area for compaction and determine whether tilling is needed.
    a) If tilling is needed for sand suitability, the area must be tilled to a depth of 36 inches. All tilling activities shall be completed prior to May 1 of any year.
    b) Tilling must occur landward of the wrack line and avoid all vegetated areas that are 3 square feet or greater, with a 3-foot buffer around all vegetation.
    c) If tilling occurs during the shorebird nesting season or seabeach amaranth growing season (after April 1), shorebird surveys and/or seabeach amaranth surveys are required prior to tilling.
    d) A summary of the compaction assessments and the actions taken shall be included in the annual report to NCDCM, the Corps, and the Service.
    e) These conditions will be evaluated and may be modified if necessary to address and identify sand compaction problems.

9.4. Monitoring and Reporting Requirements

In order to monitor the impacts of incidental take, the Corps must report the progress of the Action and its impact on the species to the Service as specified in the incidental take statement (50 CFR §402.14(i)(3)). This section provides the specific instructions for such monitoring and reporting. As necessary and appropriate to fulfill this responsibility, the Corps must require any permittee, contractor, or grantee to accomplish the monitoring and reporting through enforceable terms that are added to the permit, contract, or grant document. Such enforceable terms must include a requirement to immediately notify the Corps and the Service if the amount or extent of incidental take specified in this ITS is exceeded during Action implementation.

1. Sea turtle nesting surveys must be conducted within the project area between May 1 and November 15 of each year, for at least two consecutive nesting seasons after completion of each sand placement activity (2 years post-construction monitoring after initial construction and each maintenance event). Acquisition of readily available sea turtle nesting data from qualified sources (volunteer organizations, other agencies, etc.) is acceptable. However, in the event that data from other sources cannot be acquired, the Corps will be responsible to collect the data. Data collected for each nest should include, at a minimum, the information in the table, below. This information will be provided to the Service's Raleigh Field Office in the annual report and will be used to periodically assess the cumulative effects of these types of projects on sea turtle nesting and hatchling production and monitor suitability of post construction beaches for nesting.

Parameter	Measurement	Variable
Number of False Crawls	Visual Assessment of all false crawls	Number/location of false crawls in nourished areas; any interaction of turtles with obstructions, such as sandbags or scarps, should be noted.
Nests	Number	The number of sea turtle nests in nourished areas should be noted. If possible, the location of all sea turtle nests should be marked on a project map, and approximate distance to scarps or sandbags measured in meters. Any abnormal cavity morphologies should be reported as well as whether turtle touched sandbags or scarps during nest excavation.
Nests	Lost Nests	The number of nests lost to inundation or erosion or the number with lost markers.
Nests	Relocated nests	The number of nests relocated and a map of the relocation area(s). The number of successfully hatched eggs per relocated nest.
Lighting Impacts	Disoriented sea turtles	The number of disoriented hatchlings and adults

2. A report describing any actions taken must be submitted to the Service's Raleigh Field Office following completion of the proposed work for each year when a sand placement activity has occurred. The report must include the following information:
    a) Project location (latitude and longitude);
    b) Project description (linear feet of beach, actual fill template, access points, and borrow areas);
    c) Dates of actual construction activities;
    d) Names and qualifications of personnel involved in sea turtle nesting surveys and relocation activities (separate the nesting surveys for nourished and non-nourished areas);
    e) Descriptions and locations of self-release beach sites; and
    f) Sand compaction, escarpment formation, and lighting survey results.

3. Seabeach amaranth surveys must be conducted within the entire oceanfront sand placement area (up to 33,300 lf) for a minimum of three years after completion of construction and each maintenance event. At a minimum, the stretches of oceanfront where sand placement occurred should be surveyed. Surveys should be conducted in August or September of each year. Habitat known to support this species, including the upper edges of the beach, lower foredunes, and overwash flats must be visually surveyed for the plant. Annual reports should include numbers of plants, latitude/longitude, and habitat type.

Addresses for Notifications:

Notification by email may be addressed to raleigh@fws.gov and/or kathryn_matthews@fws.gov.

Monitoring and other general reporting requirements may be emailed or mailed to the address below.

Jennifer Archambault, Deputy Field Supervisor
Raleigh Field Office
U.S. Fish and Wildlife Service
Post Office Box 33726
Raleigh, North Carolina 27636-3726
(984) 358-4521
jennifer_archambault@fws.gov

Upon locating a dead, injured, or sick individual of an endangered or threatened species, initial notification must be made to the Service's Law Enforcement Office below. Additional notification must be made to the Service's Ecological Services Field Office identified above and to the NCWRC at (252) 241-7367. Care should be taken in handling sick or injured individuals and in the preservation of specimens in the best possible state for later analysis of cause of death or injury.

Matthew Brink
Special Agent
U.S. Fish and Wildlife Service
3916 Sunset Ridge Road
Raleigh, NC 27607
(786) 239-9386
Matthew_Brink@fws.gov

10. CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to use their authorities to further the purposes of the ESA by conducting conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary activities that an action agency may undertake to avoid or minimize the adverse effects of a proposed action, implement recovery plans, or develop information that is useful for the conservation of listed species. The Service offers the following recommendations that are relevant to the listed species addressed in this BO and that we believe are consistent with the authorities of the Corps.

For the benefit of piping plovers, red knots, and sea turtles the Service recommends the following conservation recommendations:

1. The local sponsor or the Corps should maintain suitable piping plover migrating and wintering habitat. Natural accretion at inlets should be allowed to remain. Accreting sand spits on barrier islands provide excellent foraging habitat for migrating and wintering plovers.

2. A conservation/education display sign would be helpful in educating local beach users about the coastal beach ecosystem and associated rare species. The sign could highlight the species' life history and basic biology and ways recreationists can assist in species protection efforts (e.g., keeping pets on a leash, removing trash to sealed refuse containers, turning off lights at night, etc.). The Service would be willing to assist the Corps or the local sponsor in the development of such a sign, in cooperation with NCWRC, interested non-governmental stakeholders (i.e., National Audubon Society), the Corps, and the other interested stakeholders (i.e., property owners, etc.).

3. If public driving is allowed on the project beach, and if the Corps has the authority, we recommend it exercise its discretionary authority to require the local sponsor to have authorization from the Service for incidental take of piping plover, red knot, sea turtles, including nests and hatchlings (as appropriate), due to such driving or provide written documentation from the Service that no incidental take authorization is required. If required, the incidental take authorization for driving on the beach should be obtained prior to any subsequent sand placement events.

4. If the Corps has the authority, we recommend it exercise its discretionary authority to require that leash-laws and predator control programs be implemented.

5. The Corps should aid the Service in our efforts to initiate new monitoring efforts and develop a full life-cycle demographic model to explore effects of variation in productivity, annual survival rates, dispersal rates, and carrying capacity of habitat on population viability of the piping plover's three distinct populations.

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.

11. REINITIATION NOTICE

Formal consultation for the Action considered in this BO is concluded. Reinitiating consultation is required if the Corps retains discretionary involvement or control over the Action (or is authorized by law) when:

a. the amount or extent of incidental take is exceeded;
b. new information reveals that the Action may affect listed species or designated critical habitat in a manner or to an extent not considered in this BO;
c. the Action is modified in a manner that causes effects to listed species or designated critical habitat not considered in this BO; or
d. a new species is listed or critical habitat designated that the Action may affect.

In instances where the amount or extent of incidental take is exceeded, the Corps is required to immediately request a reinitiation of formal consultation.

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for

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Coastal Storm **Risk Management** Project

Pender and Onslow Counties, North Carolina

2024

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1.0 Project Area/Background

Topsail Island is a 22-mile-long barrier island located in Pender and Onslow counties, North Carolina. From south to north, the three communities on the island are the Towns of Topsail Beach, Surf City, and North Topsail Beach (**Figure 1**). In accordance with Congressional study authorizations, Coastal Storm Risk Management (CSRM) opportunities were evaluated for the entire island. An *Integrated Feasibility Report and Environmental Impact Statement, Coastal Storm Damage Reduction, Surf City and North Topsail Beach, North Carolina, December 2010* (2010 EIS) was prepared to evaluate coastal storm risk management along Surf City and North Topsail Beach (SCNTB). In addition, a supplemental *Environmental Assessment for West Onslow Beach and New River Inlet (Topsail Beach) and Surf City and North Topsail Beach Coastal Storm Damage Reduction Projects, July 2013* (2013 EA) was prepared to address changes that were implemented after the Environmental Impact Statements (EISs) for both projects were completed. The subject of this Biological Assessment is the 2024 Surf City CSRM General Re-evaluation Report and Environmental Assessment (GRR/EA), which was authorized by the Water Resources Development Act of 2014 and recently funded by Public Law 116-20, the Additional Supplemental Appropriations Disaster Relief Act, 2019.

The proposed action, which is the elimination of the environmental window for initial construction and expansion of the window for periodic nourishments will increase flexibility and efficiencies for initial construction and periodic nourishments for the 50-year project . This approach will also comply with the 2020 National Marine Fisheries Service's South Atlantic Regional Biological Opinion (SARBO) by reducing risks to the most vulnerable species within the project area. The authorized plan for Surf City consists of a dune (14 feet above National American Vertical Datum NAVD 88) and berm (50 feet wide at 6 feet above NAVD 88) extending along approximately 9.9 miles of shoreline. The total required sediment volume for initial construction is approximately 8.0 Million Cubic Yard (MCY). The proposed plan is the elimination of environmental window for the duration of initial construction, which is expected to take about 16 months. Due to the high number of sea turtle nests annually on Topsail Island, nourishment events (every 6 years), will be done between November 16 and April 30 to the maximum extent practicable to avoid sea turtle nesting season. For the Surf City CSRM project, increasing the timeframes when work may occur, significantly lowers risks associated with limited dredge availability. These construction activities will be abiding by all environmental conditions outlined in the 2010 EIS, including benthic and turbidity monitoring of borrow sites.

For the following resource categories there is no anticipated change in effects associated with three alternatives from those analyzed in the 2010 EIS and therefore they are not addressed in this EA: wetlands and floodplains, inlets, flats and sounds, maritime scrub thicket, beach and dune, wave conditions, shoreline and sand transport, hydrology, groundwater, air and water pollution, man-made and natural resources, community cohesion and the availability of public facilities and services, and hazardous, toxic and radioactive wastes. The focus of analysis in this section is on geology and sediments, water quality, surf zone and nearshore ocean fishes, nekton, larval entrainment, benthic resources, Essential Fish Habitat (EFH) and hard bottoms, birds, cultural resources, noise, threatened and endangered species, recreation, aesthetic and fishing resources. It should be noted that although changes in the time of year for work do not result in changes to cultural resources, cultural resources will be addressed in this section since additional survey work is required prior to construction to ensure that pipeline routes between the offshore borrow sites and the beach avoid cultural resources.

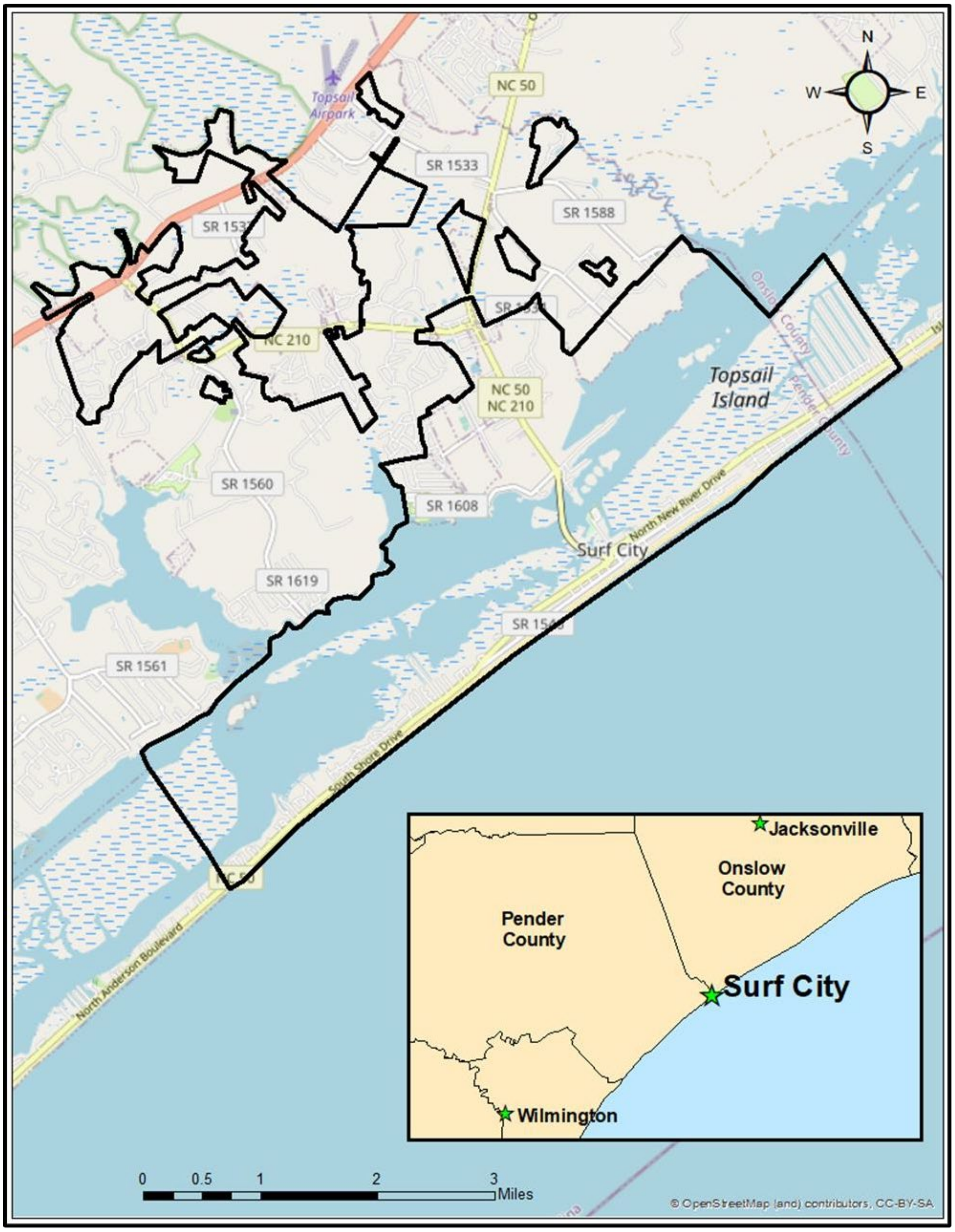


Figure 1. Project Location and Vicinity Map.

Subsurface investigations using a combination of boring data and geophysical surveys were used to identify and define borrow areas for the Surf City project. Based on these initial study phase investigations, 20 borrow areas were identified (Borrows A-T) located between 1-5 miles offshore of Topsail Island. Further investigations determined that 13 of these borrows (A, B, C, D, E, F, G, H, J, L, N, O, and P) contained sufficient beach quality sand to the meet the 50-yr volume requirements (**Figure 2**).

