APPENDIX A

SCOPING DOCUMENTS

orientation. Currently, Cambria has a population of approximately 6,400 permanent residents with a substantial tourist and second home population.

The CCSD provides water supply, wastewater collection and treatment, fire protection, garbage collection, and a limited amount of street lighting and recreation. The CCSD currently serves a population of about 6,400 as well as a large number of visitors to the Central Coast and covers approximately four square miles. The relatively remote location of Cambria has resulted in the area relying solely upon local groundwater for its water supply.

3. *Proposed Project.* To study, plan, and implement a project to provide for a reliable water supply for the community of Cambria in San Luis Obispo County, CA.

4. *Alternatives.* Potential water supply alternatives were compiled from studies conducted by the CCSD over a period of more than ten years identifying and evaluating potential sources of additional potable water for CCSD. The alternatives initially being considered for the proposed project include seawater desalination, local and imported surface water, groundwater, hard rock drilling, and seasonal reservoir storage.

5. *Scoping Process.*

a. Potential impacts associated with the proposed project will be fully evaluated. Resource categories that will be analyzed include: Physical environment, geology, biological resources, air quality, water quality, recreational usage, aesthetics, cultural resources, transportation, noise, hazardous waste, socioeconomics and safety.

b. The Corps intends to hold a public scoping meeting(s) for the EIS/EIR to aid in the determination of significant environmental issues associated with the proposed project. Affected federal, state and local resource agencies, Native American groups and concerned interest groups/individuals are encouraged to participate in the scoping process. Public participation is critical in defining the scope of analysis in the Draft EIS/EIR, identifying significant environmental issues in the Draft EIS/EIR, providing useful information such as published and unpublished data, and knowledge of relevant issues and recommending mitigation measures to offset potential impacts from proposed actions. The time and location of the public scoping meeting will be advertised in letters, public announcements and news releases.

c. Individuals and agencies may offer information or data relevant to the environmental or socioeconomic impacts of the proposed project by submitting comments, suggestions, and requests to be placed on the mailing list for announcements to (see **ADDRESSES**) or the following email address: *kathleen.s.anderson@usace.army.mil.*

d. The project will require concurrence by the California Coastal Commission with the federal Coastal Consistency Determination in accordance with the Coastal Zone Management Act, as well as certification under Section 401 of the Clean Water Act from the Regional Water Quality Control Board. Depending upon the recommended alternative, the project may also require additional real property rights for construction and operation of a facility, and compliance with the Endangered Species Act.

6. *Scoping Meeting Date, Time, and Location.* The Public Scoping Meeting will take place on March 15, 2012, 7 p.m. to 9 p.m., Veterans Hall, 1000 Main Street, Cambria, CA 93428.

7. *Availability of the Draft EIS/EIR.* The Draft EIS/EIR is scheduled to be published and circulated in September 2012. Pursuant to CEQA, a public hearing on the EIS/EIR will be held by the CCSD following its publication.

Dated: February 15, 2012.

R. Mark Toy,

Colonel, U.S. Army, Commander and District Engineer, Los Angeles District.

[FR Doc. 2012–4313 Filed 2–23–12; 8:45 am]

BILLING CODE 3720–58–P

DEPARTMENT OF DEFENSE

Department of the Army; Corps of Engineers

Intent To Prepare a Draft Environmental Impact Statement (EIS) for the Installation of a Terminal Groin Structure at Lockwood Folly Inlet and to Conduct Supplemental Beach Nourishment Along the Eastern Oceanfront Shoreline of Holden Beach, in Brunswick County, NC

AGENCY: Department of the Army, U.S. Army Corps of Engineers, DoD.

ACTION: Notice of intent.

SUMMARY: The U.S. Army Corps of Engineers (USACE), Wilmington District, Wilmington Regulatory Field Office has received a request for Department of the Army authorization, pursuant to Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbor Act, from the Town of Holden Beach to develop and implement a shoreline protection plan that includes the installation of a terminal groin structure on the west side of Lockwood Folly Inlet (a federally maintained navigational channel) and the nourishment of the oceanfront shoreline along the eastern end of Holden Beach.

DATES: A public scoping meeting for the Draft EIS will be held at Holden Beach Town Hall, located at 110 Rothschild Street in Holden Beach, on March 8, 2012 at 6 p.m. Written comments will be received until March 26, 2012.

ADDRESSES: Copies of comments and questions regarding scoping of the Draft EIS may be submitted to: U.S. Army Corps of Engineers, Wilmington District, Regulatory Division. ATTN: File Number 2011–01914, 69 Darlington Avenue, Wilmington, NC 28403.

FOR FURTHER INFORMATION CONTACT: Questions about the proposed action and Draft EIS can be directed to Mr. Mickey Sugg, Project Manager, Wilmington Regulatory Field Office, telephone: (910) 251–4811. Additional description of the Town's proposal can be found at the following link, *http://www.saw.usace.army.mil/WETLANDS/Projects/index.html,* under Holden Beach Terminal Groin and Nourishment Project.

SUPPLEMENTARY INFORMATION: 1. *Project Description.* Over the past decades, the eastern end of Holden Beach has experienced consistent and relatively severe erosional conditions along the oceanfront shoreline and primary dune system. As a result of chronic erosion, the Town has implemented, typically in coordination with the U.S. Corps of Engineers federal channel maintenance dredging, periodic beach nourishment activities within this eastern stretch and near the inlet. These measures have been short-term in nature; and it is the Town's desire to implement a long-term beach and dune stabilization strategy. As stated by the Town, this strategy would help protect public and private infrastructure from future storms. Their proposal includes constructing a terminal groin near the Lockwood Folly Inlet (western side) and conducting supplemental sand placement along the eastern end of the island. Final locations and placement of sand will be determined during the project design process. For the groin structure, final location and design has yet to be determined. No groin structure is proposed on the opposite, or eastern, side of Lockwood Folly Inlet.

2. *Issues.* There are several potential environmental and public interest issues that will be addressed in the EIS. Additional issues may be identified during the scoping process. Issues initially identified as potentially significant include:

a. Potential impacts to marine biological resources (benthic organisms, passageway for fish and other marine life) and Essential Fish Habitat.

b. Potential impacts to threatened and endangered marine mammals, birds, fish, and plants.

c. Potential impacts associated with using inlets as a sand source.

d. Potential impacts to adjacent shoreline changes on the east side Lockwood Folly Inlet, or along the Town of Oak Island.

e. Potential impacts to Navigation, commercial and recreational.

f. Potential impacts to the long-term management of the inlet and oceanfront shorelines.

g. Potential effects on regional sand sources and how it relates to sand management practices and North Carolina's Beach Inlet Management Practices.

h. Potential effects of shoreline protection.

i. Potential impacts on public health and safety.

k. Potential impacts to recreational and commercial fishing.

l. The compatibility of the material for nourishment.

m. Potential impacts to cultural resources.

n. Cumulative impacts of past, present, and foreseeable future dredging and nourishment activities.

3. *Alternatives.* Several alternatives and sand sources are being considered for the development of the protection plan. These alternatives will be further formulated and developed during the scoping process and an appropriate range of alternatives, including the no federal action alternative, will be considered in the EIS.

4. *Scoping Process.* A public scoping meeting (see **DATES**) will be held to receive public comment and assess public concerns regarding the appropriate scope and preparation of the Draft EIS. Participation in the public meeting by federal, state, and local agencies and other interested organizations and persons is encouraged.

The USACE will consult with the U.S. Fish and Wildlife Service under the Endangered Species Act and the Fish and Wildlife Coordination Act; with the National Marine Fisheries Service under the Magnuson-Stevens Fishery Conservation and Management Act and the Endangered Species Act; and with the North Carolina State Historic Preservation Office under the National Historic Preservation Act. Additionally, the USACE will coordinate the Draft EIS with the North Carolina Division of Water Quality (NCDWQ) to assess the potential water quality impacts pursuant to Section 401 of the Clean Water Act, and with the North Carolina Division of Coastal Management (NCDCM) to determine the projects consistency with the Coastal Zone Management Act. The USACE will closely work with NCDCM and NCDWQ in the development of the EIS to ensure the process complies with all State Environmental Policy Act (SEPA) requirements. It is the intention of both the USACE and the State of North Carolina to consolidate the NEPA and SEPA processes thereby eliminating duplication.

6. *Availability of the Draft PEIS.* The Draft EIS is expected to be published and circulated by early 2013. A public hearing will be held after the publication of the Draft EIS.

Dated: February 14, 2012.

S. Kenneth Jolly,

Chief, Regulatory Division.

[FR Doc. 2012–4305 Filed 2–23–12; 8:45 am]

BILLING CODE 3720–58–P

DEPARTMENT OF DEFENSE

Department of the Army; Corps of Engineers

Revised Notice of Intent To Prepare a Draft Environmental Impact Statement for the Brunswick County Beaches, NC, Coastal Storm Damage Reduction Project

AGENCY: Department of the Army, U.S. Army Corps of Engineers, DoD.

ACTION: Notice of Intent.

SUMMARY: The U.S. Army Corps of Engineers (USACE), Wilmington District (Corps) is currently conducting a General Reevaluation Report (GRR) for the Brunswick County Beaches, NC, Coastal Storm Damage Reduction (CSDR) Project. The Corps intends to prepare a Draft Environmental Impact Statement (DEIS) to evaluate the impacts of the proposed CSDR alternatives to reduce coastal storm damages from beach erosion in the towns of Holden Beach, Oak Island, and Caswell Beach, North Carolina. An array of structural, non-structural, and no action alternatives are being evaluated. Current analyses suggest that the dune and berm beach fill alternative maximizes net CSDR benefits for the project area beaches and provides additional environmental and recreation benefits. An offshore borrow area has been identified within the Southwestern portion of Frying Pan Shoals (FPS) (located off the coast of Cape Fear, North Carolina) to provide beach compatible sediment for the 50-year life of the project.

The DEIS is being prepared in accordance with the requirements of the National Environmental Policy Act (NEPA) of 1969, as amended, and will address the relationship of the proposed action to all other applicable Federal and State Laws and Executive Orders.

DATES: The earliest the DEIS will be available for public review would be August 2013.

FOR FURTHER INFORMATION CONTACT: Questions about the proposed action and DEIS can be answered by Mr. Doug Piatkowski, Environmental Resources Section; U.S. Army Engineer District, Wilmington; 69 Darlington Avenue, Wilmington, North Carolina 28403; telephone: (910) 251–4908; email: *douglas.piatkowski@usace.army.mil.*

SUPPLEMENTARY INFORMATION:

1. Previous Notice of Intent (NOI) publication. This notice is a revision of an August 26, 2003, NOI (68 FR 51257) to prepare a DEIS and is prepared in response to changes in the proposed action, availability of new information relative to the proposal and associated impacts, and the significant amount of time which has passed since the last NOI.

2. Authority. Federal improvements for CSDR along a segment of the ocean shoreline in Brunswick County, North Carolina, were authorized by the Flood Control Act of 1966 (Pub. L. 89–789). The most applicable text is copied below.

> The project for hurricane-flood control protection from Cape Fear to the North Carolina—South Carolina State line, North Carolina, is hereby authorized substantially in accordance with the recommendations of the Chief of Engineers in House Document Numbered 511, Eighty-ninth Congress.

3. Project Purpose. The project purpose is reduction of damages from beach erosion for the towns of Caswell Beach, Oak Island (the former towns of Long Beach and Yaupon Beach have been incorporated as the Town of Oak Island), and Holden Beach, North Carolina. If implemented, the project would also enhance the beach area available for recreation use and provide habitat for a variety of plants and animals.

Significant environmental resources to be addressed in the DEIS include, but are not limited to: (1) Endangered and threatened species; (2) Marine and estuarine resources; (3) Upland beach and dune resources; (4) Fish and wildlife and their habitats; (5) Essential Fish Habitat (EFH) and Cape Fear Sandy Shoals; (6) Water and air quality; (7) Socioeconomic resources; (8) Cultural

US Army Corps
Of Engineers
Wilmington District

PUBLIC NOTICE

Issue Date: February 24, 2012
Comment Deadline: March 26, 2012
Corps Action ID #: SAW-2011-01914

All interested parties are herby advised that the Wilmington District, Corps of Engineers (Corps) is holding a scoping meeting for work within jurisdictional waters of the United States that is proposed by the Town of Holden Beach. Specific plans and location information are described below and are available on the Wilmington District Web Site at http://www.saw.usace.army.mil/WETLANDS/Projects/index.html

Applicant:
Town of Holden Beach
C/o: Mr. David Hewett (Town Manager)
110 Rothschild Street
Holden Beach, North Carolina 28462

Contracting Engineer:
Applied Technology & Management, Inc. (ATM)
C/o: Mr. Fran Way
360 Concord Street, #300
Charleston, South Carolina 29401

Authority

The Corps will evaluate this project pursuant to applicable procedures for Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbor; and will prepare an Environmental Impact Statement (EIS) to assess the proposal. The Corps will be coordinating with North Carolina Division of Coastal Management and North Carolina Division of Water Quality in the development of the EIS to ensure the process complies with all State Environmental Policy Act (SEPA) requirements.

Location

The project site is located at 33-54-53.59 N, 78-14-35.80 W, and encompasses approximately 0.75 miles of Holden Beach ocean and inlet shoreline, starting from the east side of Lockwood Folly Inlet and moving westward near Avenue B and McCray Street, in Brunswick County, North Carolina.

Existing Site Conditions

The Town of Holden Beach is an approximate 8.0-mile long barrier island with the Town of Ocean Isle Beach located to the west and Long Beach (Oak Island) to the east. The island is a south facing island, bordered by Shallotte Inlet to the west, Lockwood Folly Inlet to the east, Atlantic Intracoastal Waterway (AIWW) to the north, and the Atlantic Ocean to the south. It is a typical North Carolina barrier island that has undergone a variety of natural and anthropogenic changes. The majority of the island has been developed by residential activities, but does contain a small concentrated area of commercial buildings located near the high rise access bridge. Over the last decade, separate authorizations have been granted to the Town, as well as individual owners and developments, to conduct various activities, such as dredging, beach bulldozing, and shoreline nourishment, within waters of the U.S. along the ocean shoreline. It should also be noted that the Corps has performed several beach nourishment projects associated with its Federal navigation maintenance activities.

Applicant's Stated Purpose

The stated purpose of the project is to implement an erosion control and beach/dune restoration that will provide long-term protection to residential structures and Town infrastructure along the east end of Holden Beach. This proposal, which would complement existing island wide nourishment activities, is also expected to maintain and promote a recreational beach area along with public parking and access points.

Project Description

In the 1970s, a temporary terminal groin, consisting of 15 sand-filled nylon tubes, was constructed to protect the east end of the island from erosion. The Town deemed that the groin field was successful and economical, but was short-term in nature. With chronic erosion at the east end continuing, the Town is proposing a long-term shoreline protection solution by installing a single terminal groin and conducting supplemental beach nourishment. Plans for the terminal groin, at this time, are preliminary conceptual layouts based on shoreline movement and historic conditions. The general design goals include: protection of public access, stabilization of the east end of the island, improvement of recreational beach area, enhancement of upper beach/dune habitat, and to reduce beach and AIWW dredging maintenance costs.

Two conceptual terminal groin layouts have been evaluated: Groin Alternative 1 and Groin Alternative 2. Groin Alternative 1 consists of a groin structure approximately 1,600 linear feet long that would be directly located along Lockwood Folly Inlet shoulder. This rubble (rock) structure would include a 'spur' feature which extends out perpendicular near the base, or tie-in footing, of the groin. The terminal groin profile would be similar to the existing Fort Macon groin along Beaufort Inlet in Carteret County (i.e., crest height ~7 ft MLW, crest width ~10 ft, and 2:1 side slopes). Groin Alternative

2 would be located in the general area near the terminus of Ocean Boulevard East. The conceptual design for this rubble (rock) structure has the length between 400-600 linear feet with an asymmetric T-Head feature at the seaward end of the groin. The T-Head design is expected to enhance the fillet formation and to help minimize the formation of potential rip currents.

Both groin alternatives will involve supplemental beach nourishment to help form the structure's fillet area (or shoreline area adjacent to the structure). The beach fill footprint and volumes would be directly related to the size and configuration of the terminal groin, and therefore are also conceptual. Fill footprint for Groin Alternative 1 would encompass approximately 27 acres on the west side of the structure. Assuming a 40 cy/ft unit fill placement, approximately 160,000 cubic yards of material will be required for the fillet area. With Groin alternative 2 being shorter, the conceptual footprint contains approximately 14 acres and includes both the east and west sides of the structure. Assuming a 30 cy/ft unit fill placement for the fillet, approximately 80,000 cubic yards of material will be required. Potential options for sand sources are the following: 1) Corps Lockwood Folly Inlet AIWW dredging, 2) Corps Lockwood Folly Inlet outer channel dredging, 3) Upland Borrow Areas (Turkey Trap Road Site, Smith Borrow Site, & Tripp Site), and 4) Upland Dredge Disposal Islands (Monks Island & Sheep Island).

This notice is to inform interested parties that a scheduled public scoping meeting for drafting the EIS will be held on March 8, 2012 at 6:00 P.M in the Holden Beach Town Hall Public Assembly at 110 Rothschild Street in Holden Beach. The scoping meeting is designed to solicit comments from the public; Federal, State and local agencies and officials; and other interested parties to incorporate in the Draft EIS document. The purpose of these comments concerning public interest factors, ranging from navigation to biological resources to private and public lands, will identify issues to be addressed in the Draft EIS.

Additionally, this notice announces that our Notice of Intent to prepare an EIS for this project will be published in the Federal Register on February 24, 2012 and can be found on the Federal Register website, http://www.gpo.gov/fdsys/browse/collection.action?collectionCode=FR . After connecting with the website, click through the dates to February 24, 2012 (Friday). Click on "Army Department"; and locate the Holden Beach project.

As disclosed in the Notice of Intent, any written comments pertinent to the proposed work, as outlined above, must be submitted to this office, Attention: Mickey T. Sugg, and received by March 26, 2012. Questions can be directed to Mr. Sugg at telephone (910) 251-4811, Wilmington Regulatory Field Office.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE

Southeast Regional Office
263 13th Avenue South
St. Petersburg, Florida 33701-5505
(727) 824-5317; FAX (727) 824-5300
http://sero.nmfs.noaa.gov/

March 26, 2012 F/SER4: RS/pw

(sent via electronic mail)

Colonel Steve Baker, District Engineer
US Army Corps of Engineers
P.O. Box 1890
Wilmington, North Carolina 28402-1890

Attention: Mickey Sugg

Dear Colonel Baker:

NOAA's National Marine Fisheries Service (NMFS) has reviewed Action ID No. SAW-2011-01914, dated February 24, 2012. The Town of Holden Beach proposes to construct a terminal groin at the Town's eastern end adjacent to Lockwood Folly Inlet in Brunswick County. In the public notice, the Wilmington District announces its intent to prepare an Environmental Impact Statement (EIS) for the permit action and requests the public and resource agencies identify relevant issues for the Draft EIS. As the nation's federal trustee for the conservation and management of marine, estuarine, and diadromous fishery resources, the following comments and recommendations are provided pursuant to the authorities of the Fish and Wildlife Coordination Act and the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act).

Description of the Proposed Project
To reduce chronic erosion on the eastern end of the Town of Holden Beach in the 1970s, the Town constructed a terminal groin with 15 sand-filled nylon tubes. The Town concluded the terminal groin abated the erosion, but the results were not long lasting and the erosion has continued with frequent beach nourishment used to provide limited protection. The Town is proposing a permanent terminal groin as a long-term solution. The terminal groin would be located along 0.75 miles of Holden Beach starting from the eastern side of Lockwood Folly Inlet and moving westward to near Avenue B and McCray Street. The purpose of the terminal groin would be to augment other efforts to control erosion and restore the beach and dunes to protect residential structures and Town infrastructure along the eastern end of Holden Beach. The other efforts primarily include beach nourishment.

The public notice describes two potential designs for a terminal groin. Groin Alternative 1 is a structure approximately 1,600 feet long adjacent to the south shoulder of Lockwood Folly Inlet. The rock rubble structure would include a "spar" that extends perpendicular from near the base or tie-in footing of the groin. The profile of the groin would be similar to the existing groin at Fort Macon adjacent to Beaufort Inlet. Groin Alternative 2 is a rock structure 400 to 600 feet long with an asymmetric T-Head feature on the seaward end; this groin would also be located near the terminus of Ocean Boulevard East. The T-Head is designed to enhance fillet formation and to minimize rip currents. Both groin alternatives involve beach nourishment. Groin Alternative 1 would include a fill area of approximately 27 acres in the surf zone, while Groin Alternative 2 would fill approximately 14 acres. Up to 160,000 cubic yards of sandy fill would be required to create the fillet area alternatives.

Need for an Essential Fish Habitat Assessment

Hackney et al. (1996) provide the most recent review of the scant scientific literature that is available about the surf zone. Surf zones typically harbor a diverse fish fauna. Nearly 50 species of fish have been reported from the surf zone of North Carolina beaches, including many species that are commercially or recreationally important or serve as prey for such species. This number is suspected to be considerably lower than the actual number because over 130 species of fish have been recorded in studies of the surf zone with South Carolina and Georgia. Many of the life stages of fish found within the surf zone are also found in nearby estuaries, suggesting that the surf zone is a nursery habitat; Florida pompano and kingfish are the species most likely to rely upon the surf zone as their principal nursery habitat. Late spring to early summer is the major recruitment period for larval and juvenile fish to the surf zone, which is later than the period of maximal recruitment to estuarine nursery areas. In terms of biomass, peak use of the surf zone occurs in the fall when juvenile and adult fish leave estuaries and migrate along the coast. It is generally thought that use of the surf zone as a migratory corridor is vastly under documented with respect to their actual use. The more common fish within the surf zone consume both benthic invertebrates and plankton. Siphon cropping (grazing) also has been reported among surf zone fish when clams, such as coquina clams, were present. If siphon cropping is common, reported rates of secondary production within the surf zone would likely be underestimates if the measurements were based only on standing-stock biomass. In short, little is known about the value of surf zone habitat to fish, but the limited literature that is available suggests the value is high.

Based on coordination with your staff, we understand an essential fish habitat (EFH) assessment will be prepared for the project. Based on the location of the proposed project, we confirm that this assessment is necessary. The EFH assessment may be submitted as a standalone document or integrated with the EIS; 50 CFR § 600.920 describes the contents of an EFH assessment in a tiered manner. For all projects, the assessment should include: (i) a description of the action, (ii) an analysis of the potential adverse effects of the action on EFH and managed species, (iii) federal action agency's (i.e., Wilmington District's) conclusions regarding the effects of the action on EFH, and (iv) proposed mitigation, if applicable. For complex projects and projects expected to have major impacts to EFH, the assessment should also include: (v) results of an on-site inspection to evaluate the habitat and the site-specific effects of the project, (vi) views of recognized experts on the habitat or species that may be affected, (vii) a review of pertinent literature and related information, (viii) an analysis of alternatives to the action, and (ix) other relevant information needed to gauge the expected impacts and to assess potential alternatives.

Given the importance of surf zone habitat and tidal inlets to federally managed fishery species and to state managed fishery species, NMFS advises the Wilmington District to include all of the above items in the EFH Assessment. We recommend the focal species for the EFH assessment include: white shrimp, brown shrimp, pink shrimp, Spanish mackerel, sheepshead, gag grouper, sharpnose shark, summer flounder, and bluefish. In addition to these federally managed species, this area also likely provides habitat for red drum, black drum, Atlantic menhaden, blue crab, and grass shrimp, which are important prey for federally managed species and should be included in the assessment. Please note that the Atlantic populations of red drum were managed under the Magnuson-Stevens Act until November 5, 2008; hence guidance on EFH assessments prepared before that date may indicate a requirement to describe impacts to red drum EFH. For your EFH assessment, discussions of potential impacts to red drum should be grouped with the state-managed species.

NMFS recommends the following focal issues for the EIS:

- Use of surf zone and nearshore areas by larval fish. Abele et al. (2010)[1] provide an excellent example for how this study could be done.
- Characterization of the migration of larval and young juvenile fish through Lockwood Folly Inlet and Shallotte Inlet.
- Characterization of the ebb and flood tidal shoal complexes associated with Lockwood Folly Inlet and Shallotte Inlet and how the terminal groin would affect the size and location of these shoals.
- Examination of how the terminal groin would alter longshore sediment transport and the resulting points of erosion and accretion as well as the granulometry of the beach sediments.

Thank you for the opportunity to provide these comments. Related questions or comments should be directed to the attention of Mr. Ronald Sechler at our Beaufort Field Office, 101 Pivers Island Road, Beaufort, North Carolina 28516-9722, or at (252) 728-5090.

Sincerely,

/ for

Virginia M. Fay
Assistant Regional Administrator
Habitat Conservation Division

cc:

COE, Mickey.T.Sugg@usace.army.mil
USFWS, Pete_Benjamin@fws.gov
NCDCM, Doug.Huggett@ncmail.net
EPA, Fox.Rebecca@epa.gov
SAFMC, Roger.Pugliese@safmc.net
F/SER4, David.Dale@noaa.gov
F/SER47, Ron.Sechler@noaa.gov

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[1] Kenneth W. Able, Dara H. Wilber, Angela Muzeni-Corino and Douglas G. Clarke. 2010. Spring and Summer Larval Fish Assemblages in the Surf Zone and Nearshore off Northern New Jersey, USA. Estuaries and Coasts 33:211-222

TOWN OF OAK ISLAND NORTH CAROLINA CHARTERED JULY 1, 1999

RECEIVED
MAR 2 6 2012
REG. WILM. FLD. OFC.

March 23, 2012

Mr. Mickey Sugg, Project Manager
U.S. Army Corps of Engineers
Wilmington District
69 Darlington Avenue
Wilmington, North Carolina 28403-1343

RE: HOLDEN BEACH TERMINAL GROIN STRUCTURE AND SUPPLEMENTAL BEACH NOURISHMENT
FILE NUMBER: 2011-01914

Dear Mr. Sugg:

The following comments/concerns regarding the referenced project are submitted on behalf of the Town of Oak Island.

Comments – Proposed Terminal Groin Structure

1. The potential short and long term impacts of the project concerning erosion/accretion along the shoreline of the west end of Oak Island should be studied and include modeling and a monitoring plan.
2. At a minimum, the shoreline-monitoring plan should extend to 13th Place West.
3. The modeling should predict the impact of the terminal groin on the ebb channel alignment and account for differences along a shallow draft inlet verses a deep draft inlet.

Comments - Proposed Holden Beach Supplemental Beach Nourishment

1. Impact on Brunswick County Beaches Coastal Storm Damage Reduction Project

   Please verify that this offshore borrow site has been eliminated from consideration as a sand resource for the Oak Island-Holden Beach portion of this project because of insufficient volumes of compatible sediment to support the project's volume needs. Also, please verify that this site is not an additional sand source identified as complementary sources with limited borrow capacity for this project.

2. Impact on Oak Island shoreline

   Please verify that this offshore borrow site is beyond the depth of closure for the Oak Island shoreline so that the proposed dredging would not affect either the historical long-term erosion rates or short-term storm induced erosion and wave heights.

2. Impact on Lockwoods Folly Inlet

   Please verify that this offshore borrow site is beyond the zone of influence for Lockwoods Folly Inlet so that the proposed dredging would not affect either the symmetry of the ebb-tidal delta complex or the ebb channel alignment.

3. Potential for recharge and subsequent use of borrow site

   Please determine the potential for recharge of this borrow site after the proposed dredging occurs including the length of time to recharge and the sand source for recharge.

Thank you for your consideration.

Respectfully,

Teresa Frazier
for Carol Painter
Town Council
Town of Oak Island

Gene Kudgus
Gene Kudgus, PE
Public Services Director
Town of Oak Island

CC: Tom Hogg, Interim Town Manager, Oak Island
David Hewitt, Town Manager, Holden Beach

NCDENR
North Carolina Department of Environment and Natural Resources
Division of Marine Fisheries

Beverly Eaves Perdue
Governor

Dr. Louis B. Daniel III
Director

Dee Freeman
Secretary

MEMORANDUM:

TO: Mickey T. Sugg, Project Manager, Wilmington USACE Regulatory Field Office

THROUGH: Anne Deaton, DMF Habitat Section Chief AD

FROM: Jessi Baker, DMF Habitat Alteration Permit Reviewer JB

SUBJECT: Holden Beach Terminal Groin Draft EIS - Scoping

DATE: March 27, 2012

The North Carolina Division of Marine Fisheries (DMF) submits the following comments pursuant to General Statute 113-131. Representatives from DMF attended an agency scoping meeting in Wilmington, NC for the Holden Beach terminal groin on October 12, 2011. DMF has reviewed the Corps of Engineers Public Notice and the Holden Beach Work Plan for installing a terminal groin. Holden Beach proposes to install a terminal groin with supplemental beach nourishment at the east end of Holden Beach. Two groin alternatives are presented, a longer one close to the inlet and shorter one to the west and closer to existing ocean front homes.

The 2010 Coastal Habitat Protection Plan (CHPP) summarizes the latest scientific information available to assess the status and threats to marine fish habitats. The CHPP process brings state regulatory agencies together to implement the recommendations from the CHPP. The CHPP states that research is needed to determine when and where recruitment to adult fish stocks is limited by larval ingress to estuarine nursery habitats. The CHPP also states that the long-term consequences of hardened structures on larval transport and recruitment should also be thoroughly assessed prior to approval of such structures. DMF has concerns that terminal groins will alter larval transport and impact important fish habitats through altered beach and nearshore sediment and profile.

Impacts to Larval Transport

Terminal groins can potentially interfere with the passage of larvae and early juveniles from offshore spawning grounds into estuarine nursery areas. Successful transport of larvae through the inlet occurs within a narrow zone parallel to the shoreline and is highly dependent on along-shore transport processes (Blanton et al. 1999; Churchill et al. 1999; Hare et al. 1999). Obstacles such as jetties adjacent to inlets block the natural passage for larvae into inlets and reduce recruitment success (Kapolnai et al. 1996; Churchill et al. 1997; Blanton et al. 1999) (from 2010 CHPP).

DMF requests a detailed scientific field investigation, analysis, and modelling of larval transport dynamics that exist in and near Lockwoods Folly Inlet. This information should be used to model estimated impacts of a groin of different sizes and locations to larval ingress and egress through the inlet.

Impacts to Fish Habitat

DMF has significant concerns about the use of hardened shoreline stabilization techniques along high energy ocean shorelines due to accelerated erosion in some location along the shore as a result of the longshore sediment transport being altered. These structures may also modify sediment grain size, increases turbidity in the surf zone, narrow and steepen beaches, and result in reduced intertidal habitat and diversity and abundance of macroinvertebrates. Anchoring inlets may also prevent shoal formation and diminish ebb tidal deltas, which are important foraging grounds for many fish species (Deaton et al. 2010). Changes to the surf zone or inlet could affect species that depend on these areas for nursery, spawning, or foraging.

DMF requests a field investigation of the current distribution of larval and juvenile fishes in the vicinity of the inlet and proposed groin locations as well as another similar inlet as a control. These data can identify the most highly utilized habitat areas as well as serve as baseline data to compare to larval and juvenile fish monitoring data that should be collected after groin construction.

Due to the potential for altered sediment grain size, beach profile and intertidal habitat due to the influence of a groin, DMF requests benthic macroinvertebrate monitoring within the impact area of the proposed groins.

Based on these concerns, DMF also requests detailed discussions of the following be included in the EIS.

- All Essential Fish Habitat (EFH)and state protected habitats that occurs in this area
- All fish habitats outlined in the most recent NC Coastal Habitat Protection Plan (CHPP) that occur in the area
- Characterization of fish and invertebrate composition and abundance in the inlet and adjacent surf zone
- Compilation of relevant research regarding larval transport through inlets, especially inlets with hardened structures
- Potential impacts to the benthos of the surf/swash zone and nearshore areas and a detailed plan to monitor for impacts within the impact area of the proposed groins
- Potential impacts to wetlands due to anticipated erosion on the north end of the island
- Potential impacts to commercial or recreational fishing including any indirect economic impacts due to adverse impacts to fish and fish habitat
- Potential direct impacts from dredging, beach placement, and nearshore placement and how those impacts will be minimized
- Potential impacts on regional sand budgets

If the USACE would like assistance in locating information regarding the above topics or has any other questions, please contact Jessi Baker at (252) 808-8064 or jessi.baker@ncdenr.gov.

From: Sugg, Mickey T SAW [Mickey.T.Sugg@usace.army.mil]
Sent: Wednesday, August 08, 2012 9:14 AM
To: Way, Francis; Dawn York
Cc: David Hewett
Subject: Comments for Holden Bch
Attachments: On the Continued Costs of Beach Upkeep Related to Groins and Jetties.doc

These are comments from Len Pietrafesa (Prof. at NCSU & Coastal Carolina) concerning the proposed TG at Holden. I had put these with Figure 8 proposal and didn't notice until last week that the comments were for Holden and not Figure 8.
-mickey

Mickey Sugg, Project Manager
US Army Corps of Engineers
69 Darlington Avenue
Wilmington NC 28403-1343
(910) 251-4811 (o)
(910) 251-4025 (fax)

-----Original Message-----
From: Len Pietrafesa [mailto:ljpietra@ncsu.edu]
Sent: Friday, July 06, 2012 7:29 AM
To: Sugg, Mickey T SAW
Subject: Re: Statement

Mickey:
Here is a more recent write-up, which will be published in a peer reviewed journal, for your interest.
Best regards,
Len

On 2/28/2012 10:27 AM, Sugg, Mickey T SAW wrote:
> Mr. Pietrafesa,
>
> Thank you for your interest in our review of the Town's proposal; and I hope that your family situation works out well. Your comments are appreciated and will be incorporated in the preparation of the Draft EIS. Please note that the public will also be given the opportunity to comment on the Draft and Final EIS, as well as when the Town's permit application is submitted to our office.
>
> If you have any questions regarding our review process, pls do not hesitate to call me anytime.
>
> Sincerely,
> Mickey
>
> Mickey Sugg, Project Manager
> US Army Corps of Engineers

> 69 Darlington Avenue
> Wilmington NC 28403-1343
> (910) 251-4811 (o)
> (910) 251-4025 (fax)
>
>
> -----Original Message-----
> From: Len Pietrafesa [mailto:ljpietra@ncsu.edu]
> Sent: Tuesday, February 28, 2012 10:01 AM
> To: Sugg, Mickey T SAW
> Subject: Statement
>
> Mr. Sugg:
> My name is Len Pietrafesa.
> I am a Professor Emeritus at North Carolina State University (NCSU) and a Burroughs & Chapin Scholar at Coastal Carolina University.
> I was Head of the Department of Marine, Earth & Atmospheric Sciences at NCSU for more than a decade, was the Chair of the NOAA Science Advisory Board and have served and continue to serve on numerous national and state (of NC) environmental and science policy committees and boards.
>
> Unfortunately I have a family situation that needs attending and I will not be able to attend the March 8 meeting. However I am submitting a "statement" regarding the Town of Holden Beach 's proposed East End Shoreline Terminal Groin.
>
> My statement regarding said groin is:
>
> "The placement of a terminal groin at the east end of Holden Beach will cause significant damage via destructive effects upon downstream beaches including those to the immediate west of the groin on Holden Beach and to all of the beaches of Ocean Isle Beach and Sunset Beach; both to the west of Holden Beach.
> The reason for the destructive effects is due to the blockage by the proposed groin of natural, westward moving sediments which emanate from the Cape Fear and Lockwoods Folly Rivers, from re-suspension of marine sediments during storm passages and from the natural flows of the wave and current fields.
> This will then result in an increasing number and more costly beach re-nourishment projects and also lawsuits against the Town of Holden Beach by homeowners on Holden Beach and Ocean Isle and Sunset Beaches. This scenario has occurred repeatedly wherever groins and jetties have been built along the eastern seaboard of the United States, including Fort Macon and Pea Island."
>
> Thank you,
> Len Pietrafesa
>
>
>

December 20, 2012

Mickey Sugg
Project Manager
U.S. Army Corps of Engineers
69 Darling Avenue
Wilmington, NC 28403-1343

RE: Holden Beach Terminal Groin Proposal Comment Letter on the Project Review Team's Meeting held on September 3, 2012: Corps Action ID#: SAW-2011-01914

Dear Mr. Sugg,

Please accept these comments regarding the Project Review Team (PRT) meeting held on September 6, 2012. These comments supplement our comment letter submitted to you on March 26, 2012. In that letter, among other issues, we expressed concerns about the application of the term "imminently threatened structure" as well as about the applicant's premature statement of the preferred alternative.

The Holden Beach Work Plan states that the purpose of the proposed project is to reduce high erosion losses at the east end of the island. In addition, the Plan states that "erosion rates through 2011 are slightly less than 2003 rates." Based on this information, during the PRT meeting the town claimed about 30 to 40 houses as "imminently threatened" in the proposed project area and in need of protection. Furthermore, during the meeting it was stated that 24 homes had been lost from 1995 to 2001, but that no homes were lost since 2001.

Rule (15A NCAC 07H .0308 (a)(2)(B)) states that: … *a structure shall be considered imminently threatened if its foundation, septic system, or right-of-way in the case of roads, is less than 20 feet away from the erosion scarp. Buildings and roads located more than 20 feet from the erosion scarp or in areas where there is no obvious erosion scarp may also be found to be imminently threatened when site conditions, such as a flat beach profile or accelerated erosion, increase the risk of imminent damage to the structure.*

The first part of this rule defines an "imminently threatened" structure in terms of its distance (20 feet) to the erosion scarp. There are currently no structures within 20 feet of the erosion scarp at Holden Beach within the project area. This is clearly shown by a distance approximation using Google Earth tool, which reveals that the average distance between 23 structures at the end of the island and the erosion escarpment is 222 feet and not 20 feet as prescribed by the rule.

The second part of the administrative code regarding “imminently threatened” structures allows for some structures located farther than 20 feet from the erosion scarp to be considered “imminently threatened” *when* the beach in front of them is in the process of accelerated erosion. However, this is not the case in Holden Beach. Close examination of the newly proposed erosion rates data provided by the Division of Coastal Management (DCM) reveals that the beach in front of the structures located on the east end of the island has accreted since 2009. This shows that the beach is not eroding in an accelerated rate as described by the rule.

Furthermore, the comparison of 1998 erosion rates and the 2009 rates shows that the erosion rate has decreased. Erosion rates for all the transect lines on the east end of the island decreased. This decrease ranges from 10 percent to 50 percent depending on the transect line, with an average of 32 percent of decrease in erosion rates from transects 520 to 560. This rate of decrease is rather more significant than “slightly less” as claimed in the project Work Plan and it supports the finding by the town that it has not lost any structure since 2001, expressed during the PRT meeting. For example, at the transect line #553 where the short version of a terminal groin is proposed the DCM is proposing a 10 percent lower erosion rate compared to the one in 2004.

Finally, the sandbags that have been placed on the eastern end of Holden Beach are currently covered by sand and vegetation and are not considered a priority for removal by the DCM. Current criterion for prioritization of sandbag removal followed by the DCM is beach access. Those sandbags that negatively affect and prevent beach access because they are exposed due to accelerated erosion are considered a priority for removal. This is characteristic of beaches that are either stable or accreting. On the other hand, on quickly eroding beaches sandbags are usually exposed and surrounded by erosion scarps. Clearly, that is not the case in Holden Beach.

For these reasons, the declared purpose of the project is misleading and fundamentally flawed. No structures in Holden Beach are “imminently threatened” under either definition of the rule. In order to support its claim the town should prepare a list of the structures it considers imminently threatened and support this claim with facts. The lack of “imminently threatened” structures or infrastructure means that the proposed project is not eligible for a permit under the state law that pertains to terminal groins. N.C. General Statute 113A-115.1(f)(2) requires the applicant to demonstrate that:

> *… structures or infrastructure are imminently threatened by erosion and that nonstructural approaches to erosion control, including relocation of threatened structures are impractical.*

Furthermore, the federation has already expressed, but would like to emphasize its concern with using modeling tools to project future inlet behavior. While these modeling tools can be useful in obtaining a general idea, they certainly cannot and should not be used as a case in point for predicting future events with certainty. The accuracy of these models is an important unknown and in highly complex and dynamic systems such as inlets and their surroundings, these models are unreliable tools for decision-making. Even the third party contractor that used the modeling tools to estimate future inlet behavior was unable to give an answer when asked about the accuracy of the model during the PRT meeting. This shows that the town and the agency should not be placing significant amount of weight in their decision making on a tool whose accuracy is unknown.

We have been surprised to find that technical documentation about the calibration and sensitivity analyses of the models that could support their use is not provided to your agency or for public evaluation. We have sought this information directly from the third party contractor as well, and to date it has been non-responsive in providing this technical documentation that verifies the accuracy and limitations of these models as used.

It was explained during the PRT meeting that no maintenance cost is needed since the proposed structure needs basically no maintenance. The N.C. General Statute 113A-115.1(e)(6) clearly requires the applicant to show proof of financial assurance for a variety of actions related to the proposed structure: for long term maintenance and monitoring, implementation of mitigation measures, modification or removal of the structure and restoration of public, private and public trust properties. It is clear that in order to comply with this requirement of the law, the Town of Holden Beach needs to present the abovementioned financial assurance. If there is truly no maintenance cost associated with the project, that is a clear indication that the beach is not eroding and therefore no structures are “imminently threatened.”

It is worrisome that during the PRT meeting the presenter of the proposed project already stated there was very little environmental impact from the preferred alternative, given that a full environmental analysis as required by the National Environmental Policy Act has not yet been done. The extent of the environmental impacts can only be assessed after a full Environmental Impact Statement has been performed as required by the NEPA.

The federation has significant concerns about the proposed project. The Corps must ensure that the NEPA process is applied correctly and that the issues described in this letter are addressed.

We appreciate the opportunity to comment and be involved in this project. Please do not hesitate to contact us if you have any questions of need any clarification of these preliminary comments. We intend to fully participate in the development of this EIS, the review of project permits, and any court proceedings that might follow.

Thank you.

Sincerely,

Ana Zivanovic-Nenadovic
Program and Policy Analyst

Cc: Todd Miller
Braxton Davis
Bob Emory
Joan Weld
Doug Hugget

From:	Sugg, Mickey T SAW
To:	"Ana Zivanovic-Nenadovic"
Cc:	Todd Miller; Bob Emory; Braxton C Davis; Griff & Joan Weld; Huggett, Doug; Pruitt, Carl E SAW
Subject:	RE: Holden Beach Terminal Groin PRT Comment Letter (UNCLASSIFIED)
Date:	Tuesday, March 05, 2013 2:24:00 PM

Classification: UNCLASSIFIED
Caveats: NONE

Ms. Ana,

Hope all is well; and as promised, this is my response to your December 20, 2012 e-mail and attached letter.

In your letter, the majority of the content references North Carolina statues and rules which are under the regulatory authority of NC Division of Coastal Management. As our regulations do not use the term "imminently threatened structure", I would refer you to DCM for the State's interpretation and implementation of the rule for the Holden Beach Terminal Groin Project. This recommendation would also hold the same for issues concerning sandbags and financial assurances or other requirements under SB110. Although our office does not interpret or enforce the mentioned state laws or statutes, we certainly do consider them in our permit review, especially in this case where the EIS is being developed to help satisfy both NEPA and SEPA requirements.

Please keep in mind, and as stated in the September 2012 PRT meeting, it is the Town's responsibility to define what their purpose and need is for the project. Our responsibility is to ensure that the applicant's stated P&N is not so narrowly defined that it will unfairly conclude that the least environmentally damaging practicable alternative (LEDPA) is automatically the applicant's.

Our office does concur with your statement that models are useful tools "in obtaining a general idea" and should not be used for "predicting future events with certainty". Please understand that models are used to help in our decision-making and are not used solely in our permit decision.

In ending, I would like to say that we share NCCF's position that the NEPA process must be applied correctly, and we take great strides in ensuring this.

I apologize for taking so long to provide you response. If you have any questions concerning this or any other aspect of our review for the project, pls don't hesitate to call me.

Sincerely,
-mickey

-----Original Message-----
From: Ana Zivanovic-Nenadovic [mailto:anaz@nccoast.org]
Sent: Thursday, December 20, 2012 2:42 PM
To: Sugg, Mickey T SAW
Cc: Todd Miller; Bob Emory; Braxton C Davis; Griff & Joan Weld; Huggett, Doug
Subject: Holden Beach Terminal Groin PRT Comment Letter

Dear Mickey:

Please find attache the N.C. Coastal Federation's Comment letter on Holden Beach Terminal Groin proposal PRT meeting held on September 3, 2012. If you have any questions, please do not hesitate to contact me.

Best regards,
Ana

Ana Zivanovic-Nenadovic

Program and Policy Analyst
North Carolina Coastal Federation
3609 Highway 24
Newport (Ocean), NC 28570
Phone: (252) 393-8185
anaz@nccoast.org

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Classification: UNCLASSIFIED
Caveats: NONE

Holden Beach East End Shore Protection Project

Project Review Team Meeting #1

Holden Beach Town Hall

06 September 2012 minutes

These minutes represent a summary of the first Project Review Team meeting for the Holden Beach East End Shore Protection Project. A list of participants is provided at the end of this document.

Introduction

Mickey Sugg introduced himself at 10:02 am and indicated the meeting will be informal and open discussion format. A scoping meeting took place 8 March 2012, however, **Mickey** reiterated the reason United States Army Corps of Engineers (USACE) and NC Division of Coastal Management (DCM) are involved. In the fall of 2011 Holden Beach approached the USACE to conduct shoreline protection and therefore initiated the NEPA process.

Mickey indicated the USACE gets involved when fill material is placed below MHW within waters of the U.S. Further discussion on the USACE's involvement included:

- Permits include Section 10 and Section 404, laws mandated by USACE regulations.
- National Environmental Policy Act (NEPA) provides guidelines for the USACE;
- The Project Review Team directly relates to NEPA and indirectly to Section 404;
- A permit proposal includes review of severity of action. An EIS is required if it is determined that the action will bring harm to human environment.
- Context of effects – national, state, and local importance, magnitude and severity of effects on aquatic resources and navigation – all these are taken into consideration for EIS determination.
- In most cases, the applicant will conduct an EA; if a determination is made for significant impacts, then an EIS is required. However, due to potential impacts, beneficial or detrimental, then an applicant will decide an EIS is the more effective route.

Project Review Team

The USACE has initiated the scoping process and will reach out to all agencies/stakeholders for relevant issues and potential impacts within the work area; this is why the Project Review Team (PRT) has been developed. In developing this team, **Mickey** indicated the participating parties represent large constituents within the project area and this is why many have been chosen (i.e. non-profit, environmental, homeowner, etc). The USACE/State will seek input from the PRT to help determine how the proposal will affect varied interests. The PRT is not a decision-making body, **Mickey** pointed out. The USACE is seeking input to identify relevant issues and potential problems with the proposed project.

Introductions were made and **Mickey** explained that the USACE doesn't have the in-house resources to develop the Environmental Impact Statement (EIS) on their own; therefore, a third party contractor was hired and managed by the USACE to assist in the development of the EIS. **DC&A's** role is the third party contractor.

Project Purpose and Need

Mickey reviewed the presentation agenda, including alternatives and engineering aspects. **Fran Way**, project engineer with Applied Technology and Management (ATM) started the presentation at 10:20 am with project purpose and needs (P&N). **Mickey** explained that the P&N drives the Town's proposal and is generally defined by the applicant. The USACE will assess the P&N and could revise or narrow them. It is typical for the USACE to request a more general purpose so that many alternatives can be assessed. The P&N can change if the project changes, there is some built-in flexibility. The purpose is meant to be a simple and brief statement, such as, "To implement an erosion control and beach/dune restoration". Project needs frames the purpose and includes measurable items to help support the purpose. By establishing a P&N, the USACE can identify the proper list of alternatives.

Doug Huggett then briefly described the history of the hardened structure ban and SB110 that amended CAMA, DCM's enabling legislation. SB110 allows for up to 4 terminal groins (TG) to be permitted. In addition to permitting, the bill sets forward specific requirements including:

- Preparation of an EIS to accompany any project that is trying to obtain a TG permit to meet requirements of SEPA. SEPA allows the State to defer to a NEPA document that is set-up during a joint process with USACE.

- TG must be proven necessary for imminently threatened structures.

- Non-structural alternatives must be proven as impractical (a judgment determination but no definitive formula).

- Applicant has to prepare an inlet management plan that will accompany TG permit application including plan for placement of sand concurrent with TG construction.

- Legislation requires monitoring and thresholds to be developed for a proposed project (assess TG for impacts to threatened structures) upfront so that mitigation can be implemented.