In 2010 and 2011, the Pre-construction Engineering and Design (PED) phase of work was completed for the Surf City CSRM project. The PED phase included additional analysis of the previously identified borrow areas and confirmed the presence of adequate volumes of beach quality sand for the Surf City 50-year project. Specific information regarding the PED phase and outcomes can be found in the July 2013 EA/FONSI. Otherwise, confirmatory bathymetric surveying of borrow areas was performed during March of 2020. Respective data are still being assessed, which may result in adjustments to volumetric estimates of suitable sand.

As part of the borrow area use plan, the contractor will recover the maximum amount of beach nourishment material within one portion of a borrow area before relocating to another portion of the same borrow area or to a separate borrow area. Maximum recovery of material shall be determined by dredging equipment efficiencies, entrainment of unsuitable nourishment material, or the maximum dredging depth determined by the government, whichever depth is less.

If non-beach quality material from the borrow areas is placed on the beaches, a screen will be installed on the inflow and outflow pipes to prevent further placement of large shells, clay balls, or rocks. These screens, which shall be onsite during construction, will have a 3/4 inch to 1-inch screen to prevent larger material from being placed on the beach. If non-beach quality material is placed on the beach, dredging will cease until this material is removed.

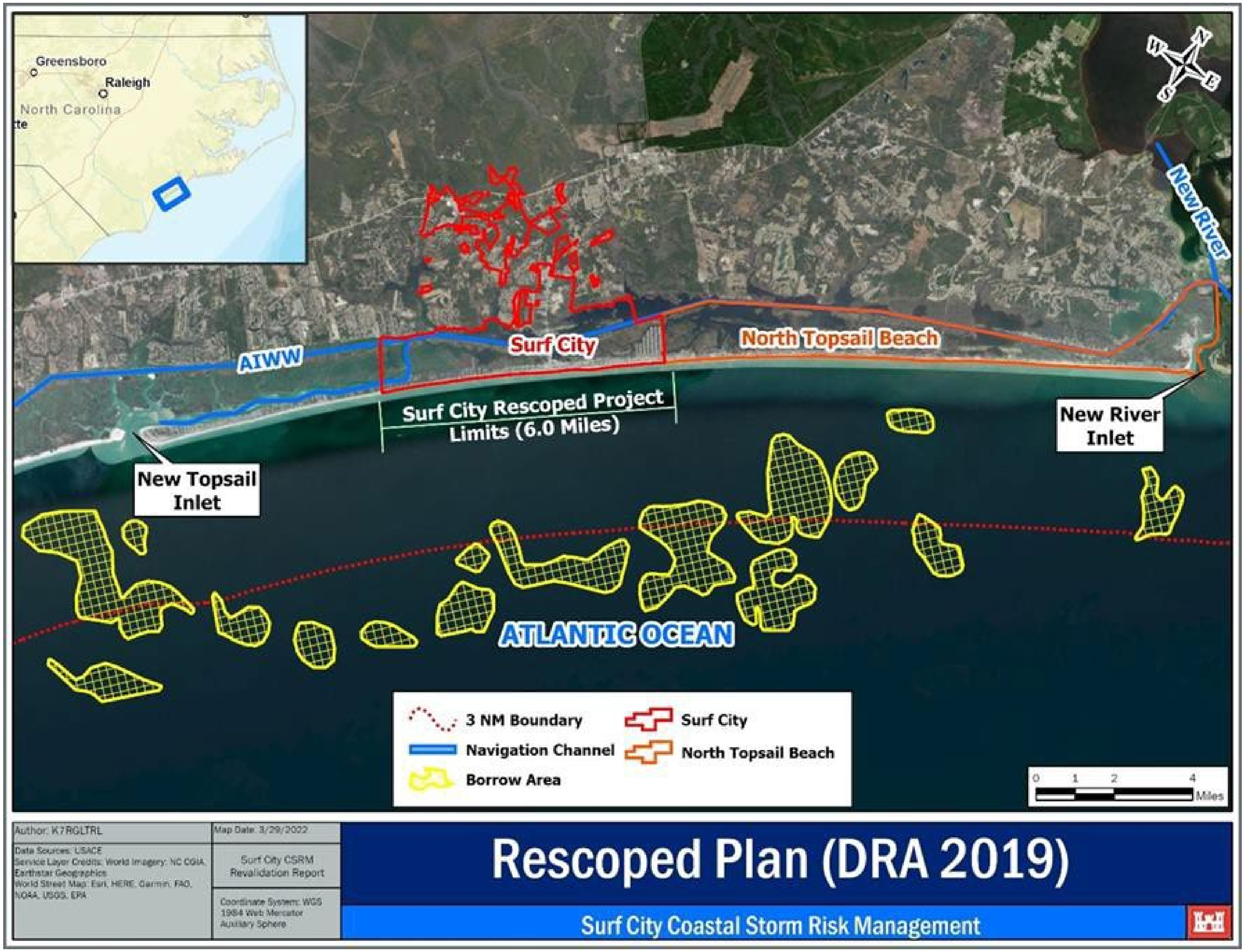


Figure 2. The Proposed Project and Borrow Area Locations.

2.0 Placement of Beach Quality Sand

The total required sediment volume for initial construction and nourishment events over the 50-year project is approximately 21.8 Million Cubic Yard (MCY). It's anticipated that initial construction will require approximately 8.0 MCY of sand. This assessment addresses the onshore components of beach quality sand delivery via a hopper dredge or hydraulic cutterhead pipeline systems. Although it's anticipated that a hopper dredge will be used for the Surf City (SC) CSRM project due to the location of the offshore borrow areas, any type of dredge plant may be used for construction or periodic nourishments.

Placement of beach quality sand is accomplished by pumping a mixture of beach quality sand and water (slurry) through a pipeline leading to the recipient beach. The placement operations typically employ a spreader that is attached to the discharge end of the pipeline. Spreaders are designed to slow the velocity of the discharge to prevent erosion and to facilitate sediment settling. Temporary shore-parallel containment dikes are constructed in front of the onshore beach discharge points to facilitate sediment settling and to reduce turbidity in the nearshore environment. As placement activities progress, the onshore pipeline is extended along the beach by adding new sections of pipe. Pipeline placement is typically on the upper beach, but seaward of the dunes and any upper beach vegetation. Booster pumps may be required along the pipelines as they are extended along the beach. The location where the pipeline emerges onto the subaerial beach may also shift incrementally as construction progresses along the beach. Throughout the construction process, front-end loaders or other heavy equipment are used to transport and position the onshore pipeline sections.

2.1 Sand Placement Redistribution and Grading

Bulldozers and other heavy equipment, such as backhoes, front-end loaders, and tractors are used to redistribute and grade the discharged sediment as it falls out of suspension. A variety of supporting vehicles, such as pick-up trucks and all-terrain vehicles, are typically used to transport equipment and personnel along the beach throughout the construction process. Grade stakes are placed throughout the beach fill template to facilitate the construction of berms and dunes to design specifications. In order to maintain separation between the public and potentially hazardous operations, the active construction area, consisting of a ~500-ft zone on either side of the beach fill discharge point, is typically fenced. Sand placement operations are generally conducted around-the-clock, thus requiring appropriate nighttime lighting in accordance with USACE and Occupational Safety and Health Administration safety regulations. The USACE Safety and Health Requirements Manual (EM 385-1-1) specifies a minimum luminance of three lumens per square foot for outdoor construction zones.

Regulations also require front and back lighting on all transport vehicles and heavy equipment during nighttime operations. Post-construction tilling and/or escarpment leveling may be conducted as needed based on North Carolina Wildlife Resources Commission (NCWRC) recommendations. Tilling and leveling are accomplished by heavy equipment similar to that employed in redistribution and grading operations. Compacted beach fill areas between the toe of the dune and the mean high water

(MHW) line are typically tilled to a depth of 24 inches using a series of overlapping passes to ensure thorough decompaction. Chain-linked fencing or a similar apparatus may be dragged over the tilled areas as necessary to eliminate any ruts and furrows created by the tilling process. Escarpments are regraded according to the original berm design specifications.

2.2 Staging Areas and Beach Access

Staging areas for equipment and pipes are generally located off the beach to the extent practicable. When necessary, staging areas on the beach are generally positioned as far landward as possible without impacting established vegetation on the upper beach or the frontal dune system. Beach access for construction equipment is typically provided by existing public beach access points. Pedestrian and emergency vehicle access is generally maintained during the construction process. Sand ramps or walkovers are constructed over pipeline sections at the access points to provide access for pedestrians and construction equipment.

2.3 Construction Lighting

According to the 2014 US Army Corps of Engineers Safety and Health Requirements Manual (EM 385-1-1), a minimum of 3 lm/ft2 is required for general outdoor work or construction areas. In order to meet these safety standards, appropriate lighting must be provided at night during specific components of the project site (i.e. disposal site, dredge, staging area, etc.). While project construction typically occurs around-the-clock to make efficient use of equipment, most of the equipment staging, mobilization, and demobilization of pipeline are performed during daylight hours. However, nighttime work does occur if there is a small construction window and the work schedule is tight. For projects where lighting is a concern for sensitive organisms, ample lighting can be obtained without impacting a large area by using light shields and appropriate angling of lights. In addition to lighting in the construction area, the vehicles used for transport, as well as, the bulldozers moving sediment will have lights on the front and back of the equipment. Features within the active placement area, including the "dump shack," equipment storage, etc. may also have lighting associated with them. Working around heavy equipment is dangerous any time. Injuries and fatalities have occurred in both the water and on the beach. Ample lighting of work areas at night is a major human safety consideration.

3.0 Status of Species and Critical Habitats

3.1 Affected Environment

Descriptions of affected environment for the Surf City CSRM project are provided in the following reports:

- U.S. Army Corps of Engineers. 2010. Final Integrated Feasibility Report and Environmental Impact Statement, Coastal Storm Damage Reduction, Surf City and North Topsail Beach, North Carolina. December 2010.

- Environmental Assessment for West Onslow Beach and New River Inlet (Topsail Beach) Surf City and North Topsail Beach Coastal Storm Damage Reduction Projects, July 2013.

- Draft General Re-evaluation Report and Environmental Assessment for Surf City Coastal Storm Risk Management Project, August 2024.

3.2 Piping Plover

Range-Wide Status

The piping plover was listed as endangered and threatened under the ESA on 10 January 1986 [50 Federal Register (FR) 50726 – 50734]. The final listing rule recognized three demographically independent populations that breed in three separate regions: the Atlantic Coast from North Carolina to Canada, the Great Lakes watershed, and the Northern Great Plains region. Birds that breed along the Atlantic Coast are recognized as the subspecies *C. m. melodus*, while birds belonging to the interior Great Lakes and Northern Great Plains breeding populations are recognized as the subspecies *C. m. circumcinctus* (Miller et al. 2010). The piping plover is classified as endangered within the Great Lakes watershed and as threatened throughout the remainder of its breeding, migratory, and wintering range. The shared migratory and wintering range of the three breeding populations encompasses the Atlantic and Gulf Coasts from North Carolina to northern Mexico, as well as the Bahamas and the West Indies. Outside of their breeding range, birds belonging to the endangered Great Lakes breeding population are indistinguishable from those belonging to the threatened Great Plains and Atlantic coast populations; and consequently, all piping plovers are classified as threatened within their shared migratory and wintering range (USFWS 2009). Critical habitat has been designated for the Great Lakes (66 FR 22938 22969) and Northern Great Plains (67 FR 57638 57717) breeding populations. Critical habitat has not been designated for the Atlantic Coast breeding population; however, critical habitat units for the United States (US) wintering population have been designated along the Atlantic and Gulf coasts from North Carolina to Texas (66 FR 36038 - 36143).

Although there is no exclusive partitioning of the wintering range based on breeding origin, band sightings indicate that Atlantic Coast breeding birds from Eastern Canada and the majority of the Great Lakes population winter along the southeast coast from North Carolina to Southwest Florida (Gratto-Trevor et al. 2012). Banded Eastern Canada plovers are more heavily concentrated in North Carolina, whereas a larger proportion of banded birds from the Great Lakes are found in South Carolina, Georgia, and Florida. Banded piping plovers from the Northern Great Plains population are concentrated farther west and south along the Gulf Coast, although a few banded individuals from Prairie Canada occur along the Atlantic Coast from North Carolina to Florida. Banding efforts on the Atlantic Coast breeding grounds have been less extensive; and consequently, the distribution of these birds during winter remains poorly understood. However, of 57 piping plovers banded in the Bahamas in 2010, 79% have been reported breeding on the Atlantic Coast (USFWS 2012).

The US Fish and Wildlife Service (USFWS) has approved separate recovery plans for the Atlantic Coast (USFWS 1996a) and Great Lakes (USFWS 2003) breeding populations. The Northern Great Plains breeding population is currently covered under the 1988 Recovery Plan for the Great Lakes and Northern Plains populations (USFWS 1988); however, on 16 March 2015, the USFWS released a draft revised Recovery Plan specific to the Northern Great Plains population (USFWS 2015a). The 1996 revised Recovery Plan for the Atlantic Coast breeding population established a recovery goal of 2,000 breeding pairs maintained for five years and distributed among four recovery units [Eastern Canada, New England, New York-New Jersey, and Southern (**Table 1**)]. The Southern Recovery Unit, encompassing North Carolina, Virginia, Delaware, and Maryland; was assigned a subpopulation goal of 400 breeding pairs. Additional recovery criteria include a five-year average annual productivity rate of 1.5 fledged chicks per pair in each of the four recovery units, and the long-term maintenance of wintering habitat sufficient to maintain a breeding population of 2,000 breeding pairs. Annual Atlantic Coast population abundance estimates are reported as numbers of breeding pairs [i.e. adult pairs that exhibit sustained (>2 weeks) territorial or courtship behavior or are observed with nests or unfledged chicks] (USFWS 1996a). Annual Atlantic Coast breeding pair estimates are based on multiple surveys of most suitable breeding habitat, including currently unoccupied sites. Sites that cannot be monitored repeatedly in May and June are surveyed at least once during a standard nine-day period (Hecht and Melvin 2009).

Table 1. Atlantic Coast Breeding Pair Recovery Criteria.

Recovery Unit	States/Provinces	Breeding Pairs
Eastern Canada	New Brunswick, Newfoundland, Nova Scotia, Prince Edward Island, Quebec	400
New England	Minnesota, New Hampshire, Maine, Rhode Island, Connecticut	625
New York – New Jersey	New York, New Jersey	575
Southern	Delaware, Maryland, Virginia, North Carolina	400
Atlantic Coast Total		**2,000**

Since its listing, the Atlantic Coast population has increased by 137% from approximately 790 pairs in 1986 to an estimated 1,870 pairs in 2015 (**Table 2**). The vast majority of the Atlantic Coast population growth between 1986 and 2015 occurred in the New England Recovery Unit, where the breeding population increased by 399% (net gain of 734 pairs). The estimated number of breeding pairs in the Southern Recovery Unit increased by 129%, and the New York-New Jersey

Unit experienced an increase of 98%. The Eastern Canada Recovery Unit experienced a net loss of 61 pairs, resulting in a 25% decrease. New England surpassed the recovery criterion of 625 pairs from 2001 through 2004 and again from 2006 through 2015. New York-New Jersey surpassed the recovery criterion of 575 pairs in 2007, but subsequently declined to 411 pairs in 2015. The Southern Recovery Unit reached a high of 377 pairs in 2012 but has yet to meet the recovery criterion of 400 pairs. The highest annual estimate of 274 pairs for Eastern Canada in 2002 was well below the recovery target of 400 pairs.

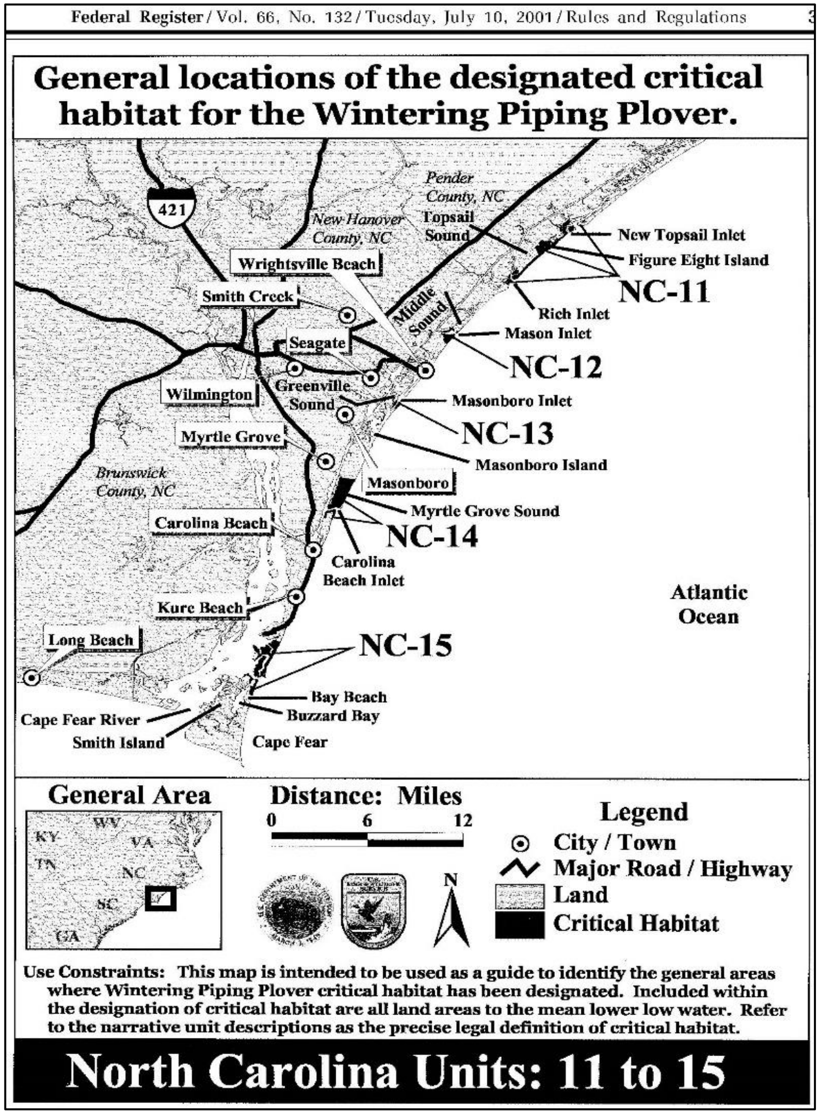
Table 2. Net change in estimated Atlantic Coast breeding pairs 1986 to 2015

Recovery Unit	Net Change Number Breeding Pairs	Percent Increase/Decrease
Eastern Canada	-61	-25%
New England	+734	+399%
New York – New Jersey	+203	+98%
Southern	+204	+129%
Overall Atlantic Coast Net Change	**+1,080**	**+137%**

Status in the Action Area

According to the Portal Access to Wildlife Systems database and ebirds.org, there were no reported piping plover breeding pairs on Surf City from 2010-2020. Likewise, Surf City is not considered part of a wintering critical habitat unit, therefore there is no data listed under the piping plover winter census (**Figure 3**). According to the ebird.org, since 2015, there have been 24 piping plovers observed on Surf City.

(https://ncpaws.org/PAWS/Wildlife/Shorebird/Shorebird.aspx).



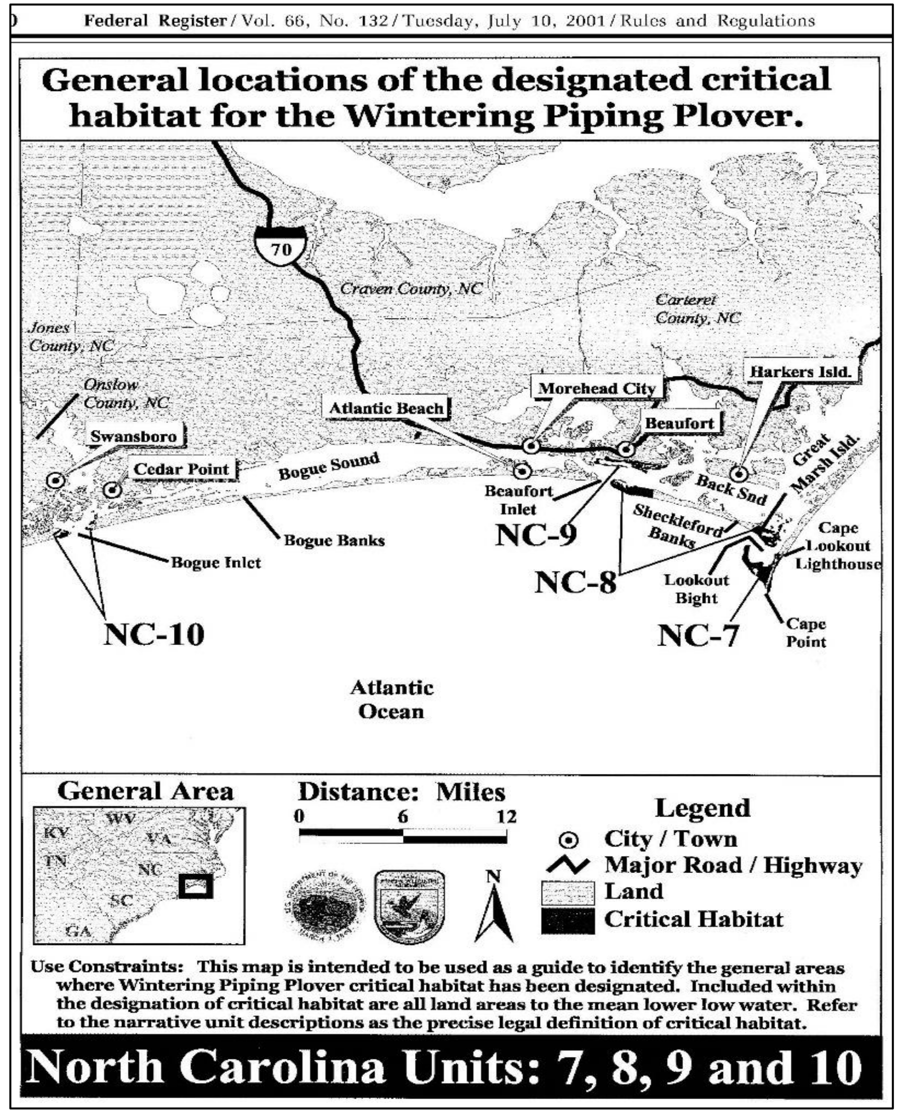


Figure 3. North Carolina Wintering Critical Habitat Units for the Piping Plover (Southern Coast).

Effects of the Proposed Action on Piping Plover

Direct Effects

The proposed plan to accomplish initial construction any time of year may have adverse impacts on piping plover nesting and brood-rearing, as the active beach construction process (heavy equipment operations, generator use, pipeline placement, night-time lighting, and related construction activities) may affect piping plovers through disturbance and behavioral modification (i.e. nest abandonment). Construction activities may impact piping plovers directly through the mechanical destruction of nests and eggs or through an increased risk of egg predation if adults are flushed from their nests.

As is typical for most beach nourishment projects, sand placement may eliminate important microhabitat elements such as wrack lines, tidal pools, and isolated clumps of vegetation; thereby reducing the quality or availability of breeding, foraging, and/or roosting habitats. The initial effects of sand placement would include the loss of most intertidal benthic invertebrates within the placement areas. Reductions in the availability of invertebrate prey may negatively affect the energy budgets of breeding and non-breeding plovers; potentially resulting in reduced survivability and productivity.

Since initial project construction could take approximately 16 months, the work is likely to occur during peak benthic invertebrate recruitment periods; however, as beach sections are completed and heavy equipment vacates completed areas, benthic recovery may begin on the completed sections. Most benthic recovery studies have reported relatively rapid recovery (≤1 year) when peak larval recruitment periods were avoided. However, it is undetermined what effect the activity will have on larval communities if work is done during the summer months. Beach construction during this time could ultimately affect food sources for foraging birds in the fall/winter months. After the initial construction, nourishment events will occur approximately every six years, giving benthic invertebrates time to recover between nourishments.

Indirect Effects

Piping plovers are largely restricted to the unstable portions of barrier islands where overwash and/or inlet processes create and maintain optimal habitats. Constructed berms and dunes may impede overwash and inlet processes; thereby limiting new habitat formation and/or reducing the quality of existing habitats through stabilization and succession. Based on the recurring nature of sand placement projects, the effects of stabilization may be long-term and cumulative.

The establishment of wider and higher dry beach habitats with little to no emergent vegetation may increase the quantity and quality of supratidal nesting and roosting habitats and enhance the ability of plovers to detect and avoid predators. The placement of beach-quality sand derived from sources outside of the inlet-dominated littoral system (e.g., offshore borrow sites) may increase inlet sediment budgets, potentially contributing to the formation of high value inlet complex habitats for piping plovers.

Cumulative Effects

Cumulative effects are those caused by the proposed federal action in combination with future non-federal actions that are reasonably certain to occur within the action area. Pursuant to the ESA, non-federal actions include anticipated state, local, and private activities that would not be subject to Section 7 consultation. Anticipated non-federal actions within the action area would include temporary sandbag placement and beach scraping activities above the MHW line. These activities would have the potential for impacts on piping plovers that are comparable to those associated with sand placement. Depending on the timing and location of specific projects, the combined impacts of the proposed action and non-federal actions could have cumulative effects on piping plovers and their habitats. Cumulative effects may occur if the combined actions increase the frequency of habitat disturbance along a specific beach or if the combined actions result in simultaneous habitat impacts along separate beaches.

Determination of Effect

Sand placement after 30 April would employ conservation measures to minimize the duration of direct effects on benthic invertebrate communities and potential nesting piping plovers; including the use of beach-quality sand and the delineation and avoidance of shorebird nesting areas. Physical habitat changes within the placement areas may temporarily reduce the quality or availability of foraging and roosting habitats; and impacts on intertidal benthic invertebrates may temporarily reduce the prey base for piping plover. The construction of stabilizing berms and dunes may have long-term indirect negative effects on the quality or availability of foraging and roosting habitats. Wider beaches may induce additional recreational activities that impact piping plover through disturbance and/or habitat modification. However, beach placement and subsequent nourishments would mean more viable future habitat for these birds. Since there have been no reports of piping plover pairs breeding or nesting within the project area, and as of 2024, no foraging individuals were observed in the project area, it is determined that the proposed action may affect, but is not likely to adversely affect the piping plover.

3.3 Red Knot

<u>Range-Wide Status</u>

The rufa red knot (hereinafter referred to as “red knot”) was listed as threatened under the ESA on 12 January 2015 (79 FR 73705 73748). The USFWS has not approved a recovery. Red knots migrate between breeding grounds in the central Canadian High Arctic and wintering areas that are widely distributed from the southeastern US coast to the southern tip of South America. Migration occurs primarily along the Atlantic coast, where red knots use key stopover and staging areas for feeding and resting. Departure from the Arctic breeding grounds occurs from mid-July through August, and the first southbound birds arrive at stopover sites along the US Atlantic coast in July. Numbers of southbound birds peak along the US Atlantic coast in mid-August; and by late September most birds have departed for their wintering grounds. Major fall stopover sites along the US Atlantic coast include the coasts of Massachusetts and New Jersey and the mouth of the Altamaha River in Georgia. Principal wintering areas include the southeastern US Atlantic Coast from North Carolina to Florida, the Gulf Coast from Florida to northern Mexico, the northern Atlantic coast of Brazil, and the island of Tierra del Fuego along the southern tip of South America. Smaller numbers of red knots also winter along the central and northeastern US Atlantic coast and in the. The core southeastern US Atlantic wintering area is thought to shift from year to year between Florida, Georgia, and South Carolina (USFWS 2014a).

On July 15, 2021 and revised on April 13, 2023, the USFWS proposed to designate a total of approximately 683,405 acres (276,564 hectares) as critical habitat for the rufa red knot across 127 units (18 of which are further subdivided into 46 subunits) in Massachusetts, New York, New Jersey, Delaware, Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, and Texas. Unit NC–5: New Topsail Inlet–Topsail Beach, North Carolina (**Figure 4**) consists of approximately 1,612 ac (652 ha) of occupied habitat in Onslow and Pender Counties consisting of shoreline habitat that stretches about 23 mi (37 km) from the west side of the New River Inlet channel west to the east side of the New Topsail Inlet channel. This unit includes from MLLW to the toe of the dunes or where densely vegetated habitat, not used by the rufa red knot, begins and where the physical or biological features no longer occur. This unit also includes the emergent sand shoals within the flood-tidal and ebb- tidal deltas associated with the west side of the New River Inlet channel, as well as the emergent sand shoals within the flood-tidal and ebb-tidal deltas on the east side of the New Topsail Inlet channel.

Red knots typically arrive at southeastern US and Caribbean wintering sites in November, but may arrive as early as September. Birds wintering along the US Atlantic coast and in the Caribbean typically remain on their wintering grounds through March, and in some cases as late as May. Northbound birds from both North and South American wintering areas use stopover sites along the US mid-Atlantic coast from late April through late May/early June (USFWS 2014a). Important spring stopover sites in the US include Delaware Bay and the Atlantic Coast from Georgia to Virginia; however, small to large groups of northbound red knots may occur in suitable habitats along all of the Atlantic and Gulf Coast states. Unknown numbers of non-breeding red knots, many consisting of one-year-old subadult birds, remain south of the breeding grounds throughout the year (USFWS 2014a).

The distribution of red knots on the breeding grounds is diffuse across large areas of the remote High Arctic; and consequently, abundance and productivity estimates have not been developed for the breeding range (USFWS 2014a). In lieu of comprehensive breeding range estimates, the status of the red knot has been monitored through extensive survey efforts in key areas throughout the migratory and wintering range. Long-term monitoring efforts in two key areas, Delaware Bay and Tierra del Fuego, have shown sustained declines in red knot numbers on the order of 75% since the 1980s.