- Mitigation can include a process for beach erosion to be identified and monitoring to take place, such as removing structures, removing TG, and placing sand on beach.

Doug indicated that this is the first time NCDCM has had to deal with this type of project and will learn as we go. NCDCM will work with the Town to move the project forward as there are many requirements. NCDCM is not reading the bill literally and will assist applicants to move projects forward. **Doug** explained the EIS needs to answer many questions and additional information may need to be included in the permit application.

Dr. Bill Cleary asked in the event a scenario arises that the threshold is exceeded, who makes the decision that it is due to the TG? **Doug** said NCDCM fully understands that erosion happens with and without the groin, that there are other circumstances due to storms that cause changes to the beach independent of the groin. **Mickey** stated the responsibility will fall on the applicant to justify that erosion is not due to the TG. **Doug** iterated monitoring thresholds will need to include error bars. **Mickey** added the Town can rely on engineers to help make a determination. The applicant needs to show that effects occurred as a result of to the TG and the reasons behind the effects. **Doug** said when the bill came out; NCDCM was more reactive verses proactive because thresholds have to be developed upfront. The NCDCM Science Panel has provided guidance however he has the same concerns as Dr. Cleary. Figure 8 Island developed a monitoring plan with criteria including: if a certain beach exceeded the erosion rate for more than two years running, then it allows for short-term nourishment events to occur. **Doug** added that mitigation is not kicked in until needed. **David Hewett** reiterated the inlet management plan requires thresholds to be set before the project is constructed.

Dr. Cleary explained that changes can occur very rapidly within an inlet. **Jay Holden** agreed and indicated Lockwood Folly Inlet has changed greatly within the last few months. **Dr. Cleary** indicated he sits on the Science Panel and this is a very difficult decision to make. **Doug** agreed. **Mickey** stated the USACE and NCDCM have been coordinating since the bill has been initiated, as it is a state law and mandated by NCDCM. For example, a particular requirement/condition set by NCDCM, the USACE may not enforce. However, the EIS is adopted by both the USACE and NCDCM and therefore requirements/conditions are adopted by both agencies. Some issues may not be addressed in the EIS and will be addressed in supporting documents.

Dr. Cleary asked if the issues consisted only of the physical aspects (i.e. shoreline changes) or were they also biological. **Doug** replied that in the past a proactive monitoring plan has been put in place to consider biological issues relating to the recreational beach, infrastructure, and the private and/or public beach. Resource agencies have the expertise to address biological issues, **Doug** added. The senate bill is focused on physical issues. **Mickey** indicated mapping and beach profiles can help us look at biological aspects.

Kathy Matthews (USFWS) suggested reviewing the P&N as the purpose (protection of structures and infrastructure) are not reflected in the needs. She added that scoping documents indicate the tax base is important. **Mickey** also mentioned the tourist industry. **Kathy** said many needs listed could be problematic. **Mickey** suggested the town consider other needs to include.

Sara Schweitzer (NCWRC) requested monitoring of coastal resources should include biological resources. **Doug** indicated every beach nourishment project allows for monitoring of potential adverse impacts to shorebirds, marsh islands, etc. **Doug** suggested not setting up impact thresholds for biological resources and allowing NCWRC to make an assessment and present mitigative measures to the Town. He added that setting up thresholds is problematic, so the past process will continue. **Sara** commented there are opportunities here for a research situation including structure impact on shorebirds, benthic communities, etc. We have a real opportunity for this type of work and can contribute to knowledge of impacts of structures whether they are positive, negative, or neutral. **Doug** responded that we plan on addressing those impacts, but will minimize application of threshold determinations. He said we should continue the development of a good biological monitoring plan on a reactive basis rather than setting up triggers upfront. **Mickey** added that before we get to monitoring, we need to assess impacts and resource to be impacted. We can't assume an impact will take place on a particular resource. He recommended a review of Chapter 6 (Avoidance and Minimization Measures) of previous projects which included a large range of biological monitoring.

Alternatives

Mickey said alternatives are the heart of the EIS. The EIS does not include a detailed alternative analysis such as the one developed in the Record of Decision. Cost, technology, and logistics are all included in the analysis, which results in the USACE's Least Environmentally Damaging Practicable Alternative (LEDPA). The LEDPA may be the preferred alternative, or it may be another alternative. The EIS will include the identification of the Applicant's Preferred Alternative based on purpose and needs, including the resident's needs. The USACE relies on the applicant to tell them what they want to do, as the USACE does not define or change what the Applicant's Preferred Alternative is, but the USACE can make suggested changes and provide guidance. NEPA defines alternatives in terms of reasonable alternatives.

Mickey continued, as the EIS is drafted, a section will be included describing the reasonable alternatives carried through analysis as well as alternatives that were not considered reasonable and applicable justifications.

The alternatives that have been drafted as of today include: 1) No Action; 2) Abandon/Relocation; 3) Inlet Relocation with Beach Nourishment; 4) Terminal Groin Structure with Beach Nourishment; and 5) Beach Nourishment only with various borrow sites.

- The No Action Alternative (#1) is interpreted as no permit (federal action) will be issued from the federal government including actions such as sandbags, dredging the AIWW, beach placement, and beach bulldozing. **Mickey** explained the other interpretation of the No Action Alternative is to continually manage as you manage the beach today (i.e. rely on USACE for AIWW dredging and beach placement, sandbag permits, trucking in from offsite area, and includes permits for smaller actions).

- The Abandon/Relocation Alternative (#2) is self-explanatory and may include those homes that may have already taken this action.

- The Inlet Relocation with Beach Nourishment Alternative (#3) is an alternative the town evaluated before the Senate Bill 110 was passed.

- The TG with Beach Nourishment Alternative (#4) will include various options of design and location.

- The Beach Nourishment Alternative (#5) can include borrow sites from AIWW, offshore, upland, etc.

Mickey asked the group if there were any questions or other alternatives that haven't been identified and there was no response. He reiterated the USACE will have to make the LEDPA decision defined as practicable and based on costs, logistics, and technology. The USACE will also make a determination in the ROD on the environmental alternative with the least amount of impacts on the natural and biological environment.

Mickey indicated the USACE has set-up a special projects page for Holden Beach which includes public notices. **Doug** mentioned North Topsail Beach has a completed EIS for a beach nourishment/inlet management project, but with no TG component. **Mickey** said these documents will provide an idea of the EIS format.

Overview of Engineering Presentation

Fran presented the project site depicting net sand transport north to south, although there are exceptions. Offshore Holden Beach is known as sand starved; North Carolina Beach and Inlet

Management Plan defines this as hardbottoms with limited sediment cover. **Fran** showed the general section of shoreline that is of concern, specifically on the east end including Dunescape property and Avenue E.

Holden Beach Activities

Ongoing Holden Beach activities include a proposed Central Reach Beach Nourishment Project. A permit has been issued by the State and a USACE Federal permit is in final review. Sediment characteristics are different in the east end as it is a highly erodible area. Hurricane Irene impacted the shoreline and the Town is conducting ongoing dune restoration. Annual monitoring is being conducted inlet to inlet.

Fran explained that federal projects are variable based on the availability of federal funds. Federal projects on Holden Beach include: 1) AIWW dredging to maintain navigation with beneficial use to the east end, and 2) Brunswick County 50-year project includes Holden Beach and forecasts to be completed with assessment in 2014. **Mickey** asked if the central reach permit is different than FEMA funded project. **Fran** answered yes, a total of 30,000 cy of material was lost during the past storm. The central reach project proposed to nourish with 1.3 million cy of material which is considered a large project. Holden Beach would like to activate existing permits and mobilize a dredge. **Mickey** asked if Holden Beach would implement the permit and go to construction this winter (2012). **David** answered that they would like to if they can get the Federal permit. **Fran** said the town would like the flexibility of winter placement in 2012 with the permit to have 3 to 5 years of flexibility.

Fran reviewed activities from 2000 to 2012 in which beach management has increased since the 90's. The central reach is the largest section of shoreline with a moderate erosion area. In 2001 and 2002, the USACE conducted beach placement with the Wilmington Harbor project; and the town conducted a gap project to help fill in spots. The east end project is approximately 3,000 to 4,000 feet in length, and is the same shoreline the USACE places material from AIWW. **Fran** continued indicating the western three miles of Holden Beach is accretional and no beach management activities have taken place. **Mickey** asked if they had identified hotspots on Holden Beach due to chronic erosion outside of the east end. **Fran** replied there was no uniform erosion, however erosion is within a range and material is placed on the eastern end of the central reach. The shoreline profiles tend to pick up the material continuing to move to the west.

Mickey asked how many structures have been lost on the east end. **Fran** said 24 homes from 1995 to 2001. **Kathy** asked if these structures were lost during particular events. **Fran** answered no, indicating the loss was from ongoing chronic erosion. **He** continued indicating Dr. Cleary has conducted studies in the 80's and 90's and erosion is dependent on the outer bar channel within the inlet. **Mickey** asked if all those homes were in the 3,000-foot stretch of the proposed East End project. **Fran** replied some structures were further west based on old aerials.

Dr. Cleary said the eastern end of the island is triggered by ebb channel orientation (ship channel) and literally wags its tail like a dog. When it is skewed in one direction, the end of the island builds up and the other side erodes. When the navigation channel was dredged, the inlet took many years to equilibrate. **Fran** added that preliminary modeling results show some sensitivity to ebb channel changes. The channel is ephemeral, although dredged quarterly. **Fran** indicated USACE federal funding has decreased and the towns/county/state had picked up the tab in 2011 for outer channel dredging. Long-term erosion trend and studies implicate outer channel alignment and longer term erosion issues to the east end. **Kathy** asked if any houses had been lost since 2001. **Fran** replied no, and added there has been no significant storm. However, there was a dune breach in 2008 due to Hurricane Hanna. The Holden Beach dune system on the east end is minimal; as volumes are not adequate for storm protection. **Mickey** asked if the dunes built in 2005 were from a truck haul project. **Fran** said yes, post-storm Hurricane Hanna maintenance was conducted in 2008 in which the dunes were rebuilt. **He** added that the USACE AIWW project does not have a dune feature in their nourishment project. **Mike Giles** asked how many houses are currently imminently threatened. **Fran** answered on the east end there are 20 to 30 that are imminently threatened. **He** added that the NC Terminal Groin study, identified over $34 million structures within the 30-year risk line.

Monitoring

Fran continued with the engineering presentation and reviewed the annual monitoring analysis. Transects exist inlet to inlet to monitor volume and shoreline change to ensure adequate beach management planning and FEMA compliance. **Mickey** asked if monitoring profiles reach out to -20' or -30'. **Fran** indicated the profiles monitor the shoreline out to -25'. Monitoring transects include Oak Island and Lockwood Folly Inlet. Based on the NC Beach and Inlet Management Plan, the western end of Oak Island is not currently monitored. **Mickey** asked if the transects on the east end of Holden Beach go to the inlet and if this information will be used to develop thresholds/monitoring conditions. **Fran** responded that the USACE continues to survey the inlet. **Mickey** asked if older profiles (since 2001) include inlet shoulders. **Fran** said yes, they include the inlet shoulder.

According to **Fran**, existing biological monitoring data includes sediment compatibility, bean clams, mole crabs, and ghost crabs.

Layton Bedsole asked if the relic infrastructure, a result of erosion due to past storms, was still present on the shoreline. **Fran** said yes. During low tide and erosional conditions, there are old pieces of road that are uncovered. **David** stated there are no archaeological artifacts at the present-time. **Fran** indicated the east end lost up to 20 cy/ft, a significant amount of sand, as a result of Hurricane Hanna. **He** added this amount is equal to one small nourishment event completed by the USACE - Navigation.

Lockwood Folly Inlet

Fran discussed the abundance of migrating inlets in NC, documented to move several hundred feet every year, but not the case for Lockwood Folly Inlet. Past studies have reviewed inlet movement and determined Lockwood Folly Inlet to be stable. This information will be taken into consideration in the formulation of alternatives including channel relocation vs. inlet relocation.

Fran explained sediment transport develops flood channels and creates erosional areas. **Mickey** asked if there is accretion on Oak Island and sediment moves across inlet, is it bypassing the east end and not welding to shoreline. **Fran** replied yes, Lockwood Folly Inlet is a smaller inlet and has smaller shoal features and they do attach on the east end, but then migrate into inlet. **Mickey** asked if there was not enough material. **Fran** answered no. **Dr. Cleary** said Nick Kraus conducted studies three or four years ago and determined littoral drift is up to 125,000 cy of material/year. **Fran** stated that in the 70's, it was established a net transport is to the east. Since the 80's, net transport is to the west. Dr. Krauss conducted a cascade model study in 2008 in which approximately 125,000 cy of material was getting trapped into the inlet. The USACE determined this is a good estimate. Sediment budgets have been calculated for this area and funded by the USACE. ATM general modeling shows agreement with USACE's sediment budget.

Fran continued and indicated the outer channel orientation is affecting erosion along Holden Beach. Channel alignment to the south or southwest is more favorable and would be less erosional to Holden Beach. If alignment is to the southeast, then the east end of Holden Beach is more erosional. The shoreline is erosional in either case, but less erosional. **Fran** indicated thru the depiction of aerials the east end was very erosional in 1993 and more stable in 2004, with some structures at risk.

Based on the Brunswick County parcel map there are approximately 15 homes that are no longer on the east end as shown by the 1993 aerial. **Layton** asked about the date of parcels platted. **Jay Holden** replied 1937 as his grandfather was the one that conducted the survey.

Borrow Area Alternatives

Fran discussed the borrow area alternatives based on potential and historic borrow areas the town has used. Upland borrow areas have been used for the past decade. According to **Fran**, the Smith Site is still available whereas Turkey Trap is owned and permitted as a borrow area. The town wants to maintain Turkey Trap for emergency/post-storm nourishment events as they can mobilize quickly and mitigate erosion losses. Additional sites include: Sheep's Island and Monks Island, upland confined disposal facilities, developed from maintenance of the AIWW. **Mickey** asked how much material is available within the Turkey Trap upland borrow area. **Fran** said approximately 400,000 cy, and it is beach compatible, however there are areas that will not be used. **Fran** confirmed upland sites will be preferentially used as they are easier to access and conduct geotechnical investigations.

Offshore borrow area studies were conducted, although related to the proposed central reach project. **Fran** explained that Dr. Cleary has conducted offshore research as well as the USACE funded large seismic and geotechnical studies to find offshore resources. In 2003, the USACE delineated a large area up to 60 million cy. The area was delineated based on geotechnical data however recently collected vibracores showed sediments with high fines. **Fran** confirmed that offshore Holden Beach there is not a lot of beach compatible sand that is worth retrieving. In 2009, ATM performed additional investigations with additional cores. **Fran** confirmed the proposed offshore borrow area is within the 3-mile limit to avoid a dual regulatory process with BOEM.

Fran said the general location of the proposed borrow area for the central reach project is offshore Oak Island; the other borrow areas described had certain characteristics that made them not worthwhile such as identified rock/debris and potential archaeological significance.

It was explained by **Fran,** that the Lockwood Folly Inlet/AIWW crossing and maintenance project placed approximately 140,000 cy of material in 2010. Under AIWW regulations, a bend widener can be used which is typically 150' wide; however in 2010 it was widened to 400'. The first time it was utilized by the USACE, funding was significant. The AIWW crossing is a very promising area with lots of material. In 2013, the USACE is not anticipated to conduct maintenance due to lack of funding and a small amount of material recovered in 2012. **Fran** explained that the AIWW crossing at Lockwood Folly Inlet is low priority for the USACE. **Mickey** asks if the compatibility analysis was done in 2010. **Fran** said yes, however the vibracores were collected in 2009. **Fran** reiterated the AIWW crossing contains compatible material.

Dr. Cleary asked how the removal of material from the AIWW crossing affects the value of the sediment transport material that was quoted as 125,000 cy. **Fran** replied that Coastal Science and Engineering conducted a Lockwood Folly River and eastern channel study in which currents and water levels were analyzed. Existing currents are 5'/second and flow is primarily thru the AIWW and then the inlet. Flows are strong and maintain current depths in the AIWW. **Fran** explained that the 400-foot bend widener is key to the proposed east end project. **Doug** asked if there is the intention of beach placement at regular intervals. **Fran** answered yes. **Doug** asked if the borrow area assessment is taking into account the need for additional material. **Jay** answered that the AIWW was dredged four consecutive winters and that is why this past year there was less material. **Fran** said that in 2007, a shallow draft report developed by the State discusses the maintenance event in which over the last decade there has been annual and biannual projects. ATM conducted a volume calculation from July 2012 and determined there is approximately 80,000 to 90,000 cy of material present within the bend widener.

Fran continued the borrow area discussion and described truck haul from upland sites is good for medium sized projects, including approximately 200,000 cy of material per event. Truck haul includes minor mob/demob costs as construction consists of trucks and excavators. Sediment color is not as good as the sediment within the offshore/inlets, and that has been an issue in the past. With smaller events over larger areas, the projects have to be done more frequently and the town has to take into account road wear and coordination with NCDOT.

Rich indicated Sheep's Island has increased in size over the last few years due to sediment accretion. **Fran** replied it could be considered as a potential borrow area but it depends on vegetation and from a permitting standpoint, it can be difficult due to importance of resources to birds. **Fran** iterated the AIWW crossing/bend widener is subtidal. **Kathy** added that the shoals around Sheeps Island are within the piping plover critical habitat area.

Fran continued and indicated the Turkey Trap upland borrow area contains approximately 460,000 cy based on available vibracore data. Although there are some wetlands and buffer areas, revegetation plans and ground monitoring are in-place. The Town owns the Turkey Trap borrow area, which is seen as a resource, but keeps it for emergency back-up. The Smith site is still available and has been used successfully for several nourishment events. The owner has indicated the Town could purchase a certain portion for beach compatible material.

Fran described the Tripp upland borrow area as a 150-foot deep lake containing beach compatible sand with appropriate color for upland sand. **Mickey** asked if there was 300,000 to 400,000 cy of material. **Fran** replied yes.

With regards to sediment criteria, **Fran** explained that the offshore borrow area has been permitted, passing all criteria. **Mickey** stated the upland sites may have an issue of color from a nesting turtle standpoint. **Mickey** asked if ATM had analyzed Munsell color characteristics. **Fran** said yes as well as a temperature sensitivity test, as it is related to turtle sex. The town ensured that different sand colors would not affect temperature. The temperature sensitivity study was conducted in 2004. **Mickey** asked if the survey was done by hand or with dataloggers. **Fran** responded that it was done by hand with probes at different depths over a range of control and impact sites.

Dr. Cleary asked about the longevity of inland/upland borrow areas. **Fran** replied that Turkey Trap borrow area has been used for two nourishment events whereas the Smith borrow area has been used once and the Tripp borrow area was used twice.

Conservatively, there is over 2 million cy within the offshore borrow area, **Fran** explains however cost is an issue. Mobilization for a hopper dredge has been estimated to be $4 million. In 2009, the volumes of Sheep Island and Monk Island confined disposal facilities were calculated, but there is a layer cake of good and bad material and would require mechanical separation. As these islands are valuable habitats, they are not as practical as borrow areas.

Fran explained the existing inlet channel is 150 feet wide at 6 feet depth (USACE authorized), sand volume is minimal and another issue is shipwrecks. There has been a time or two where the USACE has dredged the channel close to the wrecks. **Mickey** asked if the material from the inlet is just to build the fillet. **Fran** answered yes, and a bit downstream. This is a smaller project than the proposed Figure 8 project.

Terminal Groins

Fran indicated ATM has had some experience in SC, FL, and Caribbean permitting groins. **He** recommended to the group reviewing the discussion on terminal groins in the Journal of Coastal Research.

With regards to natural resource threats, **Fran** explained that USFWS and NMFS have a recovery plan however data is insufficient to calculate mortality of sea turtles with structures. Threat analysis is inconclusive for structures as it relates to turtles.

A low profile rock terminal groin is preferred by ATM, **Fran** said. This type of terminal groin doesn't prohibit walking and will be buried post-construction. A mitigation step for groins could include notching of the groin as has been done in GA and NJ.

A lunch break was taken at 12:25pm, the meeting resumed at 1:35pm.

Alternatives Discussion

With regards to the No Action Alternative, **Fran** described that 24 homes have been lost to erosion on the east end from 1995 to 2001. Oak Island estimated a No Action cost of $62 million. Road/structure debris remains (photos in 2008 on east end, old road and homes shown). **Kathy** asked which type of No Actions he was referring to. **Mickey** replied no action is defined as they are managing the oceanfront shoreline now. **Mickey** asked about individual sand bags, were they waiting for the USACE dredge to pump sand on the east end? **Fran** said yes, assuming the USACE's activities are going to continue, but it seems that these activities may not continue. **Kathy** stated she was trying to determine the difference between the alternatives, No Action and Abandon/Relocation.

Fran continued and reiterated inlet vs. channel relocation and this alternative is considered channel relocation, as Cleary discussed earlier. The channel orientation has been to the east side more often. The USACE follows deep water due to less resistance. Today the channel is more centrally located, based on a July 2012 survey. Sidecast dredge works the outer inlet channel bar, but is not as effective.

According to the USACE Shallow Draft Inlet report for Lockwood Folly Inlet, the outer bar channel has been maintained since the 1980's. A range of 50,000 cy has been placed annually on the east end from the USACE's navigation maintenance work. **Fran** confirmed the USACE is not conducting dredging in 2013 which is based on future funding.

With regards to the terminal groin alternatives, **Fran** explained, Alternative 1 terminal groin is similar to the terminal groin at Fort Macon and proposed for the Figure 8 project. The terminal groin has a proposed design length of 1,600 feet with the upland portion buried to prevent flanking. The active beach part is 700 feet below MHW. Alternative 2 terminal groin, as depicted in the engineering presentation, will be placed at end of existing beach structures. At this time only a conceptual rendering exists.

Modeling

Fran described preliminary modeling results. The following information is brief summary points, however, additional information can be found in the engineering presentation.

- ATM utilized and applied NOAA's Wavewatch data to drive the model. ATM used various model applications such as Genesis which was secondary in nature and was primarily used for the central reach project. CMS is a relatively new model developed by Waterway Experimental Station, developed in the last five years and is under constant improvements.

- Wave height and wave period roses depict sediment transport. Longer wave periods are more efficient at driving sediment transport.

- Bathy and topographic data sources: CSE (2008) conducted a survey in Eastern Channel and Lockwood Folly River.

- Flow and sediment grid with bathymetry was developed. Data was calibrated to CSE 2008 data; current and flow measurements where gauges were deployed. In terms of the flow in and out of the inlet, 80% of flow goes to west, only 20% of flow runs behind Holden Beach. It's an interesting system with the largest flow going towards the river.

- Sediment transport roses shows where the sediment transport is occurring along Oak Island and Holden Beach. These numbers are in line with literature and indicate gross transport. The net is not that big, with a general range of 100,000 cy of material going into the inlet. 2008 was large for sediment transport due to Hurricane Hanna. ATM has been in contact with the Waterways Experimental Station to review model results.

- Holden Beach East sediment transport transect results indicate a lot of sand movement in this area; the key is near shore sediment transport is going towards inlet, with offshore material moving west in a regional sense. In summertime, southwest conditions prevail with more westerly transport.

Results of Studies

Fran described the general results of the Alternatives modeling runs with each component analyzed separately to determine impacts. The base case included 2009 runs over 190 days. Preliminary results indicate the inlet channel is moving with varying erosion/accretion. Base run is defined as the No Action Alternative.

The short groin alternative, **Fran** explained, includes sand placed only on the western end of the groin. Results indicate there is much localized accretion due to the short groin and nourishment. The short groin alternative keeps material in place and negligible impacts are seen elsewhere. **Doug** asked if the preliminary results for the short groin were showing no change. **Fran** said there was an 80,000 cy change. **Mickey** asked if the change was over a one-year timeframe. **Fran** replied it was only for 190 days. **He** indicated ATM will run some of the alternatives for one year, but not all of them. **Fran** stated there were no impacts to the inlet channel.

He continued by describing the short terminal groin with the AIWW borrow area resulted in positive effects however the inlet channel is hugging Holden Beach. Since the bend widener in the AIWW is filled, water has to make a hard left into the inlet which creates erosional pressure on the east end of Holden Beach. If the town uses the AIWW, then it will release the pressure.

The long terminal groin alternative with nourishment, **Fran** explained shows nourished material on the west end of the groin. The channel training is up to the groin, which agrees with USACE literature. The channel moves closer to Holden Beach. **Fran** confirms that the longer terminal groin alternative affects a greater area. **Doug** asked if channel migration will cut off Holden Beach as well as flanking the backside of the island. **Fran** indicated the design includes a spur on the island side which will mitigate any potential flanking. **Mickey** asked if the modeling results would change when you look at the long-term. **Mike** asked what the effect of the groin is on the long-term. **Fran** said it would be a positive effect on the west end and ATM would have to evaluate the long-term to see the effect of channel migration. The preferred alternative is leading towards a shorter groin due to localized effects seen with the preliminary modeling results.

Mike asked if sediment transport continues into the inlet with the shorter terminal groin alternative. **Fran** answered that sediment is distributed, and volume calculations downdrift impacts were approximately 8,000 cy. Any nourishment would have to account for that.

The alternative containing only nourishment, **Fran** described, results in more accretion spreading towards the west. The short terminal groin only (with no nourishment) is working as expected, with erosion on the downdrift. **Layton** asked if this is depicted in the offshore. **Fran** said the results include the dune, but changes are in the areas that remain wet. **Fran** explained that sediment transport into the inlet rates increase with nourishment and groin.

Jay asked if a short groin is built, since the net movement at the inlet is to the east, to mitigate erosion, would you pump sand east of the groin. **Fran** answered yes. The groins are impermeable in the modeling run, as conservative estimates.

Fran indicated the long terminal groin alternative only (with no nourishment) resulted in changes in the outer ebb channel related to relocation of channel due to a long terminal groin. Updrift accretion to the west of the groin was also depicted. **He** stated that nourishment offsets impacts of a long terminal groin. The Central Reach Project would result in spreading of material, however does not include the east end.

The Channel Relocation alternative involves filling in the existing channel artificially and relocating the channel. **Fran** pointed out there would be significant changes to the ebb shoal feature, but negligible changes near the shoreline. Within 6 months of the modeling run, the channel has moved.

Dr. Cleary asked what the date is of the bathymetry data used in the model runs. **Fran** said it depends on the run but predominantly ranges from 2000 to 2012. **Dr. Cleary** asked which alignment would create a more favorable result for the short terminal groin alternative. **Fran** said based on literature and model runs, if you are going to dredge an outer channel, then it should be further east. But there are not a lot of benefits to the shoreline since relocation will last about three months; as it is ephemeral and will be hard to manage. **Mickey** asked if that is because the channel dimensions are smaller than other projects. **Fran** said yes, Shallotte Inlet is large and approximately 600,000 cy of material is removed, and it is outside the ColReg line. **Mickey** asked if the relocation would stay within the federal channel and no deeper. **Fran** answered yes, and due to historic civil war shipwrecks (2), this drives the dimensional approach. **Fran** explained that a sidecaster in 2008 did hit one of the wrecks and it is limiting factor on how big the inlet channel can be.

The accuracy of the model in quantitative terms was questioned. **Fran** confirmed the model has been field tested and was calibrated against hydrodynamic features. No statistical analysis has been done.

With the Channel Relocation Alternative, **Fran** explained, the modeling results do not depict a huge benefit. **Mickey** asked if you would expect to see changes in such a short-term timeframe (190 days). **Fran** said you need to pare down alternative components, but need to conduct longer runs. **He** confirmed that the model runs are similar to bathymetry data.

Fran described the trapping capacity of the long terminal groin indicating it is hard to establish a downdrift area (approximately 16,000 cy downdrift). Morphology change is a spread out effect resulting in minimal changes in currents between the No Action Alternative and the Short Terminal Groin Alternative.

Additional modeling results are described indicating there is good agreement between the model and data. Most project decisions will be made with the CMS model, **Fran** confirms, however the Genesis model will provide additional data as it runs much faster (12 years in one hr). With the preferred project, the channel relocation is not valuable at this point for the shoreline. In general, the 30-year risk line shows approximately $34 million at the east end.

Cost

Fran explained that annualized cost for a 500-foot long terminal groin is approximately $1 million per year. **Doug** asked if the one million is for nourishment for every year or for an event. **Fran** said that depending on the amount of material, yes. **Doug** asked if there is enough sand identified to take care of 30 years of nourishment and mitigation that may be required. **Fran** said the recharge rate of the AIWW and the benefit of the terminal groin is to increase the nourishment interval. There is a long-term erosion trend on the east end that exceeds a 7 foot/yr erosion rate. Managing the shoreline with nourishment only is not cost effective.

It was asked if ATM had included cost of maintenance or repair of the terminal groin. **Fran** replied they propose a rubble mound structure which requires little to no repair/maintenance. If they use large enough rocks that don't move, the design will minimize future repairs. The groin should not be replaced. **He** explained that sometimes rock restacking can take place, but it is minor.

Doug stated that SB 110 requires financial resources that deal with removal/modifications. **He** said he understands the desire to never remove or repair, but you have to plan for worst case scenario. **He** cautions the Town to move into financial considerations and take into account the required mandate. **Fran** said the maintenance plan is important. **Doug** said that maintenance or design changes need to be liberal. **Fran** stated that in SC, you have to provide a letter of financial assurance to take ownership of a groin and any adverse impacts, which is standard policy.

The study area was depicted in which **Dr. Cleary** asked what the basis was for the study area. **Mickey** said it captures all alternatives and is different than the permit area. The boundary area establishes a boundary of modeling results and captures all resources.

Fritz asked what area would be nourished in subsequent years. **Fran** said that dependent on monitoring and storm impacts, it can be adjusted based on volume. **Mickey** said every four years, pending storm events. The key is for cumulative impacts such as impacts to fisheries, birds, benthic. They need to come up with some window granted emergency situations.

It was asked whether nourishment would occur on the western side of the terminal groin but some material would be placed immediately to the east to start downdrift mitigation. **Doug** answered that by pre-filling the groin, it will allow sand to more immediately protect the structure and mirror natural transport.

Mickey said that potential mitigation may be placing material on Oak Island if monitoring shows erosion.

It was asked whether the inlet channel would have to be maintained as it is today. **Fran** said this was a big question, that there is no big value to incorporate into the preferred alternative. The town prefers to keep channel relocation as a separate project to maintain the outer navigation channel. **Mickey** asked if the USACE is going to continue navigation maintenance. **Fran** said yes, regardless of the presence of a structure. **Fran** spoke to Dave Timpy and the town is free to dredge within the federally approved footprint whereas the permit conditions for the USACE are to follow deep water. **Mickey** said they need to define the project better, as whether the channel relocation is included. **Layton** commented on Mickey's point on developing a schedule on fillet template by project. If the USACE continues to maintain AIWW crossing, **Fran** stated he assumes whatever the Town wants to do may inhibit the USACE's beneficial placement of material.

Rich said the closer the channel is to Oak Island, the more deleterious impacts to Holden Beach. With regards to a short terminal groin at the end of McRae St., how wide of an area would be identified? **Fran** said they analyzed the benefits of groin updrift vs placement and length. **Rich** asked if there was a chance of a short terminal groin moving east towards the inlet. **Fran** answered that the farther east you go, the longer the groin will be and the larger the structure.

It was asked whether channel relocation is part of the preferred plan. **Fran** said no, due to short-term benefits and it not being sustainable long-term. It is critical for maintenance of navigation. The USACE is still following deep water and analyzing relocation. **Mickey** said the town needs to realize that the terms channel maintenance (USACE authorized) and channel relocation (town alternative) is different and difficult to understand and should be a part of this permit application, whether it is with the groin or not.

It was asked how the use of a sidecast dredge impacts the terminal groin. **Fran** stated that it was negligible, as sand is moving 50 feet one way or another as it spreads. It does not impact the beach or in the future with the groin.

A request for data/literature citations from agencies was made as it relates to existing natural resources within the study area.

Conclusion of meeting was at 3 pm.

Holden Beach
Proposed Terminal Groin/Inlet Management Plan
Project Review Team Meeting
6 September 2012

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Holden Beach East End Shore Protection Project

Project Review Team Meeting #2

May 30 2013

Meeting Minutes

These minutes represent a summary of the second Project Review Team meeting for the Holden Beach East End Shore Protection Project. A list of participants is provided at the end of this document.

Introduction

The second Holden Beach East End Shore Protection Project Review Team (PRT) meeting began approximately at 10:15 am with introductions. According to **Mickey Sugg**, the meeting will take approximately 3 hours including presentations and discussions. **Sugg** welcomed everyone for coming and their participation. As a review, **Sugg** stated the PRT is not a decision making body. The COE wants to capture all relevant issues involved with the Town's proposal and all other alternatives being evaluated. Input is valued and determined a high priority.

September 2012 was the last PRT meeting and since then, the 3rd party contractor, Dial Cordy and Associates Inc., has continued to gather relevant information and is in the process of developing a Draft EIS. ATM has developed the preliminary draft engineering report (ER). **Sugg** indicated there may be fine tuning with the ER, once that is complete it'll be posted for public review and feedback encouraged from the PRT.

Sugg stated the USACE website has been hacked in the past and destroyed the website, therefore Regulatory – Special Projects does not include all materials supporting ongoing projects. As an alternative to the USACE's website, materials can be provided on the Holden Beach website that is a likely option for minutes and presentations from today's meeting. **David Hewett** noted the slide presentations will be on the website; however links to modeling results will not be able to run on the website due to file size. **Dawn York** indicated the Draft ER is part of the EIS; therefore releasing the ER may be premature. **Sugg** stated the Draft ER will be available to only team members; however the USACE will work out the details. He then asked Doug Huggett if he'd like to include any statements.

Huggett reviewed recent ongoing proposed legislation changes in Raleigh which has passed through the Senate to change existing terminal groin law that is in the CAMA law. Coastal Management (NCDCM) is aware of proposed changes; however, unless legislation is ultimately passed by state then DCM is proceeding towards applying existing terminal groin bill and language, including financial assurances. Once a bill is passed, DCM will sit down with all four terminal groin project leads and state and federal agencies to determine how to proceed and apply the necessitated changes.

Sugg asked if anyone had any questions or comments at this point. He then introduced Fran Way with ATM who will proceed through the engineering presentation based on the Draft ER including project site review, modeling of alternatives, and cost analysis. **Way** indicated they brought several hardcopies of the Draft ER for review.

Engineering Presentation

Introduction: General Location Map. In general, the sediment transport is from east to west. In the offshore, it is generally considered sand-starved.

Way stated the Lockwood Folly Inlet and crossing will be a focus of the presentation. Ongoing Holden Beach management activities include two general areas including the East End and the Central Reach, whereas the western 3 miles is unmanaged and doesn't need active management due to accretion rates. The Central Reach section has a currently-authorized permit for beach nourishment. Island-wide there have been FEMA engineered beach nourishment activities that have occurred based on past storms, such as Hurricane Hanna. Annual monitoring and reporting does occur to maintain FEMA status. The federal projects, such as AIWW dredging and placement, the Brunswick County Beaches 50-year project, and the Lockwood Folly Outer Channel dredging (via sidecast) does occur.

Sugg asked about construction dates for the FEMA Hurricane Irene project. **Hewett** responded a 6-month extension has been requested and will be constructed in conjunction with the Central Reach project. The Hurricane Irene project includes approximately 30,000 cy of material. The East End fared well post-Hurricane Irene due to a recent beach nourishment project (2010). What is the status of the USACE 50-year project, asked **Jay Holden**? It was stated the project is ongoing and the Alternative Formulation Briefing is the next step/milestone to complete project however funding is limited.

Overview of Past East End Activities

Way explained past nourishment activities. As stated before, Holden Beach has a beach management program that compliments ongoing USACE projects. East End nourishment is typically every other year, but the future trend is looking towards every two years if at all with a minimum volume to maintain navigation. Placing sand on the beach is secondary to navigation.

Oak Island fill and monitoring activities includes annual monitoring of Oak Island by Dr. Bill Cleary since 1999. The western end of Oak Island is relatively stable and considered accretional. ATM will closely monitor the western end of Oak Island and have initiated surveys on the west end of Oak Island to develop a baseline. Approximately two years of survey data have been collected. Transects monitor out to -25'.

Based on NCDCM setback factors and annual erosion rates, the East End is approximately 7'/year. At this time, the Inlet Hazard Areas are up in the air. Oak Island set back factor is 2' due to stable and accretional conditions.

Hurricane Hanna in November 2008 resulted in severe scarping/escarpments on the East End of Holden Beach. This severe erosion occurred after a successful beach management program that had been ongoing for 7 years. Approximately 27 structures have been lost on the East End due to this erosion. Aerial photographs from the ‘80’s depict early erosion control structures on the oceanfront. See NCBIMP for additional photos/information.

Based on shoreline delineations, Lockwood Folly Inlet has been positionally stable for the past 70 years due to anchoring from Lockwood Folly River and Sheeps Island. Inlet relocation is considered a potential alternative; however, it would have to be cut through Oak Island and therefore not deemed feasible for this project. It was asked if dredging maintenance keeps the inlet stable and **Way** responded no as the inlet channel has been in the same position since pre-Civil War. Outer bar channel dredging occurs in the outer area of the inlet throat, and the AIWW crossing is maintained, whereas the throat is naturally maintained. Annual surveys conducted by the USACE depict the throat of the inlet is naturally deep (approximately -20 feet).

Ana Zwanovic asked when the oceanfront houses were lost and **Way** indicated the loss occurred in 2001, a clarification due to the slide depicted a 2008 aerial photograph.

Sediment Transport Processes

Regional sediment transport may seem simple in a regional sense; however, the inlet is complex in a local sense. The flood shoal existing within the Lockwood Folly Inlet has been relatively stable and maintained over a long period of time. Bathymetry data sets from the USACE (2000 – 2012) were used to build the existing model for the East End project. Additional datasets include USACE survey, lidar, and topography used to create the bathymetry grid which depicts the natural hole created at the intersection of the AIWW and Lockwood Folly Inlet. The main channel trains up against the Holden Beach shoreline. **Way** confirmed that ATM is planning to develop a Lockwood Folly Inlet sediment budget based on the sediment budget developed by Offshore & Coastal Technologies, Inc. (OCTI) (2008). Arrows depict a general schematic of sediment transport rates and direction. ATM will utilize the OCTI design as a basis for Lockwood Folly Inlet.

Existing Dredging Features

The AIWW inlet crossing includes a 400-ft bend widener, known location of highly compatible beach material. According to **Way**, a successful beach nourishment placement project occurred in 2008 - 2009 as the USACE dredged the bend widener as well as the regularly-maintained navigation channel within the AIWW crossing. Typically, the USACE does not include the bend widener as part of their annual navigation maintenance. **Sugg** asked if the bend widener was part of the authorized USACE maintenance area, **Way** responded yes.

Cleary asked why the outer channel and ebb delta is skewed to the east. What does the model show, as the key player is the orientation of the outer bar channel. The ebb tidal delta is skewed towards Oak Island. **Cleary** indicated dominant regional drift of sediment transport is into the inlet although there is much more sand on the Oak Island side then Holden Beach side, as depicted by the regional drift of 30,000 cy difference between east and west in that one sediment compartment. **Way** explained the OCTI sediment budget volumes are a good starting point as approximately 80% of flow, based on the most current water flow study conducted by

CSE in 2008, is coming from Lockwood Folly River. These hydrodynamics allows the inlet outer bar channel to stay in the same orientation.

Way pointed out Lockwood Folly Inlet has a highly variable channel while the USACE maintains the channel in a stable location by following deep water during navigation maintenance. In addition, there are Civil War shipwrecks within the channel allowing the channel to remain locally stable. **Cleary** was unsure with that statement and said the shoals and shipwrecks may have an impact on the model. He then asked if the model was incorrect based on data input into the model. **Way** stated the model is calibrated to the data and is hydrologically correct. **Cleary** affirmed the dunes within Brunswick County are a good indicator of wind direction and they are blowing to the east, although sediment transport is depicted from west to east. Discussions between **Cleary** and **Way** indicate there may be differences between past data depicting via wave rose (directional waves) vs. wind rose.

Continuing with the presentation, **Way** depicted the inlet area the USACE's sidecast dredge follows deep water to maintain navigation. The Colregs Line, located at the intersection of the Atlantic Ocean and the Lockwood Folly Inlet, is the boundary in which smaller dredges that are not ocean-certified can work in the preferred borrow area within the AIWW Crossing.

Borrow Area Alternatives

Way summarized the four alternatives available to the East End Shore Protection Project include: upland, dredge spoil islands, offshore, and Lockwood Folly Inlet and AIWW crossing. There are about seven sand sources including confined disposal islands such as Sheeps Island and Monks Island.

In April 2010, the bend widener project by the USACE was conducted. Sand placement began at the first house on the east end of Holden Beach (Avenue E) and worked west until they ran out of material. Upland truck haul projects have occurred for smaller volume needs due to the low cost of mobilization/demobilization (mob/demob), which is a cost benefit. Cons to upland truck hauls include road wear, frequency of events, and incompatible sand color. Upland truck hauls have typically been left for emergency efforts. According to **Way**, all borrow sources are compliant with NCDCM sediment criteria.

A brief review of the proposed borrow source includes the Lockwood Folly Inlet/AIWW crossing. Based on recent survey data, this federally authorized navigation area currently has approximately 150,000 cy of material. Availability of material is expected to include 100,000 to 150,000 cy of material every few years, dependent upon the wave environment that year.

Terminal Groin Alternative

Way reviewed a recommendation by the National Research Council of the National Academy of Sciences which conclude the use of fixed structures in conjunction with beach nourishment projects should be analyzed. Several position papers for and against terminal groins exist on this topic. Journal of Coastal Research dedicated a book to the function and design of coastal groins was briefly discussed.

Way presented a USFWS 2008 recovery table for various impacts and conservation efforts. The table depicted groins as having less impact than other threats.

Way discussed briefly the updrift vs. downdrift effect and used Bald Head Island sand bag groins as an example. These types of effects can be dependent upon seasonal changes (winter vs. summer). He also discussed the differences between groins and jetties using Oregon Inlet vs. Masonboro Inlet jetty system. He mentioned some groins have spur features, and fields of terminal groins can also exist, not necessarily one groin located at the end of an island. Natural outcroppings, such as the ones located at Fort Fisher, are natural features which engineers attempt to mimic or replicate for the design and function of terminal groins. Aluminum sheet pile and rocks are also termed as rubble mound.

Conceptual alternatives include: Alternative 1) long groin which is approximately 1,600' long with a spur feature (similar to Fort Macon groin), landward end would be buried; Alternative 2) short groin, located closer to homes and has a T-head and is approximately 600' long. The short groin includes anchor that is buried in the upland to prevent flanking. **Sugg** asked if the 600' includes the buried portion, **Way** responded yes. **York** asked what the construction methodology is for placing material on the beach, **Way** indicated pipeline would be used.

Modeling Results (2nd slide presentation)

Way began the second slide presentation by describing the two different models run by ATM. The CMS Wave and CMS Flow, as well as the Genesis T model were used. These modeling techniques have been around for some time and have been developed by the USACE. In addition, NOAA WaveWatch data was used to include data from offshore into the model. The CMS wave grid is a bit larger than the CMS sediment grid. The model was calibrated to the CSE 2008 study, including flow and currents. Water level and flow measurements were collected in 2008 throughout the study area.

Cleary indicated the flow was moving quickly; thereby, skewing the channel heavily to the west (to the right if you're looking at the slide), which is why erosion began on Holden Beach approximately 30 years ago. Additionally, dominant drift causes an asymmetric delta with more sand on the right side of the channel, therefore, how do you get the channel to change direction. **Way** indicated the same situation occurs in the Shallotte Inlet during dredging (example is the 2001 project), and **Cleary** agreed, but stated Shallotte Inlet is a different situation because it is a bigger system although the channel has been skewed in the same direction for the past 60 years. **Cleary** continued by indicating models don't necessarily answer the question, if dominant transport is from east to west, then why is there so much material off the Cape Fear River? **Way** stated there is a difference between gross transport and net transport, as sand is transported in different directions and has an impact on these proposed structures.

The 27 structures lost occurred when the channel was skewed to the west, **Rich Weigand** pointed out; therefore, the consideration and importance of the terminal groin lies behind the fact protection of infrastructure is a major concern with terminal groin construction. **Way** agreed and said the channel is highly variable and can be trained towards Holden Beach or Oak Island.

It is a small inlet, therefore, yearly or even monthly aerial photographs would help determine changes with shoal attachments. **Cleary** agreed and indicated gross shoal changes are rapid and smaller, yearly photographs would be helpful in a smaller inlet, compared to a large inlet such as Oregon Inlet.

Way described modeling was used to analyze gross transport trends were analyzed with vector analyses. Significant volumes of sand are moving in and out of Lockwood Folly Inlet. Transport rates are calculated along numerous transects, with the inlet having a net 75,000 cy per year moving into the inlet.

CMS Alternatives Modeling – Part A

Way described the modeling used to analyze and compare results between three alternatives including the No Action, Beach Nourishment with Groin (short groin, intermediate groin and long groin), Inlet Relocation and Borrow Area/Inlet Crossing. The short groin includes a T-head which resulted in negligible differences vs. the No Action Alternative. The T-head resulted in sediment trapping/rip current effect around the sides of the groin. Length/size of T-head is approximately 160' which is very common, similar to terminal groin built on Hilton Head Island.

One-year post-construction results compare alternatives to No Action runs (white area = no change). Colors in the slides represent changes in depth. A comparison of the proposed borrow area, short groin, fill template, and relocated channel (towards Holden Beach) were modeled vs. No Action resulting in strong effects within the inlet channel and ebb shoal area. Channel relocation alternative effects are the strongest vs. No Action as the ebb shoal shows the biggest change. Localized effects (downdrift impacts), especially with currents, were seen around the groin.

Cleary asked if there was a 2 meter change in depth. **Sugg** asked if Way was going to review individual alternatives model results, **Way** responded yes. The Eastern Channel alternative was also modeled as a result of discussions during the last PRT meeting. After one year, Eastern Channel remains open, however flow of the AIWW seems to adjust although the nearshore area is unaffected. **York** asked Way to review the modeling results for the inlet relocation alternative, and **Way** explains the inlet channel migrates after 1 year post-construction. **Way** explains it is ideal to dredge the inlet channel every 3 months (about 4 times per year) because it is ephemeral and needs to be maintained.

Cleary asked Way if modeling results were analyzed beyond one year, **Way** responded yes. **Cleary** indicated the Eastern Channel model results shows over a period of time positive results, as there is a lag effect of two years for sand shoal movement from the right sand of the channel to the left side of the channel. **Way** indicated change is seen after approximately 6 months. A brief discussion ensued between Cleary and Way regarding tidal prism effects and the movement of sand shoals related to the inlet relocation alternative.

Nenadouc asked Way why model runs are only one year if this project is a 30-year project. **Way** explained all alternatives were modeled for four years as that is the anticipated nourishment cycle for this project. **Weigand** then indicated, based on observational data, the results of the model runs for the Eastern Channel alternative is naturally occurring already. The channel is bending back towards Sheep Island. **Way** agreed, and stated the shoal off of Sheeps Island has two channels one either side of it. At the last PRT meeting, Steve Foster asked about Eastern Channel and therefore the model was run to analyze the effects around Eastern Channel. **Weigand** indicated a bird conservation area sign was posted in the shoal area. It is the east end of Holden Beach, not just where the homes are located but the tip of the island that is eroding away. There is no longer a straight channel, the Eastern Channel alternative is happening naturally.

Finalizing the discussion on one year model runs, **Way** described the dredged outer channel alternative, similar to Shallotte Inlet where approximately 500,000 cy of material was dredged, only 150,000 cy was placed as beach fill to remain consistent with realistic volumes. ATM wants to see what the channel would do with inlet relocation. Shipwrecks and debris fields are a concern for channel alignment and want to avoid. Results after one year depict significant change to system, whereby altering tidal prism will allow more water to get into system relative to the No Action Alternative. Due to the presence of the shipwrecks and the significant changes the Inlet Relocation alternative is not feasible. **Cleary** asked what the increase in the tidal prism is. **Cleary** indicated the tidal prism would have to increase by 20-30% to have such a significant change. **Way** responded the wider channel would have a significant impact on the inlet system. **Cleary** asked if it is the inlet itself or the thalweg. **Way** responded the thalweg, the deepest part of the channel. Inlet widening projects can result in seasonal disturbances and wave regimes. How would the tidal prism increase? If more water gets in then more water gets out. Deposition or change in elevation of the channel bottom then there is no thalweg, **Cleary** stated. **Way** responded this is only relative change compared to the No Action Alternative, and these results are only a summary. **Cleary** indicated the reader will be confused with these results and **Way** responded yes, it gets very technical.