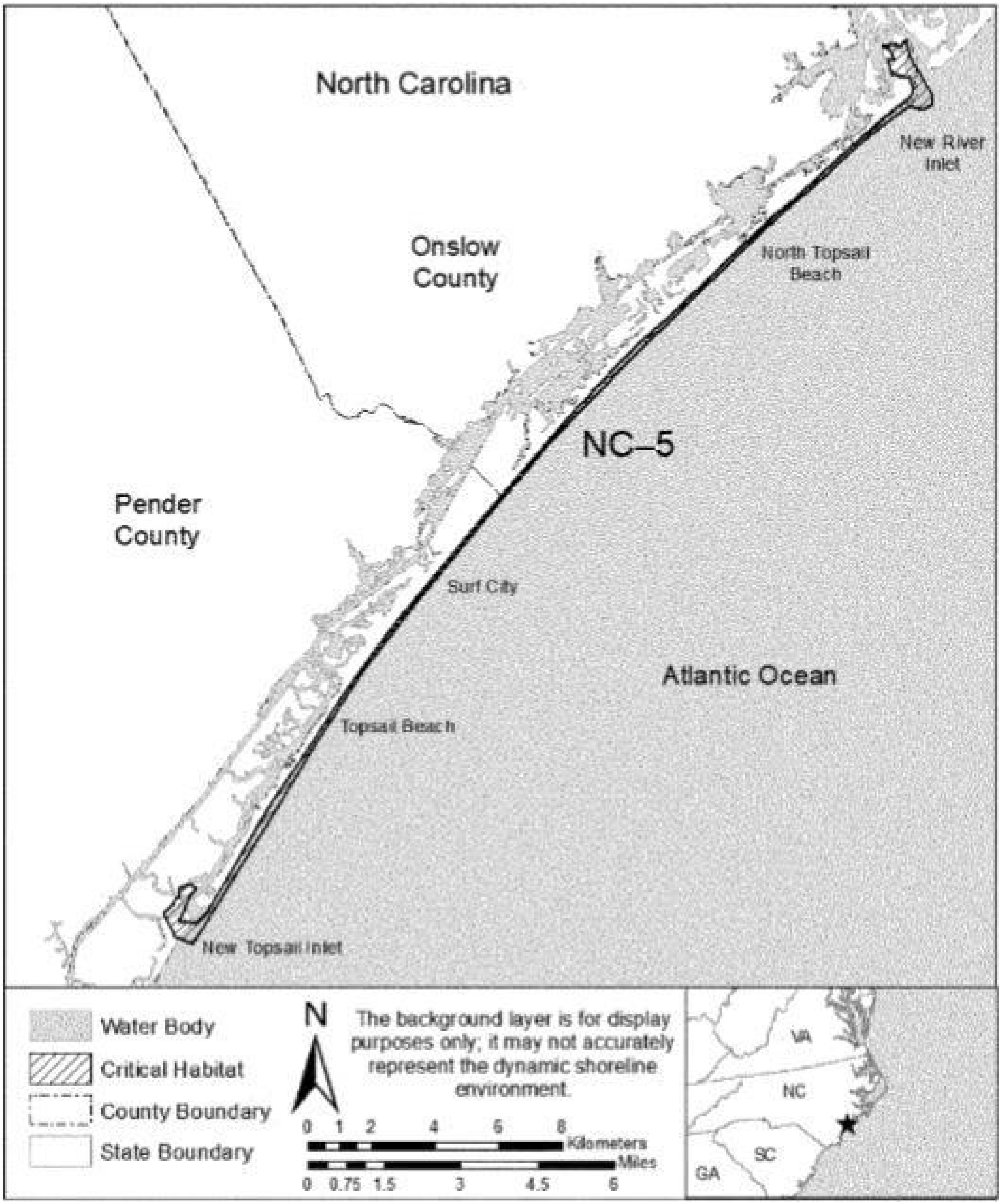


Figure 4. Proposed Critical Habitat for the Rufa Red Knot NC-5 New Topsail Inlet to Topsail Beach; Onslow and Pender Counties, North Carolina

Population estimates for the southeastern US Atlantic Coast wintering population were approximately the same during the 1980s and 2000s (USFWS 2014a), and recent evidence suggests that the southeast wintering population may number as high as 20,000 birds (USFWS 2014a). Consistent aerial surveys of the entire Virginia barrier island coast since 1995 have produced stable counts of red knots during peak migration periods, and more recent ground surveys in Virginia suggest an upward trend since 2007.

Since 2006, annual coordinated aerial surveys covering the Atlantic Coast from Florida to Delaware Bay have been conducted during the peak spring migration period (20-24 May). All changes in counts from 2006-2010 were attributed to varying geographic survey coverage (Dey et al. 2011). More recent aerial surveys show an apparent increase between 2010 and 2012; however, analyses of additional annual data sets are needed before this trend can be confirmed. Available data for the remainder of the stopover and wintering areas are generally insufficient for trend analysis (USFWS 2014a).

Ecological Requirements

Migrating and wintering red knots use similar habitats, generally expansive intertidal sand and mud flats for foraging and sparsely vegetated supratidal sand flats and beaches for roosting. The red knot is a specialized molluscivore, feeding on hard-shelled mollusks that are swallowed whole and crushed in the gizzard. The diet is sometimes supplemented with softer invertebrate prey such as shrimp- and crab-like organisms, marine worms, and horseshoe crab eggs. Both high-energy oceanfront intertidal beaches and sheltered estuarine intertidal flats are used for foraging. Preferred habitats include sand spits and emergent shoals associated with tidal inlets, and habitats associated with the mouths of bays and estuarine rivers. Access to quality high-tide roosting habitat near foraging areas is an important constituent of high-quality stopover and wintering sites (USFWS 2014a).

Status in the Action Area

Migratory bird surveys are conducted in the southeastern U.S. tri-monthly during the spring (15 March-5 June) and fall (15 July-15 October) migration periods. In 2010, comprehensive non-breeding season surveys for red knots and other focal shorebird species were initiated using the Southeast Coast Network shorebird monitoring protocol (Byrne and Muiznieks 2013). Numbers of northbound birds generally peak during the first two weeks of May, although annual peak counts have been recorded from mid-April to late May. Numbers decline rapidly after the end of August; and by the end of September most red knots have departed for their wintering grounds. According to the ebird.org, since 2015, there have been 428 red knots observed on Surf City.

Effects of the Proposed Action on Red Knot

Direct Effects

Sand placement activities would occur within foraging and roosting habitats for red knots. During the active beach construction process; heavy equipment operations, generator use, pipeline placement, night-time lighting, and related construction activities may affect red knots through disturbance and behavioral modification. Disturbance may cause migrating and wintering red knots to spend less time foraging and conserving energy; thereby potentially affecting survivability and productivity. Disturbance may prevent red knots from using otherwise suitable foraging and roosting sites; requiring birds to expend additional energy seeking out alternative habitats. The sand placement activities may occur during the peak May migration period in North Carolina .

As is typical for most beach placement projects, sand placement may eliminate important microhabitat elements such as wrack lines, tidal pools, and isolated clumps of vegetation; thereby reducing the quality or availability of foraging and/or roosting habitats. The initial effects of sand placement would include the loss of most intertidal benthic invertebrates within the placement areas. Reductions in the availability of invertebrate prey may negatively affect the energy budgets of red knots; potentially resulting in reduced survivability and productivity.

Under normal conditions, sand placement activities are expected to affect an average of 37 miles of potential red knot foraging and roosting beaches in North Carolina per year. The proposed project would add about six miles over a 16-month period with nourishments at Surf City occurring every 6 years. As a result of direct impacts on habitats and benthic communities, red knots may experience reduced foraging and roosting opportunities along the affected beaches for at least the first year following beach placement. In some cases, direct effects on habitats and benthic communities may persist into the second post-placement year. Consequently, the extent of habitat in recovery on an annual basis may be greater than the projected annual impact average of 37 miles.

Indirect Effects

Red knots exhibit a preference for the unstable portions of barrier islands where overwash and/or inlet processes create and maintain optimal habitats. Constructed berms and dunes may impede overwash and inlet processes; thereby limiting new habitat formation and/or reducing the quality of existing habitats through stabilization and succession. Based on the recurring nature of sand placement projects, the effects of stabilization may be long-term and cumulative. The construction and maintenance of wider beaches may facilitate and increase recreational activities within red knot habitats.

Beneficial Effects

The establishment of wider and higher dry beach habitats with little to no emergent vegetation may increase the quantity and quality of supratidal roosting habitats and enhance the ability of red knots to detect and avoid predators. The placement of beach-quality sand derived from sources outside of the inlet-dominated littoral system (e.g., offshore borrow sites) may increase inlet sediment budgets, potentially contributing to the formation of high-value inlet complex habitats for red knots.

Cumulative Effects

Cumulative effects are those caused by the proposed federal action in combination with future non- federal actions that are reasonably certain to occur within the action area. Pursuant to the ESA, non-federal actions include anticipated state, local, and private activities that would not be subject to Section 7 consultation. Anticipated non-federal actions within the action area would include temporary sandbag placement and beach scraping activities above the MHW line. These activities would have the potential for impacts on red knots and their habitats that are comparable to those associated with sand placement. Depending on the timing and location of specific projects, the combined impacts of the proposed and non-federal actions could have cumulative effects on red knots and their habitats. Cumulative effects could occur if the combined actions increase the frequency of habitat disturbance along a specific beach or if the combined actions result in simultaneous habitat impacts along separate beaches.

Determination of Effect

Sand placement activities may disturb migrating and wintering red knots; causing individuals to spend less time foraging and conserving energy. Sand placement after 30 April would employ conservation measures to minimize the duration of direct effects on benthic invertebrate communities and foraging, sheltering, and roosting habitat; including the use of beach-quality sand. Physical habitat changes within the placement areas may temporarily reduce the quality or availability of foraging and roosting habitats; and impacts on intertidal benthic invertebrates may temporarily reduce the prey base for red knots. The construction of stabilizing berms and dunes may have long-term indirect negative effects on the quality or availability of foraging and roosting habitats. Wider beaches may induce additional recreational activities that impact red knots through disturbance and/or habitat modification. However, beach placement and subsequent nourishments would mean more viable future habitat for these birds. The long-term effects of the project may restore lost foraging, sheltering, and roosting habitat through the addition of beach fill. Therefore, it has been determined that the project may affect, but is not likely to adversely affect the red knot.

3.4 Sea Turtles

Range-Wide Status

Loggerhead Sea Turtle

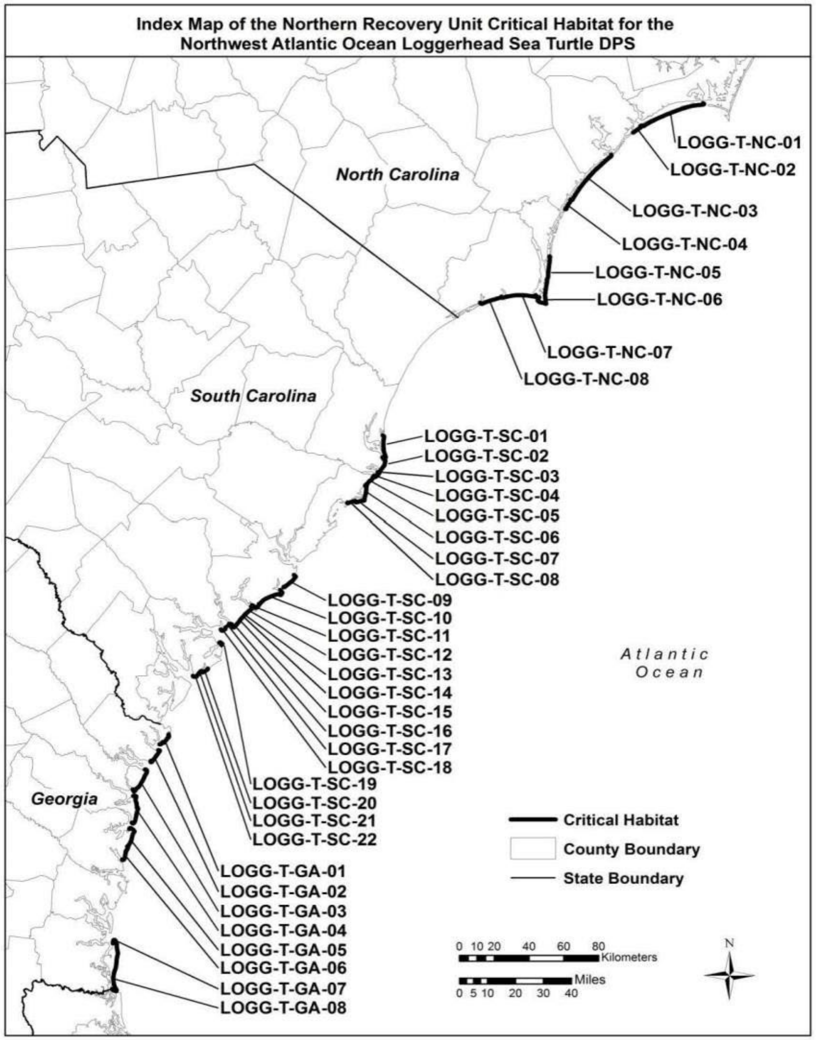
The loggerhead sea turtle (*Caretta caretta*) was initially listed under the ESA as threatened throughout its range on 28 July 1978 (43 FR 32800). On 22 September 2011, the loggerhead's ESA status was revised to threatened and endangered based on the recognition of nine distinct population segments (DPS). DPSs encompassing populations in the Northwest Atlantic Ocean, South Atlantic Ocean, Southwest Indian Ocean, and Southeast Indo-Pacific Ocean were reclassified as threatened; while the remaining five populations in the Northeast Atlantic Ocean, Mediterranean Sea, North Pacific Ocean, South Pacific Ocean, and North Indian Ocean were reclassified as endangered. Loggerhead sea turtles occur throughout temperate and tropical waters of the Atlantic, Pacific, and Indian Oceans; however, nesting occurs predominantly along the western rims of the Atlantic and Indian Oceans. Nesting in the Northwest Atlantic occurs along the coasts of North America, Central America, northern South America, the Bahamas, the Antilles, and Bermuda; however, nesting is concentrated on beaches of the southeastern US and the Yucatán Peninsula in Mexico. Nesting in the US occurs along the Atlantic and Gulf coasts from southern Virginia to Texas, but the majority of nesting occurs from North Carolina through Alabama (NMFS and USFWS 2008).

The revised 2008 Recovery Plan for the Northwest Atlantic DPS designated five recovery units: the southeastern US coast from southern Virginia to the Florida-Georgia border (Northern Recovery Unit), peninsular Florida, the Dry Tortugas, the northern Gulf Coast, and the Greater Caribbean (**Figure 5**). A total of 88 terrestrial critical habitat units encompassing ~685 miles of nesting beaches have been designated for the Northwest Atlantic Ocean DPS along the coasts of North Carolina, South Carolina, Georgia, Florida, Alabama, and Mississippi (79 FR 39756). A total of 38 units encompassing ~245 miles of nesting beaches have been designated within the Northern Recovery Unit; including eight units (~96 miles) in North Carolina, 22 units (~79 miles) in South Carolina, and eight units (~69 miles) in Georgia. Nesting in these 38 units comprises approximately 86% of all loggerhead nesting within the Northern Recovery Unit.

In addition, a 2019 Loggerhead Recovery Plan Progress Assessment was completed to review the progress since the 2008 Recovery Plan. The Northern Recovery Unit (NRU) is the second largest nesting assemblage and has an annual rate of increase in number of nests of 1.3% ($p = 0.04$) based on a log-linear regression model for 37 years of nesting data (1983-2019) (**Figure 6**). This annual rate of increase is below the 2% criterion for achieving recovery. According to the 2019 Loggerhead Recovery Plan, although there has been an observed increase in the number of nests for the past decade (total nests exceeded 14,000 for the first time in 2019), the Recovery Plan cautions that looking at short-term trends in nesting abundance can be misleading and needs to be considered in the context of one generation (= 50 years for loggerhead sea turtles) as specified in the Demographic Recovery Criteria. However, based on genetic analyses of all nests laid in the NRU, the number of annual nests since 2010 significantly correlates to the number of annual nesting females. Therefore, this Demographic Recovery Criterion for the NRU is being accomplished.

Green Sea Turtle
The green sea turtle (*Chelonia mydas)* was listed under the ESA on 28 July 1978 (43 FR 32800). Breeding populations in Florida and along the Mexican Pacific Coast were listed as endangered, while all other populations throughout the species' range were listed as threatened. In March 2015, the National Marine Fisheries Service (NMFS) and USFWS published a proposed rule to list eight threatened and three endangered green sea turtle DPSs. The proposed rule would list all North Atlantic green sea turtles as threatened under a single North Atlantic Ocean DPS. Green sea turtles are distributed circumglobally in tropical, subtropical, and to a lesser extent, temperate waters; with nesting occurring in more than 80 countries worldwide. Nesting in the US is primarily limited to Florida, although nesting occurs in small numbers along the coasts of North Carolina, South Carolina, Georgia, and Texas. Nesting turtles in Florida appear to prefer high wave energy barrier island beaches with coarse sands, steep slopes, and prominent foredunes (Witherington et al. 2006).

The highest nesting densities occur on sparsely developed beaches that have minimal levels of artificial lighting. The revised 1991 Recovery Plan for the US Atlantic population established recovery criteria of 5,000 nests per year for at least six years in Florida and the protection of at least 25% of the Florida nesting beaches



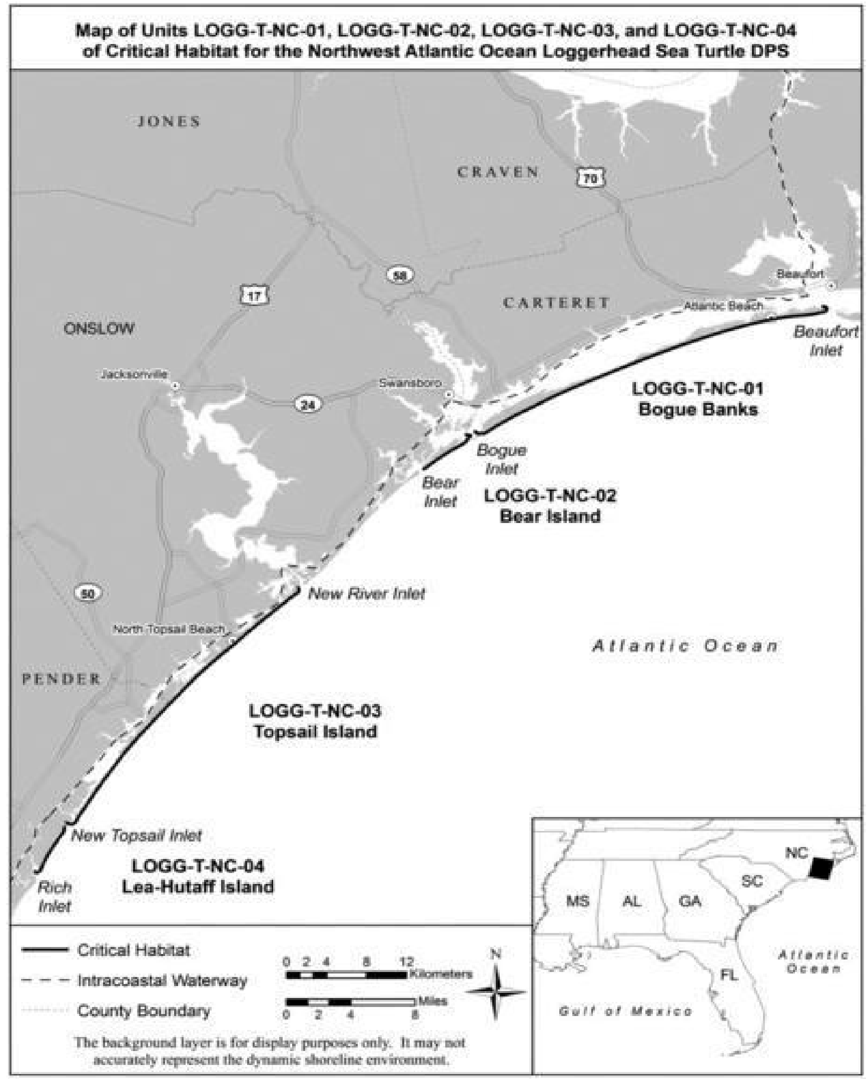


Figure 5. North Carolina Loggerhead Sea Turtle Terrestrial Critical Habitat Units

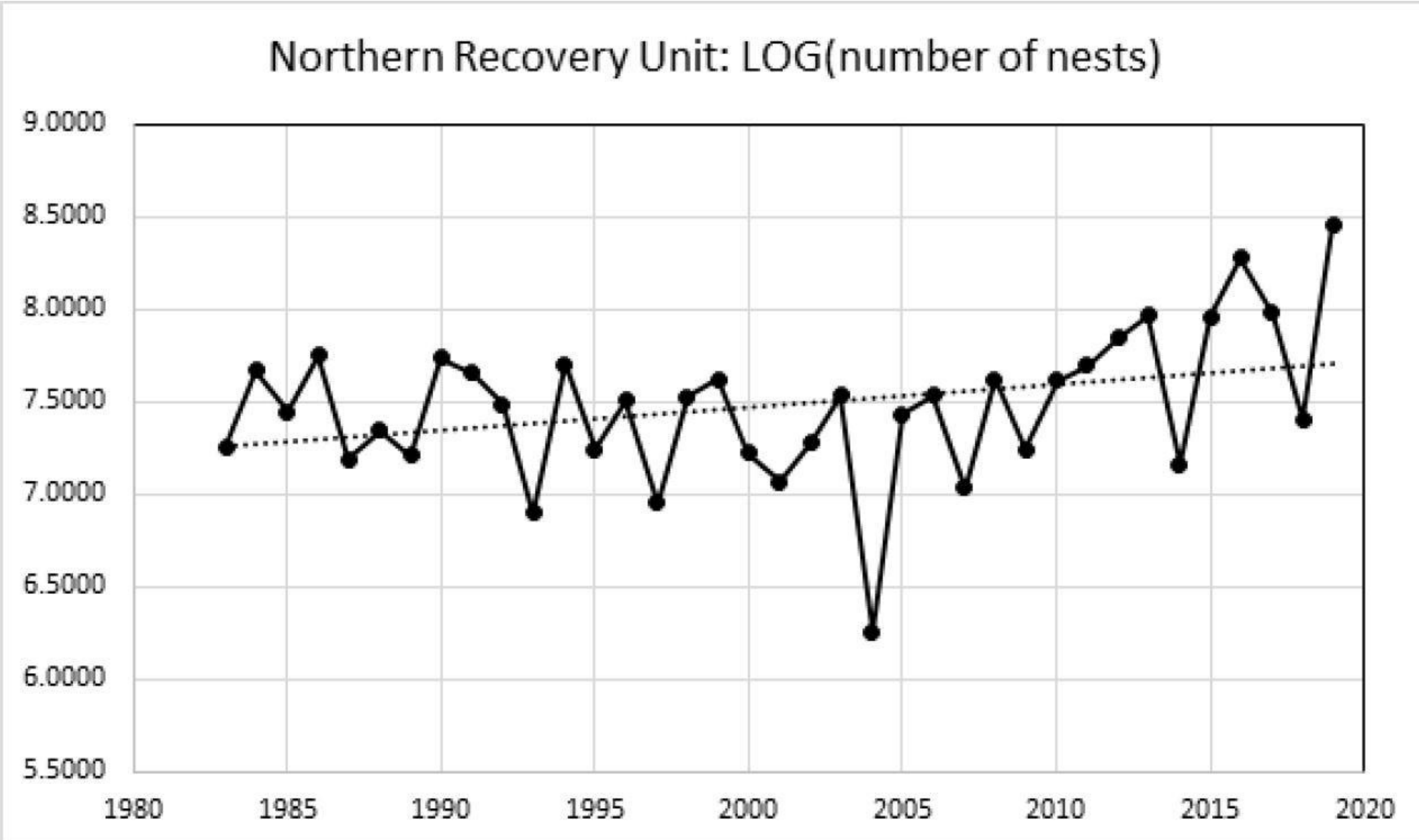


Figure 6. Log of annual loggerhead nest counts from the Northern Recovery Unit beaches, 1983-2019.

encompassing at least 50% of all nesting activity in the state. Nesting in Florida has increased exponentially over the last 20 years, with record highs of 36,195 and 37,341 nests recorded in 2013 and 2015, respectively [Florida Fish and Wildlife Conservation Commission (FWC)/Fish and Wildlife Research Institute (FWRI) 2014]. No critical habitat has been designated in the continental US.

Leatherback Sea Turtle
The leatherback sea turtle (*Dermochelys coriacea*) was listed as endangered throughout its range on 2 June 1970 (35 FR 8491). Leatherback nesting occurs on beaches throughout the tropical and subtropical regions of the Atlantic, Pacific, and Indian Oceans. Nesting in the US is primarily restricted to Florida, Puerto Rico, and the US Virgin Islands; although nesting occurs in small numbers along the coasts of North Carolina, South Carolina, Georgia, and Texas. Marine and terrestrial critical habitat have been designated for the leatherback sea turtle at Sandy Point on the western end of the island of St. Croix, US Virgin Islands [50 Code of Federal Register (CFR) 17.95]. The 1992 Recovery Plan for the US Caribbean, Atlantic, and Gulf of Mexico populations established recovery criteria for the assemblage of nesting populations in Florida, Puerto Rico, and the US Virgin Islands; including an increasing adult female population over 25 years (based on a statistically significant increasing trend in nest numbers) and the protection of nesting beaches encompassing at least 75% of all nesting activity (NMFS and USFWS 1992). Nesting in Florida has decreased by 2.1 percent annually from 2008 to 2017 with a highest nest count of 1,747 in 2009 and the lowest in 2017 with 663 nests (NMFS and USFWS 2020).

Kemp's Ridley Sea Turtle
The Kemp's ridley sea turtle (*Lepidochelys kempii*) was listed as endangered throughout its range on 2 December 1970 (35 FR 18320). Nesting is primarily restricted to coastal beaches along the Mexican states of Tamaulipas and Veracruz, although a small number of turtles nest consistently along the Texas coast [Turtle Expert Working Group (TEWG) 1998]. Rare nesting events have also occurred along the coasts of North Carolina, South Carolina, Georgia, Florida, and Alabama. A total of 80 Kemp's ridley nests were documented in Florida from 1979 to 2013 (FWC/FWRI 2014). No critical habitat has been designated for the Kemp's ridley sea turtle.

Hawksbill Sea Turtle
The hawksbill sea turtle (*Eretmochelys imbricata*) was listed as endangered throughout its range on 2 June 1970 (35 FR 8491). Nesting occurs on sandy beaches throughout the tropical and subtropical regions of the Atlantic, Pacific, and Indian Oceans. Nesting in the US is primarily limited to Florida and the US Caribbean on beaches throughout Puerto Rico and the US Virgin Islands (NMFS and USFWS 1993). Marine and nesting critical habitat for the hawksbill sea turtle have been designated in Puerto Rico along the islands of Mona, Monito, Culebrita, and Culebra (63 FR 46693). Rare nesting events in the continental US are essentially restricted to the southeastern coast of Florida and the Florida Keys (Meylan 1992; Meylan et al. 1995), although two hawksbill nests were recently confirmed in North Carolina (NPS 2015d). A total of 46 hawksbill nests were documented in Florida from 1979-2013 (FWC/FWRI 2014). Although documented

nesting in the continental US is extremely rare, hawksbill tracks are difficult to differentiate from those of the loggerhead and may not be recognized by surveyors. Therefore, surveys in Florida likely underestimate actual hawksbill nesting numbers (Meylan et al. 1995).

<u>Status in the Action Area</u>

Loggerhead Sea Turtle

Loggerhead nesting occurs along the entire North Carolina coast; however, nesting is concentrated along three sections of the coast: the Cape Fear region (Holden Beach, Oak Island, Caswell Beach, Bald Head Island, and Fort Fisher), Topsail Island and Onslow Beach, and Shackleford Banks north to Bodie Island.

Nesting is typically restricted to the period of 1 May to 15 September. Of the approximately 1807 loggerhead nests (average 90 nests per year) that were reported in North Carolina from 2000-2019, only 17 occurred outside of the 1 May to 15 September nesting window. However, annual surveys that are typically limited to the 1 May to 15 September window may underestimate the extent of nesting before and after this period. Relatively few nests are recorded during the first three weeks of May. Nesting increases rapidly from late May onward, peaking from mid-June through the end of July. Nesting declines abruptly after the end of July, and few nests are recorded after the third week of August (See **Figure 8**).

The Sea Turtle Nest Monitoring System (seaturtle.org) reported a total of 108 nests laid on Topsail Island in 2023. Of these nests, 104 were loggerheads and 4 were green sea turtles. From 2000 to 2019, 1827 total sea turtle nests were observed on the island: 1807 loggerhead, 19 green, and 1 Kemp's Ridley.

Loggerhead Sea Turtle Critical Habitat

A total of eight terrestrial critical habitat units encompassing approximately 96 miles of nesting beaches have been designated in North Carolina (79 FR 39756). All of the units are located south of Cape Lookout along the coasts of Brunswick, Carteret, New Hanover, Onslow, and Pender Counties. The designated units encompass the dry ocean beach from the MHW line landward to the toe of the secondary dune or the first developed structure. The units represent beaches that are capable of supporting a high density of nests or those that are potential expansion areas for beaches with high nest densities. Critical nesting habitats include: 1) unimpeded ocean-to-beach access for adult females and unimpeded nest-to-ocean access for hatchlings, 2) substrates that are suitable for nest construction and embryonic development, 3) a sufficiently dark nighttime environment to ensure that adult females are not deterred from nesting and that hatchlings are not prevented from reaching the ocean, and 4) natural coastal processes that maintain suitable nesting habitat or artificially maintained habitats that mimic those associated with natural processes.

Topsail Island contains 26 miles of Loggerhead terrestrial critical habitat (Unit LOGG-T-NC-07), which encompasses the entire length of the island (see Figure 9). It is the longest area of designated terrestrial critical habitat (out of eight units) in North Carolina. Approximately 10 miles of critical habitat on Topsail Island are contained within the project area.