Sugg asked if these results are only for one year, correct. Changes to tidal prism at Year 2 and Year 3 go back to natural conditions, **Way** responded. **Sugg** confirmed the beach nourishment cycle will be every 4 to 5 years.

Way then continued to show modeling results at Year 4 (post-construction) with each of the groin designs (short, intermediate, and long). Shoal attachments resulted over one year and agree with 2011 aerial photographs.

Huggett stated the T-head component of the groin does not necessarily agree to legislation that describes definition of terminal groin as a perpendicular structure. Terminal groin legislation defines a terminal groin as generally perpendicular to the shoreline. DCM reads that as not allowing the T-head design and meets the definition. Internal discussions as it relates to offsetting groins to certain degrees (30 degree offset or deflection is ok, not 90 degrees as shown by T-head design). DCM is ok with main structure, but initially T-head component is a concern to meeting definition of law. If the design does not meet the definition of the legislation, then DCM cannot permit it. **Huggett** read the definition, “a terminal groin is a structure constructed at the side of inlet at terminus of island, generally perpendicular to shoreline to limit sediment passage into an inlet." **Huggett** understands there is flexibility of offset and there is latitude in the term "generally perpendicular" definition. **David Hewett** asked Huggett for a definitive definition from CAMA because the T-head design has been provided in previous presentations (September), and the T-head has been modeled and engineered for the past 6 months. Holden Beach has expended funds for these modeling runs. **Huggett** apologized and stated he did not remember the design being defined back in September. **Hewett** asked if DCM was going to pay the bill on it.

Nenaduouc asked how the terminus of the island is defined. **Huggett** stated the legislation does broadly define the terminus of an island, potential locations to date of terminal groins do comply with intended end of island definition. **Way** stated the short groin does have the longest T-head, the intermediate groin has a minor T-head. The seaward end takes the brunt of the wave forces and therefore it has to be designed more blunt-headed. A bulbous feature (not angular) is what the end of the groin would be shaped for the intermediate groin. **Cleary** indicated it would look like a light bulb. **Way** responded yes and an angular feature is what the model sees.

Way continued and described shoal attachment runs (movies) with each groin alternative (four year runs) resulting in relatively little adverse impact on the Oak Island side. Outputs are every 7 days. **Sugg** asked if the model encompasses the entire inlet including Oak Island, **Way** responded yes. The intermediate groin seemed to result in best shoal attachment (on either side of the groin) and least downdrift effects. After 4 year runs, there is less sedimentation behind Holden Beach; therefore, more sand is being held longer on the oceanfront. **York** asked if this model was used in South Carolina projects, such as Hilton Head, to confirm results became reality. **Way** explained that modeling is not a requirement, but most engineers use sediment budgets as a test. **Cleary** explained that CPE used a model at Bogue Inlet, but Ophelia blew the Coast Guard channel which was unpredictable.

Sugg asked how the Oak Island side of the inlet faired from various alternative model runs. Relatively insignificant effects were seen in all alternatives, stated **Heath Hansel**. The differences would be shown in the ebb shoals, rather than onshore, asked **Sugg**. **Hansel** responded insignificant shoreline changes resulted from model runs. **Cleary** asked if there was a visual of the entire system during one of the model runs. **Way** responded no, all changes occur within the screenshot shown during the presentation.

A question was asked about the effects of the intermediate groin on the remaining part of the island. **Way** responded he will discuss this later on in the presentation.

Way continued with the presentation and discussed how the terminal groin will increase nourishment intervals from 2 years with nourishment only alternative to 4 years with groin plus nourishment. The fillet formation is holding sand showing less sedimentation behind Holden Beach. Model runs also analyzed only groin without nourishment to show specific effects from only the groin. After Year 2, benefit to updrift and downdrift with intermediate groin alternative. **Sugg** asked if the results come from a leaky groin design and **Way** responded it comes from shoal positions and position of terminal groin. An analysis of the shoreline width is calculated to see what the results are of the sediment transport. **Sugg** stated he assumes ATM is continuing to work with the position of the terminal groin. **Way** stated the intermediate groin is a bit longer and has similar effects of the short groin. Negligible changes in transport rates with terminal groins. With the Nourishment Only Alternative, twice as much sediment is transported into the inlet. **Way** stated the goal is to reduce transport rate after nourishment. **Jay Holden** made a comment that the No Action alternative is not an option.

Way described the results of a particle concentration tracking comparison as it relates to biological characteristics between No Action alternative and short groin/nourishment alternatives which resulted in negligible effects/changes besides localized effects. The intermediate groin results in localized current effects; however, there is a flood tide push of water. This is not conducive to rip tide currents therefore the groin will not prevent the flow of passive larvae into the inlet during flood tide stage.

The 7-m contour line (Blanton study – a larval transport study conducted in the South Atlantic Bight) is identified by the North Carolina Coastal Habitat Protection Plan as a significant delineator from a biological perspective with regards to larval transport. **Way** noted the proposed terminal groin structures are more than 500 m from this contour area. **Sugg** asked **York** to send the UNCW study identifying larval/fish impacts from beach nourishment projects at Wrightsville Beach. Several studies have identified five physical characteristics that contribute to the distribution of larvae in the intertidal zone including wave energy, bottom type, tidal exposure, temperature and salinity. The groin will affect bottom type (i.e. sediment) although sediment type updrift and downdrift will remain similar. It was asked whether larval species accumulate in the 7-m zone, and **Way** responded the positioning of the terminal groin will not affect larval passage.

Genesis T Model

Way continued and indicated net sediment transport varied in the vicinity of Lockwood Folly Inlet. These results agree with CMS results (not the 3D model). Measured and modeled shoreline change minus nourishment activities resulted in approximately 150’ of erosion on the east end. Modeling analyses indicate beach fill activities help offset background erosion Holden Beach experiences.

Short groin plus beach nourishment runs over a six-year timeframe with no fill placed downdrift (towards Lockwood Folly Inlet) of groin. Downdrift offset effects resulted based on Genesis-T model. Fillet formations occur updrift of the fillet. These results do provide evidence of the need for pre-placement of fillet material. Intermediate groin overlaid over historic shoreline variations result in the need for at least 300’ of anchor, with 700’ of groin (total 1,000’).

The Hilton Head groin, also a leaky design, was shown as an example of how construction would take place. The Hilton Head groin also includes a T-head. Huntington Island also includes a small T-head feature, or more like a circular mound of rocks.

Benefits and Monitoring Costs

Existing shoreline erosion rates over a long-term compared to sea level rise rates is much more significant. Therefore, sea level rise is considered, but is a small player. **Way** reviewed economic benefits and costs. He stated mob/demob costs are expensive and ATM is tracking closely the price of diesel fuel, inflation, and construction costs. Reducing nourishment intervals is key to reducing costs of construction.

Way described monitoring costs analysis by alternative using Beach and Inlet Management Plan costs. The COE study conducted an analysis of Holden Beach and indicated the east end project is not included in the 50-year project because sand leaves this area too quickly. **York** asked if discussions have been had with the USACE to include the east end in the Brunswick Beaches 50-year project. **Hewett** responded it hadn't been included because of the legality of the terminal groin.

Huggett stated legislation includes pre-fill terminal groin as a requirement and asked if the USACE would be willing to include the east end into the federal project if bypass processes would continue. One of the arguments about a groin is that once it is prefilled and starts to bypass, if sand movement is not disrupted, would that allow USACE to place material on the beach through the 50 year project. **Way** indicated more dry beach would develop, rather than trapping sand.

Way described costs from the 50-year project, from 2015 to 2044 (a 30-year project timeframe). The east end spreadsheet, based on USACE's 50-year Brunswick Beach's project included a 4% inflation rate; average annual cost (construction costs only and not related to benefits or damages) is approximately $1,540,000. A terminal groin is approximately $2.5 million as an initial construction cost. The longer the beach nourishment interval, money is saved annually. Indirect costs of damages and benefits also result in a significant cost, such as the preferred alternative of Beach Nourishment with Intermediate Terminal Groin $34 million vs. No Action of $76 million. **Way** reiterated the preferred project alternative is the intermediate groin with approximately 120,000 – 150,000 cy nourishment from the AIWW bend widener borrow area. Interval of nourishment is every 3 to 4 years. **Sugg** asked if the intermediate groin alternative is the preferred alternative from an engineering perspective and leaving all out other components (costs, resources, etc.). **Way** stated yes, since 1970's, this area has considered a groin or jetty. Geotech style tubes were placed on the east end and were considered temporary. This area has been considered for a groin for the past 4 decades.

Anchor section will be buried. Existing monitoring, to remain in compliant with FEMA, include volume and shoreline change through annual surveys on Holden Beach, the inlet, and Oak Island. This monitoring will be continued into the future. Biological monitoring has also been conducted on the island including surveys of mole crabs, ghost crabs, etc.

Way indicated some monitoring will be expanded into the inlet. He explained the profile data from Station 10 (downdrift of groin from 2000 to 2012) includes natural variability and an undulating nature in volume changes from erosion to accretion. The MHW line has a similar pattern and changes by 100' (gain/loss) every year. Downdrift monitoring will include thresholds and need to take into account extreme variability (standard deviations) based on natural erosion events. Thresholds will be large as under natural conditions the shoreline changes.

Huggett stated that NCDCM realize the difficulties with removing natural variability from determining a threshold and monitoring regime. ATM will include a simplified sediment budget to include in monitoring plan. A four-year model run shows areas where monitoring should occur. Mitigation steps include 1) Placing additional sand, 2) Modify groin by notching or shortening, and 3) Remove the groin. **Way** indicated adding sand is the easiest.

Cleary asked how far on Holden Beach did ATM extend the monitoring based on modeling results? **Way** stated the Town surveys the entire island of Holden Beach. Semi-annual surveys will be developed every 10,000'. **Weigand** asked about studies of impacts of placement of groins on tourism, fishing, and recreation as the area proposed for placement of groin was slammed with people during Memorial Day weekend. **Sugg** indicated Fort Macon is a good example of an area that has a recreational area with groin and it doesn't seem to have an effect. **Huggett** stated he was at Fort Macon recently and there were as many people around the groin as there were on the beach. The NC Terminal Report does discuss indirect aspects. **Huggett** indicated there have been concerns of recreational loss from the movement or loss of intertidal shoals lost thru construction of groins. **Sugg** replied that the economic value of these losses will be analyzed and evaluated based on results of engineering report. The engineering report will be dissected and evaluated from a recreation perspective.

Weigand asked what is the timeframe of the beach portion of groin to cover rubble mass? **Simmons** replied the Amelia Island groin was covered up in less than 6 months. **Way** stated the prefill placement will cover up the rubble mass and monitoring will dictate when nourishment will occur. Monitoring needs to be dynamic.

Sugg stated the USACE is dependent on local residents to provide information on recreational and navigation uses and to what degree. The USACE needs evidence, such as number of boaters, tourism dollars, etc. to study specific areas/concerns. The USACE is dependent on users of proposed area. Huggett added that if the state hadn't received public comments on the Figure Eight project, then they wouldn't have known to study critical areas.

York then provided a brief presentation on affected resources from an environmental standpoint. The NEPA process is followed with feedback and coordination from state and federal resource agencies as well as the public. Some issues included benthic infauna, piping plover, cultural resources and essential fish habitat. The reason these projects take so long as there are many complex habitats and species. The study area includes all potential alternatives and encompasses approximately 1,700 acres. Preliminary habitat mapping has been conducted and includes low marsh, subtidal (largest habitat type in the study area, totaling approximately 1,000 acres), intertidal habitat, beach and foredune, submerged aquatic vegetation. Recent aerial images and NCDCM data was used to complete the GIS habitat map.

An Essential Fish Habitat Assessment will be developed. Primary nursery areas do occur in the upper reaches of the Lockwood Folly River. Known SAV mapping by DENR shows less than one acre of submerged aquatic vegetation within the Study Area. Hardbottoms are not a concern for the east end project as the project is contained within the inlet. Probable hardbottoms do occur offshore Holden Beach; however, they occur several miles outside of the seaward boundary of the Study Area.

Benthic infauna, primary productivity for beach communities, has been monitored sparingly on Holden Beach, close to the east end. ATM monitors a few species based on potential project related impacts.

Piping plover critical habitat does occur within the Study Area on Oak Island. Dial Cordy and Associates has coordinated with NCWRC for the review of piping plover data. The data does show piping plovers use the habitat in the winter. **Sugg** asked Jay Holden if there is a local name for the shoal within the inlet. Some residents call the area "The Pointe."

A volunteer program for collecting loggerhead sea turtle nesting data does exist on Holden Beach and current data shows few nests located on the island. In 2011, approximately 30 nests were identified, and most located on the west end of the island. Critical habitat designation has been proposed and will be considered in the EIS. **Hewett** stated that Holden Beach has submitted comments. **York** asked Sugg if formal consultation will be required. **Sugg** replied that USFWS indicated they will treat beach nourishment projects the same as they have in the past. The USACE will submit the Biological Assessment as an informal document. **Hewett** asked if this was for Section 7 consultation, **Sugg** replied yes.

York continued and provided seabeach amaranth data which shows plants on the west end of the island as well as on Oak Island due to the accretional/stable nature of those areas. In addition to environmental resources, Dr. Pete Schumann of UNCW will analyze the economic value of the alternatives based on the data provided in the engineering report. Dr. Schumann was not available at the time of the presentation, therefore York presented his slides. A detailed review of existing literature of economic considerations will also be included. It will not be a formal cost analysis, and alternatives will not be ranked on cost. Value of various components will be analyzed. Public interest factors will also be considered.

York asked the audience for additional data that would be related to the resources discussed and those present in the study area. **Sugg** added that personal observations can also be provided; it doesn't have to be a referenced/formal study. Photographs are also beneficial and valuable to USACE as evidence of value on a public interest factor. Email/phone calls are always accepted.

Sugg reiterated the reason for the PRT meeting is to gain feedback from the team. The timeframe of the project and next steps were briefly discussed. **Sugg** indicated the engineering report is an important tool for consideration of impacts in the EIS. The Draft EIS is currently being prepared by Dial Cordy and Associates. The USACE and NCDCM will review for accuracy and readability, and it will then be submitted to the public. The Draft EIS will be submitted to the PRT prior to public review. A 45-day comment period will be held for review of the Draft EIS. A specific timeframe cannot be given on the EIS; it is dependent on the Town's construction timeframe. Section 7 consultation from NMFS and USFWS will be conducted after the Draft EIS has been submitted for public review. Jay Holden thanked everyone's contribution and participation in the project.

The meeting was adjourned at 1 pm.

Holden Beach Terminal Groin Project

PRT meeting (Holden Bch Town Hall)

5/30/13

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Call-in participants

John Ellis & Kathy Matthews - US Fish & Wildlife Service (Raleigh Field Office)

Maria Dunn - NC Wildlife Resource Commission (Washington Field Office)

Dan Holliman & Todd Bowers - EPA (Atlanta Regional Office)

Craig Bromby - Holden Beach Property Owners Association

Affected Resources within the Holden Beach East End Shore Protection Project

Dawn York and Rahlff Ingle
Dial Cordy and Associates Inc.

Overview of NEPA Process

Heart of the NEPA Process

- Early Scoping of Issues
- Development of Acceptable and Clearly Defined Alternatives
- Impacts of Each Alternative (Including No Action) are then Determined
- Measures to Mitigate Potentially Adverse Impacts are Developed

Majority of Problems

- Inadequate Public Involvement and Issue Identification in the Early Phase of a Project (Scoping)
- Inadequate Development of Project Alternatives
- Use of Poor Quality Data in Defining Baseline Conditions
- Inadequate Assessment of Cumulative Impacts

Key Components to a Successful NEPA Project

- Early Planning
- Effective Coordination
- Use of Quality Baseline Data

Scoping of Issues

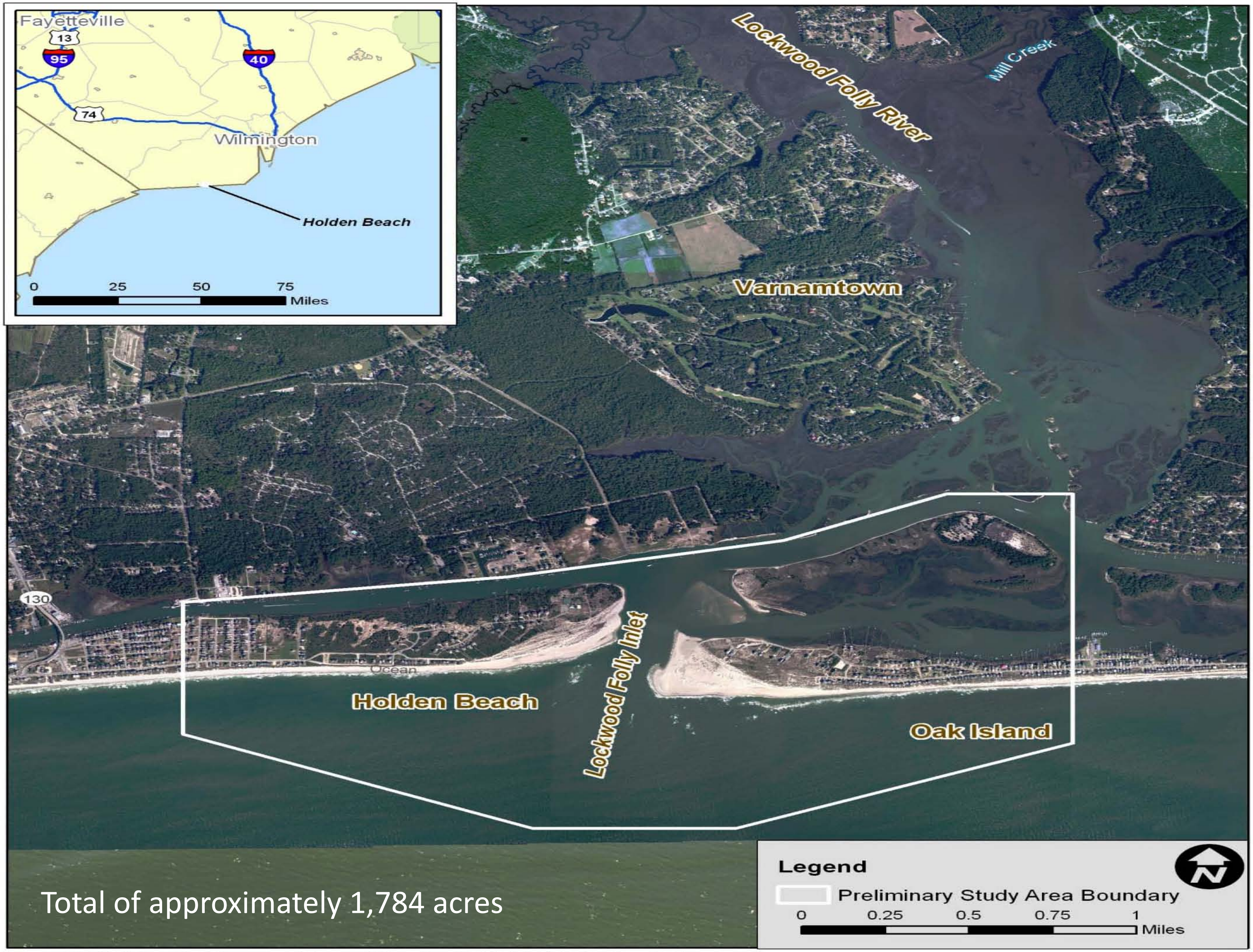
Resources of Holden Beach and Lockwoods Folly Inlet

- Infaunal Invertebrates
- Seabeach amaranth
- Piping plover and Other Migratory Birds
- Hardbottom and Artificial Reefs
- Shellfish Beds and Submerged Aquatic Vegetation
- Wetland Communities
- Sea Turtles
- Surf Zone Fishery Resources
- Oceanfront, Estuarine and Inlet Shorelines
- Commercial Fishery
- Significant Submerged Cultural Resources
- Fishery Nursery Areas
- Water Quality
- Significant Natural Heritage Areas
- Essential Fish Habitat

Scoping of Issues

Resources of Holden Beach and Lockwoods Folly Inlet

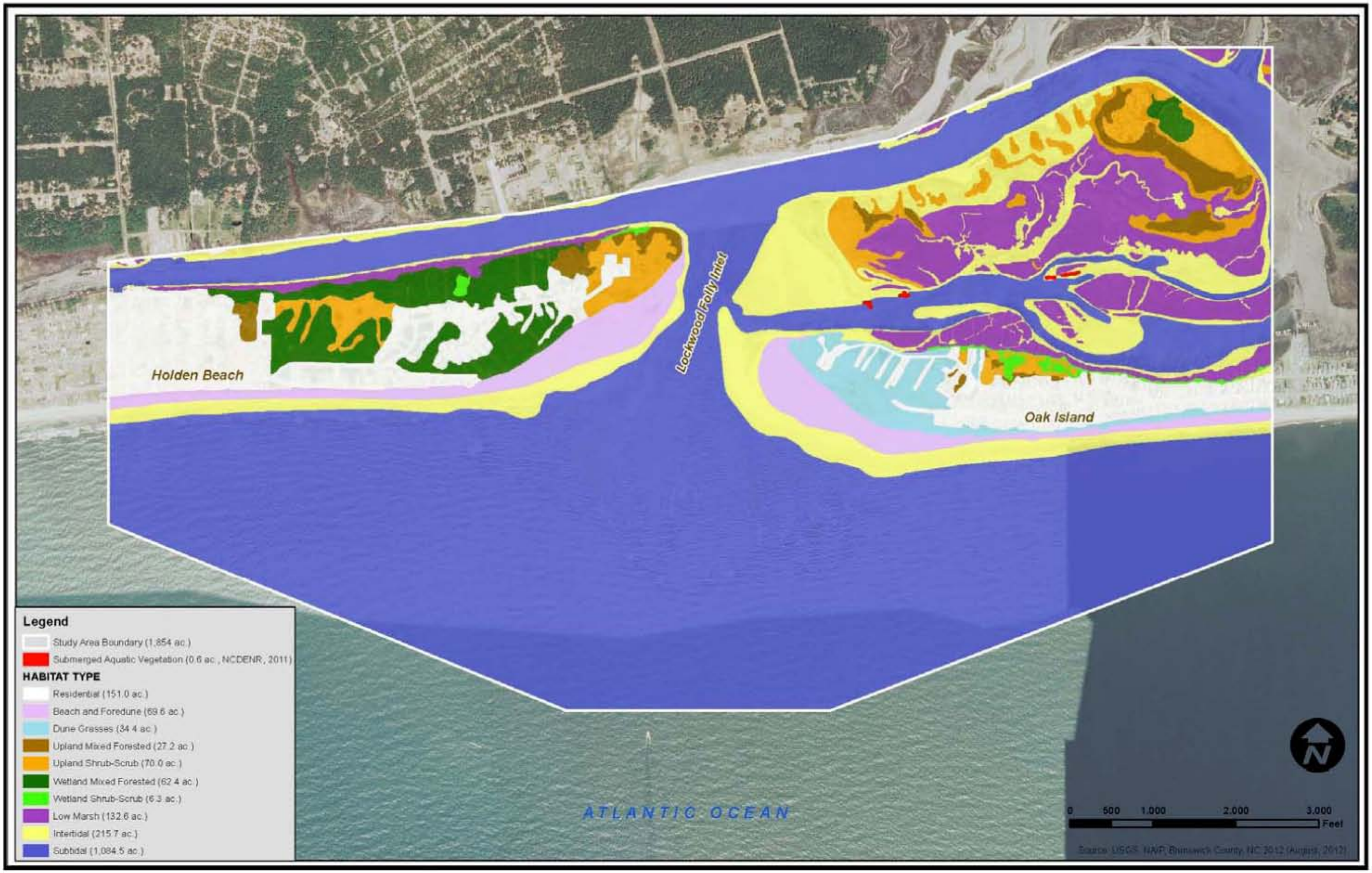
- Infaunal Invertebrates
- Seabeach amaranth
- Piping plover and Other Migratory Birds
- Hardbottom and Artificial Reefs
- Shellfish Beds and Submerged Aquatic Vegetation
- Wetland Communities
- Sea Turtles
- Surf Zone Fishery Resources
- Oceanfront, Estuarine and Inlet Shorelines
- Commercial Fishery
- Significant Submerged Cultural Resources
- Fishery Nursery Areas
- Water Quality
- Significant Natural Heritage Areas
- Essential Fish Habitat



Source: NOAA Integrated Ocean and Coastal Mapping (IOCM) Aerial, GeoCue 2011

Environmental Setting - Tidal Areas

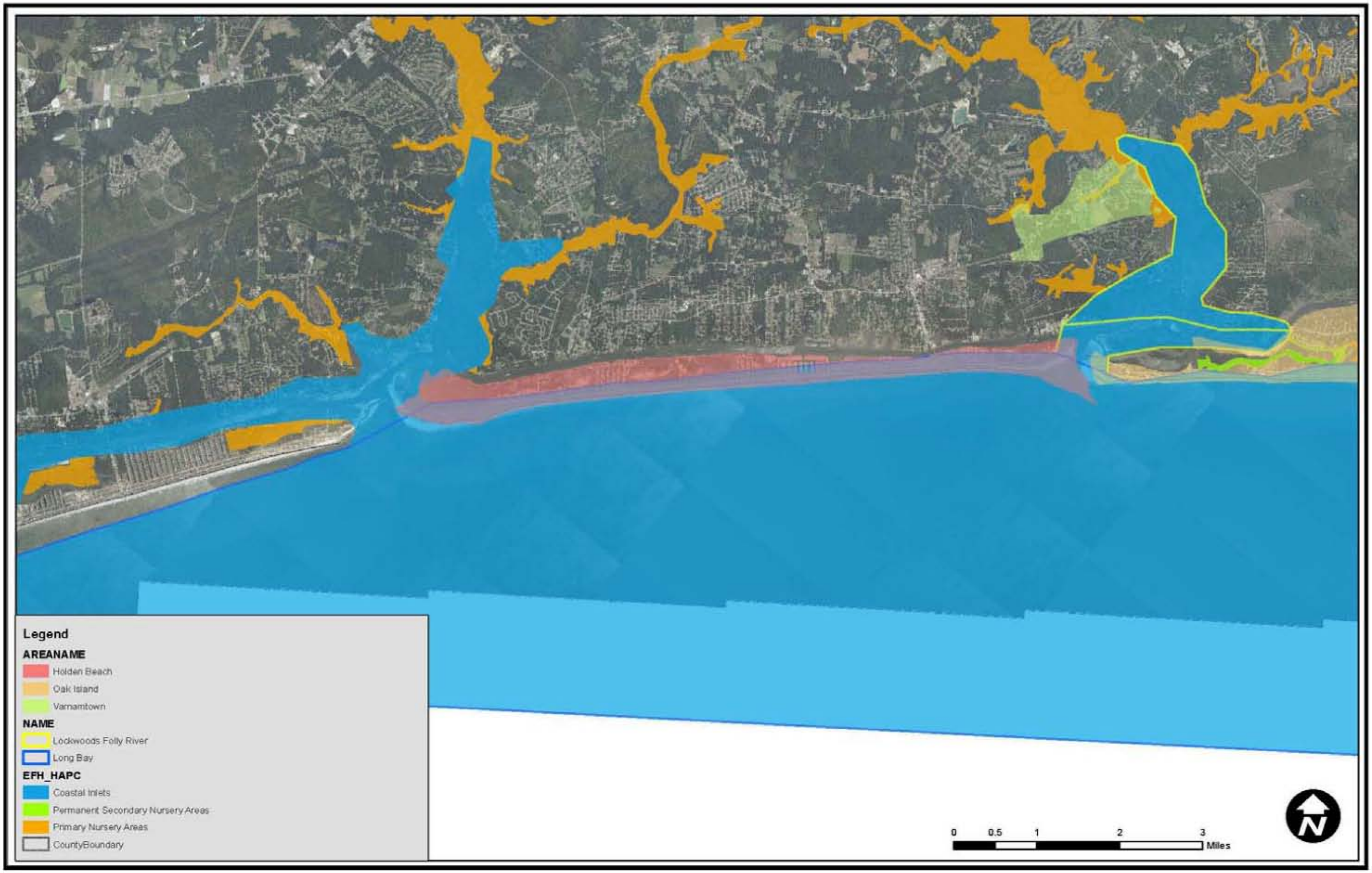
Environmental Setting – Habitats



Environmental Setting – Habitats

- Subtidal Marine (Ocean) Habitats
  - Marine Water Column
  - Soft Bottom/Benthic Habitats
  - Nearshore Hardbottom/Artificial Reef Communities
- Ocean Beach and Dune Habitats
  - Intertidal Ocean Beach
  - Dry Ocean Beach and Dune
  - Maritime Upland Forest Communities
- Inlet and Estuarine Communities
  - Lockwoods Folly Inlet Complex
  - Intertidal and Subtidal Flats and Shoals
  - Submerged Aquatic Vegetation (SAV)
  - Shell Bottom
  - Tidal Marsh

EFH Habitat


Legend
AREANAME
Holden Beach
Oak Island
Varnamtown
NAME
Lockwoods Folly River
Long Bay
EFH_HAPC
Coastal Inlets
Permanent Secondary Nursery Areas
Primary Nursery Areas
CountyBoundary
0
0.5
1
2
3
Miles
N

EFH Habitat – Submerged Aquatic Vegetation

Importance:

- Provides Important Structural Fish Habitat.
- Recognized as an Essential Fish Habitat.
- Water Quality Enhancement and Fish Utilization.

Projects:

- None

Prior Studies:

- Carraway and Priddy (1983)
- NCDMF Bottom Mapping Program (1989 - 1990, 1994 - 1996, 2000-2002, 2007, 2011)
- SAV Partners (APNEP) (2008)

Hardbottom: Artificial and Natural

Importance:

- Contribute Significant Volumes of New Sand.
- Exposed Hard Substrate Provides Stable Attachment Surfaces for Colonization.
- Vertical Relief and Irregularity of Hard Bottom Structure Affords Greater Habitat Complexity.

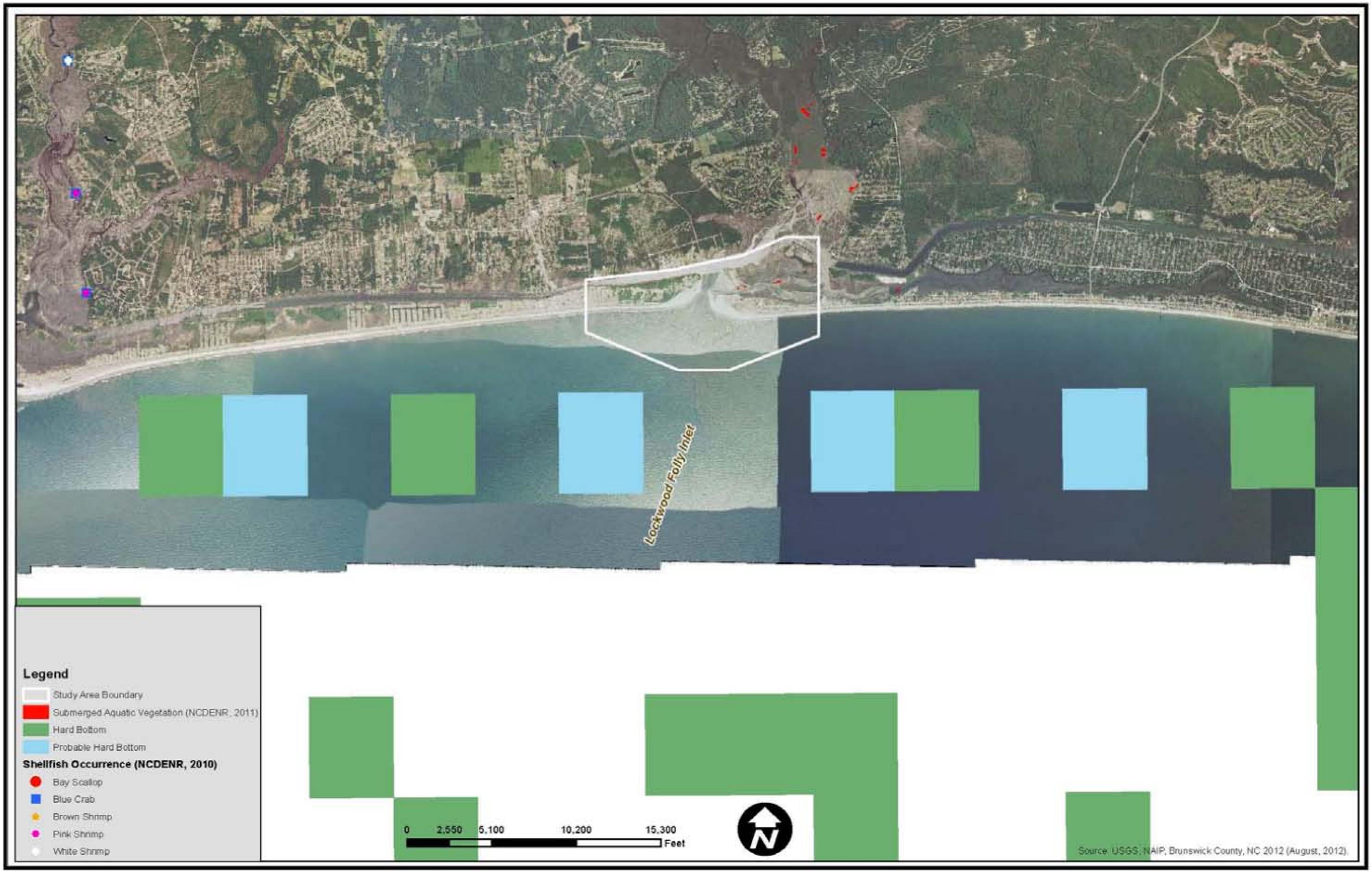
Projects:

- Federal and Non-federal Projects

Prior Studies:

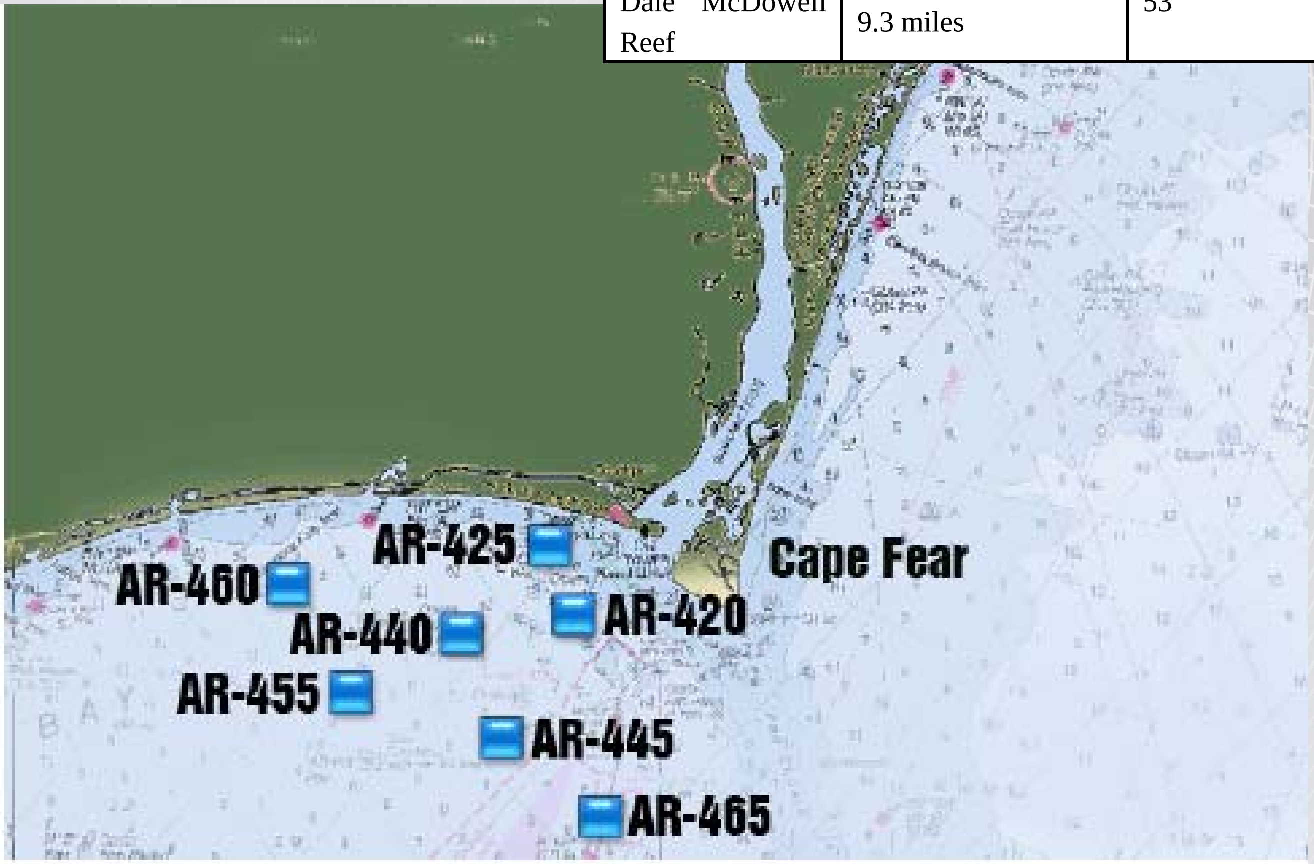
- Moser and Taylor (1995)
- SEAMAP-SA (2001, 2004)
- MATER (2007)
- TAR (2011)

Environmental Setting – Hardbottom



Environmental Setting – Artificial Reef

NC Reef Site No.	Nearest Inlet Access and Distance	Approx. Water Depth (ft.)	LORAN Position Coordinates	Latitude and Longitude
AR-440 Brunswick County Fishing Club Reef	Lockwoods Folly 4.5 miles	42	43365.8 59346.6	33°49.800' 78°13.083'
AR-445 Dale McDowell Reef	Lockwoods Folly 9.3 miles	53	45352.0 59289.0	33°44.783' 78°14.100'



Benthic Infauna

Importance:

- Critical in Maintaining High Primary Production Rates.
- Sensitive to Changes in Water Quality.
- Useful as Indicators of a Wide Range of Natural and Anthropogenic Disturbances.

Projects:

- Holden Beach – ongoing

Prior Studies:

- Versar (2003)
- ATM

Threatened and Endangered Species

Species Common Names	Scientific Name	Federal Status
Mammals		
West Indian Manatee	Trichechus manatus	Endangered
North Atlantic Right whale	Eubaleana glacialis	Endangered
Sei whale	Balaenoptera borealis	Endangered
Sperm whale	Physeter macrocephalus	Endangered
Finback whale	Balaenoptera physalus	Endangered
Humpback whale	Megaptera novaeangliae	Endangered
Blue Whale	Balaenoptera musculus	Endangered
Birds		
Roseate Tern	Sterna dougallii dougallii	Endangered
Wood Stork	Mycteria Americana	Endangered
Piping Plover	Charadrius melodus	Threatened
Red-cockaded woodpecker	Picoides borealis	Endangered
Reptiles		
Green sea turtle	Chelonia mydas	Threatened[1]
Hawksbill turtle	Eretmochelys imbricata	Endangered
Kemp's ridley sea turtle	Lepidochelys kempii	Endangered
Leatherback sea turtle	Dermochelys coriacea	Endangered
Loggerhead sea turtle	Caretta caretta	Threatened
Fish		
Atlantic Sturgeon	Acipenser oxyrhynchus oxyrhynchus	Endangered
Shortnose sturgeon	Acipenser brevirostrum	Endangered
Smalltooth sawfish	Pristis pectinata	Endangered
Vascular Plant		
Cooley’s meadowrue	Thalictrum cooleyi	Endangered
Rough-leaved loosestrife	Lysimachia asperulaefolia	Endangered
Seabeach amaranth	Amaranthus pumilus	Threatened

Piping Plover Critical Wintering Habitat

Importance:
A Critical Habitat designation recognizes specific areas "that are essential to the conservation of a listed species, and that may require species management considerations or protection".

Projects:
None

Prior Studies:
NCWRC (1970 – present)
Christmas Bird Counts

Scott Walker photographed these Piping Plovers on 19 Oct 2004 at the west end of Holden Beach, NC.

Piping Plover Critical Wintering Habitat

Important Critical Habitat Components: intertidal beaches and flats (mud flats, sand flats, algal flats, and washover passes); associated dune systems; and flats above high tide.

Loggerhead Sea Turtle

Beach	Year	Species	Nesting Activity		Total Relocated
			False Crawls	Nests	
Holden Beach	2010	Cc; Dc (1); Cm(1)	31	29	24
	2009	Cc	9	23	20
	2008	Cc	30	38	24
	2007	Cc	13	18	13
	2006	Cc	30	28	9

- The Holden Beach Turtle Watch Program currently operates along the entire Holden Beach shoreline in order to protect sea turtles by educating and by aiding stranded turtles.
- The entire ocean-facing length of Holden Beach is patrolled daily in the early morning, looking for fresh turtle crawls.
- All nests are marked and protected during incubation, and during emergence the hatchlings are provided safe passage to the ocean.
- 2011 documented 30 loggerhead nests. In 2010, 27 loggerhead nests, one green nest, and one leatherback nest on the west end were documented.

Loggerhead Turtle ***(Caretta caretta)***

Management / Regulatory Governance

"ON THE LAND"

- Federal (USF&WS)

- States

(NCWRC, Florida Fish & Wildlife Conservation Commission, SCDNR Marine Turtle Conservation Program, etc.).

Shore Protection Threats

Hard Structures – inhibit/prohibits nesting

Nourishment (twofold)

(1) equipment & construction area inhibit/prohibits ***nesting***

(2) equipment & construction area could result in mortality (***take***)

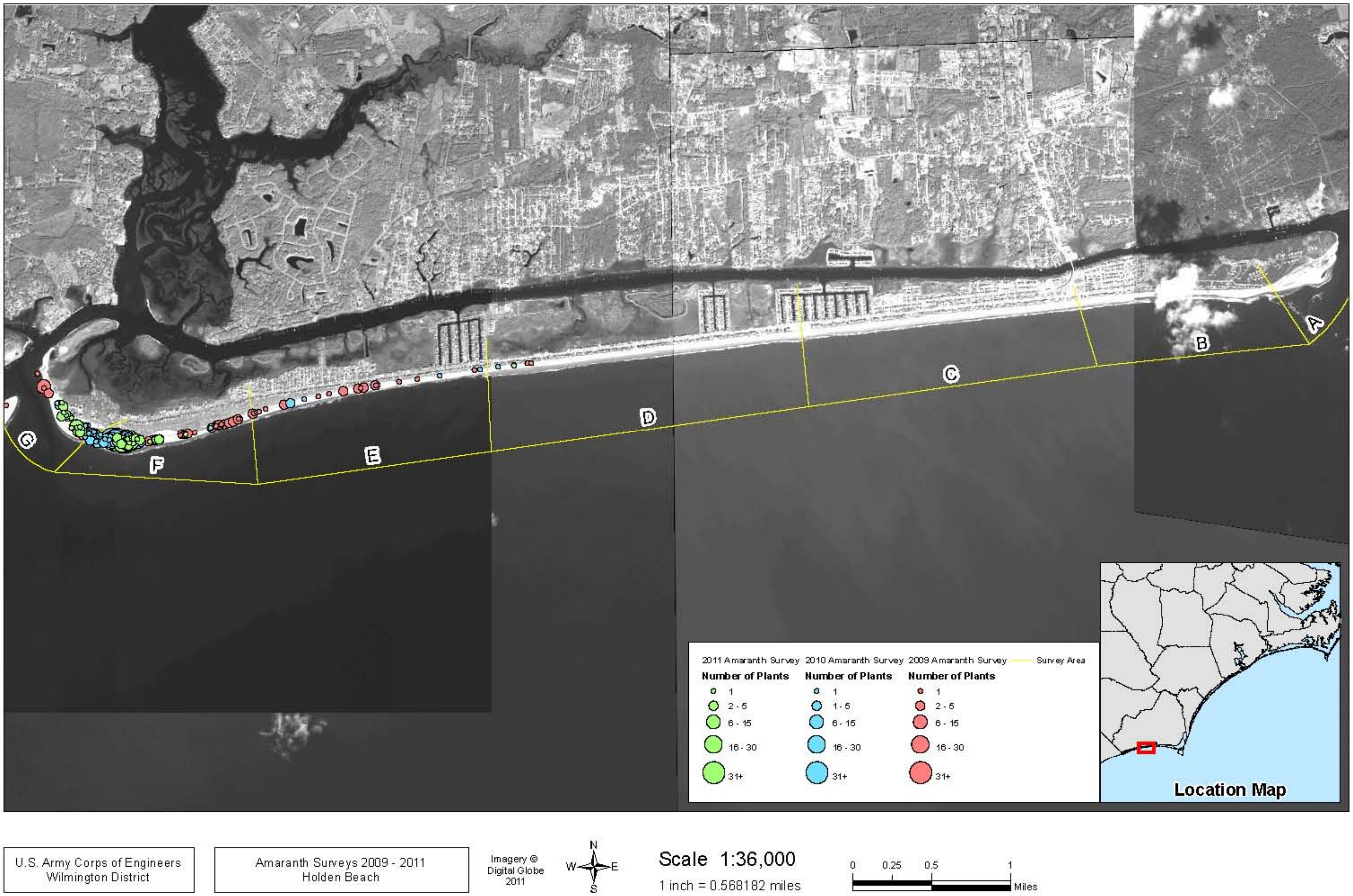
Sea Turtle – Critical Habitat Designation

Does not set up a preserve or refuge *per se*. Applies only when Federal funding, permits, or projects are involved.

(1) Specific areas within the geographical area occupied by the species at the time of listing, if they contain physical or biological features essential to conservation, and those features may require special management considerations or protection; and

(2) Specific areas outside the geographical area occupied by the species if the agency determines that the area itself is essential for conservation.