Green Sea Turtle
Green sea turtles nest in relatively small numbers along the North Carolina coast, with reported nesting from 2000 through 2019 averaging 20 nests per year. Annual nest totals from 2000 through 2019 was 406 nests. The overall statewide trend from 2000 through 2016 is very similar to that of the loggerhead turtle in North Carolina. Green sea turtle nesting records span the entire North Carolina coast but are concentrated along the barrier islands of Cape Lookout and Cape Hatteras.

From 2000 – 2019, only 19 green turtle nests were laid along Topsail Island, only 5% of the statewide total (Seaturtle.org 2019).

Based on 2019 data from the Northern Recovery Unit (GA, SC and NC) Green Turtle DNA Project, 88 nests laid in 2019 were greens. According to this data, a single green turtle lays an average of 2.6 nests per season, but often nests on the same beach (seaturtle.org Sea Turtle Nest Monitoring System).

Leatherback Sea Turtle
Leatherback nesting is rare in North Carolina, with just 37 nests reported from 2000 - 2019 for the entire state. Nesting from 2000-2019 averaged four nests per year; however, 11 of the 19 years during this period had no reported nesting events. Of the years when nesting was reported, statewide annual totals ranged from one to eight nests. Nesting records span the entire North Carolina coast, but are heavily concentrated along the barrier islands of Cape Hatteras and Cape Lookout National Seashores. The last recorded nesting of a leatherback in North Carolina was 2018 when 2 nests were laid on Fort Fisher State Recreational Area and Cape Lookout National Seashore.

No reports of leatherback nests were reported on Topsail Island from 2000 – 2019. Based on 2019 data from the Northern Recovery Unit (GA, SC and NC) Leatherback Turtle DNA Project no Leatherback nests were reported in 2019 (seaturtle.org Sea Turtle Nest Monitoring System).

Kemp's Ridley Sea Turtle
Kemp's ridley nesting is also rare in North Carolina, with just 29 nests reported from 2000 - 2019 for the entire state. Of the 29 nests, 2018 had the highest nesting rate by far, with 12 nests. Based on the 2019 data from the Northern Recovery Unit (GA, SC and NC) Kemp's Ridley Turtle DNA Project, 3 nests laid in 2019 were Kemps. According to the seaturtle.org data, Kemps only lay 2.6 nests per season on average (seaturtle.org Sea Turtle Nest Monitoring System).

<u>Effects of the Proposed Action on Sea Turtles</u>
Sand placement on Surf City between 1 May and 15 November has the potential to adversely affect nesting females, nests, and hatchlings within the project area. Potential effects include destruction/burial of nests deposited within the boundaries of the project, harassment in the form of disturbing or interfering with females nesting as a result of beach placement activities, and disorientation of hatchling turtles from project lighting on beaches.

(1) Pipe Placement

A general discussion of the construction activities associated with the placement of sediment on the beach, including pipeline routes, is included in this report. When 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 encounter the pipe and false crawl (return to the water) or nest in front of the pipeline in an area that is subject to heavy equipment operation, erosion, and washover. If nests are laid prior to placement of pipe and end up landward of the pipeline once it is placed, hatchlings may be blocked or become misoriented (oriented away from the most direct path to the ocean) during their approach to the water.

(2) Slope and Escarpments
Beach placement 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 MHW line as the constructed beach adjusts from a construction profile to a natural beach profile. For the purposes of this assessment, escarpments are defined as a continuous line steep slopes facing in one general direction, which is caused by erosion. Depending on shoreline response to the wave climate and subsequent equilibration process for a given project, the slope both above and below MHW may vary outside of the natural beach profile; thus resulting in potential escarpment formation. 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.

Adult female turtles survey a nesting beach from the water before emerging to nest (Carr and Ogren, 1960; Hendrickson, 1982). Parameters considered important to beach selection include the geomorphology and dimensions of the beach (Mortimer, 1982; Johannes and Rimmer, 1984) and bathymetric features of the offshore approach (Hughes, 1974; Mortimer, 1982). Beach profile changes and subsequent escarpment formations may act as an impediment to a nesting female resulting in a false crawl, or nesting females may choose marginal or unsuitable nesting areas either within the escarpment face or in front of the escarpment. Often times these nests are vulnerable to tidal inundation or collapse of the receding escarpment. If a female is capable of nesting landward of the escarpment prior to its formation, as the material continues to slough off and the beach profile approaches a more natural profile, there is a potential for an incubating nest to collapse or fallout during the equilibration process. Loggerheads preferentially nest on the part of the beach where the equilibration process takes place (Brock, 2005; Ecological Associates, Inc., 1999) and are more vulnerable to fallout during equilibration.

A study conducted by Ernest and Martin (1999) documented increased abundance of nests located farther from the toe of the dune on nourished vs. control beaches. Thus, post-nourishment nests may be laid in high-risk areas where vulnerability to sloughing and equilibration are greatest. Though nest relocation is not encouraged, nest relocation may be used to move nests that are laid in locations along the beach that are vulnerable to sloughing of escarpments and fallout (i.e. near the MHW line). As a nourished beach is re-worked by natural processes and the construction profile approaches a more natural profile, the frequency of escarpment formation declines and the risk of nest loss due to sloughing of escarpments is reduced.

(3) Compaction

Sediment placed on the beach can often affect sediment density (compaction), shear resistance (hardness), sediment moisture content, beach slope, sediment color, sediment grain size, sediment grain shape, and sediment grain mineral content. Changes in particle size can have a direct influence on the shear resistance of the sediment and therefore make the beach relatively harder after placement of sand. Harder or more compact beaches result primarily from angular, finer grained sediment dredged from stable offshore borrow sites, whereas less compacted beaches result from smoother, coarse sediment dredged from high energy locations such as inlets. Hard sediment can prevent a female from digging a nest or result in a poorly constructed nest cavity. Females may respond to harder physical properties of the beach by spending more time on the beach nesting, which may result in physiological stress and increased exposure to disturbances and predation; thus, in some cases leading to a false dig (Nelson and Dickerson, 1989).

Studies suggest that tilling compacted sand after project completion can be performed to reduce compaction to levels comparable to unnourished beaches. Under current USFWS guidelines, the decision to till a beach after sediment placement is based upon measurements of sediment compaction using a soil auger. The NCWRC has routinely visited a beach nourishment site directly after placement activity is completed to determine the necessity for beach tilling to mitigate compaction impacts.

(4) Lighting

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. Artificial lighting on beaches 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, 1984a.). Though nesting females prefer darker beaches, considering the increased development and associated lighting on most beaches, many do nest on lighted shorelines. Although the effects of lighting may prevent female emergence, if emergence, nest site selection, and oviposition does occur, lighting does not affect nesting behavior (Witherington and Martin, 2003). However, sea turtles rely on vision to find the sea upon completion of the nesting process and use a balance of light intensity within their eyes to orient towards the brightest direction (Ehrenfeld, 1968); thus, misdirection by lighting may occur, resulting in more time being spent to find the ocean. Furthermore, successful nesting episodes on lighted shorelines will directly affect the orientation and sea-finding process of hatchlings during the nest emergence and frenzy process to reach the ocean. Hatchlings rely almost exclusively on vision to orient to the ocean and brightness is a significant cue used during this immediate orientation process after hatch out (Mrosovsky and Kingsmill, 1985; Verheijen and Wilschut, 1973; Mrosovsky and Shettleworth, 1974; Mrosovsky et al., 1979).

Hatchlings that are misoriented (oriented away from the most direct path to the ocean) or disoriented (lacking directed orientation or frequently changing direction or circling) from the sea by artificial lighting may die from exhaustion, dehydration, predation, and other causes. Though hatchlings use directional brightness of a natural light field (celestial sources) to orient to the sea, light from artificial sources interferes with the natural light cues resulting in misdirection (Witherington and Martin, 2003).

3.5 Seabeach Amaranth

Range-Wide Status and Distribution

Seabeach amaranth (*Amaranthus pumilus*) was listed as threatened throughout its range on 7 April 1993 (58 FR 18035 18042). No critical habitat has been designated for this species. Although historically distributed along barrier island beaches from Massachusetts to South Carolina, by the 1980s extant populations were known only from North and South Carolina. In 1990, seabeach amaranth was rediscovered in New York after an absence of 40 years. Between 1998 and 2000, additional populations were rediscovered in Virginia, Maryland, Delaware, and New Jersey after periods of absence ranging from 30 to 125 years (USFWS 2005). The range-wide trend over the last 25 years has been dominated by dramatic fluctuations in the New York population. After the initial rediscovery of 341 plants in 1990, the New York population increased exponentially to an estimated 244,608 plants in 2000. The corresponding 2000 range-wide estimate of 249,261 plants was highest on record; however, the New York population accounted for 98% of the plants. The overall population trend since 2000 is characterized by equally dramatic declines in the New York and range-wide populations to just 729 and 1,308 plants in 2013, respectively. Changes in other state-specific populations, although occurring on a much smaller scale, have generally mirrored those of the overall range-wide population. All of the state-specific populations increased substantially at some point between 2000 and 2005, only to decline to record or near record low numbers by 2013.

Seabeach amaranth is an annual flowering plant that overwinters entirely in the form of small seeds. Seed germination begins in April or May and continues through July. Flowering begins as early as June, and seed production is initiated in July or August. Flowering and seed production continue until the death of the plant in late fall or early winter. Under favorable climatic conditions, some plants may survive and continue to produce seed into January (USFWS 1996b). Seabeach amaranth is a pioneering colonizer of newly formed and recently disturbed barrier island habitats; including supratidal overwash flats on the accreting ends of barrier islands, the upper dry ocean beach, and the lower exposed faces of foredunes. The species is intolerant of competition and requires habitats that are largely devoid of other plant species. Suitable habitats are eventually lost to dynamic erosional processes or succession to more stable dune grass communities. Consequently, seabeach amaranth is dependent on continual new habitat formation through dynamic barrier island and inlet processes. The species is well-adapted to this ephemeral habitat niche, producing vast numbers of tiny seeds that are widely dispersed throughout the coastal barrier system, thereby providing for the rapid colonization of new suitable habitats as they are formed.

Status of the Species in the Action Area

The Corps conducts annual seabeach amaranth surveys every summer on beaches affected by federal projects. According to the Corps' Annual Seabeach Amaranth Survey Reports, Topsail Island was surveyed from 1992 to 20120 however, this section will only focus on the last 6 years. Topsail Island reported the following number of plants from 2014-2019:

2018 – 23

2019 – 0

2020 – 0

2021 – 0

2022 – 0

2023 – 0

Effects of the Proposed Action on the Species

The principal factors affecting seabeach amaranth within the action area include habitat loss and degradation attributable to beach nourishment. Sand placement may affect seabeach amaranth by altering the dynamic coastal processes that create and maintain suitable habitat. Sand placement projects typically include the construction of berms and continuous artificial dunes that may impede natural ocean-to-sound overwash. Barrier islands respond to sea level rise by migrating landward, a process driven primarily by sediment deposition along the back-barrier estuarine shoreline via overwash events and inlet processes. In the absence of sufficient back-barrier sediment deposition, the long-term consequence of rising sea level is simultaneous ocean and back-barrier shoreline erosion, resulting in island narrowing (Riggs et al. 2009). Shoreline erosion and island narrowing may reduce the availability of suitable habitat for seabeach amaranth.

Based on seabeach amaranth annual surveys, numbers have greatly fluctuated since 2013. In 2020, seabeach amaranth surveys for the entire state of North Carolina resulted in no plants. The placement of sand from the proposed action will occur during the growing season; therefore, if plants are present, the proposed action may affect seabeach amaranth directly through the burial and mortality of plants. For this reason, the proposed action may affect, but is not likely to adversely affect the species.

3.6 West Indian Manatee

Range-Wide Status and Distribution

The manatee is an occasional summer resident off the North Carolina coast with presumably low population numbers (Clark 1987). The species can be found in shallow (5 ft to usually <20 ft), slow-moving rivers, estuaries, saltwater bays, canals, and coastal areas (USFWS 1991). The West Indian manatee is herbivorous and eats aquatic plants such as hydrilla, eelgrass, and water lettuce (USFWS, 2018).

Manatees are thermally stressed at water temperatures below 18ºC (64.4ºF) (Garrot et al. 1995); therefore, during winter months, when ambient water temperatures approach 20ºC (68ºF), the U.S. manatee population confines itself to the coastal waters of the southern half of peninsular Florida and to springs and warm water outfalls as far north as southeast Georgia. During the summer months, sightings drop off rapidly north of Georgia (Lefebvre et al, 2001) and are rare north of Cape Hatteras (Rathbun et al, 1982; Schwartz 1995). However, they are sighted infrequently in southeastern North Carolina with most records occurring in July, August, and September, as they migrate up and down the coast (Clark 1993). The Species is considered a seasonal inhabitant of North Carolina with most occurrences reported from June through October (USFWS 2001). According to Schwartz (1995), manatees have been reported in the state during nine months, with most sightings in the August-September period. Manatee population trends are poorly understood, but deaths have increased steadily. A large percent of mortality is due to collisions with watercrafts, especially of calves. Another closely related factor in their decline has been the loss of suitable habitat through incompatible coastal development, particularly destruction of sea grass beds by boating facilities (USFWS 2001).

Status of the Species in the Action Area

Manatees are rare visitors to the Surf City project area. According to Schwartz (1995), a total of 68 manatee sightings have been recorded in 11 coastal counties of North Carolina during the years 1919-1994. Therefore, it is likely that manatees transit through the project area during the warm water months. Manatees are known to infrequently occur within nearly all North Carolina ocean and inland waters (Schwartz 1995) with four North Carolina records having been from inlet-ocean sites and six from the open ocean (Rathbun et al. 1982). According to the existing literature, specific numbers of manatees using the region are not known but are presumed to be very low. More research is needed to determine the status of the species in North Carolina and identify areas (containing food and freshwater supplies), that support summer populations.

Effects of the Proposed Action on the Species

The principal factors affecting West Indian Manatee within the action area include potential habitat loss and degradation attributable to dredging within the Cape Fear River and inlet area. With the current state of knowledge on the habitat requirements for the manatee in North Carolina, it is difficult to determine the magnitude of such impacts. Studies currently underway by the USFWS using animals fitted with satellite transmitters may provide data on the nature of these seasonal movements and habitat requirements during migrational periods. Foods that are used by the manatee in North Carolina are unknown. In Florida, their diet consists primarily of vascular plants. The proposed action will impact the beach of Surf City with no known impacts to vascular plants; overall nearshore productivity should remain high throughout the project area. Therefore, potential food sources for the manatee should not be affected.

4.0 Consultations

The Corps held a virtual scoping meeting on June 15, 2020 with resource agencies to discuss the Corps' proposed window plan and to solicit input regarding associated resource impacts and impact minimization measures. Agencies represented on the call included the National Marine Fisheries Service Habitat Conservation Division, North Carolina Division of Coastal Management, the US Fish and Wildlife Service, North Carolina Audubon Society, and the North Carolina Department of Environmental Quality. As discussed in this meeting, every effort will be taken by the Corps to minimize takes of threatened and endangered species, to include: coordinating pipeline placement and equipment traffic routes with the resource agencies, lighting minimization on the beach at night, 24-hour monitoring for sea turtle nesting activities along the entire pipeline, and relocation of turtle nests from the project area. At least two sea turtle monitors shall be present on a continuous basis from dusk to dawn to monitor sea turtle activity until all equipment is off the beach. In addition to this, monitoring for piping plover activity will occur and any waterbird nests and bird nesting habitat will be delineated and avoided to the maximum extent practicable. Strict adherence to the USFWS Manatee Guidelines will also apply.

On May 26, 2020, the Corps sent a scoping letter to all agencies soliciting comments with a response deadline of June 16, 2020. This resulted in a request from the USFWS to enact formal consultation by means of submitting a Biological Assessment, and a request from the North Carolina Division of Coastal Management to provide a Coastal Zone Management Act consistency determination. Both parties have agreed to provide responses (Biological Opinion/CZMA Consistency decision).

5.0 Conservation Measures

All beach activities during the nesting season will require monitoring for sea turtle nesting activity throughout the construction area, including the discharge area and pipeline routes. Monitoring for nest activity 24 hours/day starting 1 May will be required so that nests laid in a potential construction zone can be relocated outside of the construction zone prior to project commencement to avoid potential losses.

The following direct impacts may occur due to working within the turtle nesting season. Each item is followed with proposed measures to avoid or minimize impacts:

(1) Both stockpiled pipe on the beach and the pipeline route running parallel to the shoreline may impede nesting sea turtles from accessing more suitable nesting sites.

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. Because construction activities likely will occur throughout the nesting season, 24 hour/day monitoring will be required starting 1 May to document all nests laid within the project area, as well as false crawls and false nesting. A Sea Turtle Monitoring and Nest Relocation Plan will be developed and implemented to clearly direct monitors regarding actions to take when a turtle or nest is encountered. All nests within the project area will be relocated outside of the construction area within 24 hours of nesting. This will ensure the highest success rate of hatching.

Throughout the period of sea turtle nesting and hatching, construction pipe that is placed on the beach parallel to the shoreline will 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 will be located off the beach to the maximum extent practicable. If placement on the beach is necessary, it will be done in a manner that impacts 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.

(2) The operation of heavy equipment on the beach may impact incubating nests. The goal of the Sea Turtle Monitoring Nest Relocation Plan will be to identify and remove any turtle nests from dangers of the project area as quickly as possible. This will include the entire length of the pipeline route to the farthest extent of the beachfill limits.

(3) During nighttime operations, the nourishment construction process, including heavy equipment use and associated lighting, may deter nesting females from coming ashore and disorient emerging hatchlings down the beach.

Use of heavy equipment along the pipeline route at night will be limited to the maximum extent practicable. A minimum of two nighttime monitors will traverse the length of the pipeline to identify any turtles coming ashore to nest. False crawls, false nests and successful nests will be documented. If proper monitoring and relocation are carried out, all turtle nests should avoid being buried or crushed and thus hatchlings will be safeguarded while emerging.

All lighting associated with nighttime project construction including lighting aboard dredges and associated vessels, barges, etc. operating near sea turtle nesting beaches, will be minimized to the maximum extent practicable while maintaining compliance with EM 385-1-1 and all other Corps, U.S. Coast Guard, and OSHA safety requirements. Direct lighting of the beach and nearshore waters will be limited to the immediate construction area(s). To reduce illumination of the adjacent beach and nearshore waters, to the extent practicable, lighting on offshore or onshore equipment will be minimized through reduced wattage, shielding, lowering, and/or use of low-pressure sodium lights.

Shielded low-pressure sodium vapor lights have been identified by the FWCC as the best available technology for balancing human safety and security, roadway illumination, and endangered species protection. They provide the most energy efficient, monochromatic, long-wavelength, dark sky friendly, environmentally-sensitive light of the commercially available street lights and will be highly recommended for all lights on the beach or on offshore equipment.

(4) Escarpment formations and resulting impediment to nesting females. Management techniques will be implemented to reduce the impact of escarpment formations. For completed sections of beach during sand placement operations, and for subsequent years following, as the beach profile approaches a more natural profile, visual surveys for escarpments will be performed. Escarpments that are identified that interfere with sea turtle nesting (exceed 18 inches in height for a distance of 100 ft.) will 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 should be directed by the USFWS or NCWRC.

(5) Reduced nest success because of relocation efforts.

In some instances where the nesting season cannot be avoided, nest relocation is used as a management tool to relocate nests laid in the impact area to areas that are not susceptible to disturbance. For any given project, if the earliest documented nest attempt precludes the project commencement or completion date, nest relocation may be used as a last resort mitigation effort. If relocation is implemented, the proper protocol established by the USFWS will be adhered to in order to avoid the potential adverse impacts outlined above. Considering the increased risk of finding and relocating nests, additional relocation requirements will be implemented (i.e. night time monitoring and relocation) to assure that nests are not missed.

Relocation of sea turtle nests to less vulnerable sites was once common practice throughout the southeastern U.S. to mitigate the effects of natural or human induced factors. However, the movement of eggs creates opportunities for adverse impacts. Therefore, more recent USFWS guidelines are to be far less manipulative with nests and hatchlings to the maximum extent practicable. Though not encouraged, nest relocation is still used as a management technique of last resort where issues that prompt nest relocation cannot be resolved. Potential adverse impacts associated with nest relocation include: survey error (Shroeder, 1994), handling mortality (Limpus et al. 1979; Parmenter 1980), incubation environment impacts (Limpus et al., 1979; Ackerman, 1980; Parmenter, 1980; Spotila et al., 1983; McGehee, 1990).

6.0 Conclusions

6.1 Piping Plover Effect Determination

The proposed plan to accomplish initial construction any time of year may affect piping plovers through disturbance and behavioral modification. Construction activities may impact piping plovers directly through the mechanical destruction of nests and eggs or through an increased risk of egg predation if adults are flushed from their nests. The initial effects of sand placement would include the loss of most intertidal benthic invertebrates within the placement areas. Reductions in the availability of invertebrate prey may negatively affect the energy budgets of breeding and non-breeding plovers. Most benthic recovery studies have reported relatively rapid recovery (≤1 year) when peak larval recruitment periods were avoided. However, it is undetermined what effect the activity will have on larval communities during the summer months. Beach construction during this time could ultimately affect food sources for foraging birds in the fall/winter months.

After the initial construction, nourishment events will occur approximately every six years, giving benthic invertebrates time to recover between nourishment events. The establishment of wider and higher dry beach habitats with little to no emergent vegetation may increase the quantity and quality of supratidal nesting and roosting habitats and enhance the ability of plovers to detect and avoid predators.

The placement of beach quality sand on the beach and the associated construction activities may temporarily impact foraging, sheltering, and roosting habitat and may impact the constituent elements for piping plover wintering habitat. However, considering the potential impacts of these actions, it has been determined that the placement of sand may affect, but is not likely to adversely affect the piping plover.

6.2 Red Knot Effect Determination

Sand placement activities would occur within foraging and roosting habitats for red knots. During the active beach construction process, construction activities may affect red knots through disturbance and behavioral modification. Disturbance may cause migrating and wintering red knots to spend less time foraging and conserving energy; thereby potentially affecting survivability and productivity. Disturbance may prevent red knots from using otherwise suitable foraging, sheltering, and roosting sites; requiring birds to expend additional energy seeking out alternative habitats. The initial effects of sand placement would include the loss of most intertidal benthic invertebrates within the placement areas. Reductions in the availability of invertebrate prey may negatively affect the energy budgets of red knots; potentially resulting in reduced survivability and productivity.

Considering that beach placement activities likely will occur during peak red knot migration (May-June), the placement of sand on the beach may affect may affect, but is not likely to adversely affect the species. Any beach construction action that occurs during the month of May and into June will have negative impacts on the quality and/or availability of foraging and roosting habitats. July-August numbers decline as final populations depart for their winter habitat.

6.3 Red Knot Critical Habitat Effect Determination

The entire length of Topsail Island is considered critical habitat for the red knot. Placement of 8.0 MCYs of beach quality sand over the 16 month initial construction period on about six miles of Surf City will have long-term benefits to red knot critical habitat. It has been determined that the proposed action is not likely to adversely modify the red knot critical habitat area.

6.3 Sea Turtle Effect Determination

The proposed project could potentially affect sea turtles both directly and indirectly in the following ways: (1) The pipeline route running parallel to the shoreline may impede nesting sea turtles from accessing suitable nesting sites, (2) The operation of heavy equipment on the beach may impact nesting females and incubating nests, (3) Associated lighting impacts from the nighttime operations and the increased beach profile elevation may deter nesting females from coming ashore and may disorient emerging hatchlings, (4) Burial of existing nests may occur if missed by monitoring efforts, (5) Escarpment formations could result in impediments to nesting females as well as potential losses to the beach equilibration process, (6) Relocation efforts could reduce nest success rates, and (7) Sediment density (compaction), shear resistance (hardness), sediment moisture content, beach slope, sediment color, sediment grain size, sediment grain shape, and sediment grain mineral content may be altered, potentially affecting the nesting and incubating environment.

The USACE plans to alleviate impacts to nesting sea turtles in the project area by implementing steps including, but not limited to, (1) risk assessments, (2) 24-hour monitoring for nesting activity, and (3) relocating turtle nests for the duration of the project. A Sea Turtle Monitoring and Nest Relocation Plan will be developed and implemented by the contractor to minimize impacts for the duration of the project (until all equipment is removed from the beach).

Despite implementing the conservation measures to the maximum extent practicable, the chance of impacting nesting loggerhead turtles and their incubating environment still exists. Therefore, it has been determined that the proposed action may affect and is likely to adversely affect the loggerhead sea turtle.

As for Kemp's ridley, hawksbill, and leatherback sea turtles, these species are less likely to nest on Topsail Island; therefore, it has been determined that the proposed action may affect, but is not likely to adversely affect the these sea turtle species.

6.4 Loggerhead Critical Habitat Effect Determination

The entire length of Topsail Island is considered critical habitat for the loggerhead sea turtle (see Figure 9). Placement of 8.0 MCYs of beach quality sand over the 16 month initial construction period on about six miles of Surf City will have long-term benefits to sea turtle nesting habitat. It has been determined that the proposed action is not likely to adversely modify the loggerhead critical habitat area.

6.5 Seabeach Amaranth Effect Determination

Sand placement may affect seabeach amaranth by altering the dynamic coastal processes that create and maintain suitable habitat; however, shoreline erosion and island narrowing may reduce the availability of suitable habitat for seabeach amaranth. Considering that beach placement activities may occur during seed germination (May – July) and seed production (July or August), the placement of sand on the beach in the summertime may be likely to adversely affect the species. However, since 2019 seabeach amaranth surveys only showed 19 plants in populations state-wide, it can be assumed that the proposed action may affect, but is not likely to adversely affect the species.

6.6 West Indian Manatee Effect Determination

Since the manatee is considered to be an infrequent summer resident of the North Carolina coast, the proposed action should have little effect on the manatee since its habitat and food supply will not be significantly impacted. In regards to vessel collisions, direct impacts from collision could take place, and precautionary measures for avoiding impacts to manatees, as established by USFWS, will be implemented for transiting vessels associated with the project; therefore, the proposed action may affect, but is not likely to adversely affect the manatee.

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Appendix A: Project Plans

Project plans will be placed here when complete.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services, Eastern North Carolina Field Office
3916 Sunset Ridge Rd.
Raleigh, North Carolina, 27607

25 October 2024

Mr. Eric Gasch
Planning and Environmental Branch
Wilmington District, U. S. Army Corps of Engineers
69 Darlington Avenue
Wilmington, North Carolina 28403-1343

Subject: Draft General Re-evaluation Report and Environmental Assessment (GRR/EA)
Surf City, Onslow and Pender Counties, North Carolina
Coastal Storm Risk Management (CSRM) Project
USFWS IPaC Code 2024-0048393

Dear Mr. Gasch:

The U.S. Fish and Wildlife Service (Service) has reviewed the U.S. Army Corps of Engineers' (Corps) Draft General Re-evaluation Report and Environmental Assessment, Surf City, Onslow and Pender Counties, North Carolina, Coastal Storm Risk Management (CSRM) Project, August 30, 2024. The following comments address the Corps request for concurrence under section 7 of the Service's authorities pursuant to, and in accordance with, provisions of the Endangered Species Act of 1973, as amended (ESA), the Coastal Barrier Resources Act (CBRA) (16 U.S.C. 3501 et seq), and the Migratory Bird Treaty Act (MBTA). In May 2010, Howard Hall of our office provided a final FWCA report for this project, known then by the name Surf City-North Topsail Beach (SC-NTB) Shore Protection Project. This project has also been previously associated with the West Onslow Beach and New River Inlet (Topsail Beach) Coastal Storm Damage Reduction Project (CSDR). The Service has coordinated at various times over the past 25 or more years on the Corps' Civil Works activities on Topsail Island.

Project Area, Proposed Activities, and Anticipated Impacts

The originally authorized project design template and renourishment intervals have not changed as compared to those described in the December 2010 Integrated Feasibility Report and EIS. The Service's May 2010 FWCA Report provides information concerning a larger project than is currently proposed, reaching from the boundary of Topsail Beach and Surf City limits to a point in North Topsail Beach (NTB) at the southern edge of the Coastal Barrier Resources Act CBRA)

Zone in NTB (approximately 9.9 miles). The 52,150foot-long system was to be constructed to an elevation of 14 feet North Atlantic Vertical Datum 1988 (NAVD 88) and a 25-foot-wide crest, fronted by a 50-foot-wide berm at an elevation of 6-foot (NAVD 88) and renourished seven times over 50 years at fixed six-year intervals. Other features of the project included dune vegetation and the construction of 60 dune walkover structures. Sand for the berm and dune construction and renourishment intervals was to be taken from borrow sites identified between one and six miles off the coast of Topsail Island. The plan also included post-construction monitoring over the period of Federal participation (i.e. 50 years) to ensure project performance and adjust the renourishment plan as needed. In July of 2021, the Town of NTB announced its intention to pull out of the construction phase of the project due to financial reasons. The Town of Surf City maintained its support for a Federal project and asked the Corps to examine Coastal Storm risk reduction alternatives within its town limits.

Currently, the project includes the beachfront within the corporate limits of Surf City. The northern limits of the study area are in Onslow County near the road intersection of Island Drive and Scotch Bonnet Drive, while the southern limits are in Pender County near the road intersection of South Shore Drive and Hispaniola Lane. From the shoreline, the study area extends landward approximately 500 feet. Seaward, the study area extends from the shoreline approximately one mile. The study area also includes several borrow areas offshore of Topsail Island.

The recommended plan is a berm and dune system measuring approximately 33,300 ft long, or approximately 6 miles of shoreline, with a dune constructed to an elevation of 14 feet (NAVD 88) and fronted by a 6-foot (NAVD 88) (50 ft wide) beach berm restricted by the town limits of Surf City. The alternative would include a 1000 ft transition berm in northern end of the project from the town limits of Surf City into the town limits of NTB. Other features of the alternative would include dune vegetation and 40 public walkover structures.

The proposed plan is to complete initial construction any time of year. Initial construction would result in one disturbance event, lasting approximately 16 months, from the dredges and all other required equipment in the water and on the beach. Nourishment events would occur during the beach placement window of November 16 to April 30, during one dredging season. The periodic nourishment intervals would be every six years with a total of seven nourishment events over the 50-year project life (i.e. 2024-2073).