Seabeach Amaranth – Holden Beach



Seabeach Amaranth – Holden Beach

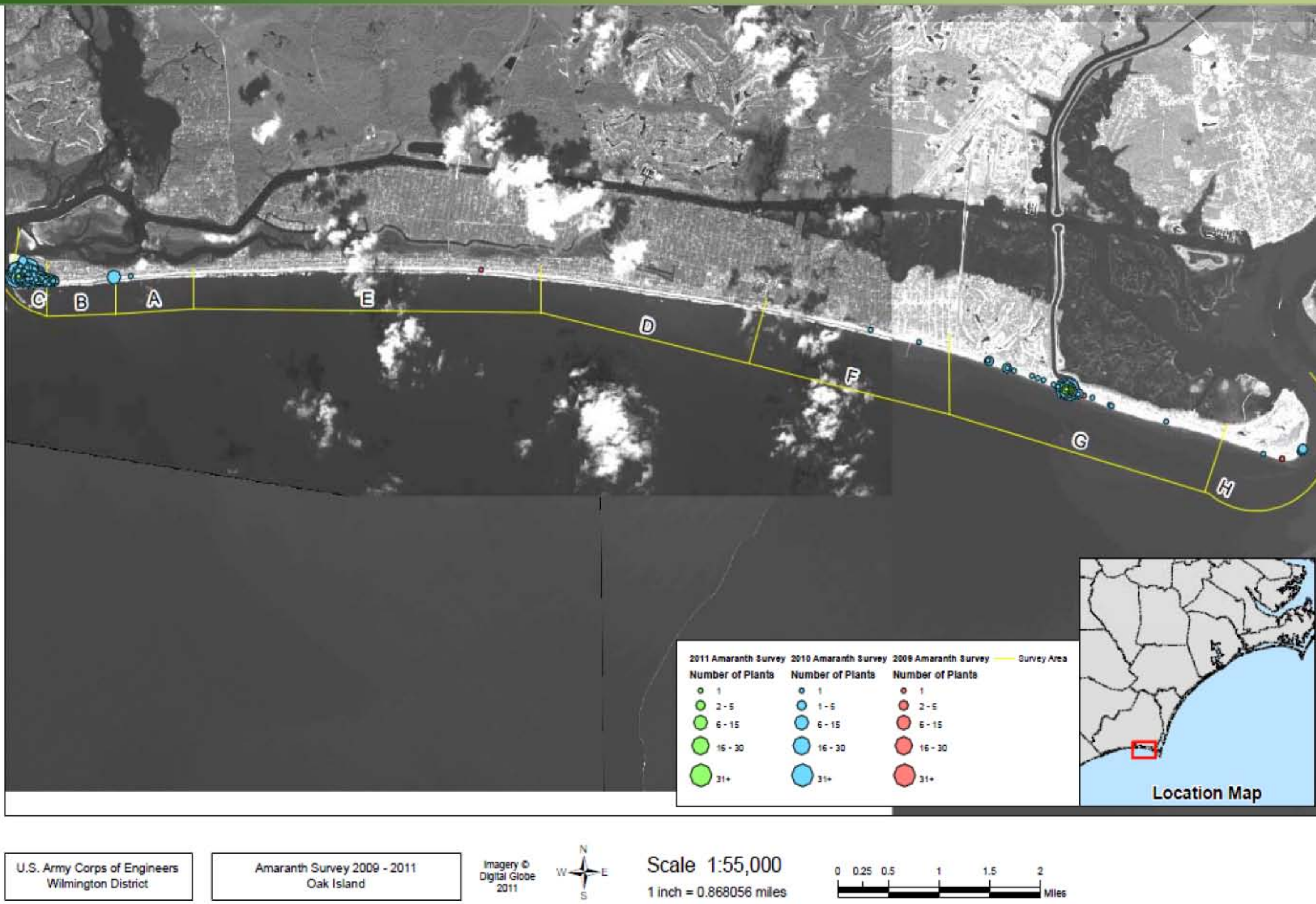
Beach	Sub-Part (Reach)	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Total All Yrs
Holden Beach	A	3	30	16	57	99	1	32	3	1	12	0	10	4	6	4	0	0	0	0	0	278
	B	18	22	223	2	0	0	0	0	0	0	0	8	0	2	5	0	0	0	0	0	280
	C								0	0	0	9	45	3	23	2	0	2	0	0	0	84
	D								0	1	0	4	39	1	70	88	11	0	2	2	1	219
	E								34	2	102	527	358	19	317	208	6	19	35	5	0	1,632
	F								192	6	109	>1,000	358	52	382	1,235	254	367	69	374	88	3,486
	G								39	^ ^ ^	0	162	25	0	^^^	412	10	186	17	53	27	931
	TOTAL	21	52	239	59	99	1	32	268	10	223	1,702	843	79	800	1,954	281	574	123	434	116	7,910

Source: Doug Piatkowski, USACE Civil Works, February 2012

NOTES

	= Not surveyed
^ ^ ^	= Count combined in reach above
	= Year of hurricane impact
	= Count exceeding 1,000 Amaranthus

Seabeach Amaranth – Oak Island



Seabeach Amaranth – Oak Island

Beach	Sub-Part (Reach)	Year 1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	Total All Yrs
Oak Island / Caswell Beach	A	45	96	299	416	231	87	349	7	5	15	197	150	0	1	20	0	0	0	1	0	1,919
	B	839	181	1,336	3,328	1,092	438	3,030	4	2	15	216	135	4	78	18	0	0	0	34	0	10,750
	C	2,264	5,826	2,774	884	660	74	1,987	4	2	33	0	17	0	13	253	105	51	40	1,337	1	16,325
	D							1	0	0	0	36	916	0	7	33	8	0	0	0	0	1,001
	E								0	0	2	83	10	5	14	16	1	3	1	0	0	135
	F								0	0	0	0	3	1	43	20	0	11	0	2	0	80
	G								0	0	1	9	36	1	5	1	0	0	21	188	15	277
	H								0	0	0	1	0	0	13	101	2	0	2	14	0	133
	TOTAL	3,148	6,103	4,409	4,628	1,983	599	5,367	15	9	66	542	1,267	11	174	462	116	65	64	1,576	16	30,620

Source: Doug Piatkowski, USACE Civil Works, February 2012

NOTES

	= Not surveyed
^ ^ ^	= Count combined in reach above
(green)	= Year of hurricane impact
(blue)	= Count exceeding 1,000 Amaranthus

What are the public interest resources within the Permit Area?

Socioeconomic Resources

Population

➢ The 2010 US Census reported a total of 575 permanent residents on Holden Beach and a total of 1,648 permanent residents on western Oak Island.

Housing

➢ The 2010 US Census reported a total of 4,461 housing units on Holden Beach and western Oak Island; including 1,085 permanently occupied units, 2,877 seasonal units, and 499 vacant units.

Economy

➢Economic impact of Holden Beach is reflected in contribution to the county tax base.

➢According to the North Carolina Department of Revenue, the value of taxable real property on Holden Beach accounts for 16.7 percent ($1.2 billion) of the overall Brunswick County property tax base.

➢In 2008, the estimated total economic impact of recreational fishing charters and private boating trips through Brunswick County's inlets exceeded $70 million, and commercial fishery activity associated with Lockwoods Folly Inlet generated $900,157 in total economic impacts (NCDENR 2011).

Economic Considerations for Project Alternatives

- Understanding the economic values associated with shoreline management alternatives is a complex and multifaceted undertaking.
  - Many affected user groups
  - Many levels of direct and indirect changes to economic values and economic impacts (construction, real estate, infrastructure, recreation & tourism, aesthetics, inlet maintenance, species, habitats & ecosystems…)

Economic Considerations for Project Alternatives

Part I:

- Summary of available evidence in the literature to frame and characterize the *potential scope* of economic costs and benefits associated with the proposed alternatives for the Holden Beach East End Shore Protection Project.
  - Description of costs and benefits by alternative
  - Summary scope of costs and benefits by alternative (matrix)

Economic Considerations for Project Alternatives

Part II (Appendix?):

- Detailed review of the extant literature regarding economic considerations and methodologies that are pertinent to the proposed management alternatives.

Economic Considerations for Project Alternatives

- The economics section of the EIS will *not* be a formal cost-benefit analysis of project alternatives.
- The full range of economic values associated with the management alternatives will not be estimated.
- Alternative actions will not be ranked based on total costs, total benefits or total net gains.

What are the public interest resources within the Permit Area?

Land Use

➢ Jurisdictional limits encompass a total area of 1,489 acres, including 809 acres of "usable" high ground and 680 acres of "unusable" conservation areas consisting of un-vegetated beaches (26 acres) and a combination of back-barrier tidal marshes and dredged material management areas (654 acres) (Imperial et al. 2009).

Infrastructure

➢ Water Supply and Wastewater Treatment

➢ Transportation

Scenic Resources - aesthetics

Light - construction

Water and Air Quality

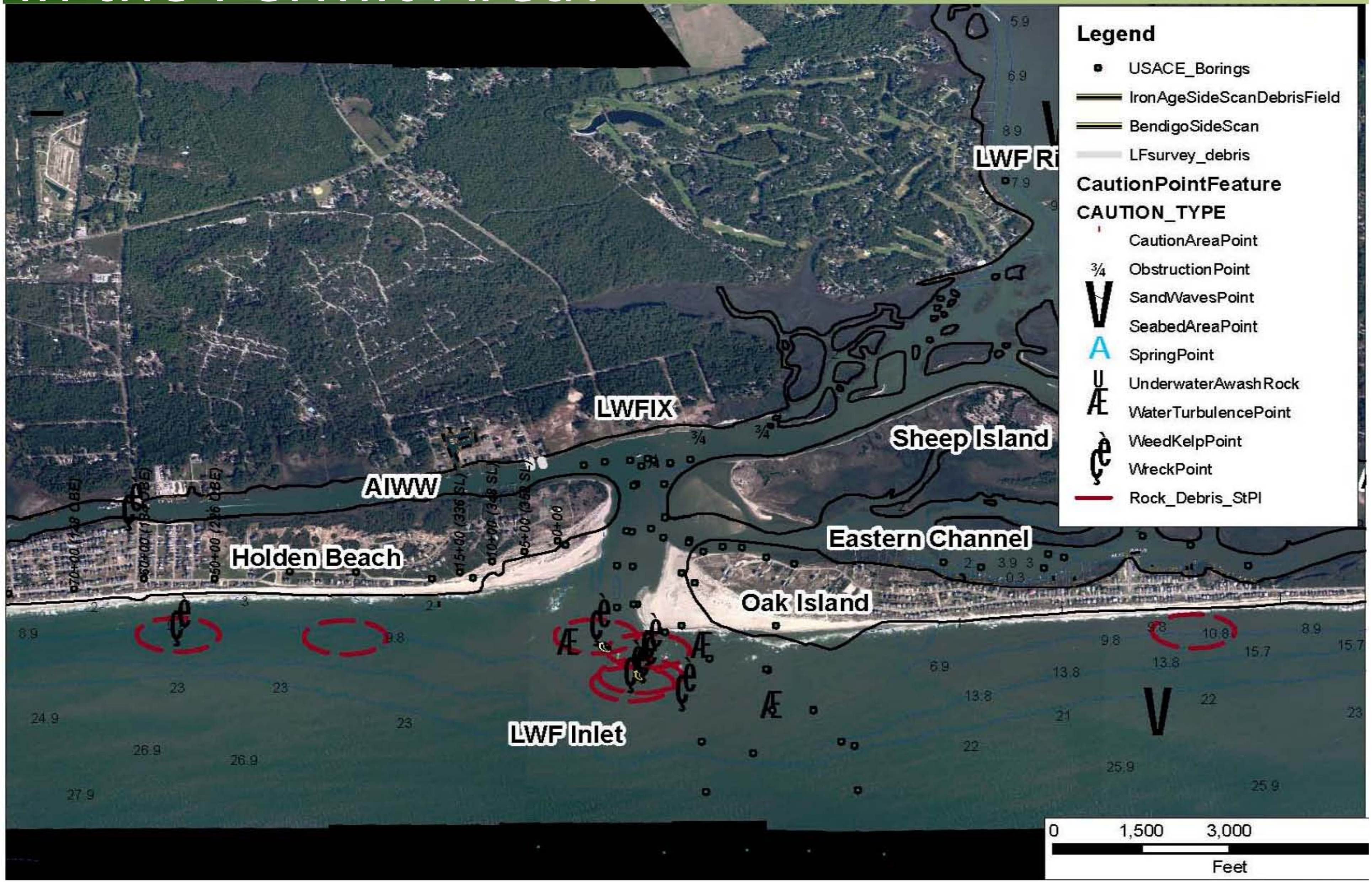
Floodplains

Navigation – Lockwoods Folly Inlet

Noise - construction

Water Safety

What are the cultural resources that occur in the Permit Area?



Environmental Dredging Windows

- USFWS identifies May 1 – November 15 as the moratoria period for sea turtle nesting areas.
- USFWS identifies April 1 – July 15 as the moratoria period for piping plover nesting areas.
- Colonial waterbird nest site (April 1-August 31 moratoria in nesting areas)
- West Indian manatee occurrence (June –October moratoria)

What is the environmental setting?

According to the BIMP:

CHPP Elements

- Class SA waters
- Open shellfish waters surrounding inlet
- Salt marsh inside of inlet near AIWW
- Hard bottom approx. two miles southeast and 2.5 miles southwest of inlet
- Soft bottom habitat associated with ebb-shoal delta
- SAV mapping needed

Protected Species & Wildlife Elements

- West Indian manatee occurrence (June –October moratoria; observers possibly required)
- Green sea turtle and Atlantic Ridley sea turtle habitat (limit takes during dredging)
- Colonial waterbird nesting (shoal habitat; April 1-August 31 moratoria in nesting areas)
- EFH present for 25 species

Shipwrecks

- Moderate potential for eighteenth- and early nineteenth-century shipwrecks
- Moderate potential for Civil War shipwrecks
- Moderate potential for late nineteenth and twentieth century shipwrecks
- Potential for areas to have been subjected to underwater archaeological survey
- Section of Cape Fear Civil War Shipwreck National Register District to south of inlet

Other

- Primary nursery areas beginning at the mouth of Lockwoods Folly River, opposite the AIWW

On the Continued Cost of Upkeep Related to Groins and Jetties

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Abstract

So called "terminal groins" which are actually jetties at the terminus of barrier islands, where inlets are located, have been the subject of controversy for half a century in North Carolina. Coastal scientists have opposed these hardened structures and point to their destructive effects upon downstream beaches; requiring ever increasing and costly beach re-nourishment projects. Meanwhile, some coastal engineers have claimed that they can be used to "stabilize" migrating inlets. Local politicians, in response to real estate interests, have argued for the construction of the hardened structures, and in contrast to the claims of the scientists on the ground, have cited examples of success of both in North Carolina and at other locales on the US eastern seaboard. So what are the facts? This brief study presents the documented facts for North Carolina and these other US east coast locales.

Introduction

In 2003, the North Carolina (NC) Legislature voted, yet again, unanimously to ban the construction of new, permanent erosion control structures from North Carolina's ocean shorelines (including inlets) Session Law 2003-427. There were no dissenting votes in either chamber. This unanimity resulted from the recognition that the NC Coastal Resources Committees had imposed a ban on coastal hard structures, which was enacted in 1985. It was viewed as sound fiscal, environmental, and management policy. However, a new NC Legislature reconsidered the issue and in 2011 voted in favor of Bill S832 which would permit the construction of "terminal groins" along the NC coast.

In the December 2011 issue of News Breakers, Volume 1, Issue 1, Ocean Isle Beach (OIB), NC Mayor Debbie Smith (D. Smith, 2011) states that: "Ocean Isle Beach has had a very successful beach nourishment project covering three miles of our beach since 2001. However, beach nourishment adjacent to an inlet is difficult to be maintained because of the constant shifting nature of the adjacent Shallotte Inlet; at the mouth of the Shallotte River. Recently the NC Legislature passed legislation giving coastal towns and counties a tool to utilize the stabilization of beaches adjacent to inlets. Senate Bill 110 allows pilot projects of up to four terminal groins to be constructed in North Carolina". She also states that "these structures have been used successfully in many coastal states for years", and the says that "in fact there are two existing terminal groins built by the

State of NC that have protected historic Fort Macon on the north end of Atlantic Beach and another terminal groin that has secured the end of Bonner Bridge over Oregon Inlet." However, Mayor Smith's statements are misleading and misrepresent the facts.

In the article cited above, Mayor Smith then makes the claim that a terminal groin (or in classic definitions a "jetty") will stabilize Shallotte Inlet, NC at the east end of OIB, and thus, in her train of logic, eradicate beach erosion. She then reaches the conclusion that the terminal groin/jetty will eliminate the continual need for costly beach re-nourishment projects. In the words of Mayor Smith: "With a terminal groin in place we may reduce the re-nourishment cycles which will certainly be a substantial cost savings for our beach management program. Other viable benefits from construction of a terminal groin are elimination of unsightly sand bag installations, improvement of the natural habitat for birds and turtles and better protection of our roads, utilities and properties." Mayor Smith is not alone in her belief in the positive value of hardening the fragile beaches of NC. In the 12 January 2012 issue of the Brunswick Beacon (Lewis, 2012), Mayor Alan Holden is calling for a groin/jetty to be built at the east end of Holden Beach; which is east of OIB. There are also potential applications for hardened structures at Figure Eight Island NC, Bald Head Island NC, North Topsail Beach NC and Shackleford Banks NC.

It is of note here that the classic definition of a "jetty" is the emplacement of a solid structure, generally perpendicular to the coastline, and more often then not at the terminus of an island. The word jetty has taken on negative connotations from the coastal sciences community as the structures have come to be associated with many examples of having created more damage that then required ever costlier solutions that never worked permanently. Thus the reference in the Mayor's write-up to "re-nourishment cycles" is explained. Alternatively, the term "terminal groin" has been classically known as the last or "terminal groin" in a field of groins, and is thus far more palatable to the uninformed ear then is the alternative jetty. But the point here is not to debate definitions; rather it is to present the facts and thus expose the misrepresentations explicit in the Breakers article.

In her article, Mayor Smith provides aerial photos, one taken in 1993 of Fort Macon, NC at the eastern end of Atlantic Beach NC, with no beach obvious, east of the Fort Macon groin. The second aerial photo, taken in 2007, shows copious amounts of sand in place to the east of the groin leading to the obvious conclusion that the groin/jetty was responsible for the sand accretion. This all sounds and looks good but unfortunately the claims made by the Mayor are misrepresentative, incomplete and thus dangerously incorrect and misleading. So, just what are the facts of the matter for Fort Macon/Atlantic Beach, NC and for other locales along the eastern seaboard of the United States where groins – jetties have been placed at a tidal inlet or river mouth?

The Facts

From the early 19th Century and well into the 20th Century, there was a series of failed engineering projects, all designed ostensibly to stabilize the inlet at the eastern end of Atlantic Beach, NC just beyond Fort Macon. The many prior projects had attempted to "stabilize", i.e. "stop", the migrating island end and thus, presumably prevent, the naturally occurring erosion of beach sediments at that locale. In 1960 a major, presumably more comprehensive, construction project was initiated and was completed in 1970, with the final stage of emplacement of a rock groin/jetty. So the groin that Mayor Smith alludes to in the 1993 photograph actually had been in place, in its entirety as far back as 1970.

It is of considerable note here that along the eastern seaboard of the United States (US), from Maine to the Florida Keys, coastal sediments move on average from north to south and east to west. These sediments emanate from coastal rivers and embayments and from marine sediments re-suspended during the passage of severe storms along the adjacent continental shelf. During the passages of atmospheric storms these sediments are carried in the directions of the ocean currents and waves which along the eastern seaboard of the US, are directed predominantly from north to south and east to west as the storms move predominantly from south to north. That is because winter storms, also called "nor-easters" and hurricanes move from southwest to northeast and the winds on the coastal sides of the storms blow towards the southwest quadrant. As a consequence barrier islands actually move or "migrate" from north to south and east to west; on average during the passages of these storms; which are highly persistent and energetic. Further the islands also move toward the mainland on the back or sound sides of the islands. These naturally occurring processes are well known to the coastal science community. It is also well known that when hardened structures are put in place in an effort to subvert or prevent the naturally occurring processes, they result in serious damage to the beaches and moreover could actually destroy the barrier islands. To counteract these destructive effects, what have been required have been massive expenditures of investments to accelerate the "beach re-nourishment" projects. The facts speak for themselves. Let us revisit Atlantic Beach/Fort Macon.

The completed construction of the Atlantic Beach/Fort Macon Groin/Jetty in 1970, was supposed to result in the salvation of the beach, which had a long documented history of being eroded, and the build-up and build-out of the east end of Atlantic Beach. In 1961, during the initial stages of Groin/Jetty construction, a $6.78 Million (in 2009 dollars, which will be the case for all figures quoted) beach re-nourishment project was also conducted and the beach was "restored". Yet, in 1973 just 12 years after the prior 1961 major beach re-nourishment project, and only 3 years after the groin was completed, a new beach re-nourishment project had to be staged. Why? The answer was, to deal with the exacerbated erosion that had occurred during and following Groin/Jetty construction-completion because of, not in lieu of, the Groin/Jetty. The cost of the project was $1.99 Million. So, did the new groin coupled with the $8.77M spent in beach re-nourishment solve the problem at Fort Macon NC? The answer is "no" as presented below.

From 1973 to 2007, there have been an additional seven re-nourishment projects that have had to staged at Fort Macon NC for a total expenditure of public dollars of $44,894,830. The beach re-nourishment project that occurred in 2007 is the reason that the aerial photo shown in the News Breakers article showed sand on the beaches. In fact the 1993 photo shows the situation in 1993 where no sand is present, some 24 years following Groin/Jetty construction. This was followed in 1994 by a $5.45 Million dollar re-nourishment project; the fruits of which disappeared within several years and had to be redone in 2002 and again in 2005. So from 1973 to 2007, a period of 34 years, nearly $45 Million of tax payer money has had to be spent on the beach east and west of the Fort Macon Groin/Jetty. That does not seem like a very good investment of precious public tax payer dollars and moreover totally refutes the argument that groin/jetties are “a” or “the” solution to the beach erosion. To the contrary, the case seems to have been built by this example is that the hardened structures are a major culprit and are a partial cause of the problem.

Mayor Smith also mentions the Groin/Jetty built at the terminus of Pea as another NC success story. Has this been the case for Pea Island? Well the facts are that from 1990 through 2004, $20.2 Million of public tax-payer money has been spent at Pea Island in re-nourishment projects. The table of the actual facts of re-nourishment projects and associated costs at Atlantic Beach/Fort Macon and Pea Island are presented below (Figure 1). The aerial photos shown were taken in 2009. Clearly Fort Macon will soon require another costly re-nourishment project. Moreover the beach to the west of the Groin/Jetty has undergone a stark recession and will also require costly re-nourishment. These data are from public records. The total costs of re-nourishment for the Fort Macon and Pea Island has been $64, 905,952 to date.

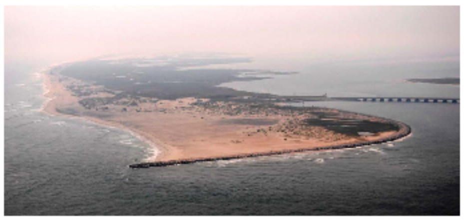
Mayor Smith also notes in her article that: “These structures have been used successfully in many coastal states for years. “ Again, what are the facts? Well, as shown in the table below, the 15 such structures put in place from Ocean City, MD to Boca Grand Pass, FL (not including NC) have required $778,798,382 in beach re-nourishment projects. These numbers are well documented in Riggs (2009) and Riggs and Ames (2011).

So the total 17 Groin/Jetty structures from Florida to Maryland have required expenditures of $843,704,334 up through 2009. This is $49,629,431 per structure. In NC alone the rate of re-nourishment cost to the public has been $11,180,109 per decade or $5,900,055 per Groin/Jetty per decade. That is a daunting figure for an island such as Ocean Isle Beach. Who will pay those documented costs of approximately $6 Million per decade? And what land is being protected? Well if the photographs do not lie, then very few land owners are actually being protected. Certainly the land downstream of the structures will be deprived of sediments, as shown over and over. The classic, textbook example of the downstream damage affected by these structures is shown for the New Jersey coast below; a horrifying prospect for a small, 6.5 mile in length, Barrier Island. Pity the homeowners at the central and west end of Ocean Isle Beach and pity the homeowners of Sunset Beach, an island only 3.5 miles long and in the lee of OIB. Legal experts and banking interests fear that coming property owner law suits will surely bankrupt such small and resource limited barrier islands. Further, if a groin/jetty is built at the east end of Holden Beach, it will deprive Ocean Isle Beach of Cape Fear River sediment effluents as well those emanating from the Lockwood Folly Inlet. Both the Cape Fear River Plume and the Lockwood Folly Inlet Plume turn, on average, towards the west as they out-well onto the adjacent Continental Shelf. Thus OIB beaches will be further starved; including that of Sunset Beach.

The message to the public as regards Groins and Jetties are: 1) Individual snapshots to prove a particular perspective should not be used, when the photos only represent one particular time in a long series of groin/jetty and beach re-nourishment projects; 2) The true record of what has actually transpired and what the associated costs have been should be presented; 3) An honest, unbiased effort to understand naturally occurring processes, should be made by managers and decision makers. Naturally occurring processes, such as frequent atmospheric storms, will not be denied; 4) Public decision makers, who in many cases have a principal knowledge base that is real estate development, and who may have vested interests, should not be spending public funds nor advocating for the expenditure of public funds where a conflict of interest may exist; 5) The public should be fully informed of the folly of building on the tips of barrier islands, as these locales are highly, naturally unstable and cannot be stabilized in-place. The tips of barrier islands will and must move as the islands must migrate to survive rising sea level and continued atmospheric storms; 6) The NC Legislature nor any other state legislative body, should not be so controlled by the real estate and construction lobby that it makes ill-conceived decisions that put the public beaches at risk, which it has done in the case of NC; 7) The banking community should be fully aware of the risks of subsidizing housing at the tips of barrier islands and thus not make building loans for such construction; 8) Sea Level is rising and Groins and Jetties will exacerbate the erosion effects of storms occurring on a higher base of sea level; 9) Cost analyses of the continued costs of counter-acting the damage done by Groins and Jetties should be conducted using the facts; and 10) The tax value and taxes derived from properties purportedly to be protected by the structures should be part of a Cost-Benefit Analysis. The question should be are the taxes to be derived sufficient to cover the continuing costs associated with these structures? Here again, we consider public records.

Andy Coburn of Western Carolina University conducted the analysis summarized below. Basically, using the US Army Corps of Engineers figures of the property that will purportedly benefit from an Ocean Isle Beach (OIB) east end Groin/Jetty is shown in the ellipse. This is a government drawn figure. It is ambitious at best, but let us accept it at face value. The Total Properties in the ellipse number 60. Here we note that the assumption is that the Groin/Jetty will benefit all OIB properties in the ellipse but that is not a solid assumption. In fact the aerial photos of Fort Macon NC and the New Jersey coast speak to that untruth. Moreover the structure will hurt all OIB properties to the west of the ellipse. Basically: 1) the Total Appraised Value of Properties inside of the ellipse is $18,100,460 (2009 assessments); 2) the Average Appraised Value/Property inside of the ellipse is $301,674; 3) the County Tax Revenue/Year (@ 0.305/100) is $55,206; 4) the County Tax Revenue/Property/Year is $920; and 5) the Total OIB Tax Revenue/Year (@ 0.09/100) is $16,290. This cost –benefit analysis begs two questions: 1) How is a multi-tens of millions of dollars of costs of construction of value to the community; and moreover, 2) How do the continuing costs of approximately $6,000,000 (at today's costs) per decade of value to barrier islands such as OIB? The answer to both questions is: It is not! The Public should resoundingly reject and vote down this ill-conceived, misguided initiative.

Figure 1.



Location	Date	Volume (cy)	Actual Cost	2009 Dollars*
Pea Island	1990	254,955	-	-
Pea Island	1991	282,600	-	-
Pea Island	1992	184,300	-	-
Pea Island	1992	1,078,000	-	-
Pea Island	1993	433,235	-	-
Pea Island	1995	203,191	$1,294,327	$1,806,528.88
Pea Island	1996	500,217	-	-
Pea Island	1997	294,000	$1,159,642	$1,536,861.62
Pea Island	1998	260,183	$637,448	$831,846.18
Pea Island	1999	328,919	$545,515	$696,494.30
Pea Island	2000	419,305	$1,228,564	$1,517,576.19
Pea Island	2001	513,706	$2,568,530	$3,084,977.12
Pea Island	2002	732,852	$2,822,329	$3,337,047.13
Pea Island	2003	1,029,543	$3,860,786	$4,463,173.53
Pea Island	2004	616,448	$2,510,229	$2,826,618.85
Pea Island		**7,131,454**	**$16,627,370**	**$20,101,123.80**

Location	Date	Volume (cy)	Actual Cost	2009 Dollars*
Fort Macon	1961	-	$952,000	$6,772,540.74
Atlantic Beach/Fort Macon	1973	504,266	$414,807	$1,987,233.83
Atlantic Beach/Fort Macon	1978	1,179,600	$1,565,177	$5,106,245.93
Atlantic Beach/Fort Macon	1986	4,168,600	$5,316,038	$10,317,236.56
Atlantic Beach/Fort Macon	1990	-	-	-
Atlantic Beach/Fort Macon	1994	4,664,000	$3,794,727	$5,446,508.67
Atlantic Beach/Fort Macon	2002	209,348	-	-
Atlantic Beach/Fort Macon	2005	2,800,000	$12,900,000	$14,049,903.23
Fort Macon	2007	211,000	$1,184,500	$1,215,160.51
		13,736,814	**$26,127,249.00**	**$44,894,829.47**

*The BLS CPI inflation calculator uses the average Consumer Price Index for a given calendar year. This data represents changes in prices of all goods and services purchased for consumption by urban households. This index value has been calculated every year since 1913. For the current year, the latest monthly index value is used.

Figure 2.

Location of Terminal Structure	Volume Emplaced	Cumulative Cost
BOCA GRANDE PASS (FL)	1,336,781	$17,542,500
JOHNS PASS (FL)	13,248,650	$162,417,417
BAKERS HAULOVER (FL)	17,150,775	$38,229,274
CLEARWATER PASS (FL)	10,902,450	$151,791,898
ST. LUCIE INLET (FL)	30,985,280	137,950,278
BIG CARLOS PASS (FL)	360,000	$3,237,280
BLIND PASS (FL)	5,506,700	$11,582,900
NASSAU SOUND (FL)	6,185,096	$10,874,735
PORT CANAVERAL (FL)	15,614,000	$92,748,198
REDFISH PASS (FL)	6,864,600	$20,222,483
ST. AUGUSTINE INLET (FL)	5,465,500	$12,662,600
MIDWAY INLET (SC)	530,700	$2,312,000
ST. HELENA SOUND (SC)	6,012,149	$17,778,553
TYBEE ISLAND (GA)	5,960,000	$9,736,000
OCEAN CITY INLET (MD)	14,366,391	$89,712,266
TOTAL	140,489,072	$778,798,382

Figure 3.

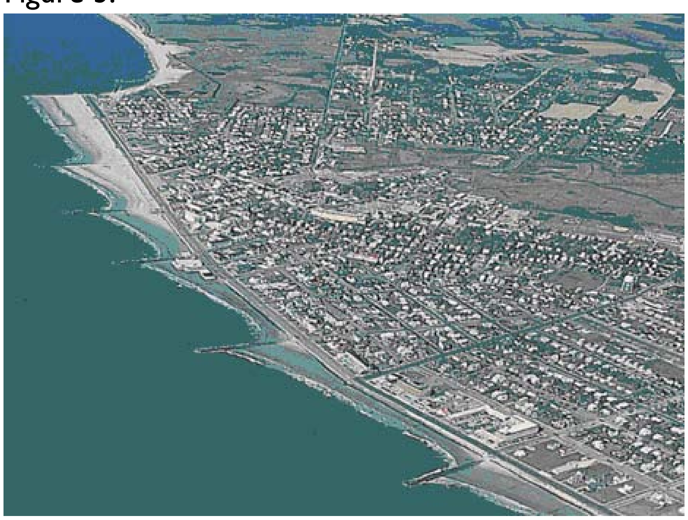


Figure 4.

Analysis done by Andy Coburn WCU

Shallotte Inlet/Ocean Isle Beach (within red circle):
Total Properties: 60
(NOTE: Terminal groin assumed to benefit all properties in red)

Assessed Value

2009 Assessed Value of Properties: $18,100,460 ($301,674/property)

2009 Brunswick County Assessed Value: $31,392,480,327.87
Percent of 2009 County Assessed Value: 0.058%

2009 OIB Assessed Value: $2,640,888,866
Percent of 2009 OIB Assessed Value: 0.685%

County Tax Value (@ .305/100)

- 2009 County Ad Valorem Tax Revenue: $95,747,065.00
- 2009 County Ad Valorem Tax Revenue Generated by Properties: $55,206 ($920/Property)
- 2009 County Ad Valorem Tax Revenue Generated by Properties: 0.058%

OIB Tax Value (@ .09/100)

- 2009 OIB Ad Valorem Tax Revenue: $2,376,800
- 2009 OIB Ad Valorem Tax Revenue Generated by Properties: $16,290 ($272/Property)
- 2009 OIB Ad Valorem Tax Revenue Generated by Properties: 0.685%

Occupancy Tax Revenue

- FY 2006-07 OIB Occupancy Tax Received: $1,134,847
- # of Structures Rented: 828 (p19 OIB LUP)
- Occupancy Tax/Structure: $1,371
- Estimated Occupancy Tax Revenue: (60x.33)x$1,371 = $27,145/Yr

Basically, it should be understood that beach migration is a naturally occurring process. The beaches move when energetic atmospheric storms which create highly energetic coastal ocean currents and large amplitude waves which then mechanically move sediments along, away from and towards the coast. The Egyptians Chinese, Greeks and Romans all understood this. Moreover Native American Indians, the earliest inhabitants of the coastal areas of the eastern seaboard of the US understood this. The approach taken by those cultures was to go wherever the beaches were. In fact the Romans were known to create rice fields in the wetlands behind European barrier islands; rice patties that are still lucrative enterprises today. The inlets, which must move as the islands migrate are also natural passageways for estuarine dependent finfish and are heavily used by marine wildlife for food and habitats. Any changes in the inlet functioning will necessarily impact wildlife balances and survival.

Well intentioned coastal engineers, whose business is construction, have tried many so-called solutions in attempts to take on, deal with and solve inlet migration, beach movements and sea level rise. But all efforts involving groins and jetties have failed. In the mid-1990s, the US National Academy of Sciences and the US Park Service asked a team of expert coastal scientists and engineers to study the issue of the Cape Hatteras Lighthouse NC, which was under threat of being destroyed by the encroaching Atlantic Ocean. This was after a period over which a series of groins had been built to protect the Lighthouse, by stabilizing the Hatteras shoreface and in building out the beaches. Unfortunately the erosion in front of the Lighthouse was exacerbated by the groins and the Expert Panel agreed that the only viable solution was to move the Lighthouse. The NAS and PS agreed with the recommendation, the Lighthouse was moved and the whole issue has gone away with movable beach resources being enjoyed by the public.

Given the well known effects of the passages of winter storms in causing coastal erosion and inlet migration, one would assume that the frequency occurrence of winter storms on an annual basis should correlate with any beach erosion and or beach re-nourishment projects. As it occurs, Riggs and Ames (2011) meticulously created an “erosion vs. accretion” profile for Pea Island NC using a combination of NC Department of Transportation aerial photographs and beach surveys over the years 1947 to 2006. However, if one looks at the beach re-nourishment campaigns that have been staged by NC for Pea Island (see Figure 1 above), one sees that from 1990 to 2005, there has been a series of yearly projects peaking in 1992 with 1.27 million yards of sediment dumped on the beaches. So a one to one annual comparison (Figure 5) is not mathematically tractable. However if we conduct an empirical ensemble modal decomposition (Huang et al, 1998) of the annual winter storm data set we find that there is a long period mode of about 30 years (IMF mode C4). If one compares the Riggs erosion-accretion data time series, one sees a clear relationship that suggests that over the long haul, the erosion vs. accretion curve is in keeping with the variability of the frequency of occurrence of US east coast winter storms (Figure 6, lower panel). Unfortunately, higher frequency modes of variability, such as IMF modes (C3 + C4) vs. the erosion-accretion curve (also Figure 6, upper panel) are masked by re-nourishment projects. It is of note that the Fort Macon time series of re-nourishment projects (Figure 1) seems to align very well with IMF mode C2, which nominally has about a 7-8 year cycle. This suggests that if the re-nourishment strategy of putting sediments on the Fort Macon beaches during particularly energetic storm years or actually a sequence of them, then there is a cleat argument that at a maximum, beach re-nourishment due to the combined effects of winter storm occurrence and the presence of groin/jetties will require major re-nourishment expenditures on no less than every 7 years and more likely more frequently.

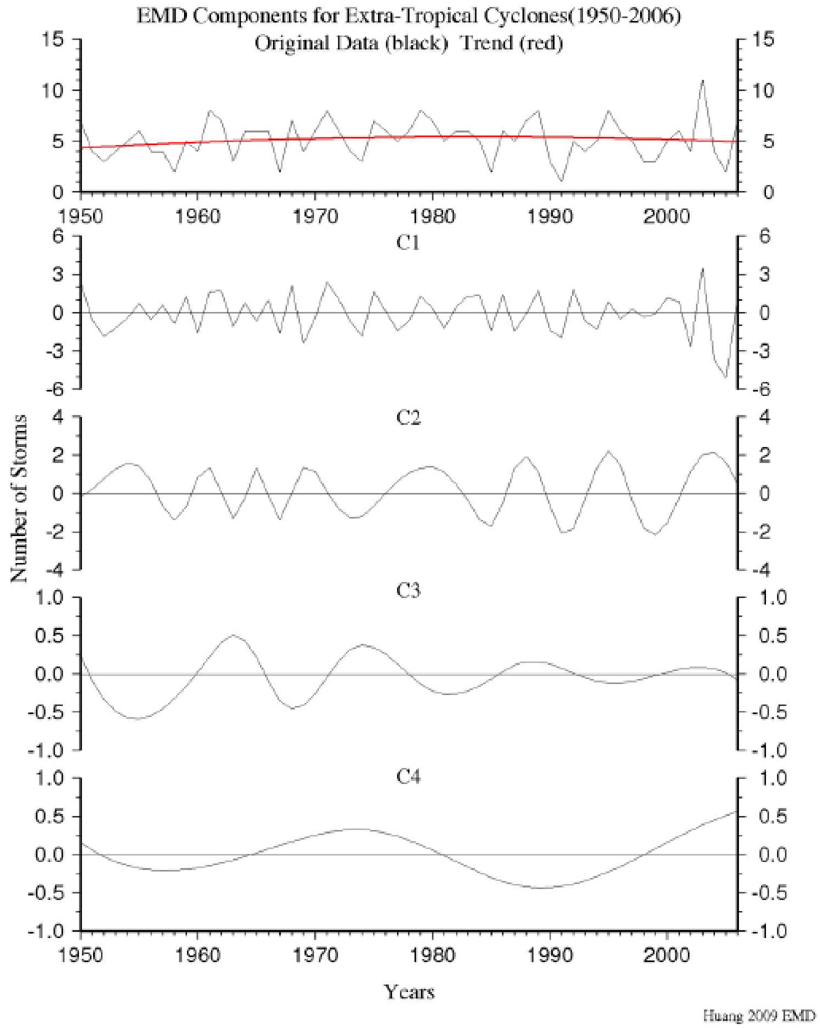
The structures proposed in places like Figure 8 Island, Holden Beach and Ocean Isle are on the down-drift side of the neighboring inlet. A shore-perpendicular structure, placed at the down-drift side of an inlet, will block the natural flow of sand onto the island where the structure is located. This will cause an increase in shoreline erosion in front of oceanfront homes down-drift of the structure. Protecting homes at the inlet will be at the expense of a larger number of homes down the beach.

The unfettered flow of sand through natural inlets is an important mechanism maintaining barrier island health. Blocking this flow of sand will inhibit the ability of the barrier island to respond to rising sea level and storms. Also, Groins can impact near-shore circulation by directing currents offshore, especially during storms. Groins can be particularly destructive following storms if a significant portion of the nourishment project is transported offshore, leaving the groin uncovered. During this period, the groin will block all along-coast transport until the cell is filled in again.

Conclusions

The lessons learned by the examples presented above are: 1) The public will use beaches wherever they are; 2) Sediments are not lost from the total barrier island beach system during storm passage, rather they are relocated within the system; 3) Inlets, the tips of islands, are sources of sediments that should be used naturally by the barrier island system per se to maintain itself; 4) There should be a moratorium on the public policy of allowing building on the ends or tips of barrier islands. Basically these lands should be viewed as being in a continual state of migration and should be allowed to move as necessary. Inlets do not close, they just relocate; 5) Hardened structures will not stabilize inlets or eliminate erosion, rather they will cause erosion and thus should be banned in perpetuity; 6) Public, elected officials should tell the whole story and not cherry-pick facts for their own use, and if they do, they should be held accountable; and 7) Public funds should not be used for either groin/jetty or re-nourishment projects. This is a misuse of public revenues and managers who do so should be held accountable.

Figure 5.


EMD Components for Extra-Tropical Cyclones(1950-2006)
Original Data (black) Trend (red)
C1
C2
C3
C4
Number of Storms
Years
Huang 2009 EMD

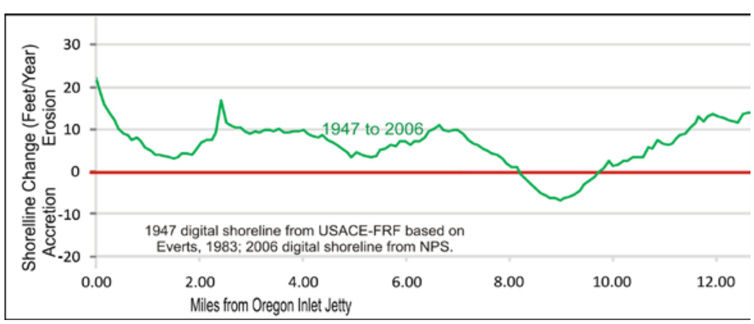
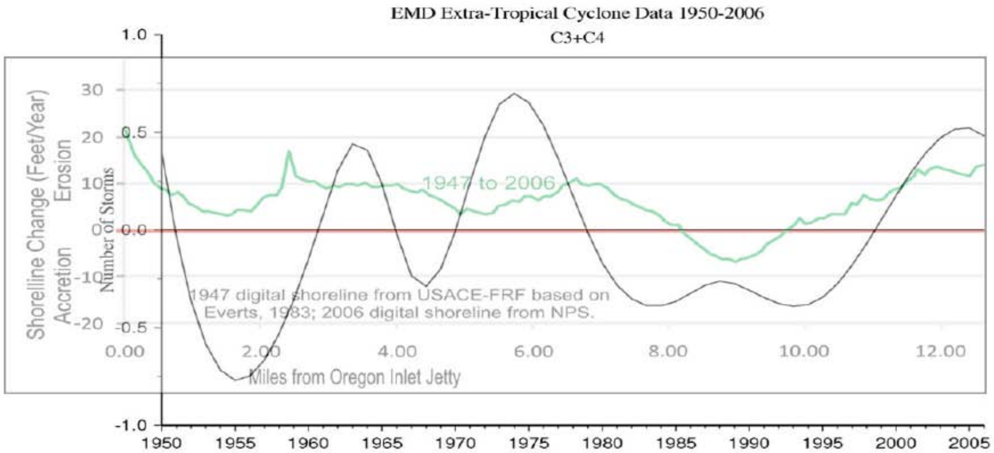
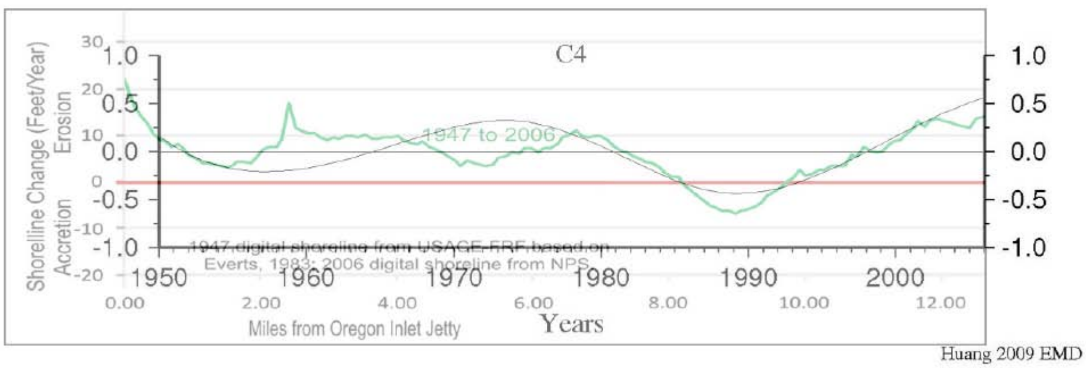

Shoreline Change (Feet/Year)
Erosion
Accretion
1947 to 2006
1947 digital shoreline from USACE-FRF based on
Everts, 1983; 2006 digital shoreline from NPS.
Miles from Oregon Inlet Jetty

Figure 6.





<u>Figure Legends</u>

Figure 1. Aerial photographs of Pea Island (left) and Atlantic Beach/Fort Macon (right) and table of beach re-nourishment projects for each by year and cost for each island terminus. Note the eroded, cuspate coastline downstream of the Pea Island groin and the eroded coast on the leeside of the Fort Macon groin.

Figure 2. Table of Florida, Georgia, South Carolina and Maryland groins and the re-nourishment projects required to replace eroded beaches, by volume of sediment and cost associated with each project.

Figure 3. Aerial photograph of New Jersey shoreline showing eroded, cuspate shoreline downstream of groins.

Figure 4. Ocean Isle Beach (OIB) NC Tax Value and Tax Benefits of proposed OIB groin. The US Army Corps of Engineers projected that 60 properties (in the red ellipse) would be protected by the proposed groin. Andrew Coburn of Western Carolina University conducted an analyses of county and town tax records which show that these properties 0.058% (or less than six hundredths of one percent) to the Brunswick County Tax Base and 0.685% (or less than seven tenths of one percent) to the OIB Tax Base.

Figure 5. Rate or shoreline erosion (above red line) and or accretion (below red line) of the coastline at Pea Island from 1947 through 2006 vs. the EEMD modal decomposition

of the frequency of occurrence of atmospheric winter storms in the vicinity of Cape Hatteras NC.
Figure 6. Rate of erosion/accretion of the coastline at Pea Island vs.: (upper panel) the decadal plus multi-decadal frequency of occurrence of winter storms (Modes C3 + C4) from Figure 5; and (lower panel) the multi-decadal frequency of occurrence (Mode C4) from Figure 5.

Acknowledgements
The authors acknowledge the tables and imagery provided by Dr. S. Riggs of East Carolina University (ECU) and Mr. A. Coburn (Western Carolina University, WCU). The authors also acknowledge the many discussions held with scientists Dr. O. Pilkey of Duke University (DU), Dr. R. Young (WCU), Dr. J.P. Walsh (ECU), Dr. Steve Culver (ECU), Dr. Dave Mallinson (ECU), Dr. P. Peterson (University of North Carolina-Chapel Hill, UNC-CH), Dr. Tony Rodriguez (UNC-CH), Dr. M. Stutz (Meredith College), Dr. D. Heron (DU). The collective group of scientists has stated: "We are not anti-development. Nor are we an environmental lobby. We are simply electing to play our role in helping the state develop sound, science-based policy". Mr. J. Epps is thanked for acquiring and processing the storm data from the National Oceanic & Atmospheric Administration - National Climatic Data Center.

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APPENDIX B

DRAFT EIS COMMENTS AND RESPONSES

US Army Corps
Of Engineers
Wilmington District

PUBLIC NOTICE

Issue Date: August 28, 2015
Comment Deadline: October 13, 2015
Corps Action ID Number: SAW-2011-01914

The Wilmington District, Corps of Engineers (Corps) received an application from the Town of Holden Beach (Town) seeking Department of the Army authorization to discharge fill material into waters of the United States, associated with the construction of a 700-ft-long terminal groin with a 300-ft shore anchorage system and associated long-term beach nourishment component, in order to address erosion and protect infrastructure, roads, homes, beaches, dunes and wildlife habitat in Holden Beach, Brunswick County, North Carolina. Specific plans and location information are described below and shown on the attached plans.

This notice serves to announce receipt of a DA permit application in accordance with 33 CFR 325.3, and release of the draft Environmental Impact Statement (DEIS) for this project in accordance with 33 CFR 325 Appendix B, and 40 CFR 1502.19 - 1506.10. Comments will be received for 45 days, with an end comment period date of October 13, 2015. A public hearing to receive public comment will be held at the Holden Beach Town Hall at 110 Rothschild Street, Holden Beach, NC 28462, on September 24th, at 6:00pm. Beginning August 28, 2015, the DEIS may be obtained from the following link: http://www.saw.usace.army.mil/Missions/RegulatoryPermitProgram/MajorProjects Comments received from the DEIS will be used in the development of a Final EIS (FEIS) for this project.

APPLICANT:
Town of Holden Beach
Attn: Mr. David Hewett, Town Manger

AGENT (if applicable):
Dial Cordy & Associates
Attn: Mrs. Dawn York, Project Manager

Authority

The Corps evaluates this application and decides whether to issue, conditionally issue, or deny the proposed work pursuant to applicable procedures of the following Statutory Authorities:

☒ Section 404 of the Clean Water Act (33 U.S.C. 1344)

☒ Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403)

☐ Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972 (33 U.S.C. 1413)

Location

The project site is located on the eastern portion of Holden Beach and within the Lockwood Folly Inlet complex, and will encompass approximately 1.0 mile of oceanfront shoreline on Holden Beach, Brunswick County, North Carolina.

Directions to Site: Holden Beach, North Carolina, is located 35 miles south of Wilmington, NC and 40 miles north of Myrtle Beach, SC. From Wilmington, take US Highway 17 to Stone Chimney Rd SE to Holden Beach. Take a left on Ocean Blvd E (State Rd 1116) and drive east to the end. Public parking access is located just past Avenue D.

Project Area (acres): 1,655 ac Nearest Town: Holden Beach
Nearest Waterway: Atlantic Ocean River Basin: Lumber
Latitude and Longitude: 33.914483N, -78.244248W

Existing Site Conditions

The barrier islands of Holden Beach (eight miles long) and Oak Island (12 miles long) are located west of the Cape Fear River and have an east-west orientation, facing Long Bay and the Atlantic Ocean to the south, and separated from mainland Brunswick County to the north by tidal marshes and the Atlantic Intracoastal Waterway (AIWW). Holden Beach and Oak Island are separated by the Lockwood Folly Inlet (LFI). The relatively narrow subaerial ocean beach along the eastern end of Holden Beach is backed by a narrow line of low vegetated foredunes and wide interior parabolic dunes that protrude northward towards the AIWW. The majority of the interior dunes have been fully or partially developed for residential use. The interior dunes are backed by a narrow fringe of tidal marsh that separates the island from the AIWW. The AIWW extends east across LFI and behind the west end of Oak Island where it crosses the Lower Lockwood Folly River. The west end of Oak Island is backed by a narrow fringe of tidal marsh that separates the island from a waterway known as the Eastern Channel. A spoil island-marsh complex known as Sheep Island lies between the Eastern Channel and the AIWW to the north. The Lower Lockwood Folly River estuary to the north of the AIWW contains an expansive estuarine complex of marsh islands, sandy shoals, shellfish beds, and tidal creeks.

The marine component of the Permit Area encompasses the subtidal ocean bottom (benthic) and ocean water column (pelagic) habitats and communities that occur seaward of the intertidal ocean beach to approximately the 40-ft isobath on the inner continental shelf of Long Bay. The shoreface and inner shelf along Holden Beach contain underlying ancient hard strata (sandstones and limestones) that are covered by a thin and discontinuous veneer of modern sand.

The Permit Area includes a variety of biotic community types and sizes:

Biotic communities in the Permit Area.

Habitat Type	Size (ac)
Residential	107.3
Beach and Foredune	70.0
Dune Grasses	34.4
Upland Mixed Forest	35.1
Upland Shrub-Scrub	70.5
Wetland Mixed Forest	59.3
Wetland Shrub-Scrub	19.6
Low Marsh	148.2
Intertidal	208.8
Subtidal	902.7

Applicant's Stated Purpose

The purpose of the Proposed Action is to establish a comprehensive shoreline protection program, under the independent authority of the Town of Holden Beach, which will restore and maintain the East End beach and provide for the short- and long-term protection of residential structures, Town infrastructure, and recreational assets. The Proposed Action is needed to mitigate ongoing and chronic East End shoreline erosion, which is projected to continue for the foreseeable future and threatens residential structures, Town infrastructure, recreational assets, and natural resources. Furthermore, based on the increasing need for additional shore protection beyond that provided by federal beneficial use placements, and the trend of declining federal funding for nourishment projects, an independent shore protection program under the authority of the Town is needed to ensure that the East End shoreline will be adequately protected.

Project Description

In June 2011, Senate Bill 110 authorized the permitting of terminal groins at four (4) inlets in North Carolina. As part of the Senate Bill, requests for terminal groins must include the following provisions: a monitoring plan; a baseline for assessing adverse impacts and thresholds for when adverse impacts must be mitigated; a description of mitigation measures to be undertaken should the impact thresholds be reached; and a plan to modify or remove the terminal groin if adverse impacts cannot be mitigated.

The following additional alternatives are being considered in the evaluation of the least environmentally damaging practicable alternative:

Alternative 1 - No Action (Status-Quo)

Under the No-Action Alternative (Alternative 1), the Town would continue to rely solely on the Corps' beneficial use projects for shore protection of the East End of Holden Beach. Since 2002, the East End has been nourished nine times with dredged material derived from the AIWW Lockwood Folly Inlet Crossing (LFIX) navigation channel. On average, these nourishment events placed ~77,000 cy of dredged material on the East End of Holden Beach at two-year intervals.

Alternative 2 - Abandon and Retreat

Under Alternative 2, the Town would not pursue a long-term management plan, and there would not be any Federally implemented or federally permitted actions undertaken to mitigate erosion along the East End of Holden Beach. Thus, the Corps would not conduct any East End Beneficial Use Projects, and the Town would not implement any actions, such as beach nourishment, beach scraping, dune restoration, temporary sandbag placement, and inlet dredging, which require a federal dredge and fill permit.
Instead, the Town would develop and implement a 30-year managed retreat plan under which structures that are threatened with erosional damage would be either relocated to unimproved interior lots or demolished. This plan would establish an erosional threshold that would trigger preemptive relocations or demolitions prior to the point of imminent structural failure.

Alternative 3 - Beach Nourishment

Under Alternative 3, the Town would assume responsibility for East End shore protection through the implementation of an independent, 30-year nourishment-only beach management plan. Under the proposed plan, the East End of Holden Beach would be nourished with ~100,000 to 150,000 cy of sand every two years. The conceptual beach fill placement area encompasses ~3,700 linear ft of the East End oceanfront beach between Blockade Runner Drive (~Station 00 + 40) and LFI (~Station 00 + 10). The preferred source of beach fill under Alternative 3 would be the LFIX navigation channel and associated 400-ft bend widener.

Alternative 4 - Inlet Management and Beach Nourishment

Under Alternative 4, the Town would assume responsibility for shore protection of the East End of Holden Beach through the implementation of an independent, 30-year inlet management and beach nourishment plan. The anticipated management regime would involve periodic relocations of the LFI outer ebb channel and concurrent East End nourishment events approximately every two years. Outer inlet channel relocation events would involve the construction of a wider and deeper outer channel with a more westerly alignment towards the inlet shoulder of Holden Beach. The new channel would be dredged to a uniform depth of 14 ft (MLW) and would have a variable width ranging from ~350 ft at the inlet throat to ~850 ft at the 14-ft isobaths.

Alternative 5 - Short Terminal Groin and Beach Nourishment

Under Alternative 5, the Town would assume responsibility for shore protection of the East End of Holden Beach through the construction of an ~800-ft-long "short" terminal groin at the eastern end of the oceanfront beach between Stations 10+00 and 20+00 and the implementation of an independent, 30-year beach nourishment plan. The main stem of the short terminal groin would include a 550-ft-long segment extending seaward from the toe of the primary dune and a ~250-ft-long anchor segment extending landward from the toe of the primary dune. The groin would also include a 250-ft-long shore-parallel T-Head segment centered on the seaward terminus of the main stem.

Nourishment events would place ~100,000 to 150,000 cy of sand on the east end of Holden Beach every four years. The initial nourishment event would include the construction of a wedged-shaped "groin fillet" sediment feature that would establish a gradual, transitional shoreline between the western end of the beach fill footprint and the seaward terminus of the short groin. The proposed borrow site dredging regime under Alternative 5 would involve the extraction of ~120,000 to 180,000 cy of sand from the preferred LFIX/bend-widener borrow site every four years with the addition of potential supplemental sand acquisition from the inland LFI navigation channel and the Central Reach offshore borrow site.

Alternative 6 - Intermediate Terminal Groin and Beach Nourishment (Applicant's Preferred Alternative)

Under Alternative 6, the Town would assume responsibility for shore protection of the East End of Holden Beach through the construction of a ~1,000-ft-long intermediate terminal groin at the eastern end of the oceanfront beach between Stations 00+00 and 10+00 and the implementation of an independent, 30-year beach nourishment plan. The main stem of the intermediate terminal groin would include a 700-ft-long segment extending seaward from the toe of the primary dune and a ~300-ft anchor segment extending landward from the toe of the primary dune. The groin would also include a 120-ft-long shore-parallel T-Head segment centered on the seaward terminus of the main stem.

The projected beach nourishment regime would involve the placement of ~100,000 to 150,000 cy of sand on the East End of Holden Beach every four years. The beach fill profile design would be similar to that of Alternatives 3, 4, and 5 and include a +9-ft NAVD high dune with a 50-ft-wide crest, a +7-ft NAVD high, 200-ft-wide berm, and a 90- to 200-ft-wide transition with a 15 percent slope. The anticipated borrow sites and dredging regimes would be the same as those described under Alternative 5.

Avoidance and Minimization

The applicant provided the following information in support of efforts to avoid and/or minimize impacts to the aquatic environment: The Applicant has completed an Inlet Management Plan (IMP) that provides detailed information regarding required plan components including: (1) determination and type of data to define the baseline condition; (2) post-construction monitoring to compare baseline data and assess potential adverse impacts; (3) timeframes for post-construction monitoring; (4) identification of thresholds for implementation of mitigation measures; and (5) mitigation measures that may be implemented. In addition, terminal groin construction and beach fill placement activities would adhere to a 16 November to 30 April environmental window; thereby avoiding the sea turtle nesting season, the majority of the shorebird breeding season, the majority of the seabeach amaranth growing season, and peak benthic invertebrate recruitment periods.

Compensatory Mitigation

The applicant offered the following compensatory mitigation plan to offset unavoidable functional loss to the aquatic environment: The project as proposed will not impact wetlands. Therefore, no compensatory mitigation will be required for the applicant's project as proposed. Changes to the project and/or additional information received which suggest impacts to wetlands and or waters of the United States, will warrant further evaluation for avoidance and minimization of wetland impacts and any compensatory mitigation.

Essential Fish Habitat

Pursuant to the Magnuson-Stevens Fishery Conservation and Management Act, this Public Notice initiates the Essential Fish Habitat (EFH) consultation requirements. The Corps' initial determination is that the proposed project may adversely affect EFH or associated fisheries managed by the South Atlantic or Mid Atlantic Fishery Management Councils or the National Marine Fisheries Service. Consultation with the National Marine Fisheries Service on EFH will be requested under separate letter.

Cultural Resources

Pursuant to Section 106 of the National Historic Preservation Act of 1966, Appendix C of 33 CFR Part 325, and the 2005 Revised Interim Guidance for Implementing Appendix C, the District Engineer consulted district files and records and the latest published version of the National Register of Historic Places and initially determines that:

☐ Should historic properties, or properties eligible for inclusion in the National Register, be present within the Corps' permit area; the proposed activity requiring the DA permit (the undertaking) is a type of activity that will have no potential to cause an effect to an historic properties.

☐ No historic properties, nor properties eligible for inclusion in the National Register, are present within the Corps' permit area; therefore, there will be no historic properties affected. The Corps subsequently requests concurrence from the SHPO (or THPO).

☐ Properties ineligible for inclusion in the National Register are present within the Corps' permit area; there will be no historic properties affected by the proposed work. The Corps subsequently requests concurrence from the SHPO (or THPO).

☒ Historic properties, or properties eligible for inclusion in the National Register, are present within the Corps' permit area; however, the undertaking will have no adverse effect on these historic properties. The Corps subsequently requests concurrence from the SHPO (or THPO).

☐ Historic properties, or properties eligible for inclusion in the National Register, are present within the Corps' permit area; moreover, the undertaking may have an adverse effect on these historic properties. The Corps subsequently initiates consultation with the SHPO (or THPO).

☐ The proposed work takes place in an area known to have the potential for the presence of prehistoric and historic cultural resources; however, the area has not been formally surveyed for the presence of cultural resources. No sites eligible for inclusion in the National Register of Historic Places are known to be present in the vicinity of the proposed work. Additional work may be necessary to identify and assess any historic or prehistoric resources that may be present.

The District Engineer's final eligibility and effect determination will be based upon coordination with the SHPO and/or THPO, as appropriate and required, and with full consideration given to the proposed undertaking's potential direct and indirect effects on historic properties within the Corps-indentified permit area.

Endangered Species

Pursuant to the Endangered Species Act of 1973, the Corps reviewed the project area, examined all information provided by the applicant and consulted the latest North Carolina Natural Heritage Database. Based on available information:

☐ The Corps determines that the proposed project would not affect federally listed endangered or threatened species or their formally designated critical habitat.

☒ The Corps determines that the proposed project may affect federally listed endangered or threatened species or their formally designated critical habitat. Initiation of formal consultation, pursuant to Section 7, ESA, will be requested with the U.S. Fish and Wildlife Service under separate letter for effects on nesting sea turtles and critical habitat. Also, informal consultation and a concurrence dtermination that the project may affect, but is not likely to adversely affect whales, marine sea turtles, sebeach amaranth, red knot, piping plover, Atlantic sturgeon, and manatee will be coordinated with the National Marine Fisheries Service and U.S. Fish and Wildlife Service under separate letters. The Federal resource agencies (i.e., FWS and NMFS) will be requested to initiate consultation under Section 7 of the ESA on the above effect determinations. The Corps will not make a permit decision until the consultation process is complete.

☐ The Corps is not aware of the presence of species listed as threatened or endangered or their critical habitat formally designated pursuant to the Endangered Species Act of 1973 (ESA) within the project area. The Corps will make a final determination on the effects of the proposed project upon additional review of the project and completion of any necessary biological assessment and/or consultation with the U.S. Fish and Wildlife Service and/or National Marine Fisheries Service.

Other Required Authorizations

The Corps forwards this notice and all applicable application materials to the appropriate State agencies for review.

<u>North Carolina Division of Water Resources (NCDWR)</u>: The Corps will generally not make a final permit decision until the NCDWR issues, denies, or waives the state Certification as required by Section 401 of the Clean Water Act (PL 92-500). The receipt of the application and this public notice, combined with the appropriate application fee, at the NCDWR Central Office in Raleigh constitutes initial receipt of an application for a 401 Certification. A waiver will be deemed to occur if the NCDWR fails to act on this request for certification within sixty days of receipt of a complete application. Additional information regarding the 401 Certification may be reviewed at the NCDWR Central Office, 401 and Buffer Permitting Unit, 512 North Salisbury Street, Raleigh, North Carolina 27604-2260. All persons desiring to make comments regarding the application for a 401 Certification should do so, in writing, <u>by October 13, 2015</u> to:

NCDWR Central Office
Attention: Ms. Karen Higgins, 401 and Buffer Permitting Unit
(USPS mailing address): 1617 Mail Service Center, Raleigh, NC 27699-1617

Or,

(physical address): 512 North Salisbury Street, Raleigh, North Carolina 27604

<u>North Carolina Division of Coastal Management (NCDCM):</u>

☒ The application did not include a certification that the proposed work complies with and would be conducted in a manner that is consistent with the approved North Carolina Coastal Zone Management Program. Pursuant to 33 CFR 325.2 (b)(2) the Corps cannot issue a Department of Army (DA) permit for the proposed work until the applicant submits such a certification to the Corps and the NCDCM, and the NCDCM notifies the Corps that it concurs with the applicant’s consistency certification. As the application did not include the consistency certification, the Corps will request, upon receipt,, concurrence or objection from the NCDCM.

☐ Based upon all available information, the Corps determines that this application for a Department of Army (DA) permit does not involve an activity which would affect the coastal zone, which is defined by the Coastal Zone Management (CZM) Act (16 U.S.C. § 1453).

Evaluation

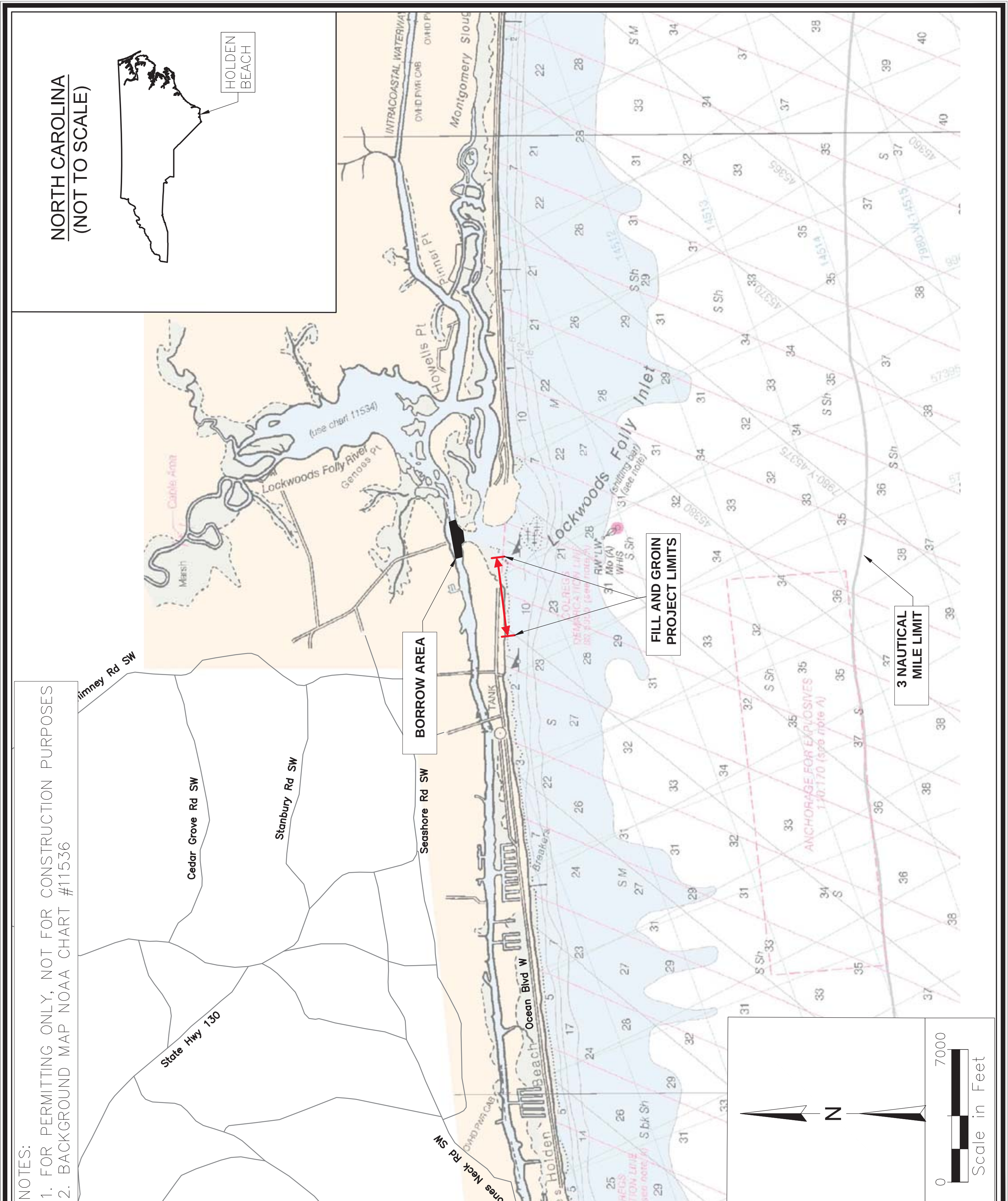
The decision whether to issue a permit will be based on an evaluation of the probable impacts including cumulative impacts of the proposed activity on the public interest. That decision will reflect the national concern for both protection and utilization of important resources. The benefit which reasonably may be expected to accrue from the proposal must be balanced against its reasonably foreseeable detriments. All factors which may be relevant to the proposal will be considered including the cumulative effects thereof; among those are conservation, economics, aesthetics, general environmental concerns, wetlands, historic properties, fish and wildlife values, flood hazards, flood plain values (in accordance with Executive Order 11988), land use, navigation, shoreline erosion and accretion, recreation, water supply and conservation, water quality, energy needs, safety, food and fiber production, mineral needs, considerations of property ownership, and, in general, the needs and welfare of the people. For activities involving the discharge of dredged or fill materials in waters of the United States, the evaluation of the impact of the activity on the public interest will include application of the Environmental Protection Agency's 404(b)(1) guidelines.

Commenting Information

The Corps of Engineers is soliciting comments from the public; Federal, State and local agencies and officials, including any consolidated State Viewpoint or written position of the Governor; Indian Tribes and other interested parties in order to consider and evaluate the impacts of this proposed activity. Any comments received will be considered by the Corps of Engineers to determine whether to issue, modify, condition or deny a permit for this proposal. To make this decision, comments are used to assess impacts on endangered species, historic properties, water quality, general environmental effects and the other public interest factors listed above. Comments are used in the preparation of an Environmental Assessment (EA) and/or an Environmental Impact Statement (EIS) pursuant to the National Environmental Policy Act (NEPA). Comments are also used to determine the need for a public hearing and to determine the overall public interest of the proposed activity.

Any person may request, in writing, within the comment period specified in this notice, that a public hearing be held to consider the application. Requests for public hearings shall state, with particularity, the reasons for holding a public hearing. Requests for a public hearing shall be granted, unless the District Engineer determines that the issues raised are insubstantial or there is otherwise no valid interest to be served by a hearing.

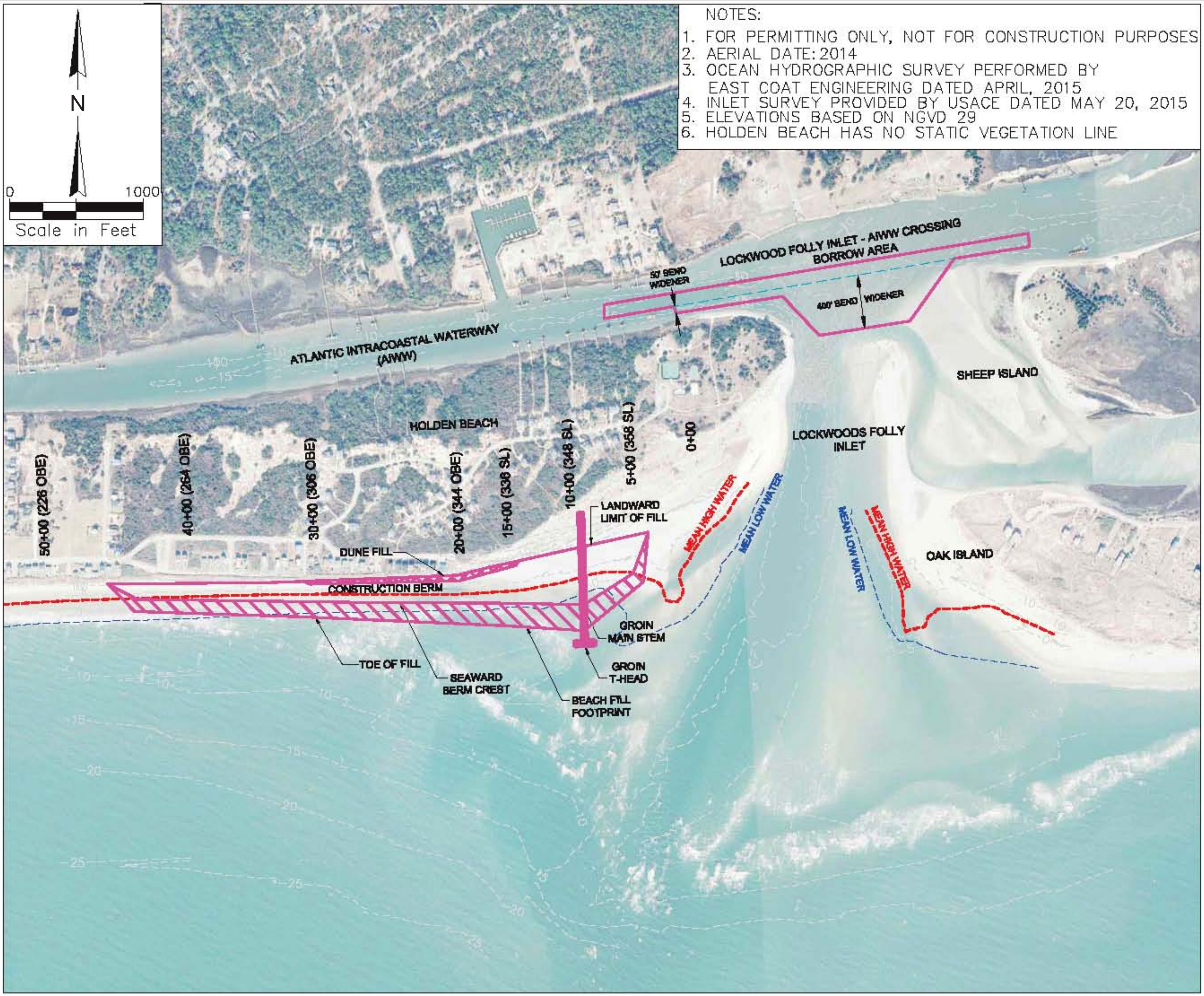
The Corps of Engineers, Wilmington District will receive written comments pertinent to the proposed work, as outlined above, and on the DEIS for this project, for 45 days and until 5pm, October 13, 2015. Comments should be submitted to Mrs. Emily Hughes, Wilmington Regulatory Field Office, 69 Darlington Avenue,
Wilmington, North Carolina 28403 , at (910) 251-4635, or by email at:
Emily.b.hughes@usace.army.mil



NOTES:
1. FOR PERMITTING ONLY, NOT FOR CONSTRUCTION PURPOSES
2. BACKGROUND MAP NOAA CHART #11536

ATM APPLIED TECHNOLOGY & MANAGEMENT 941 Houston Northcutt Blvd #201 Mt Pleasant, SC 29464 843.414.1040 NC License # C-1718	LOCATION MAP Holden Beach East End Shoreline Stabilization Brunswick County, North Carolina	JOB NUMBER: 08-1687 ISSUE DATE: 08-11-2015 SHEET NUMBER: 1	APPLICANT INFORMATION TOWN OF HOLDEN BEACH 110 ROTHSCHILD STREET HOLDEN BEACH, NC 28462

NOTES:
1. FOR PERMITTING ONLY, NOT FOR CONSTRUCTION PURPOSES
2. AERIAL DATE: 2014
3. OCEAN HYDROGRAPHIC SURVEY PERFORMED BY EAST COAT ENGINEERING DATED APRIL, 2015
4. INLET SURVEY PROVIDED BY USACE DATED MAY 20, 2015
5. ELEVATIONS BASED ON NGVD 29
6. HOLDEN BEACH HAS NO STATIC VEGETATION LINE



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PROPOSED PROJECT OVERVIEW
Holden Beach East End
Shoreline Stabilization
Brunswick County, North Carolina

JOB NUMBER: 08-1687
ISSUE DATE: 08-11-2015
SHEET NUMBER: 2

APPLICANT INFORMATION
TOWN OF HOLDEN BEACH
110 ROTHSCHILD STREET
HOLDEN BEACH, NC 28462

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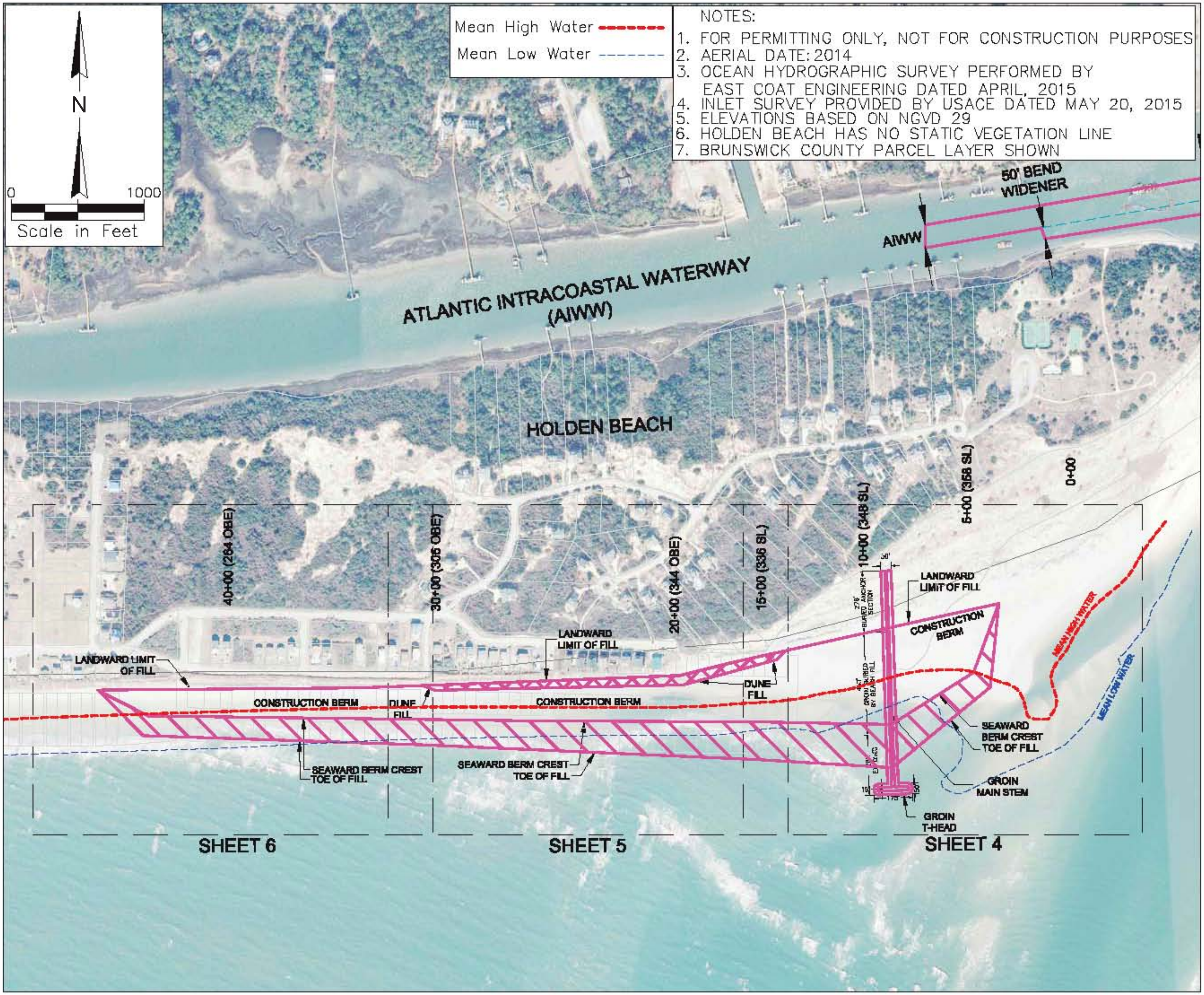
PROPOSED PROJECT

Holden Beach East End
Shoreline Stabilization
Brunswick County, North Carolina

JOB NUMBER: 08-1687
ISSUE DATE: 08-11-2015
SHEET NUMBER: 3

APPLICANT INFORMATION
TOWN OF HOLDEN BEACH
110 ROTHSCHILD STREET
HOLDEN BEACH, NC 28462



NOTES:
1. FOR PERMITTING ONLY, NOT FOR CONSTRUCTION PURPOSES
2. AERIAL DATE: 2014
3. OCEAN HYDROGRAPHIC SURVEY PERFORMED BY EAST COAT ENGINEERING DATED APRIL, 2015
4. INLET SURVEY PROVIDED BY USACE DATED MAY 20, 2015
5. ELEVATIONS BASED ON NGVD 29
6. HOLDEN BEACH HAS NO STATIC VEGETATION LINE
7. BRUNSWICK COUNTY PARCEL LAYER SHOWN

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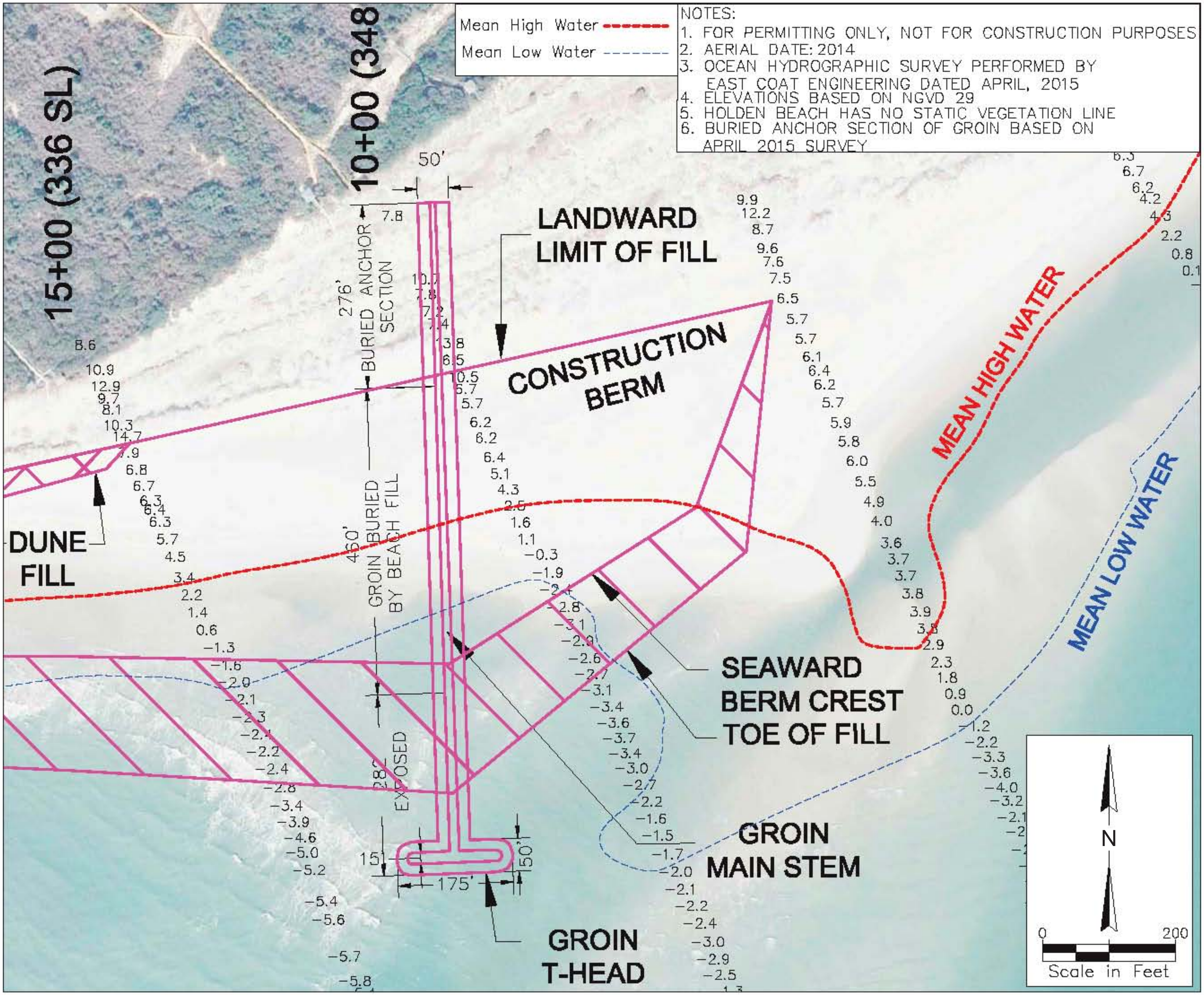
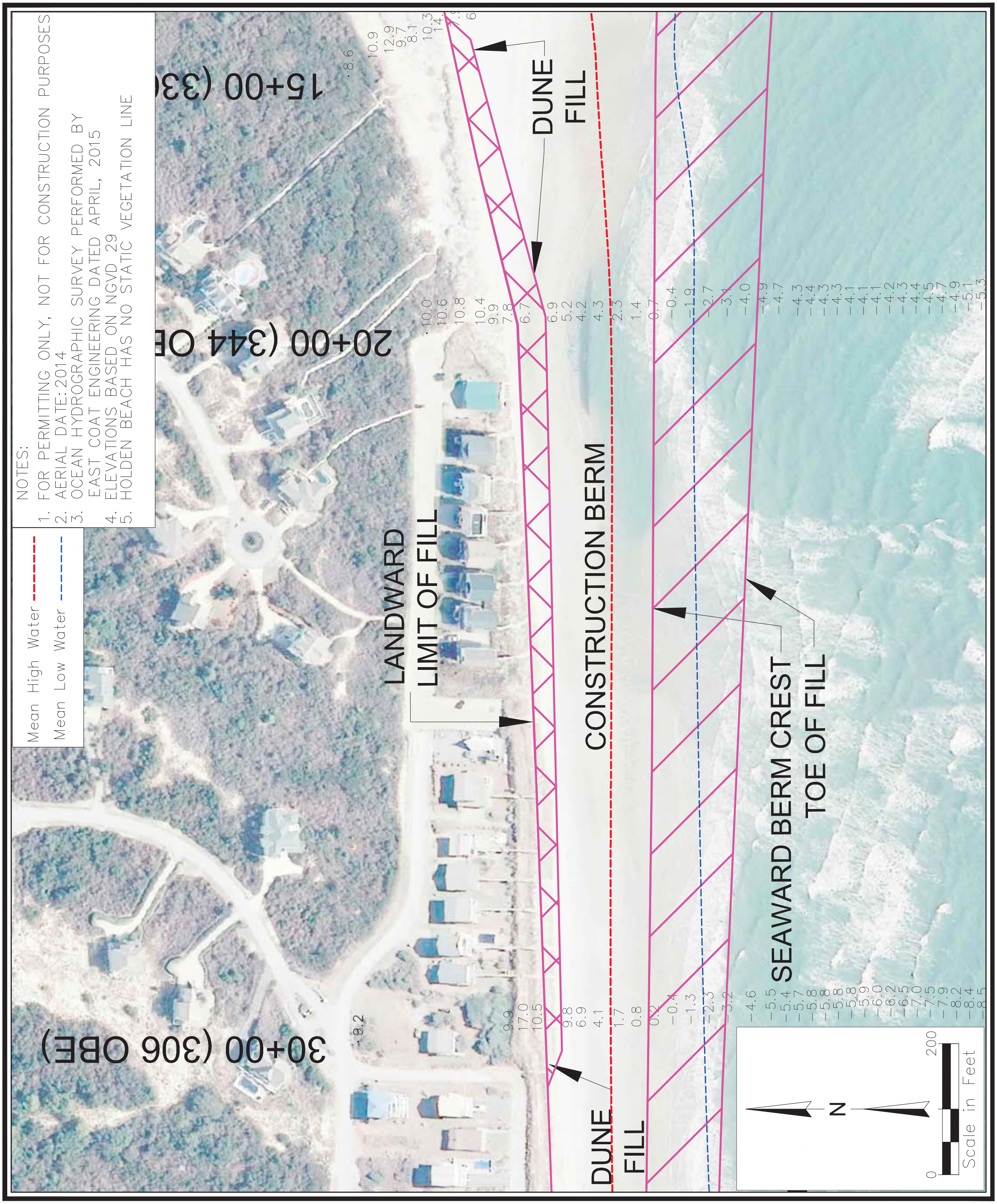
PROPOSED PROJECT

Holden Beach East End
Shoreline Stabilization
Brunswick County, North Carolina

JOB NUMBER: 08-1687
ISSUE DATE: 08-11-2015
SHEET NUMBER: 4

APPLICANT INFORMATION
TOWN OF HOLDEN BEACH
110 ROTHSCHILD STREET
HOLDEN BEACH, NC 28462





APPLIED TECHNOLOGY & MANAGEMENT

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PROPOSED PROJECT

Holden Beach East End
Shoreline Stabilization
Brunswick County, North Carolina

JOB NUMBER: 08-1687

ISSUE DATE: 08-11-2015

SHEET NUMBER: 5

APPLICANT INFORMATION

TOWN OF HOLDEN BEACH
110 ROTHSCHILD STREET
HOLDEN BEACH, NC 28462

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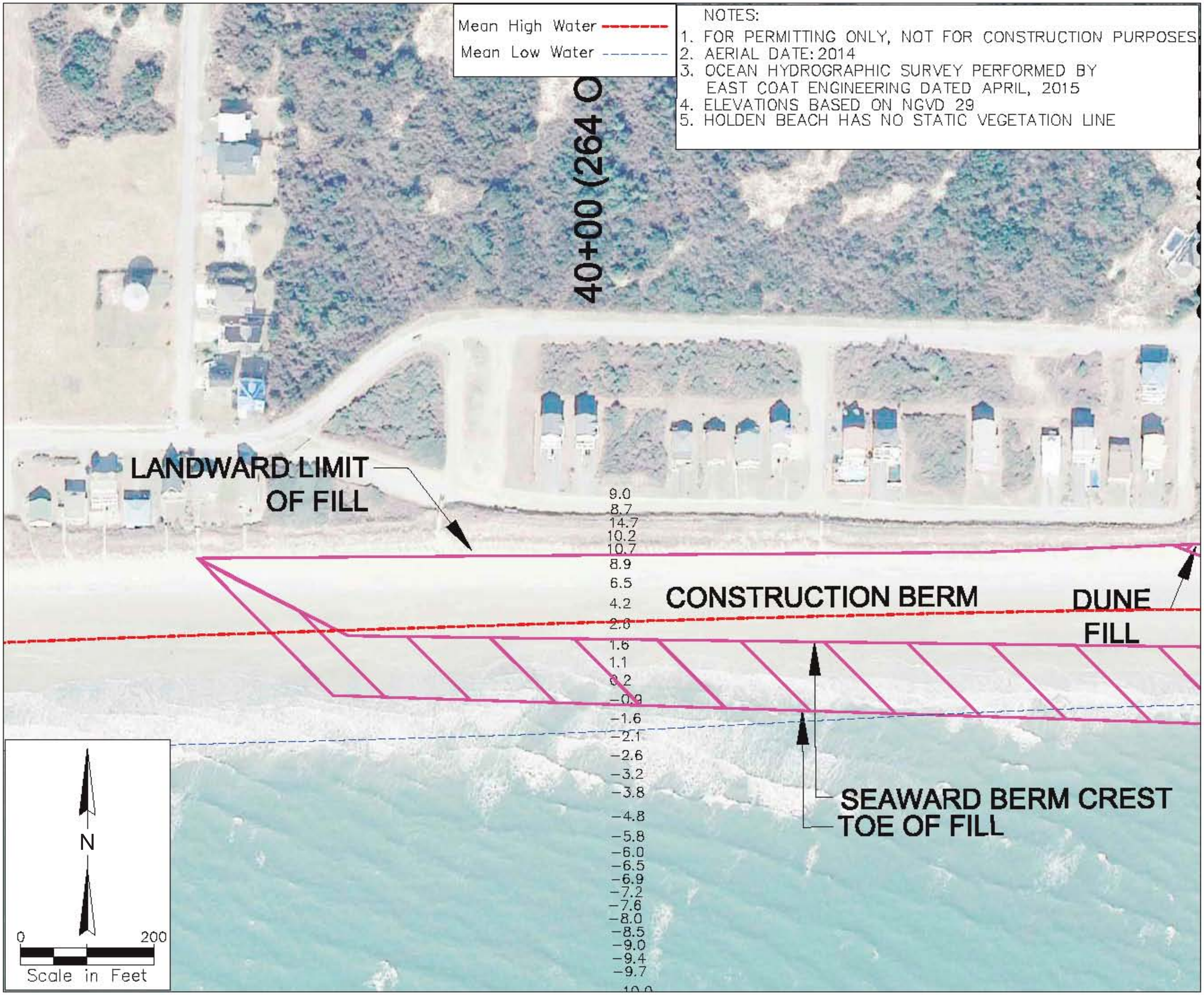
PROPOSED PROJECT
Holden Beach East End
Shoreline Stabilization
Brunswick County, North Carolina

JOB NUMBER: 08-1687
ISSUE DATE: 08-11-2015
SHEET NUMBER: 6

APPLICANT INFORMATION
TOWN OF HOLDEN BEACH
110 ROTHSCHILD STREET
HOLDEN BEACH, NC 28462

NOTES:
1. FOR PERMITTING ONLY, NOT FOR CONSTRUCTION PURPOSES
2. AERIAL DATE: 2014
3. OCEAN HYDROGRAPHIC SURVEY PERFORMED BY EAST COAT ENGINEERING DATED APRIL, 2015
4. ELEVATIONS BASED ON NGVD 29
5. HOLDEN BEACH HAS NO STATIC VEGETATION LINE



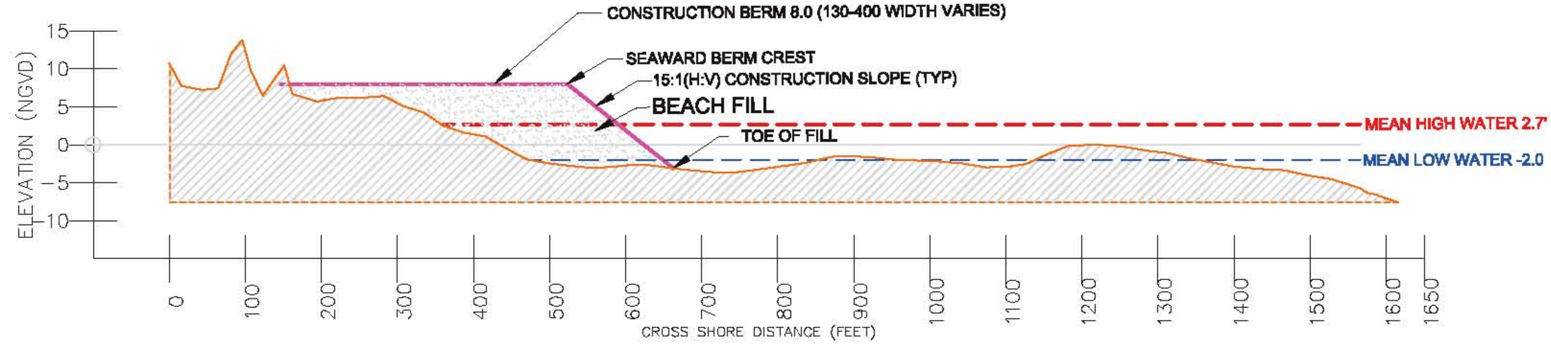
LOCKWOOD FOLLY INLET TIDAL DATUMS

2.7'	MEAN HIGH WATER
1.0'	NAVD 88
0.5'	MEAN SEA LEVEL
0.0'	NGVD 29
-2.0'	MEAN LOW WATER

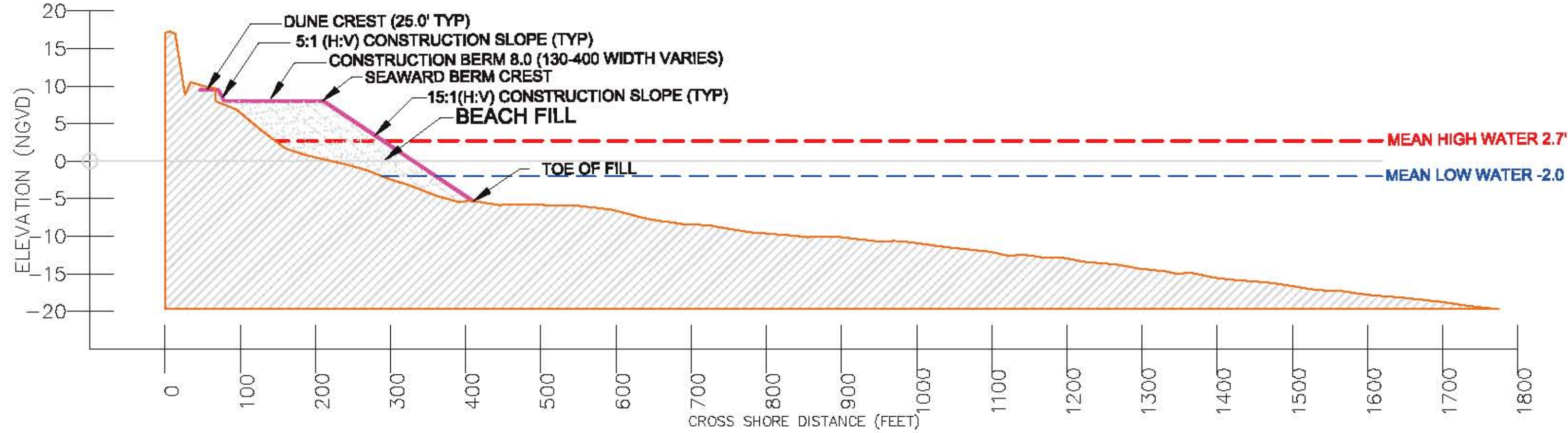
	FILL
	EXISTING SURFACE

Notes:
1. FOR PERMITTING ONLY, NOT FOR CONSTRUCTION PURPOSES
2. HYDROGRAPHIC SURVEY PERFORMED BY EAST COAT ENGINEERING DATED APRIL, 2015
3. HORIZONTAL COORDINATES ARE NC GRID (NAD83)
4. ELEVATIONS BASED ON NGVD 29
5. HOLDEN BEACH HAS NO STATIC VEGETATION LINE

STA 10+00 PROFILE



STA 30+00 PROFILE



HORIZONTAL
0 250
Scale in Feet

VERTICAL
0 25
Scale in Feet

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PROFILE VIEWS
TYPICAL BEACH FILL