Federally Protected Species

Based on the information provided and other information available, the following endangered and threatened species may be adversely affected by the proposed construction associated with the requested CSRM project: piping plover, red knot, seabeach amaranth, green, leatherback Kemp's ridley and hawksbill sea turtles and West Indian manatee. In addition, designated critical habitat is present in the project area for nesting loggerhead sea turtles (Unit LOGG-T-NC-03), and proposed critical habitat is present for the red knot (Unit NC-5).

Piping plovers (Threatened [T]; Great Lakes Population is Endangered [E])

North Carolina is the only state where the piping plover's breeding and wintering ranges overlap, and the birds are present year-round. Topsail Inlet and the northern inlet shoulder is optimal habitat for breeding, migrating, and overwintering piping plovers. Breeding piping plovers from the Atlantic population have been documented on the north and south ends of Topsail Island in recent years (www.ncpaws.org, accessed October 3, 2024). In 2024, one nest on the south side of New River Inlet (North Topsail Beach) fledged four chicks, and one nest each in 2018 and 2019 on the south end of Topsail Island fledged one chick. Although the current project does not propose impacts to the inlet habitats or piping plover critical habitat, piping plovers of all three populations (including the endangered Great Lakes population) may utilize the beachfront areas of Surf City.

The proposed action has the potential to adversely affect wintering, migrating, and breeding piping plovers and their habitat. Potential effects to piping plover include direct loss of foraging and roosting habitat and attraction of predators due to food waste from the construction crew. Plovers face predation by avian and mammalian predators that are present year-round on the wintering and nesting grounds.

Red Knots (T)

Migrating and overwintering red knots utilize the proposed renourishment area. Red knots may be present any month of the year, although they are less likely to be present during the height of the breeding season (July). Spring migration peaks in North Carolina in May-June, while fall migration peaks between mid-August and early September, though many individuals stay until November, and small flocks may utilize the beachfront for the entire winter (nc.audubon.org).

The area proposed for renourishment is within and adjacent to proposed red knot critical habitat Unit NC–5. This unit contains a high concentration of rufa red knots during the spring migration period, serving as an important northbound stopover site. Additionally, this unit contains a high concentration of rufa red knots during the winter period, providing important wintering habitat on the Southeastern U.S. portion of the subspecies range for foraging and roosting during a time of the year when rufa red knots are seeking to build energy sources for migration.

The proposed action has the potential to adversely affect wintering and migrating red knots and their habitat. Potential effects to red knots include degradation of foraging habitat and destruction of the prey base from sand disposal, and attraction of predators due to food waste from the construction crew. Like the piping plover, red knots face predation by avian and mammalian predators that are present year-round on the migration and wintering grounds. Potential effects to red knot proposed critical habitat include habitat degradation and destruction of the prey base.

Loggerhead (T), Green (T), Leatherback (E), Kemp's ridley (E), and Hawksbill Sea (E) Turtles

Loggerhead, Green and Kemps ridley sea turtles are known to nest on Topsail Island. Topsail Beach is located within loggerhead sea turtle critical habitat Unit LOGG-T-NC-03 and contains the highest-density nesting by loggerhead sea turtles in North Carolina. The other species of turtles are known to occur in the surrounding area.

Potential adverse effects of sand placement during the sea turtle nesting season include disturbance of existing nests, which may have been missed by surveyors and thus not marked for avoidance, disturbance of females attempting to nest, and disorientation of emerging hatchlings. In addition, heavy equipment will be required to re-distribute the sand to the original natural beach template. This equipment will have to traverse the beach portion of the Action Area, which could result in harm to nesting sea turtles, their nests, and emerging hatchlings.

Placement of sand on a beach in and of itself may not provide suitable nesting habitat for sea turtles. Although sand placement activities may increase the potential nesting area, significant negative impacts to sea turtles may result if protective measures are not incorporated during project construction. Sand placement activities during the nesting season can cause increased loss of eggs and hatchlings and, along with other mortality sources, may significantly impact the long-term survival of the species. For instance, projects conducted during the nesting and hatching season could result in the loss of sea turtles through disruption of adult nesting activity and by burial or crushing of nests or 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. In addition, nests may be destroyed by operations at night prior to beach patrols being performed. Even under the best of conditions, about 7 percent of the nests can be misidentified as false crawls by experienced sea turtle nest surveyors (Schroeder 1994).

Regardless of the time of year (even outside of the sea turtle nesting season), 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 sea turtle nest site selection, digging behavior, clutch viability, and hatchling emergence in the following nesting season(s) (Nelson and Dickerson 1987; Nelson 1988). There are remaining concerns about the potential for incompatible material in the borrow areas offshore Topsail Island. Recent offshore dredging activities have resulted in the placement of large amounts of rock on the beach just north of the project area. The Service appreciates the avoidance of those particular borrow areas, but the concerns remain for this offshore area in general.

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). Beach compaction and unnatural beach profiles resulting from beach nourishment activities could negatively impact sea turtles regardless of the timing of projects. 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). The placement of rocky material may have similar effects. These impacts can be minimized by using suitable sand.

A change in sediment color on a beach could change the natural incubation temperatures of sea turtle 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.

Seabeach amaranth (T)

Seabeach amaranth is an annual plant. The typical habitat where it is found includes the lower foredunes and upper beach strands on the ocean side of the primary sand dunes and overwash flats at accreting spits or ends of barrier islands. It also may be found in dune swales such as those in the area proposed for renourishment. Seabeach amaranth populations are declining range-wide, so every population is important. Historically, this area contained one of the largest populations of seabeach amaranth along the North Carolina coast. In 2016, the USFWS coordinated with the Town of Surf City, to conduct an experimental planting of seabeach amaranth in the conservation area at the south end of the island. We planted several hundred seeds on the upper beach along the oceanfront edge of the natural area. Over time, we hope to boost this population to historical numbers.

The proposed action has the potential to adversely affect seabeach amaranth and its habitat. Potential effects include burying, trampling, or injuring plants as a result of construction operations and/or sediment disposal activities; burying seeds to a depth that would prevent future germination as a result of construction operations and/or sediment disposal activities; and destruction of plants by trampling or breaking as a result of increased recreational activities. The Corps proposes to place sand over a 16-month period, including during the seabeach amaranth growing season.

Service Concerns and Recommendations

1. All of the species listed above are affected in general by coastal activity and anthropogenic disturbance. The Service is concerned for the potential for direct and indirect adverse impacts to listed species and nesting shorebirds from construction activities, presence of heavy machinery in suitable habitat, increased human activity, and increased light pollution. In addition, the Service is concerned for potential future storm recovery or erosion protection activities. Development doesn't allow beaches to move naturally, which, combined with sea level rise and increased erosion from tropical storms effectively limits the available habitat along the oceanfront portions of developed barrier islands. Rising water further limits the available habitat and results in a condition called "coastal squeeze" (Defeo et al. 2021).

2. The Service can concur with the Corps' determinations of May Affect, Not Likely to Adversely Affect for the West Indian manatee, based on the location of the borrow area and low likelihood of presence of the species.

3. The Service concurs with the species determination of "May Affect, Likely to Adversely Affect" for the loggerhead sea turtle, and the determination of "May Affect, Not Likely to Adversely Affect" for the leatherback and hawksbill sea turtles because there are no recent records of those two species on Topsail Island. However, the Service cannot concur with the determination of "May Affect, Not Likely to Adversely Affect" for the green and Kemp's ridley sea turtles. The project is likely to cause direct and/or indirect adverse effects to nesting sea turtle species, and the presence of nesting green sea turtles and Kemp's ridley sea turtles cannot be discounted in the proposed project area. The Service recommends that the Corps request the initiation of formal consultation for this project for the loggerhead, green, and Kemp's ridley sea turtles.

   The Corps has also determined that the proposed action is not likely to "adversely modify" loggerhead critical habitat. The Service recognizes that the Corps probably intended to make a determination of "Not Likely to Adversely Affect" (because the determination of adverse modification is relatively equivalent to the determination of species jeopardy). The Service recommends that effects to designated loggerhead nesting critical habitat be included in the request for formal consultation.

4. Piping plover: Although piping plover critical habitat won't be affected by the Surf City project, Topsail provides important habitat for plovers on the north and south extents. Presence of wintering birds in the middle of the island cannot be discounted. Therefore, the Service cannot concur with the determination of May Affect, Not Likely to Adversely Affect for piping plover and recommends including piping plover in the request for formal consultation.

5. Red knot: Sand placement activities will disturb migrating and wintering red knot. Individuals are likely to succumb from lack of prey availability and increased disturbance during one of their most sensitive times, migration. The formation of high-value inlet complex habitats is moot if they are unable to reach northern breeding grounds, especially since an indirect effect listed was an increase in recreational activities within red knot habitats. Long-term positive effects will not make up for increased disturbance during their most sensitive migration events. The Service cannot concur with the determination of May Affect, Not Likely to Adversely Affect for red knot and recommends including red knot in the request for formal consultation. Also, the Corps did not analyze the potential for effects to proposed critical habitat for the red knot. The Service recommends that the Corps include coordination of potential impacts to proposed critical habitat during formal consultation.

6. In order to avoid and minimize impacts to the West Indian manatee, the Service recommends that any contract for the project require adherence to the Service's 2017 Guidelines for Avoiding Impacts to the West Indian Manatee.

7. The Service acknowledges that the Corps has tested sediment quality in the currently proposed borrow areas and found it compatible, but existing survey methods may not be adequate to characterize an entire area, and there is a risk that incompatible sediment will be placed on the beach. The Corps states that it will require the contractor be present and monitor the dredge discharge location and work zone continuously while the discharge is occurring, and that frequent visual inspections of the beach placement will be conducted by a government inspector and Wilmington District technical staff. The Service appreciates the commitment to continuous sediment quality monitoring. During formal consultation, the Service would like to work with the Corps to develop other procedures as appropriate to avoid and minimize the placement of incompatible materials on the beach.

With the commitments made by the Corps in the Draft GRR/EA, the Service can concur with the Corps determination of May Affect, Not Likely to Adversely Affect for West Indian manatee and leatherback and hawksbill sea turtles. The Service also concurs with the determination of May Affect, Likely to Adversely Affect for loggerhead sea turtle. We cannot concur that the project is Not Likely to Adversely Affect the green and Kemp's ridley sea turtles, piping plover, red knot, and seabeach amaranth. The Service recommends that the Corps request initiation of consultation for these species, as well as for designated loggerhead nesting critical habitat and proposed red knot critical habitat.

The Service appreciates the opportunity to comment on this Draft GRR/EA. If you have questions regarding these comments, please contact Caroline Causey at 919-371-6785 or by e-mail at <caroline_causey@fws.gov >.

Sincerely,

For Pete Benjamin
Field Supervisor

cc (via email):

Maria Dunn, NC Wildlife Resources Commission, Washington
NCDCM, Morehead City, NC

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
Ecological Services, Eastern North Carolina Field Office
3916 Sunset Ridge Rd.
Raleigh, North Carolina, 27607

October 17, 2024

Mr. Eric Gasch
U. S. Army Corps of Engineers
69 Darlington Avenue
Wilmington, North Carolina 28403

Subject: Final Fish and Wildlife Coordination Act Report
Surf City Coastal Storm Risk Management Project
USFWS Project Code: 2024-0048393

Dear Mr. Gasch:

This letter responds to your September 16, 2024 request concerning the status of the U. S. Fish and Wildlife Service's (Service) final Fish and Wildlife Coordination Act (FWCA) Report for the U.S. Army Corps of Engineer's (Corps) Surf City Coastal Storm Risk Management (CSRM) project. This letter addresses only the Service's authorities under the FWCA. The Service will provide separate comments to the August 30, 2024 request for comments on the Draft General Re-evaluation Report and Environmental Assessment (GRR/EA) for the Surf City CSRM Project, including recommendations for consultation under Section 7 of the Endangered Species Act. In May 2010, Howard Hall of our office provided a final FWCA report for this project, known then by the name Surf City-North Topsail Beach (SC-NTB) Shore Protection Project. This project has also been previously associated with the West Onslow Beach and New River Inlet (Topsail Beach) Coastal Storm Damage Reduction Project (CSDR). The Service has coordinated at various times over the past 25 or more years on the Corps' Civil Works activities on Topsail Island. Previous points of contact on this project include:

- March 2001: The Service provided scoping comments to the Corps.
- September 9, 2003: The Service provided a Planning Aid Letter.
- June 2008, the Service provided a draft FWCA Report with 15 recommendations.
- March 2010: DOI provided comments on the draft Integrated Feasibility Report and Environmental Impact Statement (EIS).
- May 2010: the Service provided a final FWCA Report.
- December 2010: The Corps issued the final Integrated Feasibility Report and EIS

- March 2014: The Service provided comments to the July 2013 Supplemental EA for the West Onslow Beach and New River Inlet (Topsail Beach) and Surf City and North Topsail Beach CSDRs.
- April 2014: The Corps issued a Finding of No Significant Impact (FONSI) for the West Onslow Beach and New River Inlet (Topsail Beach) and Surf City and North Topsail Beach CSDRs.

The originally authorized project design template and renourishment intervals have not changed as compared to those described in the December 2010 Integrated Feasibility Report and EIS. The Service's May 2010 FWCA Report provides information concerning a larger project than is currently proposed, reaching from the boundary of Topsail Beach and Surf City limits to a point in North Topsail Beach (NTB) at the southern edge of the Coastal Barrier Resources Act (CBRA) Zone in NTB (approximately 9.9 miles). The 52,150-foot-long system was to be constructed to an elevation of 14 feet North Atlantic Vertical Datum 1988 (NAVD 88) and a 25-foot-wide crest, fronted by a 50-foot-wide berm at an elevation of 6-foot (NAVD 88) and renourished seven times over 50 years at fixed six-year intervals. Other features of the project included dune vegetation and the construction of 60 dune walkover structures. Sand for the berm and dune construction and renourishment intervals was to be taken from borrow sites identified between one and six miles off the coast of Topsail Island. The plan also included post-construction monitoring over the period of Federal participation (i.e. 50 years) to ensure project performance and adjust the renourishment plan as needed. In July of 2021, the Town of NTB announced its intention to pull out of the construction phase of the project due to financial reasons. The Town of Surf City maintained its support for a Federal project and asked the Corps to examine Coastal Storm risk reduction alternatives within its town limits.

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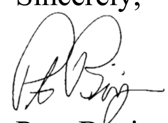
Service Recommendations under the FWCA

Though there are modifications to the project, including the extent of the affected habitat and the seasonal timing, the Service believes that the substance of the May 2010 Final FWCA Report is still valid, particularly the discussions of non-listed resources that may be present and may be affected. At this time, the Service does not recommend that a new FWCA Report be developed. We look forward to addressing potential concerns for federally listed species through consultation under the Endangered Species Act.

Thank you for the coordination with respect to the FWCA. Please contact Kathy Matthews (Kathryn_Matthews@fws.gov) or Caroline Causey (Caroline_Causey@fws.gov) if you have questions or concerns.

Sincerely,



Pete Benjamin
Field Supervisor