Holden Beach East End
Shoreline Stabilization
Brunswick County, North Carolina

JOB NUMBER: 08-1687
ISSUE DATE: 08-11-2015
SHEET NUMBER: 7

APPLICANT INFORMATION
TOWN OF HOLDEN BEACH
110 ROTHSCHILD STREET
HOLDEN BEACH, NC 28462

HORIZONTAL

0 150

Scale in Feet

VERTICAL

0 15

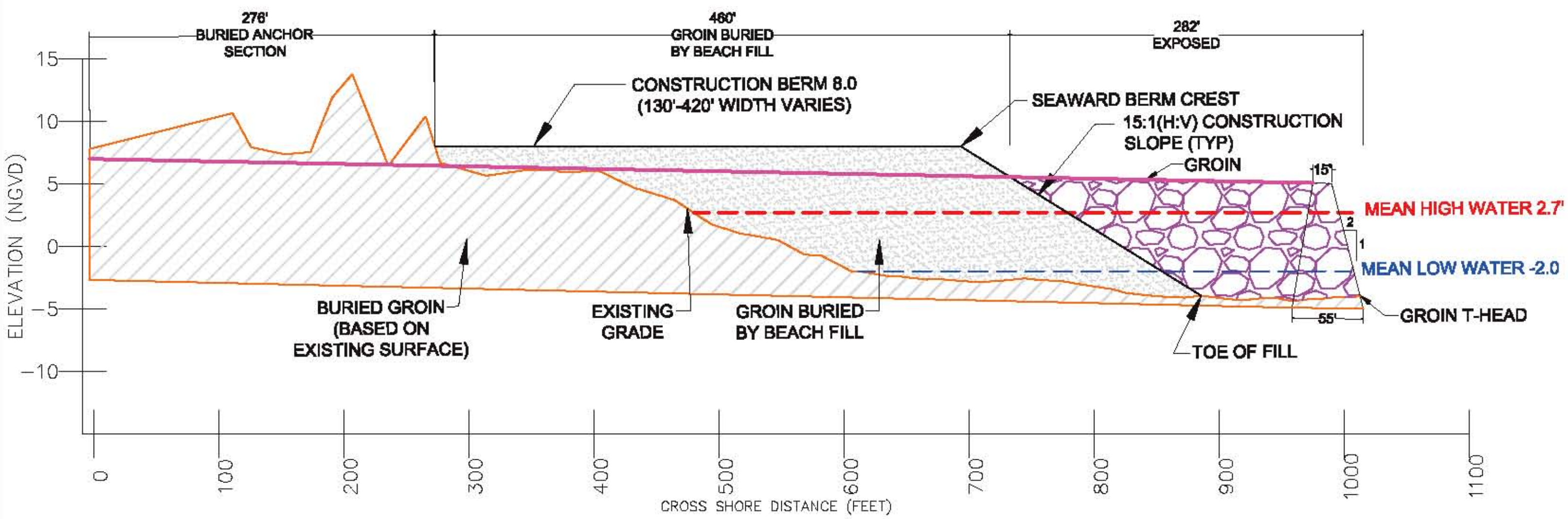
Scale in Feet

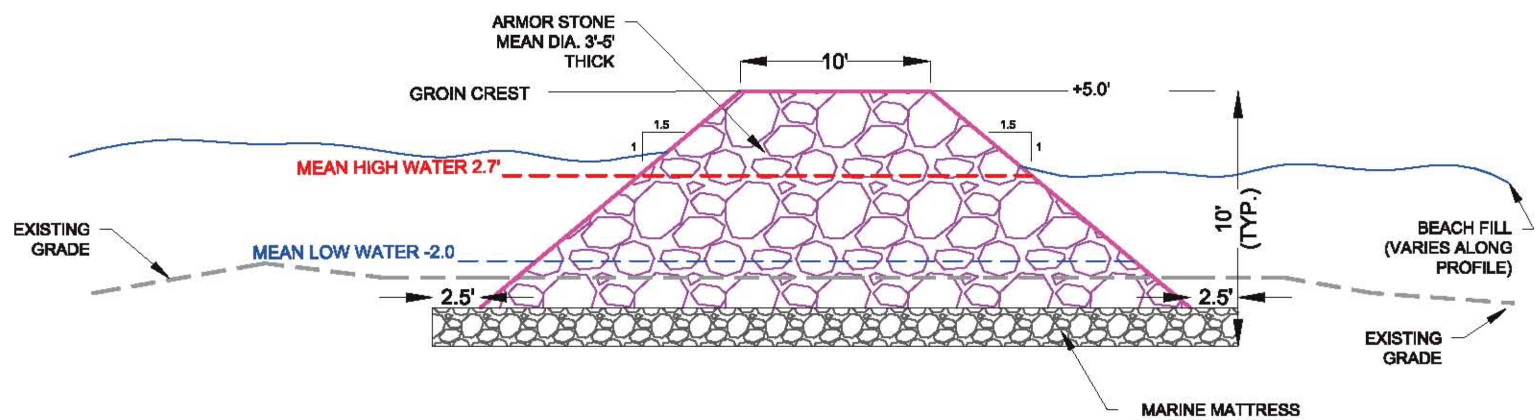
	EXISTING GRADE (EXCAVATION NOT SHOWN)
	BEACH FILL
	GROIN / T-HEAD

Notes:

1. FOR PERMITTING ONLY, NOT FOR CONSTRUCTION PURPOSES
2. ELEVATIONS BASED ON NGVD 29
3. HOLDEN BEACH HAS NO STATIC VEGETATION LINE
4. NO CORE STONE PROPOSED TO ALLOW MORE PERMEABILITY
5. BURIED ANCHOR SECTION OF GROIN BASED ON APRIL 2015 SURVEY

GROIN PROFILE





TYPICAL GROIN CROSS SECTION
(MAIN STEM)
(NOT TO SCALE)

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GROIN PROFILE VIEW

Holden Beach East End
Shoreline Stabilization
Brunswick County, North Carolina

JOB NUMBER: 08-1687

ISSUE DATE: 08-11-2015

SHEET NUMBER: 8

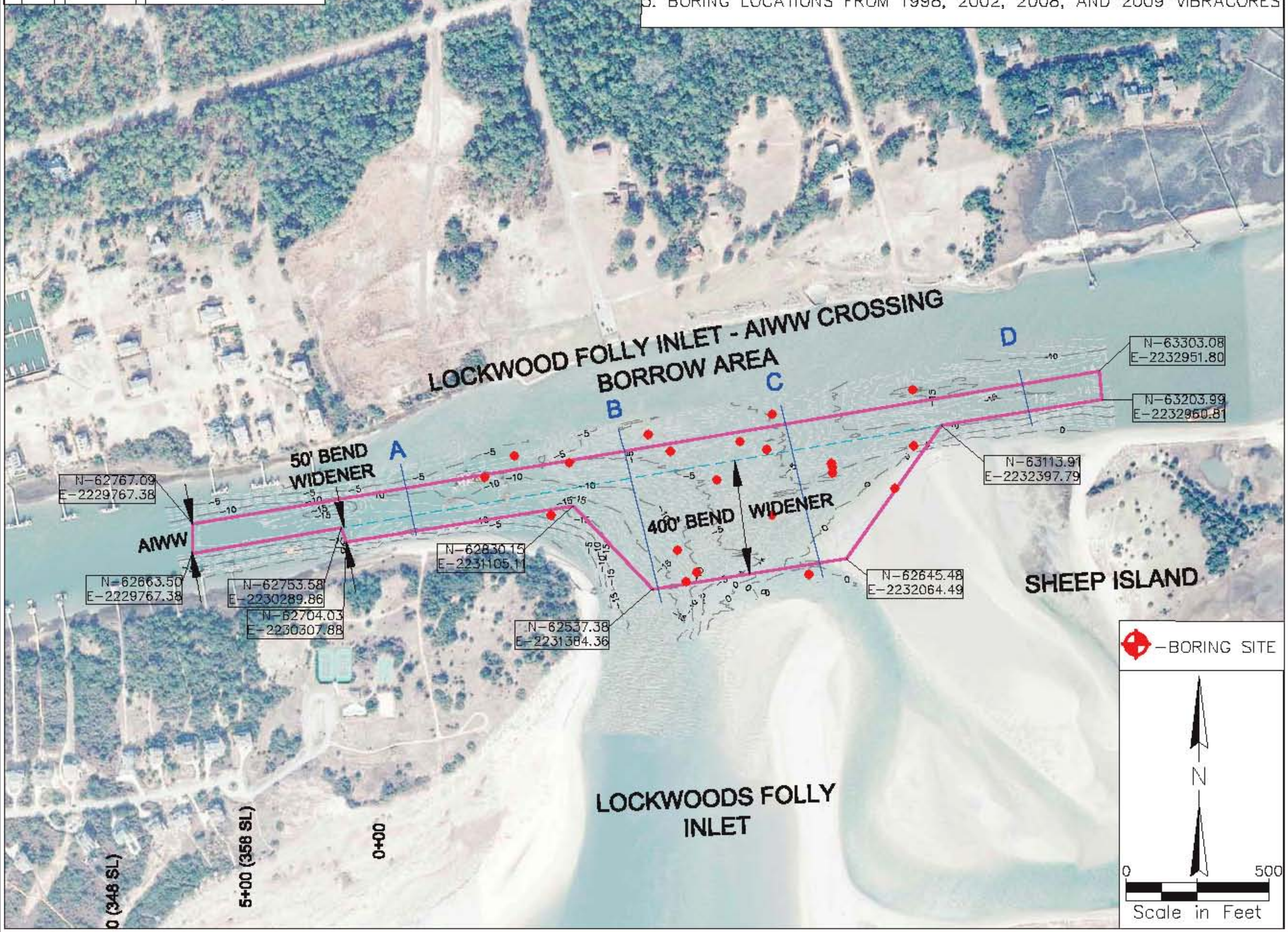
APPLICANT INFORMATION

TOWN OF HOLDEN BEACH
110 ROTHSCHILD STREET
HOLDEN BEACH, NC 28462

LOCKWOOD FOLLY INLET TIDAL DATUMS

2.7'	MEAN HIGH WATER
1.0'	NAVD 88
0.5'	MEAN SEA LEVEL
0.0'	NGVD 29
-2.0'	MEAN LOW WATER

NOTES:
1. FOR PERMITTING ONLY, NOT FOR CONSTRUCTION PURPOSES
2. AERIAL DATE: 2014
3. HYDROGRAPHIC SURVEY PERFORMED BY USACE DATED NOV 2013 (REPRESENTATIVE OF PRE-PROJECT CONDITIONS)
4. ELEVATIONS BASED ON MLW
5. BORING LOCATIONS FROM 1998, 2002, 2008, AND 2009 VIBRACORES



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BORROW AREA

Holden Beach East End
Shoreline Stabilization
Brunswick County, North Carolina

JOB NUMBER: 08-1687
ISSUE DATE: 08-11-2015
SHEET NUMBER: 9

APPLICANT INFORMATION
TOWN OF HOLDEN BEACH
110 ROTHSCHILD STREET
HOLDEN BEACH, NC 28462

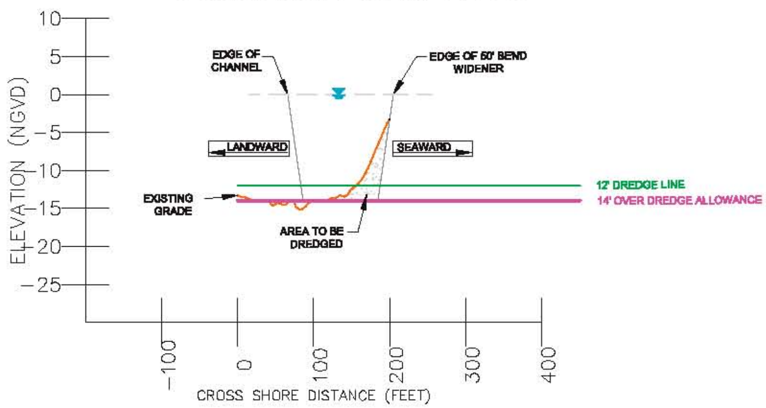
LOCKWOOD FOLLY INLET TIDAL DATUMS

2.7'	MEAN HIGH WATER
1.0'	NAVD 88
0.5'	MEAN SEA LEVEL
0.0'	NGVD 29
-2.0'	MEAN LOW WATER

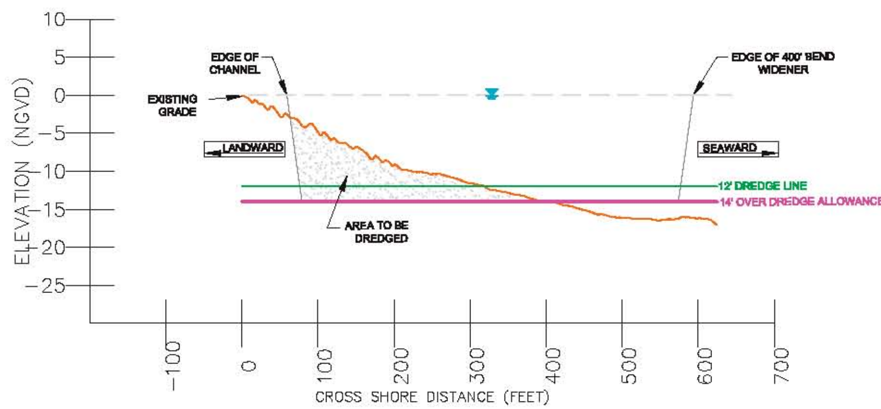
	AREAS TO BE DREDGED
	EXISTING GRADE

NOTES:
1. FOR PERMITTING ONLY, NOT FOR CONSTRUCTION PURPOSES
2. HYDROGRAPHIC SURVEY PERFORMED BY USACE DATED NOV. 2013 (REPRESENTATIVE OF PRE–PROJECT CONDITIONS)
3. HORIZONTAL COORDINATES ARE NC GRID (NAD83)
4. ELEVATIONS BASED ON MLW
5. HOLDEN BEACH HAS NO STATIC VEGETATION LINE

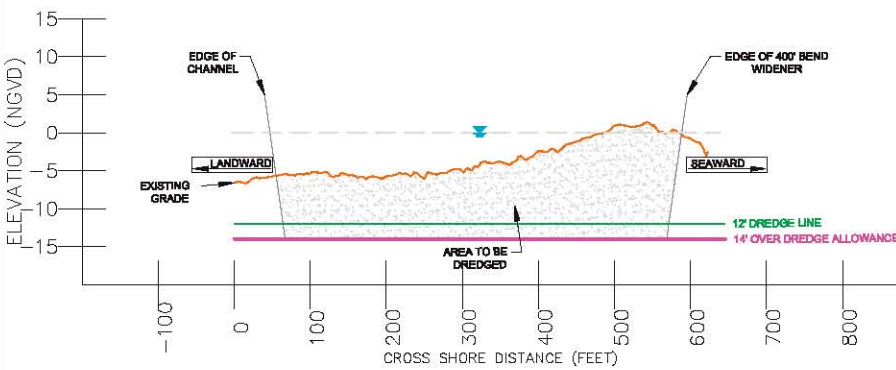
BORROW AREA PROFILE A



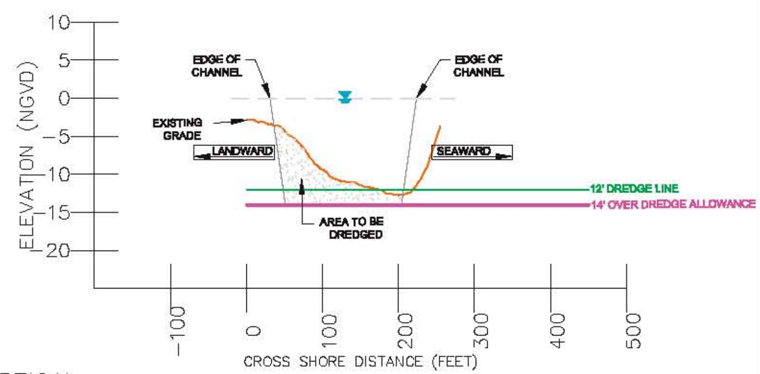
BORROW AREA PROFILE B



BORROW AREA PROFILE C



BORROW AREA PROFILE D



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INSHORE BORROW PROFILES

Holden Beach East End
Shoreline Stabilization
Brunswick County, North Carolina

JOB NUMBER: 08-1687
ISSUE DATE: 08-11-2015
SHEET NUMBER: 10

APPLICANT INFORMATION
TOWN OF HOLDEN BEACH
110 ROTHSCHILD STREET
HOLDEN BEACH, NC 28462

Holden Beach East End Shore Protection Project
Final Environmental Impact Statement
Appendix B

Comments Received on Draft Environmental Impact Statement (DEIS) and Summary Table of Comment-Response

I. Summary Table of Contents on DEIS and EIS Updates

II. Federal Agency Comments

A. U.S. Fish and Wildlife Service (FWS - Benjamin)
B. U.S. Environmental Protection Agency (EPA - Mueller)
C. U.S. Department of Interior (DOI - Stanley)
D. National Marine Fisheries Service (NMFS - Fay)
E. National Marine Fisheries Service (NMFS - Crabtree)

III. State Agency Comments

A. NC Department of Administration - State Environmental Review Clearinghouse (NCDOA - Best)
B. NC Department of Environment and Natural Resources (NCDENR - Hardison)
C. NC Division of Coastal Management (NCDCM - Huggett)
D. NC Department of Cultural Resources - State Historic Preservation Office (SHPO - Gledhill-Early) (No Comment)

IV. Non-Governmental Organization Comments

A. North Carolina Coastal Federation (NCCF - Zivonavic-Nenadovic)
B. Southern Environmental Law Center (SELC - Gisler)
C. Audubon North Carolina (Audubon - Golder)

V. Local Government Comments

A. Town of Oak Island (Holloman)
B. Town of Oak Island Meeting
C. Holden Beach (Hewett)
D. Town of Oak Island (Stites)

VI. General Public Comments

A. Sandra Brooks-Mathers
B. Skip Klapheke
C. Eileen Governale
D. Peter and Catherine Meyer
E. Vicki Y. Myers
F. April Ozamiz
G. Robert Peek
H. Pam Sabalos
I. Lora Sharkey

J. Richard S. Weigand
K. Diana Willard
L. Terry Willard

VII. Public Hearing Transcript

Nature of Comment (Summary)	Commenting Agency/Entity	Comment Type	FEIS Revised to Address Comment (Y/N)	FEIS Chapter	FEIS Page	Response to Comment
Appendix (unspecified) cites Delaware study to support assertion that relocation/abandonment are much more costly than beach nourishment and other shoreline erosion mitigation options, but provides no details on Delaware study. Relative to the DEIS analyses, it is unclear if the Delaware study was based on an equivalently small number of properties and limited infrastructure.	USFWS	Alt 2 relocation analysis	N	N/A	N/A	The Delaware study (Parsons and Powell 2001) was a state-wide assessment that compared the cost of retreat to the cost of nourishment over a 50-year period. The cost parameters used in the Delaware study were the same as those employed in the Holden Beach EIS (see App O); including land loss, structure loss, beach proximity loss, and transition costs. For the Delaware study, the 50-yr cost of retreat was determined to be $291 million, compared with a 50-yr nourishment cost of $60 million.
The extended 4-year nourishment interval under Alt 6 may not accurately reflect the actual nourishment interval that will be required to prevent property impacts. DEIS indicates that a 2-3 year nourishment interval would be required under Alt 6.	USFWS	Alt 6 nourishment interval	Y	Chapter 5	5-3	The 4-year modeling simulations were designed to be conservative and included the erosional effects of Hurricanes Hanna (2008) and Irene (2011). Therefore, the model-predicted erosion rates are expected to be higher than the long-term averages. The occurrence of two hurricanes over a 4-year period could potentially require an expedited nourishment event; however, an average nourishment interval of 4 years is expected over the life of the project. Even with the inclusion of 2 hurricanes in the modeling runs, the modeling results show that the groin alternative lengthens the nourishment interval by a factor of 2 in comparison with the nourishment-only alternative.
Service is concerned that 4-year nourishment interval under Alt 6 will not be adequate. Service is concerned that acceleration of nourishment interval may occur due to storm surge, sea level rise, or other factors.	USFWS	Alt 6 nourishment interval/sea level rise	N	N/A	N/A	A discussion of sea level rise is included in the Engineering Report (FEIS Appendix H). Generally, the influence of sea level rise over the next 30 years is very minor in comparison with the effects of major storms. The four-year modeling simulations incorporate elevated water level events associated with Hurricanes Hanna and Irene.
Chapter 5: for all alternatives, indicate whether sandbags will remain in front of properties or will be removed.	USFWS	Fate of existing sandbags	Y	Chapter 5	5-144	NCDCM issues sandbag permits to individual homeowners, and the Town has no authority over their installation or removal. However, sandbags are permitted on a temporary basis and must eventually be removed when a more permanent solution to the erosional hazard is implemented.
The DEIS indicates that the proposed groin is not expected to mitigate erosion due to the regional westward transport of sand, which is the principal cause of erosion within the project area.	USFWS	Groin effectiveness	N	N/A	N/A	The principal cause of East End erosion is localized inlet-driven eastward sediment transport, not regional westward transport. As in the case of many NC inlets, there is a localized reversal of the regional transport pattern along the adjoining inlet-influenced (East End) shoreline reach. As described in Chapter 5 of the EIS, the model-projected mitigative effects of both groin alternatives include a consistently wider East End beach and an extended 4-year nourishment interval (as opposed to a much narrower beach and a 2-year nourishment interval under all other nourishment alternatives).

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Chapter 6, page 6-2: DEIS indicates construction of sand fillet, but Chapter 5 figures show no fillet.	USFWS	Groin fillet missing from figures	Y	Chapter 5 Chapter 6	3-18 5-124 6-2	The beach fill template extends beyond the fillet footprint, thus the fillet is not distinguishable from the filled template. The cusp-shaped fillet will take shape over time as the main beach fill erodes. The figures have been revised to show a fillet.
DEIS indicates that groin will cause erosion on both sides of groin.	USFWS	Groin shoreline effects	N	N/A	N/A	The 4-year modeling simulations were designed to be conservative and included the erosional effects of Hurricanes Hanna (2008) and Irene (2011). Therefore, substantial erosion occurs under all the alternatives. However, as described in Chapter 5 of the EIS (see Table 5.4), the projected relative beach width under Alternative 6 at the end of the 4-year simulation is three times that of the no action and nourishment only alternatives. Thus, the modeling results indicate that the groin reduces erosion in relation to the other alternatives.
The modeling indicates that the groin is expected to cause accelerated erosion east of the groin.	USFWS	Groin shoreline effects	N	N/A	N/A	The modeling indicates a relative reduction in the erosion rate along the east side of the groin. Although East End shoreline erosion occurs under all of the alternatives; as described in Chapter 5 of the EIS, the intermediate terminal groin significantly reduces erosion in relation to all other alternatives. See figures 5.6 through 5.9 in the EIS.
Other than beach width at year 4, the modeling does not show a significant difference between the Alternatives 1, 3, 4, 5, and 6.	USFWS	Relative effectiveness of alternatives	N	N/A	N/A	The 4-year modeling simulations were designed to be conservative and included the erosional effects of Hurricanes Hanna (2008) and Irene (2011). Therefore, substantial erosion occurs under all the alternatives. However, as described in Chapter 5 of the EIS (see Table 5.4), the projected relative beach width under Alternative 6 at the end of the 4-year simulation is three times that of the nourishment only alternative, and the number of properties at risk under the preferred alternative is reduced by nearly 50 percent in relation to the no-project alternative (Alt 2). Based on modeling results, the terminal groin will extend the nourishment interval from 2 to 4 years, thereby reducing sand placement impacts and costs in relation to existing practices and the non-structural nourishment alternatives. Given the high DCM erosion rate for the East End of 7 feet per year, the benefits are significant.
Alternative 4 actually appears to cause more erosion than Alternative 2.	USFWS	Relative effectiveness of alternatives	N	N/A	N/A	As described in Chapter 5 of the EIS, the modeling results indicate that Alternative 4 (wide outer channel and nourishment) has adverse effects on inlet hydrodynamics. As a result, erosion along the Holden Beach inlet shoreline is increased in relation to Alternative 2.

Nature of Comment (Summary)	Commenting Agency/Entity	Comment Type	FEIS Revised to Address Comment (Y/N)	FEIS Chapter	FEIS Page	Response to Comment
The preferred alternative (Alt 6) results in more erosion and property damage than Alt 5.	USFWS	Relative effectiveness of alternatives	N	N/A	N/A	The criteria used to define "properties at risk" (MHW line within 25 ft of parcel boundary) do not necessarily indicate "property damage." Although minor differences in the model-projected Year-4 MHW lines result in a slightly higher number of properties at risk, Alternative 6 maintains a significantly wider beach and a higher beach profile sand volume. The added width and volume under Alternative 6 is expected to provide a higher level of protection against hotspot erosion and storm damage. As described in Chapter 5 of the EIS (see Table 5.3), model-projected net habitat changes are essentially the same under Alternatives 5 and 6.
The modeling indicates significant erosion under all of the alternatives at year 4.	USFWS	Relative effectiveness of alternatives	N	N/A	N/A	The 4-year modeling simulations were designed to be conservative and included the erosional effects of Hurricanes Hanna (2008) and Irene (2011). Therefore, substantial erosion occurs under all the alternatives. However, as described in Chapter 5 of the EIS (see Table 5.4), the model-projected relative beach width under Alternative 6 at the end of the 4-year simulation is three times that of the nourishment only alternative.
Differences in property impacts under the alternatives are small; therefore, given that modeling is not a precise science, the projected differences may be moot.	USFWS	Relative effectiveness of alternatives	N	N/A	N/A	The proposed project encompasses a relatively short shoreline reach; and consequently, the relative impacts are generally on a small scale. However, as described in Chapter 5 of the EIS (see Table 5.4), the model-projected relative beach width under Alternative 6 at the end of the 4-year simulation is three times that of the nourishment only alternative, and the number of properties at risk under the preferred alternative is reduced by nearly 50 percent in relation to the no-project alternative (Alt 2). Based on modeling results, the terminal groin will extend the nourishment interval from 2 to 4 years, thereby reducing sand placement impacts and costs in relation to existing practices and the non-structural nourishment alternatives. Given the high DCM erosion rate for the East End of 7 feet per year, the benefits are significant.
DEIS should clarify differences between the alternatives and provide data showing that a 4-year nourishment interval under Alt 6 will protect properties and infrastructure.	USFWS	Relative effectiveness of alternatives/Alt 6 nourishment interval	N	N/A	N/A	The 4-year modeling simulations were designed to be conservative and included the erosional effects of Hurricanes Hanna (2008) and Irene (2011). Therefore, substantial erosion occurs under all the alternatives. However, as described in Chapter 5 of the EIS (see Table 5.4), the model-projected relative beach width under Alternative 6 at the end of the 4-year simulation is three times that of the nourishment only alternative, and the number of properties at risk under the preferred alternative is reduced by nearly 50 percent in relation to the no-project alternative (Alt 2). The criteria used to define "properties at risk" (MHW line within 25 ft of parcel boundary) do not necessarily indicate "property damage." Based on modeling results, Alternative 6 out performs all other alternatives in terms of maintaining beach width and profile volume; and consequently, is expected to provide the highest level of protection against hotspot erosion and storm damage.

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Hard structures disrupt dynamic coastal processes, resulting in the eventual loss of the beach and its associated shorebird habitats.	USFWS	Shorebirds/Threatened and Endangered Species	N	N/A	N/A	The term "hard structure" encompasses a wide range of structure types (sea walls, jetties, bulkheads, groins, etc.). As stated by Griggs (2003): "Groins have often been lumped with the much larger breakwaters and jetties as coastal engineering structures that have had major secondary or negative downdrift effects." Although many hardening techniques, including the use of impermeable and/or improperly designed groins, have been shown to cause downdrift erosion, the proposed East End terminal groin is a permeable and relatively short structure that has been designed allow sand bypassing, thereby avoiding these types of downdrift effects. Pursuant to the NC Terminal Groin Law, the ability to modify or remove the groin in the event that adverse downdrift impacts occur was incorporated into the groin design. Potential adaptive management modifications to the structure include decreasing the crest width, notching, shortening, and/or the addition of a weir.
DEIS provides no discussion of vacant lots and relocation options under Alt 2.	USFWS	Alt 2 relocation analysis	Y	Chapter 3	3-7	According to the 2009 Holden Beach CAMA Land Use Plan, there are 910 vacant parcels encompassing 265 acres of usable (i.e., buildable) land in the Town of Holden Beach. If all of this land were developed at a density of .25 residential units per acre, this would equate to 1,060 residential units. Since .25 acres per residence is less dense than what current zoning allows, it is clear that there is sufficient buildable land for relocations. This information has been incorporated into the FEIS.
Shoreline stabilization may result in less suitable nesting habitat for shorebirds, including the piping plover.	USFWS	Shorebirds/Threatened and Endangered Species	Y	Appendix C		Potential impacts on piping plovers and red knots have been addressed through Section 7 consultation with the USFWS. The resulting USFWS Biological Opinion is included in the FEIS (Appendix C).
Hard structures are likely to increase the amount of piping plover/red knot habitat lost as sea level continues to rise.	USFWS	Threatened/Endangered Species	Y	Appendix C		The term "hard structure" encompasses a wide range of structure types (sea walls, jetties, bulkheads, groins, etc.). As stated by Griggs (2003): "Groins have often been lumped with the much larger breakwaters and jetties as coastal engineering structures that have had major secondary or negative downdrift effects." Although many hardening techniques, including the use of impermeable and/or improperly designed groins, have been shown to cause downdrift erosion, the proposed East End terminal groin is a permeable and relatively short structure that has been designed allow sand bypassing, thereby avoiding these types of downdrift effects. The relationship between sea level rise and the proposed groin is discussed in the Engineering Report (FEIS Appendix H). Generally, the influence of sea level rise over the next 30 years is very minor in comparison with the effects of major storms. The four-year modeling simulations incorporate elevated water level events associated with Hurricanes Hanna and Irene. Potential impacts on piping plovers and red knots have been addressed through Section 7 consultation with the USFWS. The resulting USFWS Biological Opinion is included in the FEIS (Appendix C).

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Appendix F provides no data to support assertion that there are too few oceanfront properties to receive all threatened structures. DEIS indicates that 256 acres of vacant land are present on Holden Beach. DEIS should provide data to support statements in Appendix F.	USFWS	Alt 2 relocation analysis	Y	Chapter 3	3-7	There are currently ~35 vacant oceanfront lots on Holden Beach. Some of these lots are public access points or common areas that would presumably be unavailable for relocations. Furthermore, many of these vacant lots are likely to be developed before the full need to relocate all at risk structures is realized over the next 30 years. Currently there are ~47 oceanfront structures along the East End beach that could be at risk over the next 30 years under Alternative 2. Thus, the availability of vacant oceanfront lots is expected to fall well short of the potential 30-year relocation need under Alternative 2. In contrast, the availability of non-oceanfront lots is expected to be more than sufficient to receive all relocations. According to the 2009 Holden Beach CAMA Land Use Plan, there were 910 vacant parcels encompassing 265 acres of usable (i.e., buildable) land in the Town of Holden Beach. If all of this land were developed at a density of .25 residential units per acre, this would equate to 1,060 residential units. Since .25 acres per residence is less dense than what current zoning allows, it is clear that there is sufficient buildable non-oceanfront land for relocations. This information has been incorporated into the FEIS.
Chapter 5, page 5-62: note that critical habitat for Northwest Atlantic DPS of loggerhead sea turtle has been designated.	USFWS	Loggerhead turtle critical habitat designation	Y	Chapter 5	5-64 5-116	Acknowledged. FEIS has been revised accordingly.
DEIS should identify length of beach to be nourished under Alternatives 1, 3, 4, 5, and 6.	USFWS	Nourishment beach length	Y	Chapter 5	5-25 5-70 5-95 5-124 5-149	Acknowledged. The FEIS has been revised to clarify the lengths of the nourishment reaches.
Chapter 5, page 5-44: note that red knot is listed as threatened.	USFWS	Red knot listing status	Y	Chapter 5	5-46	Noted. FEIS has been revised accordingly.
Proposed groin is anticipated to result in decreased sea turtle nesting and loss of nests for all subsequent seasons following project completion.	USFWS	Threatened/Endangered Species	Y	Appendix C		Although many hardening techniques, including the use of impermeable and/or improperly designed groins, have been shown to cause downdrift erosion, the proposed East End terminal groin is a permeable and relatively short structure that has been designed allow sand bypassing, thereby avoiding these types of downdrift effects. Potential impacts on sea turtles have been addressed through Section 7 consultation with the USFWS. The resulting USFWS Biological Opinion is included in the FEIS (Appendix C).
Proposed action may adversely affect piping plovers and red knots through direct losses of foraging and roosting habitats updrift and downdrift of project area, degradation of foraging habitat and loss of prey due to sand placement, and attraction of predators due to food waste/increased use of area.	USFWS	Threatened/Endangered Species	Y	Appendix C		Although many hardening techniques, including the use of impermeable and/or improperly designed groins, have been shown to cause downdrift erosion, the proposed East End terminal groin is a permeable and relatively short structure that has been designed allow sand bypassing, thereby avoiding these types of downdrift effects. The impacts of sand placement on shorebird foraging habitat and benthic prey are addressed in Chapter 5 of the EIS. Potential impacts on piping plovers and red knots have been addressed through Section 7 consultation with the USFWS. The resulting USFWS Biological Opinion is included in the FEIS (Appendix C).

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Potential impacts on impact amaranth include direct injury to plants and/or burial of seeds as a result of construction activities, sand placement, and increased recreational use of the beach.	USFWS	Threatened/Endangered Species	Y	Appendix C		Potential impacts on seabeach amaranth have been addressed through Section 7 consultation with the USFWS. The resulting USFWS Biological Opinion is included in the FEIS (Appendix C).
Shoreline stabilization may indirectly impact seabeach amaranth through habitat degradation.	USFWS	Threatened/Endangered Species	Y	Appendix C		Potential impacts on seabeach amaranth have been addressed through Section 7 consultation with the USFWS. The resulting USFWS Biological Opinion is included in the FEIS (Appendix Q).
Due to potential impacts to threatened and endangered species, the Service recommends that the preferred alternative not be authorized.	USFWS	Threatened/Endangered Species	Y	Appendix C		Potential impacts on threatened and endangered species have been addressed through Section 7 consultation with the USFWS. The resulting USFWS Biological Opinion is included in the FEIS (Appendix C).
E&SC and Stormwater Permits are not necessary for work in the ocean. Any staging area >1 acre landward of first vegetation line needs permits.	DEMLR (Land Quality)	Permits	N	N/A	N/A	Noted.
Environmental documents developed under federal law meet state requirements	NC Department of Administration	State Clearinghouse Review	N	N/A	N/A	Noted.
44CFR 60.3.e prohibits man-made alteration of sand dunes within Zones V1-30, VE, and V on the community's FIRM which would increase potential flood damage. Grading activity shall be accompanied by a hydraulic study to assure there will be no increase in flood damage potential.	NC Department of Public Safety	Flood Zone	N	N/A	N/A	The proposed project is designed to reduce flood damage potential through enhancement of the dune system. No actions that would increase potential flood damage are proposed. All floodplain regulatory compliance requirements will be addressed through the federal and state permitting process.
An individual 401 Water Quality Certification will be required. 4 complete sets of an application and associated maps are to be submitted to the DWR Central Office in Raleigh.	NC Division of Water Resources	401 WQ Certification	N	N/A	N/A	Acknowledged. All Section 401 regulatory compliance requirements will be addressed through the federal and state permitting process.

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East End could experience increase in rip current frequency which could accelerate erosion requiring additional nourishment and altering foraging grounds for surf zone species.	NCDEQ - NCDCM	Accelerated Erosion from TG	N	N/A	N/A	No accelerated erosion due to rip currents is anticipated under the preferred alternative. While the modeling did show some temporary rip current formations, no quantifiable sediment loss occurred in these areas. Rip currents are not a significant contributor to sediment transport in the project area. According to Spencer Rogers, "rip currents are generally only an issue for about 5 days a year in NC." Rare rip currents are a public safety concern, and the T-Head design has been incorporated as a measure to minimize this risk.
Alternatives 1, 2 and 3 would be least impactful to fisheries resources.	NCDEQ - NCDCM	Impacts on fisheries	N	N/A	N/A	Noted.
Hardbottom surveys within outer channel footprint	NCDEQ - NCDCM	Hardbottom surveys/impacts	N	N/A	N/A	In the event that Alternative 4 is determined by the USACE to be the Least Environmentally Damaging Practicable Alternative, hardbottom surveys will be conducted prior to construction.
If Alternative 4 is pursued a hardbottom survey should be conducted and agency coordination for buffer development	NCDEQ - NCDCM	Hardbottom surveys/impacts	N	N/A	N/A	In the event that Alternative 4 is selected for implementation, hardbottom surveys and agency coordination will be conducted prior to construction.
DEIS does not provide estimation of larval distribution within Long Bay.	NCDEQ - NCDCM	Larval Transport	N	N/A	N/A	According to NMFS, larval transport in Long Bay is similar to that of Onslow Bay. The results of long term larval transport monitoring in Beaufort Inlet (Onslow Bay) were incorporated into the analyses of potential impacts on larval transport in Lockwood Folly Inlet.

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CMS model is designed for sediment transport and not larval transport, therefore concludsions may be unrepresentative of larval transport impacts. Need further description to understand accuracy of CMS model to predict larval transport effects.	NCDEQ - NCDCM	Larval Transport Modeling	N	N/A	N/A	The capabilities of the CMS model extend well beyond sediment transport, including modeling the movements of neutrally buoyant particles in the water column. As described in the Engineering Report (FEIS Appendix H), biological particles (larvae, micro/macroscopic marine invertebrates) can be both active and passive travelers in the water column. Especially in higher energy environments such as the surf and intertidal zones of the project area, patterns of biological transport are not significantly affected by active biological movement, and transport can be represented by passive particles that are controlled exclusively by physical dynamics (Kim et al. 2010). Therefore, the CMS hydrodynamic and sediment transport simulations (physical dynamics interacting with passive particles) were used to correlate larval transport in the project area. The procedures used to model larval transport with the CMS application were identical to those used by Bald Head Island to model larval transport for its terminal groin project. Kim, C.K., K. Park, S.P. Powers, W.M. Graham, and K.M. Bayha. 2010. Oyster larval transport in coastal Alabama: Dominance of physical transport over biological behavior in a shallow estuary. J. Geophys. Res., 115, C10.
Larval transport monitoring methodology recommended along with relevant research regarding larval transport through inlets	NCDEQ - NCDCM	Larval Transport Monitoring	N	N/A	N/A	Studies at Beaufort Inlet (e.g., Churchill et al. 1999; Luettich et al. 1999) have not reported any impacts attributable to the Fort Macon terminal groin. Based on studies indicating that larvae passing seaward of inlet shoals may bypass the inlet withdrawal zone, researchers have suggested that the placement of “any obstacles such as jetties that would block what appears to be a natural conduit” could be detrimental to larval ingress (Blanton et al. 1999). However, the in-water portion of the proposed Holden Beach groin is relatively short in comparison to the much broader longshore sediment transport corridor and the existing seaward-protruding inlet ebb tidal shoal. As described in Chapter 5 of the EIS, the current vector modeling results show that under flood tide conditions the potential for any deflection of longshore currents by the groin is overridden by the expansive tidal push of water into the inlet; and consequently, easterly longshore currents along the oceanfront shoreline are driven tightly around the groin and into the inlet where they resume their normal pattern of flow.

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Chpt 5.2.1 - Modeling should include activities that can contribute to cumulative effect (AIWW nav dredging)	NCDEQ - NCDCM	Modeling	N	N/A	N/A	The 4-year modeling simulations were designed to identify project-related effects on coastal processes and morphology in relation to natural background processes. In order to avoid masking proposed action effects, separate engineering projects such as AIWW dredging were excluded from the 4-year modeling runs. As stated in the EIS, the modeling results were used primarily to assess the relative effects of alternatives on coastal processes and general patterns of morphological change. As described in the Engineering Report (FEIS Appendix H), other components of the modeling analyses did incorporate AIWW dredging and dredging of the LFI AIWW crossing bend-widener.
Inlet Management Plan is insufficient to satisfy 113A-115.1(f)(5)	NCDEQ - NCDCM	Inlet Management Plan	Y	Appendix E		See the revised Inlet Management Plan (Appendix E of the FEIS).
Appendix C - 2.3, include commitment to monitor Oak Island side of the inlet as part of annual survey	NCDEQ - NCDCM	Inlet Management Plan	Y	Appendix E		See the revised Inlet Management Plan (Appendix E of the FEIS).
Appendix C - 2.4, commit to aerial photography of entire project horizon	NCDEQ - NCDCM	Inlet Management Plan	Y	Appendix E		See the revised Inlet Management Plan (Appendix E of the FEIS).
Appendix C - 2.6, Elaborate on shoreline change analysis would be performed and consistency of data	NCDEQ - NCDCM	Inlet Management Plan	Y	Appendix E		See the revised Inlet Management Plan (Appendix E of the FEIS).
Appendix C - 3.2, Town should commit to continuing post-con sampling surveys for a period greater than 2 years unless approval from DCM is obtained.	NCDEQ - NCDCM	Inlet Management Plan	Y	Appendix E		See the revised Inlet Management Plan (Appendix E of the FEIS).
Appendix C - 5.3, Figure D-9 is incorrect	NCDEQ - NCDCM	Inlet Management Plan	Y	Appendix E		See the revised Inlet Management Plan (Appendix E of the FEIS).
Appendix C - 5.4, Baseline and thresholds should be established for both sides of the inlet and should be more comprehensive than applying a single trigger at one point along the shoreline	NCDEQ - NCDCM	Inlet Management Plan	Y	Appendix E		See the revised Inlet Management Plan (Appendix E of the FEIS).
Chpt 6 (pg 6-7), Include TAC proposal to the Inlet Management Plan	NCDEQ - NCDCM	Inlet Management Plan	Y	Appendix E		Acknowledged. FEIS has been revised accordingly.

Nature of Comment (Summary)	Commenting Agency/Entity	Comment Type	FEIS Revised to Address Comment (Y/N)	FEIS Chapter	FEIS Page	Response to Comment
Chpt 1.5 - Include number and condition of structures protected by temporary erosion control structures	NCDEQ - NCDCM	Sandbags	Y	Chapter 1		Acknowledged. FEIS has been revised accordingly.
Financial assurance information should be included into the cost analysis of the terminal groin portions of the alternatives section of the FEIS	NCDEQ - NCDCM	Alternatives cost	Y	Appendix E		Acknowledged. Inlet Management Plan (Appendix E of the FEIS) has been revised accordingly.
Appendix D - figure references are incorrect (i.e., Figure D-9)	NCDEQ - NCDCM	Appendix D figures	Y	Appendix E		References to appendix figures have been corrected in the FEIS.
Further description needed for macroinvertebrate data collection/analysis/methodology	NCDEQ - NCDCM	Benthic Monitoring Protocols	Y	Appendix E		See revised Inlet Management Plan (Appendix E) in FEIS.
Cost estimates difficult to understand and to compare between alternatives	NCDEQ - NCDCM	Costs	Y	Chapter 5	5-23 5-24	Acknowledged. A comprehensive alternative cost comparison table has been added to the FEIS.
Alternative 4 should include dredging moratorium implemented on in-water work to include dredging from April 1st to September 30th.	NCDEQ - NCDCM	Dredging Moratorium	Y	Chapter 5	5-95 5-124 5-150	Under Alternative 4, dredging would adhere to a 16 November - 31 March environmental window. Under Alternatives 5 and 6, the initial groin construction event would require construction during the month of April; however, all subsequent dredging and beach placement activities would be completed within a 16 November - 31 March window. The final EIS has been revised to clarify these windows.
DCM recommends a moratorium on in water work, including dredging, from 1 April to 30 September.	NCDEQ - NCDCM	Dredging Moratorium	Y	Chapter 5	5-95 5-124 5-150	The initial groin construction event would require construction during the month of April; however, all subsequent dredging and beach placement activities would be completed within the recommended window. The final EIS has been revised to clarify the proposed alternative environmental windows.
Difference in elevation reference - D-10, 12, 13 reference NGVD29 vs EIS references NAVD88 - error in data?	NCDEQ - NCDCM	Elevation reference	Y	Appendix E		All modeling analyses were performed in NAVD88. However, older surveys and the volume/shoreline change analyses using the USACE Beach Morphology Analysis Package (BMAP) are in NGVD29. BMAP is a very useful tool; however, it would require significant effort to change all BMAP files (annually back to ~2001) to NAVD88. Figures D-10, D-12 and D-13 are from BMAP. In general vertical datum conversions are common in coastal engineering, and a note referencing the NGVD29-to-NAVD88 conversion factor has been added to these figures in the revised Inlet Management Plan (Appendix E of the FEIS).
Chpt 2 - clarify project limits and sand sources for existing authorizations on East End	NCDEQ - NCDCM	Existing Authorizations	Y	Chapter 2		Acknowledged. FEIS has been revised accordingly.
Pg 2.8 - CAMA Major Permit #14-02 modified to include offshore borrow area but not yet utilized	NCDEQ - NCDCM	Existing Authorizations	Y	Chapter 2		Acknowledged. FEIS has been revised accordingly.

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Financial costs associated with requirements of SB151 should be included in FEIS - request more detailed cost information in FEIS.	NCDEQ - NCDCM	Financial Assurances	Y	Appendix E		Acknowledged. Inlet Management Plan (Appendix E of the FEIS) has been revised accordingly.
Financial assurances include information such as: costs associated with additional monitoring initiatives, development and operation of TAC, financial assurance plan verified by DEQ or CRC, detailed cost estimate for full removal of the terminal groin structure.	NCDEQ - NCDCM	Financial Assurances	Y	Appendix E		Acknowledged. Inlet Management Plan (Appendix E of the FEIS) has been revised accordingly.
Reference SB151 throughout all documents vs SB110	NCDEQ - NCDCM	Legislative update	Y	Chapter 1		Acknowledged. FEIS has been revised accordingly.
Long-term shoreline change rates - differences of rates as discussed	NCDEQ - NCDCM	Shoreline Change Rates	Y	Appendix E		See the revised Inlet Management Plan (Appendix E of the FEIS).
Statistical analysis of development of threshold of volumetric baseline rate - and how comparable the linear DCM erosion rate and how these rates compare would be beneficial	NCDEQ - NCDCM	Shoreline Change Rates	Y	Appendix E		See the revised Inlet Management Plan (Appendix E of the FEIS).
Appendix C - 2.1, update to reflect Town's most recent annual survey	NCDEQ - NCDCM	Survey data	Y	Appendix E		See the revised Inlet Management Plan (Appendix E of the FEIS).
Placement of dredged materials along a swimming beach has potential to cause localized increase in bacteria concentrations within waters surrounding project	NCDEQ - Shellfish Sanitation	Public Health	N	N/A	N/A	All placement of dredged material is expected to occur within the Nov 1 - March 31 window cited by the commenter. All regulatory compliance requirements will be addressed through the federal and state permitting process.
If placement of dredged material occurs along the beach after March 31st then a swimming advisory must be issued, notifying public of risks	NCDEQ - Shellfish Sanitation	Public Health	N	N/A	N/A	All placement of dredged material is expected to occur within the Nov 1 - March 31 window cited by the commenter. All regulatory compliance requirements will be addressed through the federal and state permitting process.
Swimming advisories can be avoided by scheduling project between November 1 - March 31, outside of swimming season	NCDEQ - Shellfish Sanitation	Public Health	N	N/A	N/A	All placement of dredged material is expected to occur within the Nov 1 - March 31 window cited by the commenter. All regulatory compliance requirements will be addressed through the federal and state permitting process.

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Groin will impact fishes by interrupting larval transport, replacement of the native fish community by a hard structure associated community, and direct mortality to surf zone fishes.	Audubon	Fish communities	N	N/A	N/A	Analyses of groin-related effects on fish communities and larval transport, including the results of larval transport modeling, were presented in Chapter 5 of the EIS. As described in Chapter 5, the fish communities associated with groins are comparable to the native fish communities of natural nearshore hardbottom habitats.
Larval fish are not adapted for high mobility in response to habitat burial or increased turbidity levels.	Audubon	Fish communities	N	N/A	N/A	The EIS acknowledges the impacts of project-related turbidity increases on the behavior (e.g., feeding, predator avoidance, habitat selection) and physiological functions (e.g., photosynthesis, gill-breathing, filter-feeding) of marine pelagic organisms. As described in Chapter 5, sediment suspension and turbidity effects would be short term and localized.
Beach nourishment degrades important swash-zone feeding habitats for demersal surf zone fishes.	Audubon	Fish communities	N	N/A	N/A	The EIS acknowledges the impacts of sand placement on surf zone foraging habitat and benthic prey for demersal fishes. As described in Chapter 5 of the EIS, the use of compatible beach fill material and avoidance of peak infaunal recruitment periods is expected to minimize the duration of these effects.
Impacts to benthic invertebrate prey may have indirect effects of surf zone fishes.	Audubon	Fish communities	N	N/A	N/A	The EIS acknowledges the impacts of sand placement on surf zone foraging habitat and benthic prey for demersal fishes. As described in Chapter 5 of the EIS, the use of compatible beach fill material and avoidance of peak infaunal recruitment periods is expected to minimize the duration of these effects.
The 4-yr nourishment interval is questionable given that Wrightsville Beach, Masonboro Island, Mason Inlet, southern Figure 8 Island, Oregon Inlet, and Fort Macon require nourishment more frequently than every four-years.	Audubon	4-yr nourishment interval	N	N/A	N/A	The Wrightsville Beach, Masonboro Island, Oregon Inlet, and Fort Macon structures are relatively long, impermeable jetties or groins that are not comparable to the proposed leaky groin. Nourishment intervals are highly site specific and dependent on local erosion rates and sediment transport dynamics. Holden Beach is located in Long Bay where wave energy and coastal processes are different from those of the groin locations cited. Dynamics are more similar to those of the nearby Grand Strand (North Myrtle Beach, Myrtle Beach, Garden City), where groin nourishment intervals are much longer (~10 years).
Alternative 2, as presented in the DEIS, is the only alternative in the DEIS that can and should be considered.	Audubon	Alt 2 is the only viable alternative	N	N/A	N/A	Pursuant to NEPA requirements, the EIS must consider a range of reasonable alternatives.
The alternatives in the DEIS that involve hard structures or channelization (Alternatives 4, 5, and 6) at Lockwood Folly Inlet should be permanently removed from further consideration.	Audubon	Alts 4, 5, and 6 should be removed from DEIS	N	N/A	N/A	Pursuant to NEPA requirements, the EIS considers a range of reasonable alternatives. Hard structures and channelization are included as alternatives that may potentially meet the identified purpose and need of the project.
Predominantly westward longshore transport along East End beach indicates groin will accelerate erosion and place all homes on Holden Beach at risk.	Audubon	Groin shoreline effects	N	N/A	N/A	The principal cause of East End erosion is localized inlet-driven eastward sediment transport, not regional westward transport. As in the case of many NC inlets, there is a localized reversal of the regional transport pattern along the adjoining inlet-influenced (East End) shoreline reach. As described in Chapter 5 of the EIS, the model-projected mitigative effects of both groin alternatives include a consistently wider East End beach and an extended 4-year nourishment interval (as opposed to a much narrower beach and a 2-year nourishment interval under all other nourishment alternatives).

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DEIS does not address likelihood that groin will cause the beach to narrow farther to the west, thus requiring additional/more frequent beach nourishment.	Audubon	Groin shoreline effects	N	N/A	N/A	As in the case of many NC inlets, there is a localized reversal of the regional transport pattern along the adjoining inlet-influenced East End shoreline reach. The functional design of the groin is related to the localized eastward sediment transport pattern and not regional westward transport. Rigorous modeling analyses have demonstrated that the influence of the groin is limited to the localized inlet-influenced zone of net eastward sediment transport along the relatively short East End beach. The modeling results do not show any negative groin-related effects on regional westward sediment transport.
Studies show that other NC groins such the Ft Macon and Oregon inlet jetties have caused downdrift erosion.	Audubon	Groin shoreline effects	N	N/A	N/A	The Fort Macon and Oregon Inlet groins are relatively long, impermeable structures that are not comparable to the relatively short and leaky proposed East End terminal groin. Similar leaky groins located in Long Bay (e.g., North Myrtle Beach, Myrtle Beach, Surfside/Garden City) have long (~10-year) nourishment intervals. Pawleys Island is another example where groins have resulted in long nourishment intervals without causing downdrift impacts (see Kana 2004).
DEIS does not address groin-related losses of sand from the inlet system and loss of salt marsh habitat.	Audubon	Groin shoreline effects	N	N/A	N/A	Intertidal habitat impacts are analyzed extensively in Chapter 5 of the EIS. As detailed in Chapter 5, the potential for downdrift/inlet sediment budget impacts and associated intertidal marsh habitat effects were a major focus of the modeling analyses. Model-projected shoreline and intertidal habitat changes are quantified and discussed extensively in Chapter 5.
Masonboro Inlet study demonstrates that groins cause loss of ebb and flood tidal shoals.	Audubon	Groin shoreline effects	N	N/A	N/A	Masonboro Inlet is flanked by 2 relatively long (~3,000 ft), impermeable jetties that are not comparable to the relatively short and leaky proposed East End terminal groin. Jetties are primarily designed to maintain navigation channels, whereas terminal groins are designed to minimize beach erosion.
DEIS fails to address cumulative impacts of sand mining and groin on the adjacent downdrift beach. The regular removal of sand from Lockwood Folly Inlet and the proposed groin would disrupt longshore sand transport and potentially threaten Holden Beach.	Audubon	Groin shoreline effects	N	N/A	N/A	As in the case of many NC inlets, there is a localized reversal of the regional transport pattern along the adjoining inlet-influenced (East End) shoreline reach. As a result of local net eastward transport, sand placed on the East End beach is transported back into Lockwoods Folly Inlet. The functional design of the groin is related to the localized eastward sediment transport pattern and not regional westward transport. Rigorous modeling analyses have demonstrated that the influence of the groin is limited to the localized inlet-influenced zone of net eastward sediment transport along the relatively short East End beach. The modeling results do not show any negative groin-related effects on regional westward sediment transport.
Peer-reviewed literature shows that terminal groins do not function as presented in the DEIS and cause more harm than good.	Audubon	Groin shoreline effects	N	N/A	N/A	Although many hardening techniques, including the use of impermeable and/or improperly designed groins (in most cases without concurrent beach nourishment), have been shown to cause downdrift erosion, the proposed East End project employs a permeable and relatively short terminal groin and concurrent nourishment to avoid these types of downdrift effects. A study by Galgano (2004) found that "in many circumstances, groins have functioned effectively and stabilized an eroding beach without seriously harming adjacent areas….the groins, in conjunction with beach fill, arrested beach erosion at the site and effectively stabilized the beach for nearly 50 years notwithstanding their structural deficiencies."

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The modeling for Alternatives 5 and 6 indicates significant loss of sediment from the inlet system, resulting in loss of habitat, primarily low-energy shoals and sandbars which provide habitat for benthic invertebrates that are consumed by shorebirds and fishes.	Audubon	Groin shoreline effects	N	N/A	N/A	Compared with all other alternatives, the modeling results for Alternatives 5 and 6 show relative increases in shoal habitat (see Table 5.3 of the EIS).
DEIS does not adequately address effects of groin/nourishment/inlet channelization; including downdrift erosion, loss of sediment from the inlet system, impacts to spits, loss of critical habitat, and cumulative impacts.	Audubon	Inadequate analysis of groin, nourishment, and inlet channelization impacts	N	N/A	N/A	Each of these issues is analyzed extensively in Chapter 5 of the EIS. As detailed in Chapter 5, the potential for downdrift/inlet sediment budget impacts and associated habitat effects were a major focus of the modeling analyses. Model-projected shoreline and habitat changes are quantified and discussed extensively in Chapter 5.
The best, most recent data and peer-reviewed literature available to assess groin impacts are omitted or misrepresented, and the recommendations of multiple management and recovery plans, including USFWS recovery plans, are largely disregarded.	Audubon	Inadequate literature review	N	N/A	N/A	Recovery plans typically attribute adverse effects to a broad class shoreline hardening practices (e.g., coastal armoring, hard structures) with little or no consideration of structure type or design. Coastal armoring encompasses a wide range of shoreline hardening practices (sea walls, jetties, bulkheads, groins, etc.). Although many hardening techniques, including the use of impermeable and/or improperly designed groins (in most cases without concurrent beach nourishment), have been shown to cause downdrift erosion, the proposed East End project employs a permeable and relatively short terminal groin and concurrent nourishment to avoid these types of downdrift effects.
The DEIS omits the vast majority of the ample body of scientific literature that is available to describe the well-known and accepted physical impacts of terminal groins and beach fill. It then fails to accurately describe the direct, indirect, and cumulative impacts that these activities would have on biological resources within Lockwood Folly Inlet, particularly the Piping Plover.	Audubon	Inadequate literature review	N	N/A	N/A	The engineering report (FEIS Appendix H) provides a comprehensive review of physical impacts related to groins. The commenter's assertion that the analyses of biological impacts are inaccurate is noted.
DEIS does not discuss or cite the wealth of literature on the impacts of terminal groins.	Audubon	Inadequate review of groin literature	N	N/A	N/A	The engineering report (FEIS Appendix H) provides a comprehensive review of physical impacts related to groins.

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DEIS overlooks impacts of the alternatives on the infaunal communities. Use of the terms "short-term,", "rapid recovery," and "rapid recolonization" are misleading because some organisms take up to four years to recover.	Audubon	Infaunal communities	N	N/A	N/A	The EIS acknowledges that the use of incompatible beach fill material can result in lengthy recovery periods. The study cited by the commenter (Peterson et al. 2014) involved the placement of grossly incompatible material during a 2001/2002 nourishment project (prior to the promulgation of NC technical standards for beach fill). The nourishment alternatives addressed in the EIS would use only beach compatible material. As stated by Peterson (2014) in his comments on the Figure 8 EIS: "Matching the natural beach sedimentology, grain size distributions and minerelogical content, especially amount of shell and shell hash, leads to the most rapid recovery, probably requiring about a year."
Peterson et al. (2014) monitored infaunal recovery for 3-4 years after nourishment and documented that haustoriid amphipods and Donax spp. had reduced densities for 3-4 years. E. talpoida had lower densities for 1-2 years following nourishment, and ghost crabs had lower abundances for four years.	Audubon	Infaunal communities	N	N/A	N/A	The EIS acknowledges that the use of incompatible beach fill material can result in lengthy recovery periods. The study cited by the commenter (Peterson et al. 2014) involved the placement of grossly incompatible material during a 2001/2002 nourishment project (prior to the promulgation of NC technical standards for beach fill). The nourishment alternatives addressed in the EIS would use only beach compatible material. As stated by Peterson (2014) in his comments on the Figure 8 EIS: "Matching the natural beach sedimentology, grain size distributions and minerelogical content, especially amount of shell and shell hash, leads to the most rapid recovery, probably requiring about a year."
Inlets with terminal groins require nourishment every 1-4 years. Since some infaunal species recover in 3-4 years, the cumulative impacts to infaunal communities at such sites is that the community cannot recover before the next nourishment cycle.	Audubon	Infaunal communities	N	N/A	N/A	Based on modeling results, the intermediate terminal groin would extend the nourishment interval to four years, thereby reducing the frequency of impacts in relation to the current two-year nourishment cycle. As described in the response above, the use of compatible beach fill would facilitate relatively rapid benthic community recovery, probably in about one year.
DEIS should address potential for additional infaunal impacts due to more frequent nourishment and out-of-season nourishment (outside proposed environmental window).	Audubon	Infaunal communities	N	N/A	N/A	Based on modeling results, the intermediate terminal groin would extend the nourishment interval to four years, thereby reducing the frequency of impacts in relation to the current two-year nourishment cycle. As described in the response above, the use of compatible beach fill would facilitate relatively rapid benthic community recovery, probably in about one year. Although the initial groin construction event would require work during the month of April, all subsequent beach placement activities would be completed between 16 Nov and 31 March.
Beach nourishment degrades beach habitats and decreases densities of invertebrate prey for shorebirds. This will negatively impact species that forage in oceanfront intertidal and swash habitats.	Audubon	Infaunal communities	N	N/A	N/A	The EIS acknowledges temporary losses of intertidal benthic invertebrates and the associated negative effects on shorebirds. However, the best available scientific information indicates that impacts on benthic communities are relatively short term (≤ 1 yr) when highly compatible beach fill material is used and peak infaunal recruitment periods are avoided.

Nature of Comment (Summary)	Commenting Agency/Entity	Comment Type	FEIS Revised to Address Comment (Y/N)	FEIS Chapter	FEIS Page	Response to Comment
DEIS underestimates and marginalizes impacts to infaunal communities.	Audubon	Infaunal communities	N	N/A	N/A	The EIS acknowledges temporary losses of intertidal benthic invertebrates and the associated negative effects on shorebirds. However, the best available scientific information indicates that impacts on benthic communities are relatively short term (≤ 1 yr) when highly compatible beach fill material is used and peak infaunal recruitment periods are avoided. As stated by Peterson (2014) in his comments on the Figure 8 EIS: "Matching the natural beach sedimentology, grain size distributions and minerelogical content, especially amount of shell and shell hash, leads to the most rapid recovery, probably requiring about a year."
Numerous studies (n=34) report that nourishment results in impacts to infauna, but DEIS cites only 2 of these articles.	Audubon	Infaunal communities	N	N/A	N/A	Chapter 5 of the EIS cites and describes the benthic infaunal impacts reported by the following studies: <u>intertidal benthic infauna</u> (n=10) Wilber and Clark 2007, Burlas et al. 2001, Jutte et al. 1999a, Rakocinski et al. 1996, Van Dolah et al. 1994, Van Dolah et al. 1992, Gorzelany and Nelson 1987, Salomon and Naughton 1984, Parr et al. 1978, Hayden and Dolan 1974; <u>subtidal benthic infauna</u> (n=11) Wilber and Clark 2007, Bolam et al. 2006, Burlas et al. 2001, Jutte et al. 1999b, Rakocinski et al. 1996, Van Dolah et al. 1984, Van Dolah et al. 1979, Oliver et al. 1977, McCall 1977, Stickney and Perlmutter 1975, Stickney 1974.
The results of Rakocinski et al. 1996, were not accurately reported by the DEIS because relevant findings were omitted.	Audubon	Infaunal communities	N	N/A	N/A	The study by Rakocinski et al. (1996) employed numerous sampling stations along a lengthy onshore-offshore transect and assessed impacts and recovery in multiple habitat types (e.g., dry beach, intertidal beach, subtidal surf zone, and offshore). The EIS cites Rakocinski et al. (1996) according to the habitat type being discussed. Analyses of intertidal beach impacts in Chapter 5 of the EIS reference the relatively long intertidal benthic recovery periods reported by Rakocinski et al.; whereas analyses of surf zone soft bottom communities in Chapter 5 reference the relatively short subtidal surf zone benthic recovery periods reported by Rakocinski et al. (1996).
In its treatment of impacts to the infauna, the DEIS relies nearly exclusively on outdated literature that is generally not peer-reviewed, and it omits the many recent, peer-reviewed scientific papers that are available on the subject. Peterson and Bishop (2005) suggested that weaknesses in nourishment studies are due to studies being conducted by project advocates with no peer review process and the duration of monitoring being inadequate to characterize the fauna before and after nourishment. Thus, uncertainty surrounding biological impacts of nourishment can be attributed to the poor quality of monitoring studies, not an absence of impacts.	Audubon	Infaunal communities	N	N/A	N/A	The EIS acknowledges the temporary loss of all or most benthic invertebrates within the beach fill footprints as well as the potential for lengthy recovery periods when incompatible beach fill material is used. The recent study cited by the commenter (Peterson et al. 2014) involved the placement of grossly incompatible material during a 2001/2002 nourishment project (prior to the promulgation of NC technical standards for beach fill). The nourishment alternatives addressed in the EIS would use only beach compatible material. As stated by Peterson (2014) in his comments on the Figure 8 EIS: "Matching the natural beach sedimentology, grain size distributions and minerelogical content, especially amount of shell and shell hash, leads to the most rapid recovery, probably requiring about a year."

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The base of the food chain (infaunal community) requires 1-4 years to recover from a nourishment event, and that has not been the case at the East End beach. If the base of the food chain is absent or largely absent due to nourishment activities every two years, then the organisms that consume them, like birds and fishes, will not be present either. The DEIS fails to make this connection. Alternatives 1, 3, 4, 5, and 6 as presented in the DEIS would negatively impact birds, as well as infauna, fishes, and sea turtles.	Audubon	Infaunal communities	N	N/A	N/A	The EIS acknowledges the temporary loss of all or most benthic invertebrates within the beach fill footprints and the associated prey-loss effects on shorebirds and surf zone fishes. The EIS acknowledges the potential for lengthy recovery periods when incompatible beach fill material is used; however, the nourishment alternatives addressed in the EIS would use only beach compatible material. As stated by Peterson (2014) in his comments on the Figure 8 EIS: "Matching the natural beach sedimentology, grain size distributions and minerelogical content, especially amount of shell and shell hash, leads to the most rapid recovery, probably requiring about a year."
Studies demonstrate that coastal armoring accelerates beach erosion and increases ecological impacts to sandy beach communities (infaunal communities and shorebirds).	Audubon	Infaunal communities/shorebirds	N	N/A	N/A	Coastal armoring encompasses a wide range of shoreline hardening practices (sea walls, jetties, bulkheads, groins, etc.). Although many hardening techniques, including the use of impermeable and/or improperly designed groins, have been shown to cause downdrift erosion, the proposed East End terminal groin is a permeable and relatively short structure that has been designed to avoid these types of downdrift effects.
DEIS perpetuates the misconception that breeding and non-breeding shorebirds/waterbirds have alternative places to go when habitat is lost. Shorebirds like piping plovers, as well as terns and skimmers are now confined to a small fraction of the habitat once available to them.	Audubon	Shorebird/Waterbirds	N	N/A	N/A	As described in Chapter 5 of the EIS, permanent impacts to shorebird foraging habitat (0.2 acre) and roosting habitat (0.3 acre) within the groin footprint would be negligible. No additional shorebird habitat would be permanently lost. The EIS acknowledges the temporary impacts of sand placement on shorebird foraging habitat and benthic prey. Based on modeling, the terminal groin will extend the nourishment interval from 2 to 4 years, thereby reducing the frequency of repeated sand placement impacts on foraging habitat and the benthic prey base.
Unmodified inlets containing a mosaic of habitat types are essential to sustaining shorebird communities. Shorebirds depend on unmodified inlets to provide all the resources/habitats required at the locations essential to meeting their spatial and temporal energetic needs. Required inlet habitats are specific and limited in extent, and other coastal habitats do not provide equivalent substitute resources.	Audubon	Shorebirds	N	N/A	N/A	Potential groin-related adverse effects on Lockwoods Folly Inlet were a major consideration in the model simulations. In fact, model-projected adverse effects on the inlet were the principal reason that the “long groin” alternative was not carried forward for full analysis in the EIS. The project design incorporated recommendations from the Terminal Groin study in an effort to minimize potential adverse inlet effects. As described in Chapter 5 of the EIS, rigorous modeling analyses indicate that the influence of the groins under Alternatives 5 and 6 is limited to the localized inlet-influenced zone of net eastward sediment transport along the relatively short East End beach. The modeling results do not show any negative groin-related downdrift effects on Lockwoods Folly Inlet.

Nature of Comment (Summary)	Commenting Agency/Entity	Comment Type	FEIS Revised to Address Comment (Y/N)	FEIS Chapter	FEIS Page	Response to Comment
Piping plovers and other shorebirds are dependent of inlets and associated intertidal flats that support benthic invertebrate prey.	Audubon	Shorebirds	N	N/A	N/A	The EIS acknowledges the importance of inlet complex habitats for shorebirds. As described above, potential inlet effects were a major consideration in the modeling analyses. As described in Chapter 5, the model-projected inlet responses under the groin alternatives (Alts 5 and 6) are essentially the same as the response under Alternative 2, thus indicating little to no effect on inlet habitats.
Shorebird populations are declining, and the cumulative loss or degradation of habitat, including that associated with coastal engineering projects, is a primary threat to shorebird conservation.	Audubon	Shorebirds	N	N/A	N/A	Cumulative effects on shorebirds and their habitats were evaluated in Section 5 of the EIS. The scope of the cumulative effects analysis in the FEIS has been expanded to a more regional scale encompassing the southeastern NC coast south of Cape Lookout. This expanded scope has been applied to the analysis of cumulative effects under each alternative in Chapter 5 of the FEIS.
Alternatives 1, 3, 4, 5, and 6 will have significant and lasting negative direct, indirect, and cumulative impacts on birds and other wildlife that depend on the dynamism of mid-Atlantic coastal inlets.	Audubon	Wildlife	N	N/A	N/A	The direct, indirect, and cumulative impacts of these alternatives on birds and other wildlife are evaluated in Chapter 5 of the EIS.
NC study indicates piers and groins negatively affect sea turtle nesting.	Audubon	Threatened/Endangered Species	Y	Appendix C		Although many hardening techniques, including the use of impermeable and/or improperly designed groins, have been shown to cause downdrift erosion and habitat loss, the proposed East End terminal groin is a permeable and relatively short structure that has been designed allow sand bypassing, thereby avoiding these types of downdrift effects. Potential impacts on sea turtles have been addressed through Section 7 consultation with the USFWS. The resulting USFWS Biological Opinion is included in the FEIS (Appendix C).
Florida study indicates managed inlets negatively affect sea turtle nesting.	Audubon	Threatened/Endangered Species	Y	Appendix C		Although many hardening techniques, including the use of impermeable and/or improperly designed groins, have been shown to cause downdrift erosion and habitat loss, the proposed East End terminal groin is a permeable and relatively short structure that has been designed allow sand bypassing, thereby avoiding these types of downdrift effects. Potential impacts on sea turtles have been addressed through Section 7 consultation with the USFWS. The resulting USFWS Biological Opinion is included in the FEIS (Appendix C).
DEIS does not address impacts to sea turtles should the nourishment interval turn out to be similar to those at other NC inlets with hardened structures, rather than the projected four-year interval.	Audubon	Threatened/Endangered Species	Y	Appendix C		The 4-year modeling simulations were designed to be conservative and included the erosional effects of Hurricanes Hanna (2008) and Irene (2011). Therefore, a nourishment interval of at least 4 years is expected. Potential impacts on sea turtles have been addressed through Section 7 consultation with the USFWS. The resulting USFWS Biological Opinion is included in the FEIS (Appendix C).
DEIS does not address impacts to sea turtles in the event of groin-induced downdrift erosion.	Audubon	Threatened/Endangered Species	Y	Appendix C		The modeling results do not indicate any downdrift effects on sea turtle nesting habitat. Potential impacts on sea turtles have been addressed through Section 7 consultation with the USFWS. The resulting USFWS Biological Opinion is included in the FEIS (Appendix C).

Nature of Comment (Summary)	Commenting Agency/Entity	Comment Type	FEIS Revised to Address Comment (Y/N)	FEIS Chapter	FEIS Page	Response to Comment
Studies of hard structures found negative impacts to sea turtles. Modification of the subtidal beach profile may negatively affect sea turtle nesting. Studies report that seawalls and pilings negatively affect sea turtle nesting.	Audubon	Threatened/Endangered Species	Y	Appendix C		The term "hard structures" encompasses a wide range of structure types (sea walls, jetties, bulkheads, groins, etc.). As stated by Griggs (2003): "Groins have often been lumped with the much larger breakwaters and jetties as coastal engineering structures that have had major secondary or negative downdrift effects." Although many hardening techniques, including the use of impermeable and/or improperly designed groins, have been shown to cause downdrift erosion, the proposed East End terminal groin is a permeable and relatively short structure that has been designed allow sand bypassing, thereby avoiding these types of downdrift effects. Sea walls and pilings are not comparable to the proposed East End terminal groin. Potential impacts on sea turtles have been addressed through Section 7 consultation with the USFWS. The resulting USFWS Biological Opinion is included in the FEIS (Appendix C).
Beach nourishment can cause compaction, escarpment formation, and other substrate changes that can negatively affect sea turtle nesting.	Audubon	Threatened/Endangered Species	Y	Appendix C		Potential impacts on sea turtles have been addressed through Section 7 consultation with the USFWS. The resulting USFWS Biological Opinion is included in the FEIS (Appendix C).
Sea turtles may be impacted by beach construction (obstructions) or dredging (entrainment), especially when work takes place outside the environmental window for sea turtles.	Audubon	Threatened/Endangered Species	Y	Appendix C		Potential impacts on sea turtles have been addressed through Section 7 consultation with the USFWS. The resulting USFWS Biological Opinion is included in the FEIS (Appendix C).
DEIS does not accurately address the cumulative impacts of the preferred alternative. The cumulative impacts of groin construction along the NC coast and US Atlantic Coast have been one of the most significant contributing factors to the loss of habitat for birds.	Audubon	Cumulative groin effects	Y	Chapter 5	5-28 5-31 5-38 5-41 5-74 5-99 5-137 5-138	The scope of the cumulative effects analysis in the FEIS has been expanded to a more regional scale encompassing the southeastern NC coast south of Cape Lookout. This expanded scope has been applied to the analysis of cumulative effects under each alternative in Chapter 5 of the FEIS.
Appendix "Q" was a typo, should be appendix "M"	Lindsay Addison, Audubon	Typo	Y	Chapter 5	5-23 5-52 5-68 5-147 5-165	Acknowledged. FEIS has been revised accordingly.
Biological opinion (appendix A) of appendix P was overlooked and needs to be re-added	Lindsay Addison, Audubon	Typo	Y	Appendix C		USFWS Biological Opinion is included in the FEIS (Appendix C).
Best alternative for management of the Lockwood Folly Inlet is Alternative 4, Inlet Management and Beach Nourishment	North Carolina Coastal Federation	Alternative Analysis	N	N/A	N/A	Noted.
Alternative 2 could be least damaging and cost effective alternative	North Carolina Coastal Federation	Alternative Analysis	N	N/A	N/A	Noted.

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Alternative 4 should be explored further as to long term costs and benefits	North Carolina Coastal Federation	Alternative Analysis/Cost benefits	N	N/A	N/A	The long-term costs and benefits of all alternatives, including Alternative 4, are discussed in Chapter 5 and Appendix H of the FEIS.
Comparison of benefits between alternatives shows little added protection from structure	North Carolina Coastal Federation	Benefits of terminal groin	N	N/A	N/A	As described in the EIS, the modeling results indicate that the intermediate terminal groin will extend the protective life of each nourishment event by at least 2 years. The modeling results also indicate that the number of properties at risk under the preferred alternative (Alt 6) is reduced by nearly 50 percent in relation to the no-project alternative (Alt 2). The 4-year modeling simulations were run under highly erosional conditions, and thus are conservative in terms of predicting the mitigative effects of the alternatives on shoreline erosion. The starting (Year 0) shoreline position corresponds to the highly eroded 2008 shoreline, and four-year simulations incorporate the erosional effects of Hurricanes Hanna (2008) and Irene (2011). Therefore, the model-predicted erosion rates are higher than the expected long-term averages, and substantial beach erosion occurs under all the alternatives.
Exactly how much the project will cost taxpayers and how many individual homes will be protected	North Carolina Coastal Federation	Construction costs and value	N	N/A	N/A	The implementation costs of each alternative over the 30-year planning cycle are provided in Chapter 5 of the EIS. The preferred alternative is designed to save money over the 30-yr planning cycle when compared with the other alternatives (nourishment only, retreat, etc.). Economic benefits would be realized through maintenance and enhancement of the existing beach system as well as protection of existing homes and infrastructure. The 4-year modeling simulations were designed to be conservative and included the erosional effects of Hurricanes Hanna (2008) and Irene (2011). Therefore, substantial erosion is predicted under all of the alternatives (including the preferred alternative). However, the number of properties at risk under the preferred alternative is reduced by nearly 50 percent in relation to the no-project alternative (Alt 2).
USACE is responsible for protecting Lockwood Folly Inlet for all citizens	North Carolina Coastal Federation	Federal authority	N	N/A	N/A	Noted.
GENESIS does not take into account wind-dominated currents	North Carolina Coastal Federation	Modeling	N	N/A	N/A	Wind-dominated currents represent a negligible influence in shoreline processes. Significant literature is devoted to wind stresses and drag coefficients as they relate to the water/air boundary, and it is generally found that the influence of wind dominated currents is negligible in comparison with tidal and wave-generated currents. GENESIS-T is based on the wave field, which constitutes the dominant sediment transport mechanism. Although the EIS analyses rely heavily on the CMS model results, the GENESIS-T model was used to provide additional valuable information related to the effects of the nourishment and groin alternatives.
GENESIS cannot model channel realignment therefore a cannot provide analysis for all alternatives and therefore should not be used	North Carolina Coastal Federation	Modeling	N	N/A	N/A	In terms of modeling, the EIS analyses rely heavily on the CMS model results; however, the GENESIS model, while not used to simulate channel realignment, provides additional valuable information related to the effects of nourishment under Alternatives 1, 3, 4, 5, and 6 and groin construction under Alternatives 5 and 6. As described in the Engineering Report (FEIS Appendix H), while the model is capable of simulating groin and beach fill alternatives, inlet-related changes such as channel relocation and LWFIX borrow area inclusion are more difficult to model with the GENESIS-T model application.

Nature of Comment (Summary)	Commenting Agency/Entity	Comment Type	FEIS Revised to Address Comment (Y/N)	FEIS Chapter	FEIS Page	Response to Comment
Modeling study flawed due to: calibration limited to two weeks compared to 30-yr lifetime of TG, analysis include 7 out of 42 variables, only 2 of 10 deployed gauges were used to assess model accuracy	North Carolina Coastal Federation	Modeling (accuracy)	N	N/A	N/A	The calibration was a rigorous effort that employed a time period sufficient to capture the hydrodynamics of the LWF inlet system. All gages deployed within or near the study area boundaries were used in the development of the model. All gage data was used in the calibration and development of the model applications. Calibration and model development incorporated all necessary components and parameters and were based on sound and widely accepted engineering/scientific protocols (comparisons of measured and simulated data for water levels, tide phasing, current directions and magnitudes, etc.).
Engineering modeling analysis uses changing/disparate timelines and prevents meaningful analysis and comparison of data among alternatives	North Carolina Coastal Federation	Modeling (methodology)	N	N/A	N/A	The model used comprehensive topo/bathy data sets from 2000, 2004, 2008, and 2012; and was run under many different conditions. The incorporation of data from different time periods is an essential component of the modeling analyses that allows an assessment of project alternatives under a range of historical conditions (inlet/shoreline configurations, topo/bathy, water levels, waves, etc.). The 4-year modeling simulations described in the EIS used identical time periods and forcing conditions for each of the alternatives.
Terminal groin in not in public interest and will benefit only a few private property owners	North Carolina Coastal Federation	Public interest/cost-benefit	N	N/A	N/A	The benefits identified by the commenter are limited to property value, whereas the EIS considers a more comprehensive set of economic and natural resource values (e.g., reduced nourishment costs, recreation and tourism, habitat).
The DEIS does not comply with the Endangered Species Act, no Section 7 consultation has been initiated	North Carolina Coastal Federation	Section 7 consultation	Y	Appendix C		Section 7 consultation has been completed and the resulting USFWS Biological Opinion is included in the FEIS (Appendix C).
As required by state law, the inlet channel has to be managed if a groin is constructed	North Carolina Coastal Federation	State law	Y	Appendix E		Acknowledged. See the revised Inlet Management Plan (Appendix E of the FEIS).
Pursuant to the CWA, the Corps is only allowed to permit the least environmentally damaging practicable alternative. The DEIS shows that each of the alternatives is practicable. Alternatives 5 and 6 will permanently impact benthic communities, habitats, and hydrodynamics; and therefore, are the most environmentally damaging when evaluated according to the CWA. Alternative 2 would have no impact on communities, habitats, and hydrodynamics; and therefore, is the least environmentally damaging practicable alternative.	SELC	Alt 2 is the least environmentally damaging alternative	N	N/A	N/A	As described in Chapter 5 of the EIS, permanent impacts on dry beach (0.3 acre) and intertidal beach (0.2 acre) habitats within the Alternative 5 and 6 groin footprints would be negligible. No additional habitat would be permanently lost. The EIS acknowledges the temporary impacts of sand placement on benthic habitats and communities. Based on modeling, the terminal groins under Alternatives 5 and 6 would extend the nourishment interval from 2 to 4 years, thereby reducing the frequency of repeated sand placement impacts on benthic habitats and communities. The modeling results indicate that groin-related hydrodynamic effects under Alternatives 5 and 6 are minor and highly localized to the groin structures. As described in Chapter 5 of the EIS, the modeling results indicate that erosional losses of dry and intertidal beach habitat along the East End beach are by far the highest under Alternative 2. In the absence of beach management under Alternative 2, the modeling results indicate that unmitigated erosion would rapidly eliminate the majority of the subaerial East End beach. The responses of individual homeowners would likely involve armoring the shoreline with sandbags, which are beyond the control of the Town and could remain in place indefinitely without a longer-term mitigative solution.

Nature of Comment (Summary)	Commenting Agency/Entity	Comment Type	FEIS Revised to Address Comment (Y/N)	FEIS Chapter	FEIS Page	Response to Comment
The model overestimates the erosion rate under Alternative 2 at 20 ft/yr.	SELC	Alt 2 shoreline erosion rate overestimated	N	N/A	N/A	The 4-year modeling simulation was designed to be conservative and included the erosional effects of Hurricanes Hanna (2008) and Irene (2011). Therefore, the model-predicted erosion rates are expected to be higher than the long-term averages.
Projected loss of property/infrastructure under the preferred alternative does not meet the purpose and need for action.	SELC	Alt 6 property impacts not consistent with purpose and need	N	N/A	N/A	The 4-year modeling simulations were designed to be conservative and included the erosional effects of Hurricanes Hanna (2008) and Irene (2011). Therefore, substantial erosion is predicted under all of the alternatives (including the preferred alternative). However, the number of properties at risk under the preferred alternative is reduced by nearly 50 percent in relation to the no-project alternative (Alt 2).
Corps cannot assume that preferred alternative will be beneficial, as many properties would continue to be adversely affected under Alternative 6.	SELC	Beneficial effects of Alt 6	N	N/A	N/A	The 4-year modeling simulations were designed to be conservative and include the erosional effects of Hurricanes Hanna (2008) and Irene (2011). Therefore, substantial erosion is predicted under all of the alternatives (including the preferred alternative). However, the number of properties at risk under the preferred alternative is reduced by nearly 50 percent in relation to the no-project alternative (Alt 2).
DEIS states that preferred alternative will have long-term benefits, but benefits are not identified or estimated.	SELC	Beneficial effects of Alt 6	N	N/A	N/A	Compared with the model-projected two-year nourishment intervals under Alternatives 1, 3, and 4; the longer four-year nourishment interval under the preferred alternative (Alt 6) would have economic benefits in the form of substantially reduced nourishment costs. Additional economic benefits would be realized through enhanced protection of property, infrastructure, and the recreational beach. These economic benefits are described in Chapter 5 of the EIS.
The DEIS does not comply with NEPA, and the deficiencies are too significant to be remedied in a final EIS. Therefore the Corps should issue a revised or supplemental EIS that addresses the limited scope of modeling analyses and the inadequate evaluation of indirect and cumulative effects.	SELC	Corps must issue a revised or supplemental EIS	N	N/A	N/A	The EIS evaluates the direct, indirect, and cumulative effects of each alternative in accordance the Corps NEPA regulation (33 CFR part 230) and CEQ regulations for implementing NEPA (40 CFR 1500–1508). Public and agency scoping and participation were integral components of the NEPA process leading up to the release of the FEIS. The modeling constitutes a rigorous and comprehensive approach that was employed in the iterative design of project alternatives. Although coastal models are limited in their capability to predict precise multi-decadal effects, they represent the best tool for assessing potential long-term morphological change. The application of USACE coastal models to the NEPA process in this manner is a long-established and accepted practice. The scope of the cumulative effects analysis in the FEIS has been expanded to a more regional scale encompassing the southeastern NC coast south of Cape Lookout. This expanded scope has been applied to the analysis of cumulative effects under each alternative in Chapter 5 of the FEIS.
The costs of Alternative 6 outweigh the benefits provided in terms of protection for properties and infrastructure. Lost revenue and assessed property value under Alternative 2 is far less than the cost of Alternative 6. Alternative 2 is the only economically feasible alternative.	SELC	Costs of Alt 6 outweigh benefits	N	N/A	N/A	The benefits identified by the commenter are limited to tax value and tax revenue, whereas the EIS considers a more comprehensive set of economic values (e.g., reduced nourishment costs, recreation and tourism).

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Erosional effects attributable to the inlet are limited to a short segment of the beach and threaten only a small number of properties. Since there is no indication that inlet-induced erosion will spread beyond the east end beach, the potentially affected properties should be relocated, thereby allowing natural processes to restore the beach.	SELC	Costs outweigh benefits	N	N/A	N/A	The erosional effects identified by the commenter are limited to property value, whereas the EIS considers a more comprehensive set of economic, recreational, and natural resource values (e.g., reduced nourishment costs, recreation and tourism, beach habitat). Under Alternative 2 (abandon and retreat), natural processes would not be expected to restore the beach. As described in the EIS, the East End beach has experienced chronic erosion for many decades and has one the highest long-term erosion rates in the state. In the absence of beach management, the modeling results indicate that unmitigated erosion would rapidly eliminate the majority of the subaerial East End beach. The responses of individual homeowners would likely involve armoring the shoreline with sandbags, which are beyond the control of the Town and could remain in place indefinitely without a longer-term mitigative solution.
The CRC Terminal Groin Study indicates that groins modify inlet processes in ways that substantially eliminate inlet habitats for shorebirds, waterbirds, and other species.	SELC	Groin effects on inlet habitats/wildlife	N	N/A	N/A	The CRC Terminal Groin study identifies the potential for both beneficial and adverse effects on inlet habitats. Furthermore, a number of groins included in the study are relatively long, impermeable structures that are not comparable to the relatively short and leaky (permeable) proposed East End terminal groin. The project design incorporated recommendations from the Terminal Groin study in an effort to minimize potential adverse habitat impacts. Pursuant to the NC Terminal Groin Law, the ability to modify or remove the groin in the event that adverse impacts occur was incorporated into the groin design. Potential adaptive management modifications to the structure include decreasing the crest width, notching, shortening, and/or the addition of a weir.
The recreational beach would be eliminated at year 4 under the preferred alternative.	SELC	Groin shoreline effects	N	N/A	N/A	The 4-year modeling simulations were run under highly erosional conditions, and thus are conservative in terms of predicting the mitigative effects of the alternatives on shoreline erosion. The starting (Year 0) shoreline position corresponds to the highly eroded 2008 shoreline, and four-year simulations incorporate the erosional effects of Hurricanes Hanna (2008) and Irene (2011). Therefore, the model-predicted erosion rates are higher than the expected long-term averages, and substantial beach erosion occurs under all the alternatives. However, as described in Chapter 5 of the EIS (see Table 5.4), the projected relative beach width under Alternative 6 at the end of the 4-year simulation is three times that of the nourishment only alternative.
The Corps Coastal Engineering Manual and a DCM report analyzing the Oregon Inlet and Fort Macon jetties indicate that groins result in adverse erosional effects on downdrift beaches.	SELC	Groin shoreline effects	N	N/A	N/A	The Corps Coastal Engineering Manual also states that "present coastal engineering knowledge and predictive tools have advanced to the point where competent functional design of groins and groin fields is now possible." The Fort Macon and Oregon Inlet groins are relatively long, impermeable structures that are not comparable to the relatively short and leaky proposed East End terminal groin. The project design incorporated recommendations from the Terminal Groin study in an effort to minimize potential negative downdrift impacts.

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The CRC Terminal Groin Study indicates that the adverse effects of groins are likely increased when groins are installed at shallow draft inlets such as Lockwoods Folly Inlet.	SELC	Groin shoreline effects	N	N/A	N/A	Potential groin-related adverse effects on Lockwoods Folly Inlet were a major consideration in the model simulations. In fact, model-projected adverse effects on the inlet were the principal reason that the "long groin" alternative was not carried forward for full analysis in the EIS. The CRC Terminal Groin study identifies the potential for both beneficial and adverse effects on inlets. Furthermore, a number of groins included in the study are relatively long, impermeable structures that are not comparable to the relatively short and leaky proposed East End terminal groin. The project design incorporated recommendations from the Terminal Groin study in an effort to minimize potential adverse inlet effects, and rigorous modeling analyses indicate that the influence of the groins under Alternatives 5 and 6 is limited to the localized inlet-influenced zone of net eastward sediment transport along the relatively short East End beach. As described in Chapter 5 of the EIS, the modeling results do not show any increased risk of negative groin-related downdrift effects on Lockwoods Folly Inlet.
DEIS does not adequately incorporate the modeling analyses provided in Appendix F. The relation of the DEIS analyses to Appendix F is not adequately explained.	SELC	Inadequate description of modeling	N	N/A	N/A	A discussion of the modeling methods and the use of modeling results in the impact analyses is provided in Chapter 5.1 of the FEIS (Impact Analysis Methodology).
Use of CMS model is inconsistent with other terminal groin EIS documents. Corps has failed to explain why different models were used.	SELC	Inconsistent use of CMS model	N	N/A	N/A	The USACE CMS model is one of several accepted and widely-employed coastal models that are used to assess coastal engineering projects. Although different applicants for NC terminal groin projects have opted to use different coastal models, all of the models employed are suitable for terminal groin applications. The USACE conducts a rigorous review of the engineering analyses for all projects to ensure that appropriate models and modeling procedures are used.
Corps must evaluate alternatives based on their effectiveness in providing long-term protection of properties, infrastructure, and recreational assets. Such an evaluation would show that Alternative 2 is the only reasonable alternative.	SELC	Insufficient modeling	N	N/A	N/A	In evaluating the alternatives, the EIS considers a more comprehensive set of economic, recreational, and natural resource values (e.g., reduced nourishment costs, recreation and tourism, habitat and wildlife). As described in Chapter 5 of the EIS, Alternative 2 is the least effective alternative in terms of providing long-term protection of properties, infrastructure, and recreational assets.
Short-term modeling time periods do not account for long-term indirect and cumulative effects of terminal groin.	SELC	Insufficient modeling	N	N/A	N/A	The modeling used available comprehensive topo/bathy data sets from 2000, 2004, 2008, and 2012; and the model was run under many different conditions. The modeling constitutes a rigorous and comprehensive approach that was employed in the iterative design and fine tuning of the project alternatives. Although coastal models are limited in their capability to predict precise multi-decadal effects, they represent the best tool for assessing potential long-term morphological change. The application of USACE coastal models to the NEPA process in this manner is a long-established and accepted practice.

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Limited 4-yr modeling analysis violates NEPA.	SELC	Insufficient modeling	N	N/A	N/A	The modeling used available comprehensive topo/bathy data sets from 2000, 2004, 2008, and 2012; and the model was run under many different conditions. The modeling constitutes a rigorous and comprehensive approach that was employed in the iterative design and fine tuning of the project alternatives. Although coastal models are limited in their capability to predict precise multi-decadal effects, they represent the best tool for assessing potential long-term morphological change. The application of USACE coastal models to the NEPA process in this manner is a long-established and accepted practice.
DEIS fails to adequately describe baseline data. No baseline data provided for years 5-30 of the 30-year project.	SELC	Insufficient modeling	N	N/A	N/A	The modeling used available comprehensive topo/bathy baseline data sets from 2000, 2004, 2008, and 2012; and the model was run under many different conditions. The CMS model requires substantial bathymetric and topographic baseline data. The baseline years selected have comprehensive data and are sufficiently spaced in time to capture a range of different beach conditions (beach width, inlet channel alignments, shoal configurations, etc.). The modeling constitutes a rigorous and comprehensive approach that was employed in the iterative design and fine tuning of the project alternatives. Although coastal models are limited in their capability to predict precise multi-decadal effects, they represent the best tool for assessing potential long-term morphological change. The application of USACE coastal models to the NEPA process in this manner is a long-established and accepted practice.
DEIS fails to evaluate the indirect effects of the terminal groin alternatives. Limited 4-year indirect effects analysis does not adequately assess the indirect effects of the terminal groin alternatives.	SELC	Insufficient modeling	N	N/A	N/A	The modeling used available comprehensive topo/bathy data sets from 2000, 2004, 2008, and 2012; and the model was run under many different conditions. The modeling constitutes a rigorous and comprehensive approach that was employed in the iterative design and fine tuning of the project alternatives. Although coastal models are limited in their capability to predict precise multi-decadal effects, they represent the best tool for assessing potential long-term morphological change. The application of USACE coastal models to the NEPA process in this manner is a long-established and accepted practice.
DEIS fails to provide information necessary for public to compare alternatives. Limited 4-year analysis does not provide information necessary to fully evaluate the environmental and economic impacts of the alternatives over the 30-year project.	SELC	Insufficient modeling	N	N/A	N/A	The EIS employs a wide range of quantitative and qualitative methods of analysis and is not limited to the modeling results. The modeling used available comprehensive topo/bathy data sets from 2000, 2004, 2008, and 2012; and the model was run under many different conditions. The modeling constitutes a rigorous and comprehensive approach that was employed in the iterative design and fine tuning of the project alternatives. Although coastal models are limited in their capability to predict precise multi-decadal effects, they represent the best tool for assessing potential long-term morphological change. The application of USACE coastal models to the NEPA process in this manner is a long-established and accepted practice.

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It is well established that a terminal groin will degrade inlet habitats by disrupting natural inlet processes. Effects that take hold after 4 years should be analyzed.	SELC	Insufficient modeling	N	N/A	N/A	The EIS employs a wide range of quantitative and qualitative methods of analysis and is not limited to the modeling results (see EIS Section 5.1 - Impact Analysis Methodology). The overall CMS modeling effort involved an extensive suite of model simulations representing a wide range of timeframes, physical conditions, and actions within the Permit Area. Modeling runs of 6 months, 1 year, 2 years and 4 years were conducted to assess short to long term morphological responses. Modeling simulations were also conducted under a wide range of local forcing conditions representing various physical data sets ranging from 2000 to 2012. In addition to the analysis of alternatives, specific modeling runs were used to assess the response of the system to separate actions such as federal navigation dredging. For impact analysis purposes, the EIS focuses on a specific suite of four-year modeling runs that are based on local physical data sets from 2008-2011. Although coastal models are limited in their capability to predict precise multi-decadal effects, they represent the best tool for assessing potential long-term morphological change. The application of USACE coastal models to the NEPA process in this manner is a long-established and accepted practice.
The DEIS should address potential groin effects beyond the 4-year modeling period.	SELC	Insufficient modeling	N	N/A	N/A	The EIS employs a wide range of quantitative and qualitative methods of analysis and is not limited to the modeling results. The modeling used available comprehensive topo/bathy data sets from 2000, 2004, 2008, and 2012; and the model was run under many different conditions. The modeling constitutes a rigorous and comprehensive approach that was employed in the iterative design and fine tuning of the project alternatives. Although coastal models are limited in their capability to predict precise multi-decadal effects, they represent the best tool for assessing potential long-term morphological change. The application of USACE coastal models to the NEPA process in this manner is a long-established and accepted practice.
DEIS does not identify the shoreline data that represents year 0 in the modeling analyses.	SELC	Model year 0 shoreline data not identified	N	N/A	N/A	The starting point for the 4-year modeling runs described in the EIS is the eroded 2008 East End shoreline. The modeling was a very conservative approach that started with the shoreline in a highly erosional state and included the erosional effects of Hurricane Hanna (2008) and Hurricane Irene (2011).

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The conclusions of no cumulative effects under Alternatives 5 and 6 are in error given the unlawful (4-yr modeling) analysis of indirect effects in the DEIS.	SELC	NEPA compliance/indirect and cumulative effects	N	N/A	N/A	The EIS employs a wide range of quantitative and qualitative methods to assess indirect and cumulative effects and is not limited to the modeling results. The model was run under a wide range of different conditions based on comprehensive topo/bathy data sets from 2000, 2004, 2008, and 2012. The modeling constitutes a rigorous and comprehensive approach that was employed in the iterative design and fine tuning of the project alternatives. Although coastal models are limited in their capability to predict precise multi-decadal effects, they represent the best tool for assessing potential long-term morphological change. The application of USACE coastal models to the NEPA process in this manner is a long-established and accepted practice. The modeling results indicate that the long-term indirect effects of the terminal groin under Alternative 5 would be minor and highly localized to the groin structure. Therefore, groin-related cumulative effects would not be expected. Based on modeling results, the terminal groin will extend the nourishment interval from 2 to 4 years, thereby reducing the frequency of recurring sand placement impacts and the potential for long-term cumulative effects.
The preferred alternative does not provide even short-term protection for properties, infrastructure, and recreational assets. The DEIS does not show any meaningful difference in recreational beach width between the alternatives.	SELC	Relative effectiveness of alternatives	N	N/A	N/A	The 4-year modeling simulations were designed to be conservative and included the erosional effects of Hurricanes Hanna (2008) and Irene (2011). Therefore, substantial erosion occurs under all the alternatives. However, as described in Chapter 5 of the EIS (see Table 5.4), the projected relative beach width under Alternative 6 at the end of the 4-year simulation is three times that of the nourishment only alternative, and the number of properties at risk under the preferred alternative is reduced by nearly 50 percent in relation to the no-project alternative (Alt 2). Based on modeling results, the terminal groin will extend the nourishment interval from 2 to 4 years, thereby reducing sand placement impacts and costs in relation to existing practices and the non-structural nourishment alternatives.
The DEIS fails to adequately address direct, indirect, and cumulative effects; and therefore, does not provide the information necessary for the Corps to conduct its required analyses pursuant to Section 404 of the CWA.	SELC	Section 404 permit decision	N	N/A	N/A	The FEIS evaluates the direct, indirect, and cumulative effects of each alternative in accordance the Corps NEPA regulation (33 CFR part 230), NEPA Implementation Procedures for the Regulatory Program (33 CFR 325 - Appendix B), and CEQ regulations (40 CFR 1500–1508).
The 5-year piping plover status review and the recovery plans for all 3 piping plover populations identify habitat loss and degradation attributable to groins and inlet stabilization as a serious threat to piping plover populations.	SELC	Threatened/Endangered Species	Y	Appendix C		Potential impacts on piping plovers have been addressed through Section 7 consultation with the USFWS. The resulting USFWS Biological Opinion is included in the FEIS (Appendix C).

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The DEIS should address the cumulative effects of Alternative 6 in combination with proposed groins at Bald Head Island, Ocean Isle Beach, Figure Eight Island, and other NC inlets.	SELC	Cumulative effects	Y	Chapter 5	5-28 5-31 5-38 5-41 5-74 5-99 5-137 5-138	The scope of the cumulative effects analysis in the FEIS has been expanded to a more regional scale encompassing the southeastern NC coast south of Cape Lookout. This expanded scope has been applied to the analysis of cumulative effects under each alternative in Chapter 5 of the FEIS.
Use of Oak Island Shorebird Monitoring data with no financial contribution, agreement between the two town's establishing responsibilities should be developed.	Town of Oak Island	Bird Monitoring	N	N/A	N/A	Noted.
What is the potential and timeframe estimated for the recharge of the Central Reach borrow source	Town of Oak Island	Central Reach borrow source	N	N/A	N/A	Due to its offshore location in relatively deep water, recharge will likely occur slowly at the Central Reach borrow site. The North Myrtle Beach borrow area, which is similar in geology and location, exhibited a recharge rate of less than 0.5 ft/yr during the 1st post-project year. Sediment mobilization is limited at these depths; and consequently, bottom sediments are relatively static.
Will dredging of the Central Reach borrow source alter the symmetry of the ebb-tidal delta complex or channel alignment in LFI?	Town of Oak Island	Oak Island shoreline effects	N	N/A	N/A	Due to its offshore location (~3.3 miles seaward of the ebb tidal delta) in relatively deep water (~36 ft MSL), dredging at the Central Reach borrow site will not affect the ebb tidal delta.
EIS does not address Oak Island's 2012 comments regarding concerns over offshore Central Reach borrow area and alignment of LFI to Oak Island's shoreline.	Town of Oak Island	Oak Island shoreline effects	N	N/A	N/A	The letter in question was submitted to the USACE, and the Town of Holden Beach addressed this comment through direct consultation with Oak Island during the Central Reach Project NEPA/permitting process.
Are any circumstances expected where a volume greater than 150,000 cy every 4 years will be needed?	Town of Oak Island	Preferred borrow source	N	N/A	N/A	Erosional losses attributable to major storm events and/or higher than normal wave energy years could increase the volumetric need to more than 150,000 cy every 4 years. However, on average, a volumetric need of 150,000 cy every 4 years is anticipated over the 30-year life of the project.

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If the LFIX and AIWW bend widener provide the preferred borrow source, under what condition(s) will LFI navigation channel or Central Reach borrow source be used?	Town of Oak Island	Preferred borrow source	N	N/A	N/A	The LFIX and AIWW bend widener are anticipated to meet all the volumetric nourishment needs for the project. However the inlet channel and offshore borrow area are included as potential supplemental sources in the event of an unanticipated shortfall. Sand extraction from the LFI outer channel and the Central Reach offshore borrow site would both require an "ocean certified" dredge, which have very high mobilization/demobilization costs typically ranging from \$2 to \$4 million. Consequently, these borrow areas would only be used under very limited circumstances (e.g., in conjunction with dredging for the Holden Beach Central Reach nourishment project). Specialized USACE shallow draft hopper dredges have mobilization costs that are feasible for small projects, and could be used to dredge the outer LFI channel with nearshore disposal of the dredged material along Holden Beach. However, these dredges are in high demand for USACE projects along the Eastern and Gulf coasts. Nonetheless, Holden Beach could potentially contract with the USACE to have a shallow draft hopper dredge place material in the nearshore portion of the project area.
Town of Oak Island supports efforts to protect and preserve Holden Beach shoreline and community through use of terminal groin and beach fill.	Town of Oak Island	Project support	N	N/A	N/A	Noted.
To provide a fair and equivalent sediment source for both Oak Island and Holden Beach, perhaps only half of the available volume from any LFI or navigation channel borrow source (including the AIWW bend widener) should be available for either town.	Town of Oak Island	Sediment Source	N	N/A	N/A	Given the disparity between NCDCM long-term erosion rates for the East End of Holden Beach (~7 ft/yr) and the west end of Oak Island (~2 ft/yr), a strict 50/50 sand sharing agreement may not be feasible. However, the Town of Holden Beach acknowledges the sand needs of Oak Island and is amenable to the development of a flexible and adaptive sand-sharing agreement.
Any borrow source within the LFI system should be agreed upon by Oak Island, or at a minimum the TAC.	Town of Oak Island	Sediment Source	N	N/A	N/A	The Town of Holden Beach acknowledges the sand needs of Oak Island and is amenable to the development of a flexible and adaptive sand-sharing agreement.
The "fillet" will change the shoreline orientation and wave approach angle among other key components influencing sediment transport. True modified transport rate will not be known until after project construction.	Town of Oak Island	Sediment Transport Rate	N	N/A	N/A	The modeling accounts for the "fillet"; and therefore, is capable of predicting the change in transport rate. It is acknowledged that transport rates vary from year to year; however, a reduced sediment transport rate is to be expected. It is important to note that unlike the Bald Head terminal groin, which is specifically designed to reorient the shoreline, the proposed Holden Beach East End groin is designed to maintain the existing shoreline orientation.
Potential impacts in form of direct erosional catalysts or indirect conduits may potentially affect shoreline stabilization efforts for Oak Island must be considered.	Town of Oak Island	Oak Island shoreline effects	Y	Appendix E		The NC terminal groin law requires intensive long-term monitoring to identify any downdrift shoreline effects, as well as contingency planning and financial assurances for groin removal in the event that it is not functioning as intended. Holden Beach has surveyed 7 survey transects on western Oak Island annually since 2012 for the purpose of establishing baseline data. See Appendix E (Revised Inlet Management Plan) in the FEIS for additional information.

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Establishment of a technical advisory committee (TAC) to review monitoring results is not required until after construction has commenced. Does not provide Oak Island reasonable assurances the committee will form with enough time to QA/QC and inspect construction operations.	Town of Oak Island	Technical Advisory Committee	Y	Appendix E		The Town of Holden Beach is amenable to the establishment of a TAC prior to construction. See the revised Inlet Management Plan (Appendix E of the FEIS).
The Inlet Management Plan does not reference specific volumetric or shoreline change thresholds proposed for determining if impacts occur.	Town of Oak Island	Inlet Management Plan	Y	Appendix E		See the revised Inlet Management Plan (Appendix E of the FEIS).
Monitoring survey timeframes are not specified	Town of Oak Island	Inlet Management Plan	Y	Appendix E		See the revised Inlet Management Plan (Appendix E of the FEIS).
No guaranteed funding source available for mitigation efforts, BPART's balance or escrow account.	Town of Oak Island	Mitigation funding	Y	Appendix E		See the revised Inlet Management Plan (Appendix E of the FEIS).
Opposition to building hardened structures	April O	Ecosystem preservation	N	N/A	N/A	Noted.
Worried about the longevity of building the groin and environmental impacts associated with placement of a hardened structure	April O	Ecosystem preservation	Y	Appendix E		While the groin is designed to be a relatively permanent structure, the NC terminal groin law requires intensive long-term monitoring to identify any downdrift shoreline effects, as well as contingency planning and financial assurances for groin removal in the event that it is not functioning as intended. See Appendix E (Revised Inlet Management Plan) in the FEIS for additional information.
There are fiscal conflicts associated with any of the alternatives that will contend for tax dollars.	Charles Klapheke (Skip)	Cost prohibitive	N	N/A	N/A	The groin construction costs under Alternatives 5 and 6 make up only ~7% of the total project costs, whereas beach nourishment and dredge mobilization/demobilization account for ~80% of total project costs. Based on modeling results, the terminal groin will extend the nourishment interval from 2 to 4 years, thereby reducing costs in relation to the non-structural alternatives.
What other major town initiatives will be differed or abandoned to implement this one?	Charles Klapheke (Skip)	Differed town initiatives	N	N/A	N/A	Modifications to other major town initiatives are not anticipated. The groin construction costs under Alternatives 5 and 6 make up only ~7% of the total project costs, whereas beach nourishment and dredge mobilization/demobilization account for ~80% of total project costs. Based on modeling results, the terminal groin will extend the nourishment interval from 2 to 4 years, thereby reducing costs in relation to existing practices and the non-structural nourishment alternatives.

Nature of Comment (Summary)	Commenting Agency/Entity	Comment Type	FEIS Revised to Address Comment (Y/N)	FEIS Chapter	FEIS Page	Response to Comment
Without knowing if the alternatives 5 and 6 will work the town may be forced to remove the groin at its own expense, however alternatives 1-4 allow for some flexibility and periodic review with potential course change.	Charles Klapheke (Skip)	Insufficient information	N	N/A	N/A	While the groin is designed to be a relatively permanent structure, the NC terminal groin law requires contingency planning and financial assurances for groin removal in the event that it is not functioning as intended. The groin construction costs under Alternatives 5 and 6 make up only ~7% of the total project costs, whereas beach nourishment and dredge mobilization/demobilization account for ~80% of total project costs. Based on modeling results, the terminal groin will extend the nourishment interval from 2 to 4 years, thereby reducing costs in relation to the non-structural alternatives.
More information is needed as to where the funding for the alternatives will come from (Federal, State, Town) and what revenue vehicle will be used (grants, appropriations, additional taxes?).	Charles Klapheke (Skip)	Insufficient information	N	N/A	N/A	The groin construction costs under Alternatives 5 and 6 make up only ~7% of the total project costs, whereas beach nourishment and dredge mobilization/demobilization account for ~80% of total project costs. Based on modeling results, the terminal groin will extend the nourishment interval from 2 to 4 years, thereby reducing nourishment costs in relation to the non-structural alternatives. Nourishment funding is anticipated to come from the existing BPART fund as well as State and Federal Navigation Dredging Funds. Nourishment of the East End using LWF inlet crossing dredged material has been occurring for decades, with the primary sponsor being the USACE. While USACE funding is expected to continue; increased funding from the State, County, and Town will likely be needed in the future. The State has recently established a shallow inlet dredging fund that can provide up to 50 percent of the total project cost. No tax increases are proposed.
The study is not sufficient enough to allow for a well-informed discussion of the proposed alternatives.	Charles Klapheke (Skip)	Insufficient information	N	N/A	N/A	Noted. The USACE Legal Counsel will evaluate the legal sufficiency of the FEIS in conjunction with the decision process.
Alternatives 5 and 6 should have included the 12 properties on Serenity lane as they will be impacted though aesthetics and tax increases.	Charles Klapheke (Skip)	Missing information	N	N/A	N/A	No tax increases are proposed. The aesthetic impacts of the groin alternatives are addressed in Chapter 5 of the FEIS.
Information provided about the predictive model is insufficient, the majority of the study is based on the results of one model which has not been successful on predicting sand movement in other locations.	Charles Klapheke (Skip)	Modeling	N	N/A	N/A	As described in the Engineering Report (FEIS Appendix H), analyses employed two sediment transport models developed by the USACE: CMS (Coastal Modeling System) and GENESIS-T (Generalized Model for Simulating Shoreline Change). Both models have been applied to coastal engineering projects throughout the US and abroad. The USACE ERDC Coastal Inlets Research Program (CIRP) maintains a website specifically dedicated to these models and their applications (http://cirpwiki.info/wiki/Main_Page). The principal intent of the modeling analyses is to provide a relative comparison of shoreline and physical process responses under the various alternatives. As described in Chapter 5 of the FEIS, although the modeling results are presented as quantitative projections, the projected changes are not intended to represent a precise estimate of future conditions.

Nature of Comment (Summary)	Commenting Agency/Entity	Comment Type	FEIS Revised to Address Comment (Y/N)	FEIS Chapter	FEIS Page	Response to Comment
Because this study only utilized one model for predicting sand movement and erosion patterns the conclusion drawn are seriously undermined, also because the study relies highly on the predictive model there should be more information on the details of the model used, including limitations and probability of successfully predicting the future.	Charles Klapheke (Skip)	Modeling	N	N/A	N/A	As described in the Engineering Report (FEIS Appendix H), analyses employed two sediment transport models developed by the USACE: CMS (Coastal Modeling System) and GENESIS-T (Generalized Model for Simulating Shoreline Change). Both models have been applied to coastal engineering projects throughout the US and abroad. The USACE ERDC Coastal Inlets Research Program (CIRP) maintains a website specifically dedicated to these models and their applications (http://cirpwiki.info/wiki/Main_Page).
Study appears to begin with a preordained outcome	Charles Klapheke (Skip)	Potential bias	N	N/A	N/A	The FEIS was prepared in accordance with the Corps NEPA regulation (33 CFR part 230), NEPA Implementation Procedures for the Regulatory Program (33 CFR 325 - Appendix B), and CEQ regulations for implementing NEPA (40 CFR 1500–1508). Pursuant to these regulations, the FEIS presents an objective evaluation of all reasonable alternatives.
What is the time frame for the Town commissioners to receive the final study, solicit input from their constituency, select an alternative, and determine sources and impact funding?	Charles Klapheke (Skip)	Project timeline	N	N/A	N/A	The NEPA decision process is conducted independently by the USACE. Subsequent actions by the Holden Beach Town Commissioners are not a component of this process. The FEIS will serve as the basis for a permit decision by the USACE, but is not in and of itself a decision document. After considering all comments on the FEIS, the USACE will issue its decision in a separate Record of Decision (ROD) document.
A review of the alternatives of the study would be a little easier to conduct if the tables summarizing the costs and benefits were located in the corresponding sub-sections of chapter 5.	Charles Klapheke (Skip)	Formatting	Y	Chapter 5	5-23 5-24	A comprehensive alternative cost comparison table has been added to the FEIS.
There does not appear to be any conclusion as to the impact of this project on any of the named federally endangered species	Charles Klapheke (Skip)	Natural resource protection	Y	Appendix C		Chapter 5 of the EIS describes the anticipated direct, indirect, and cumulative impacts of each alternative on federally listed threatened and endangered species. Additionally, ESA Section 7 consultation has been completed and the resulting USFWS Biological Opinion is included in the FEIS (Appendix C).
The financials of the alternatives may not be credible and therefore evaluation is impossible, infrastructure costs are considered in alternative 6 however not in alternative 5.	Charles Klapheke (Skip)	Insufficient information	Y	Chapter 5	5-94 5-123 5-148 5-166	It is acknowledged that the EIS text contained some typographical errors related to costs, and these errors have been corrected in the FEIS. Appendix O of the FEIS provides a more comprehensive discussion of the economic analyses.
In favor of the terminal groin	Diana Willard	Beneficial coastal economics	N	N/A	N/A	Noted.
The ecological and economic impacts to Oak Island were not thoroughly addressed.	Eileen Governale	Oak Island consideration	N	N/A	N/A	The ecological and economic impacts to Oak Island were fully evaluated and described in Chapter 5 of the FEIS. However, the model-projected effects of the alternatives on Oak Island are minimal to non-existent; and consequently, the effect descriptions are relatively limited in comparison with the discussion of impacts on Holden Beach.

Nature of Comment (Summary)	Commenting Agency/Entity	Comment Type	FEIS Revised to Address Comment (Y/N)	FEIS Chapter	FEIS Page	Response to Comment
On page 5-156, the Holden Beach DEIS refers to an Appendix Q. The appendices on the website only go to Appendix P. Is there an Appendix Q?	Geoff Gisler	Appendix	Y	Chapter 5	5-23 5-52 5-68 5-147 5-165	References to appendices have been corrected in the FEIS.
Collaboration between government agencies and the towns of Brunswick county is needed to produce a comprehensive erosion control master plan.	Lora Sharkey	Comprehensive erosion control plan	N	N/A	N/A	A comprehensive inter-local erosion control master plan is beyond the scope of the EIS. However, the project will adhere to all sediment and erosion control best management practices (BMPs) as well as all State, County, and Town erosion control regulations and protocols.
Disturbance caused by placement of groin will disrupt endagered birds through reduction of food.	Lora Sharkey	Ecosystem preservation	N	N/A	N/A	The FEIS acknowledges groin-related impacts on shorebird foraging habitat. As described in Chapter 5 of the FEIS, permanent impacts to shorebird intertidal foraging habitat within the groin footprint (0.2 acre) would be negligible. Based on modeling results, the terminal groin will extend the nourishment interval from 2 to 4 years, thereby reducing the frequency of repeated sand placement impacts on foraging habitat.
Terminal groins are not aesthetically pleasing.	Pam Sabalos	Aesthetics	N	N/A	N/A	Noted. The aesthetic impacts of the groin alternatives are evaluated in Chapter 5 of the FEIS.
Expensive to build/remove and only protects a small number of homes that were a bad investment choice.	Pam Sabalos	Cost prohibitive	N	N/A	N/A	The groin construction costs under Alternatives 5 and 6 make up only ~7% of the total project costs, whereas beach nourishment and dredge mobilization/demobilization account for ~80% of total project costs. Based on modeling results, the terminal groin will extend the nourishment interval from 2 to 4 years, thereby reducing costs in relation to the non-structural alternatives.
The potential environmental degradation is not worth the benefits of a few home owners.	Pam Sabalos	Ecosystem preservation	N	N/A	N/A	The benefits identified by the commenter are limited to property value, whereas the FEIS considers a more comprehensive set of economic and natural resource values (e.g., reduced nourishment costs, recreation and tourism, habitat). Based on modeling results, the terminal groin will extend the nourishment interval from 2 to 4 years, thereby reducing costs in relation to existing practices and the non-structural nourishment alternatives.
Opposition to building hardened structures	Pam Sabalos	Ecosystem preservation	N	N/A	N/A	Noted.
The models associated with sand movement around terminal groins may not predict correctly.	Pam Sabalos	Modeling	N	N/A	N/A	As described in the Engineering Report (FEIS Appendix H), analyses employed two sediment transport models developed by the USACE: CMS (Coastal Modeling System) and GENESIS-T (Generalized Model for Simulating Shoreline Change). Both models have been applied to coastal engineering projects throughout the US and abroad.
Does not eliminate the need for renourishment.	Pam Sabalos	Still need periodic renourishment	N	N/A	N/A	The FEIS acknowledges that continuing nourishment is a major component of the preferred alternative. However, based on modeling results, the terminal groin will extend the nourishment interval from 2 to 4 years, thereby reducing costs in relation to the non-structural alternatives.

Nature of Comment (Summary)	Commenting Agency/Entity	Comment Type	FEIS Revised to Address Comment (Y/N)	FEIS Chapter	FEIS Page	Response to Comment
Proposed action is not beneficial to significant public interests.	Peter and Catherine Meyer	Natural resource protection	N	N/A	N/A	The FEIS considers a comprehensive set of economic, recreational, and natural resource values (e.g., reduced nourishment costs, recreation and tourism, wildlife habitat). Economic benefits would be realized through maintenance and enhancement of the existing beach system for recreation as well as protection of existing homes and infrastructure. Based on modeling results, the terminal groin will extend the nourishment interval from 2 to 4 years, thereby reducing costs in relation to existing practices and the non-structural nourishment alternatives.
The "primary dune" is landward of the Mean High Water (MHW) line. Therefore the dune is on "private" property, not state property. Therefore there can be no attachment/construction to the "primary dune" without the approval of the property owner.	Richard Weigland	Private property consideration	N	N/A	N/A	Noted.
Opposition to building hardened structures.	Robert Peek	Natural resource protection	N	N/A	N/A	Noted.
Against hardening Holden Beach eastern end.	Sandra Brooks-Mathers	Natural resource protection	N	N/A	N/A	Noted.
General lack of familiarity with present value analysis, the firm needs to take the time to educate the decision makers that Present Value of the alternatives needs to be the basis of any financial comparison.	Skip Klapheke	Insufficient information	N	N/A	N/A	The FEIS presents the costs of each alternative as a range of present values based on discount rates of 2.5 percent, 4.125 percent and 6.0 percent. A 4.125 percent discount rate is standard practice for USACE civil works projects, thus the use of rates above and below 4.125 provides sensitivity to the analyses of this parameter. As the decision-maker in the NEPA process, the USACE is well aware of the importance of present value. Appendix O of the FEIS provides a more comprehensive discussion of the economic analyses and the methods used to determine present value.
In favor of the terminal groin.	Terry Willard	Beneficial coastal economics	N	N/A	N/A	Noted.
Why was public comment on the DEIS asked for before appropriate government agencies weighed in?	Vicki Myers	EIS process	N	N/A	N/A	The NEPA process is being conducted in accordance the Corps NEPA regulation (33 CFR part 230) and CEQ NEPA regulations (40 CFR 1500–1508).
Why will "robust monitoring" not reach farther down the beach?	Vicki Myers	Erosion monitoring	N	N/A	N/A	Holden Beach currently conducts physical monitoring of the entire shoreline (LWF inlet to Shallotte inlet) on an annual basis. Island-wide monitoring for purposes of assessing erosion/accretion and maintaining eligibility for FEMA "engineered beach" mitigation funding will continue to occur on an annual basis.
Need to address potential effects of erosion exacerbation over the second mile away from the groin.	Vicki Myers	Erosoin control	N	N/A	N/A	As in the case of many NC inlets, there is a localized reversal of the regional transport pattern along the adjoining inlet-influenced East End shoreline reach. The functional design of the groin is related to the localized eastward sediment transport pattern and not regional westward transport. Rigorous modeling analyses have demonstrated that the influence of the groin is limited to the localized inlet-influenced zone of net eastward sediment transport along the relatively short East End beach. The modeling results do not show any negative groin-related effects on regional westward sediment transport.

Nature of Comment (Summary)	Commenting Agency/Entity	Comment Type	FEIS Revised to Address Comment (Y/N)	FEIS Chapter	FEIS Page	Response to Comment
What is the impact of the current inlet alignment on the project cost, modeling, and other factors.	Vicki Myers	Inlet alignment / cost change?	N	N/A	N/A	The modeling and engineering analyses are based on a wide range of historical inlet and ebb channel configurations. The model used comprehensive topo/bathy data sets from 2000, 2004, 2008, and 2012; and was run under many different conditions. The 4-year modeling simulation described in the FEIS is a very conservative approach that starts with the highly erosional 2008 shoreline condition and includes the erosional effects of Hurricane Hanna (2008) and Hurricane Irene (2011).
It is also not comforting to have the report state that it can't predict changes, but all the recommendations are based on modeling.	Vicki Myers	Modeling	N	N/A	N/A	The FEIS employs a wide range of quantitative and qualitative methods of analysis and is not limited to the modeling results. The modeling used available comprehensive topo/bathy data sets from 2000, 2004, 2008, and 2012; and the model was run under many different conditions. The modeling constitutes a rigorous and comprehensive approach that was employed in the iterative design and fine tuning of the project alternatives. Although coastal models are limited in their capability to predict precise multi-decadal effects, they represent the best tool for assessing potential long-term morphological change. The application of USACE coastal models to the NEPA process in this manner is a long-established and accepted practice.
The diagram in the handout shows a groin cross section 10' wide at the top, but the DEIS shows it to be 5" wide (page 5-142).	Vicki Myers	Incorrect information	Y	Chapter 3	5-149 3-21 3-22	The 5-foot wide crest was presented as part of a conceptual groin design that was based on the USACE Coastal Engineering Manual (CEM). A 10-foot wide crest for the groin stem is proposed for the project. Chapter 5 has been revised accordingly. Updated engineering drawings have been incorporated into Chapter 3 of the FEIS.
Page 5-36 of the DEIS states the Central Reach Project will occur in 2014/2015. This is not correct.	Vicki Myers	Incorrect information	Y	Chapter 5	5-5	Acknowledged. FEIS has been revised accordingly.
There should be a table or section that compares the economics of the alternatives	Vicki Myers	Tables	Y	Chapter 5	5-23 5-24	A comprehensive alternative cost comparison table has been added to the FEIS.
Information in charts does not match verbage. Ex.Alternative 6, page 5-156: "In present value terms, construction costs range from $15.24 million (6% discount rate) to approximately $23.43 million (2.5% discount rate)," but table 5.17 on page 5-159 shows a present value of $21.97M – $36.32M.	Vicki Myers	Tables not matching verbage	Y	Chapter 5	5-94 5-123 5-148 5-166	Acknowledged. Typographical errors have been corrected in the FEIS.

United States Department of the Interior

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October 2, 2015

Emily Hughes
Wilmington Regulatory Field Office
U. S. Army Corps of Engineers
69 Darlington Ave.
Wilmington, North Carolina 28403

Subject: Town of Holden Beach, Draft Environmental Impact Statement for Terminal Groin
USACE Action ID #SAW-2011-01914

Dear Ms. Hughes:

This is in response to your August 28, 2015 Public Notice, requesting comments on the Draft Environmental Impact Statement (DEIS) for the Town of Holden Beach. The Town of Holden Beach has applied for Department of Army (DA) authorization to construct a terminal groin and conduct a long-term beach nourishment program along oceanfront beach in Brunswick County, North Carolina. The U.S. Fish and Wildlife Service, Raleigh Ecological Services office (Service) has reviewed the public notice and DEIS for the project and our comments are listed below. These comments are submitted in accordance with the Fish and Wildlife Coordination Act (FWCA) (48 Stat. 401, as amended; 16 U.S.C. 661-667d). Comments related to the FWCA are to be used in your determination of compliance with 404(b)(1) guidelines (40 CFR 230) and in your public interest review (33 CFR 320.4) in relation to the protection of fish and wildlife resources. Additional comments are provided regarding the District Engineer's determination of project impacts pursuant to Section 7 of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531-1543).

Project Area, Proposed Activities, and Anticipated Impacts

The project area is the eastern end of Holden Beach and the adjacent Atlantic Ocean, and Lockwoods Folly Inlet. The purpose of the project, as stated in the DEIS is "to reduce or mitigate ongoing and chronic erosion at the East End of Holden Beach and to protect and secure public infrastructure, roads, homes, businesses, rental properties, beaches, recreational assets, and protective dunes."

Six alternatives are proposed: (1) No Action (Status-Quo), (2) Abandon and Retreat, (3) Beach Nourishment, (4) Inlet Management and Beach Nourishment, (5) Short Terminal Groin and

Beach Nourishment, and (6) Intermediate Terminal Groin and Beach Nourishment. The applicant's preferred alternative is Alternative 6, which involves the construction of a 1,000-foot long terminal groin at the eastern end of Holden Beach, and the implementation of an independent, 30-year beach nourishment plan. The projected beach nourishment plan involves the placement of approximately 100,000 to 150,000 cubic yards (cy) of sand on the east end of Holden Beach every four years. The initial nourishment event would include the construction of a wedge-shaped groin fillet to establish a gradual transitional shoreline between the western end of the beach fill footprint and the seaward terminus of the groin. The proposed borrow site is the LFIX/bend-widener borrow site in Lockwoods Folly Inlet, along with potential supplemental sand acquisition from the inland Lockwoods Folly Inlet navigation channel and the Central Reach offshore borrow site.

Federal Protected Species

The DEIS lists the following Federal listed species under the authority of the Service within the project area: West Indian manatee (*Trichechus manatus*), piping plover (*Charadrius melodus*), red knot (*Calidris canutus rufa*), seabeach amaranth (*Amaranthus pumilus*), and the Kemp's ridley (*Lepidochelys kempi*), hawksbill (*Eretmochelys imbricata*), leatherback (*Dermochelys coriacea*), loggerhead (*Caretta caretta*), and green (*Chelonia mydas*) sea turtles. Whales, shortnose sturgeon (*Acipenser brevirostrum*), Atlantic sturgeon (*Acipenser oxyrinchus*), and sea turtles in the water are under the jurisdiction of NOAA Fisheries' Protected Species Division.

The Corps has determined that the proposed project may affect federally listed species or their designated Critical Habitat. In particular, the public notice states that the Corps will request initiation of formal consultation for effects to nesting sea turtles and loggerhead Critical Habitat. The public notice also states that the Corps has determined that the project may affect, but is not likely to adversely affect seabeach amaranth, red knot, piping plover, and manatee. Wood stork (*Mycteria americana*) is discussed in the DEIS but is not addressed by the Corps in its public notice. Due to potential adverse impacts to Federally-listed species (including seabeach amaranth, red knot, piping plover, and the Kemp's ridley, leatherback, green, and loggerhead sea turtles and loggerhead Critical Habitat), the Service agrees that formal consultation will be required for this project. Therefore, this letter primarily addresses comments concerning the project itself and the DEIS. We look forward to reviewing the Biological Assessment and working with your office during the consultation process.

Of the five sea turtle species, the leatherback, loggerhead, Kemp's ridley, and green sea turtle may nest in the project area. On July 10, 2014, the Service designated Critical Habitat for the Northwest Atlantic Ocean distinct population segment (DPS) of the loggerhead sea turtle. The project area is within Critical Habitat Unit LOGG-T-NC-08 on Holden Beach. This unit consists of 13.4 km (8.3 mi) of island shoreline along the Atlantic Ocean and extends from Lockwoods Folly Inlet to Shallotte Inlet.

Piping plover Critical Habitat Unit NC-16 is located in Lockwoods Folly Inlet and on Oak Island, east of the proposed project. The entire unit is privately owned. This unit extends from the end of West Beach Drive, west to [Mean Low Low Water] (MLLW) at Lockwood Folly Inlet, including emergent sandbars south and adjacent to the island. This unit includes land from MLLW on the Atlantic Ocean across to MLLW adjacent to the Eastern Channel and the Intracoastal Waterway.

On December 11, 2014, the Service listed the rufa red knot (or red knot) as threatened throughout its range. The rule became effective on January 12, 2015. Please refer to 79 FR 73706 for more information on the listing of the red knot.

Because of the potential to adversely affect nesting female sea turtles, nests, and hatchlings on the beach, piping plovers, red knots, and seabeach amaranth within the proposed project area, the Service recommends that the project, as proposed in the applicant's preferred alternative, not be authorized.

Potential effects to sea turtles include disorientation of hatchling turtles on beaches adjacent to the construction area as they emerge from the nest and crawl to the water as a result of lighting or presence of the groin, and behavior modification of nesting females during the nesting season resulting in false crawls or situations where they choose marginal or unsuitable nesting areas to deposit eggs due to escarpment formation or presence of the groin within the action area. The presence of the groin could affect the movement of sand by altering the natural coastal processes and could affect the ability of female turtles to nest, the suitability of the nest incubation environment, and the ability of hatchlings to emerge from the nest and crawl to the ocean. The presence of the groin may create a physical obstacle to nesting sea turtles, and the proposed groin is anticipated to result in decreased nesting and loss of nests that do get laid within the project area for all subsequent nesting seasons following the completion of the proposed project.

Potential effects to piping plover and red knots include degradation and loss of habitat, particularly down-drift of the structure. Groins can act as barriers to longshore sand transport and cause downdrift erosion (Hayes and Michel 2008), which prevents optimal habitat creation by limiting sediment deposition and accretion. It appears from the information in the DEIS that the presence of the groin is likely to cause erosion on both sides of the groin, as the east is downdrift of local sand movement, while the area to the west of the groin is downdrift of regional sand transport. The proposed action has the potential to adversely affect wintering and migrating red knots, wintering and migrating piping plovers and their habitat from all breeding populations, and breeding piping plovers from the Atlantic Coast breeding population that may use the project area. Potential effects to piping plovers and red knots include direct loss of foraging and roosting habitat in the Action Area and in the updrift and downdrift portions of the project area, degradation of foraging habitat and destruction of the prey base from sand disposal, and attraction of predators due to food waste from increased use of the area during and following construction. Plovers and red knots face predation by avian and mammalian predators that are present year-round on the wintering and nesting grounds. Although the piping plover is not currently known to nest in the Action Area, the stabilization of the shoreline may also result in less suitable nesting habitat for all shorebirds, including the piping plover.

Structural development along the shoreline and manipulation of natural inlets upset the naturally dynamic coastal processes and result in loss or degradation of beach habitat (Melvin et al. 1991). As beaches narrow, the reduced habitat can directly lower the diversity and abundance of biota, especially in the upper intertidal zone. Shorebirds may be impacted both by reduced habitat area for roosting and foraging, and by declining intertidal prey resources (Defeo et al. 2009; Dugan and Hubbard 2006). Shorebird habitat has been, and may continue to be, lost where hard structures have been built (Clark in Farrell and Martin 1997). In addition to directly eliminating red knot habitat, hard structures interfere with the creation of new shorebird habitats by interrupting the natural processes of overwash and inlet formation. Where hard stabilization is installed, the eventual loss of the beach and its associated habitats is virtually assured (Rice 2009), absent beach nourishment, which may also impact piping plover and red knots. Where they are maintained, hard structures are likely to significantly increase the amount of piping plover and red knot habitat lost as sea levels continue to rise.

Potential impacts to seabeach amaranth 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 Applicant proposes to place sand between November 15 and March 31 of any given year. However, given favorable weather, seabeach amaranth plants may persist until January. Therefore, there is still the potential for sand placement to adversely impact plants in the Action Area. Indirect impacts to seabeach amaranth include degradation of habitat from stabilization of the shoreline.

General Comments

1. <u>Alternatives Analysis</u>

In multiple places throughout the DEIS and Appendices, a strong net transport of sand from east to west is identified as a significant erosion factor. Appendix C of the DEIS, the Draft Inlet Management Plan (DIMP), states on Page D-11 that in a regional net transport sense, Holden

Beach (to the west) is downdrift of the proposed terminal groin, while locally, the inlet throat (and therefore, inlet shoulder) is downdrift of any groin placed along the inlet margin. Appendix D, the Holden Beach Master Plan, states "a starvation of sand along the eastern portion of the island ... has caused an 'erosional wave' propagating west. Net transport has been estimated to be approximately 228,000 cy/year to the west" (page 3-1). Appendix E, the 2011 Terminal Groin Work Plan, states "OCTI (2008) estimates ... a net transport of approximately 250,000 cy/year to the west" (page 5-5). Appendix F, the August 2013 Engineering and Modeling Report for the East End Shore Protection Project (page 4-2), states that "westward net sand transport has been documented, although seasonal switches under spring/summer southwest wind/wave conditions are common." Appendix F (Page 7-19), also states that the "groin alternatives decreased local sediment in the nearshore on eastern Holden Beach, while regional transport [to the west] remained unaffected." In other words, it appears that the groin is not expected to improve erosion due to regional (westward) transport of sand, which is a significant contributor to erosion in the project area.

The Service is concerned that according to the modeling that has been conducted and several other studies over the years, the groin can be expected to cause accelerated erosion east of the groin, and may not significantly improve erosion in the project area to the west of the groin.

Chapter 5 of the DEIS includes a comparison of Alternative 2 (Abandon and Retreat) with the five other alternatives. Relative to Alternative 2, the five other alternatives reduce beach and dune loss by one to five acres over the four-year period that was modeled. There does not appear to be a very significant difference between the other five alternatives, except in the model results for beach width at year four. Alternative 4 actually appears to cause more erosion than Alternative 2. In addition, the preferred alternative (Alternative 6 – Intermediate Groin with Beach Nourishment) appears to result in more erosion and more impacts to properties at year four than Alternative 5 (Short Groin with Beach Nourishment).

On page 5-129 of Chapter 5, it appears that the model shows significant erosion in year four in all of the alternatives. The number of properties at risk at year four range from 10 or 11 (6 homes) (Alternative 5) to 28 (19 homes) (Alternative 2). It is interesting to note that the two nourishment-only alternatives (Alternatives 1 and 3) are anticipated to result in 19 properties at risk (13 with houses) at year four, while the preferred alternative (Alternative 6) results in 16 properties at risk (11 with houses) during the same interval. Modeling is not a precise science, and the Service is concerned that unknown factors and unpredictable coastal conditions may actually make the predicted differences between these alternatives moot.

Further, the Service is concerned that the "extended 4-year nourishment interval" discussed on page 5-129 in Chapter 5 for the preferred alternative may not accurately reflect the nourishment interval that may be required to prevent impacts to properties in the project area. Data is not provided to indicate that a four-year nourishment interval will be generally adequate. To the contrary, model results and Figures 5.1 through 5.9 appear to indicate that nourishment will be required much more often, perhaps on the same interval as the current nourishment regime (every two or three years). Chapter 5 of the DEIS should clarify the significant differences between the alternatives and provide data (if possible) to show that the four-year nourishment interval proposed for the groin alternatives will be protective of infrastructure and properties in the project area.

2. Economic Costs and Benefits

Section 5 and Appendix M discuss costs and benefits of the six alternatives. According to the DEIS, there appear to be 28 properties (19 of those with improvements), and approximately 800 linear feet of utilities and infrastructure at risk in the project area. The combined value of these properties and infrastructure is between $5,000,000 and $6,000,000. The tax value from these properties to the Town of Holden Beach is not provided. The present value of the cost of construction (Page 5-156) of the preferred alternative is between $15,240,000 and $23,430,000. Total cost of the preferred alternative is $34,410,000.

There is no discussion in the DEIS of empty lots and relocation options under Alternative 2 (Abandon and Retreat). Appendix F (August 2013 Engineering and Modeling Report for the East End Shore Protection Project) appears to dismiss Alternative 2 without a substantial amount of detail, based on an assumption that it does not meet the purpose and needs of the project. However, since this Alternative is the basis for comparison for the other five alternatives, all aspects of an abandon and relocate program should be investigated. The Service also notes that the Appendix cites a study in Delaware to support the statement that abandonment and relocation of homes is much more costly than nourishment and other alternatives. However, there are no details provided for the Delaware study. This project area includes 28 properties, (19 of which are improved), and approximately 800 lf of utilities. It is unclear whether the Delaware study included a similar small number of improved properties and relatively short amount of infrastructure.

Appendix F states that there is "not enough comparable oceanfront or waterfront properties available to receive all of the threatened structures." However, no data is provided on how many empty lots remain on Holden Beach. There are only 19 structures, and not all of them are currently threatened. Chapter 4.8 of the DEIS indicates that 265 acres (18% of the island) is currently vacant land. The DEIS should provide data to support the statements in Appendix F concerning the availability of lots for relocation.

3. Sea Level Rise and Nourishment Intervals

A nourishment schedule of four years is proposed for the preferred alternative. However, it appears from the DEIS that at the end of four years, erosion is expected to impact 16 properties (11 buildings) and 130 lf of utilities (for the preferred alternative). Erosion does not happen in a controlled, even fashion, but often as a result of storm events. The Service is concerned that a four-year nourishment schedule will not be adequate, and that, regardless of the presence of a groin, a two- or three-year nourishment schedule will be needed to prevent impacts to infrastructure and properties. The Service would be concerned with the acceleration of nourishment schedules based upon increased storm surge or sea level rise, or other factors.

4. For Alternatives 1, 3, 4, 5, and 6, the description should include the length of beach that is proposed for nourishment. Currently, Alternative 3 appears to be the only one with a clear statement of the length of beach proposed for nourishment.

5. Chapter 5, page 5-44: Please note that the red knot was listed on December 11, 2014 as threatened throughout its range.

6. Chapter 5, page 5-62: Please note that Critical Habitat was designated on July 10, 2014 for the Northwest Atlantic DPS of the loggerhead sea turtle.

7. Chapter 5, all alternatives: please indicate whether sandbags are anticipated to remain in front of properties, or whether the sandbags will be removed.

8. Chapter 6, page 6-2 indicates that the initial nourishment includes the construction of a sand fillet. However, the figures in Chapter 5 do not appear to show a sand fillet in the groin alternatives.

9. The Service appreciates the Town's involvement in the shorebird monitoring for the Eastern Channel project. We note that with respect to this proposed project, the Service will examine the adequacy of that effort during formal consultation and determine whether additional monitoring should be required.

Summary of Service Recommendations

Based upon our concerns outlined above for potential impacts to our trust resources, at this time the Service recommends denial of the Corps permit for the project as proposed. In particular, the Service is concerned that according to the modeling and several other studies, the groin can be expected to cause accelerated erosion east of the groin, and may not significantly improve erosion in the project area to the west of the groin. We look forward to working with the Corps and the applicant to address our concerns. Thank you for the opportunity to comment on this project. We look forward to working with you. If you have any questions or comments, please contact Kathy Matthews at 919-856-4520, x27.

Sincerely yours,

Tom Augspurger

for Pete Benjamin
Field Supervisor
Raleigh Ecological Services Office

cc: Fritz Rohde, NMFS, Beaufort, NC
Maria Dunn, NCWRC, Washington, NC
Doug Huggett, NCDCM, Morehead City, NC
Dan Holliman, USEPA
Todd Bowers, USEPA

References:

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 4
ATLANTA FEDERAL CENTER
61 FORSYTH STREET
ATLANTA, GEORGIA 30303-8960

October 13, 2015

Mr. Scott McLendon
Chief, Wilmington Regulatory Division
Department of the Army
Wilmington District, US Army Corps of Engineers
69 Darlington Avenue
Wilmington, NC 28403

Subject: **Draft Environmental Impact Statement (DEIS) for Holden Beach East End Shore Protection Project, Holden Beach, NC; CEQ Number: 20150243; ERP Number: COE-E30047-NC; CEQ Federal Register Date: 08/28/2015**

Dear Mr. McLendon:

Pursuant to Section 309 of the Clean Air Act and Section 102(2)(C) of the National Environmental Policy Act (NEPA), the EPA Region 4 Office has reviewed the Draft Environmental Impact Statement (DEIS) for the Holden Beach Shoreline Protection Project. This DEIS features an evaluation of the environmental consequences of a proposed protection project of the barrier island of Holden Beach which is eight miles long. The EPA notes that Holden Beach Island is located west of the Cape Fear River and has an east-west orientation, facing Long Bay and the open Atlantic Ocean to the south, and separated from mainland Brunswick County to the north by tidal marshes and the Atlantic Intracoastal Waterway (AIWW). Holden Beach is located along the eastern portion of Brunswick County. The island was incorporated in 1969 and has a current year-round resident population of approximately 575, with a seasonal population of over 10,000. The Town of Holden Beach is seeking Federal and state permits to allow for the construction of a 30-year shoreline protection project that would serve to mitigate chronic erosion experienced along the eastern portion on the Town's oceanfront shoreline. The purpose of the project is to protect and secure public infrastructure, roads, homes, businesses, beaches, recreational assets, and its protective dunes.

Previously, a temporary terminal groin field was constructed in the 1970s along the East End of Holden Beach due to extreme erosion. Although the groin field was successful and economical, the temporary nature of the nylon material and the lack of ongoing sand nourishment activities limited its long-term effectiveness. According to the DEIS, the Town sponsored projects have collectively placed 825,900 cubic yards (cy) of beach compatible material on the oceanfront shoreline, primarily to the east of station 110+00. The Town has not implemented any beach fill projects on the East End but instead has relied on United States Army Corps of Engineers' (USACE) navigation maintenance dredging projects for East End sand placement.

The EPA notes that the DEIS appropriately includes a section on "purpose and need" for the Proposed Action and that is to establish a comprehensive shoreline protection program. Furthermore, the program is to be under the independent authority of the Town of Holden Beach which will restore and maintain the East End beach and provide for the short- and long-term protection of residential structures, Town infrastructure, and recreational assets. The Proposed Action is needed to mitigate ongoing and chronic East End shoreline erosion which is projected to continue for the foreseeable future and that it threatens residential structures, Town infrastructure, recreational assets, and natural resources. Based upon our review of the DEIS, we have provided detailed comments in an attachment to this letter (See Attachment A).

Based upon the EPA's review, a NEPA rating of EC- 2 has been assigned to this DEIS, meaning that we have environmental concerns and have requested that the FEIS include updated information (where available) on a number of environmental issues. The DEIS did not provide a full analysis of potential Greenhouse gas (GHG) emissions and climate change effects. The EPA also has environmental concerns for water quality impacts that may result from the proposed project. If you have any questions, please contact Mr. Larry Gissentanna of my staff at gissentanna.larry@epa.gov or (404) 562-8248.

Sincerely,

Christopher A. Militscher
Chief, NEPA Program Office
Resource Conservation and Restoration Division

Attachment: Detailed comments

Attachment A – Detailed Comments
Holden Beach East End Shore Protection Project, Holden Beach, NC
Draft Environmental Impact Statement
CEQ Number: 20150243

The EPA also notes that the DEIS appropriately considers detailed alternatives for responding to the on-going erosion along Holden's Beach East End shore. The DEIS includes detailed discussions of each alternative, how each was formulated, and the costs of implementation. An economic impact assessment on the existing island development and infrastructure is also included in the DEIS (Section 3). As requested by the EPA for similar coastal erosion projects studied by the COE, both "no action" and "abandon/retreat" were considered in the DEIS among the detailed alternatives:

- Alternative 1 - No Action
- Alternative 2 - Abandon/Retreat
- Alternative 3 - Beach Nourishment
- Alternative 4 - Inlet Management and Beach Nourishment
- Alternative 5 - Short Terminal Groin and Beach Nourishment
- Alternative 6 - Intermediate Terminal Groin and Beach Nourishment

The DEIS reports that development of the recommended channel modifications and inlet management plan for Rich Inlet involved a screening process utilizing "Delft3D" computer model simulations ("runs") in which various designs for Nixon Channel, Green Channel, and the main entrance channel were evaluated. The results of all screening runs are included in the DEIS (Appendix B), as well as the morphologic conditions/history of Rich Inlet developed by Dr. William Cleary of the University of North Carolina at Wilmington, which are included with the DEIS (Sub-Appendix A in Appendix B).

The Preferred Alternative 6 (Alternative 6 – Intermediate Terminal Groin with Beach Nourishment) has been identified in the DEIS as the "Applicant's Preferred Alternative," and this alternative features a "terminal groin" with beach fill (from other sources).

The terminal groin in 5B would have the same design as that described for Alternative 5A, as would the beach fill plan proposed along Nixon Channel. Analysis of the Delft3D model results for Alternative 5A indicated the initial beach fill was excessive, particularly along the segment of the beach south of station 80+00. The DEIS reports that beach fill design associated with Alternative 5A was based upon the "optimal utilization of the material removed to construct the new channel connector" from the inlet gorge into Nixon Channel, and not on the beach fill volume needed to offset shoreline erosion. Since Alternative 5B does not include the excavation of a new connector channel into Nixon Channel, the beach fill for 5B was designed to address only erosion protection needs.

In addition to appropriately including information on "purpose and need" and including a detailed alternatives analysis, the EPA also notes that the DEIS complies with NEPA by including a chapter on the "affected environment" and identifying existing resources which occur in the project area. Further, the DEIS also includes a chapter on environmental consequences and evaluates the project alternatives and discusses the anticipated changes to the existing environment including "direct, indirect, and cumulative effects." Finally, the DEIS appropriately includes a chapter on avoidance and minimization, and describes several actions and measures incorporated to avoid or minimize adverse effects to resources. The EPA offers the following additional comments on the DEIS for your consideration:

The DEIS did not include any analysis or information pertaining to the Council on Environmental Quality's (CEQ's) final draft guidance on Greenhouse Gas (GHG) Emission sand Climate Change Impacts. (See: https://www.whitehouse.gov/administration/eop/ceq/initiatives/nepa/ghg-guidance).

The USACE did not provide a discussion as to why this guidance is not applicable to the proposed project. The FEIS should provide an assessment of potential GHG emissions and what contribution to climate change may be anticipated from the proposed project, as appropriate. Section 7 Reference within the DEIS should include reference to the Council on Environmental Quality (CEQ) December 2014 revised draft guidance on climate change and greenhouse gases. Because the NEPA process includes an assessment of potential water quality impacts pursuant to Section 401 of the Clean Water Act, the EPA recommends the USACE to continue to coordinate with the North Carolina Division of Water Resources (DWR) and seek a DWR Section 401 water quality certification. The EPA has environmental concerns for potential impacts to water quality during the project implementation. Further, the EPA recommends that the USACE also to continue to coordinate with the North Carolina Division of Coastal Management (DCM) to ensure the full compliance with all State Environmental Policy Act (SEPA) requirements and to determine consistency with the Coastal Zone Management Act (CZMA). The EPA recommends that the FEIS document all of these efforts at coordination and include in the appendices all relevant and required certifications. The FEIS should provide for final requirements for avoidance and minimization and include any environmental commitments being made by the project sponsor (i.e., The Town of Holden Beach).

United States Department of the Interior

OFFICE OF THE SECRETARY
Office of Environmental Policy and Compliance
Richard B. Russell Federal Building
75 Ted Turner Drive, S.W., Suite 1144
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ER 15/0475
9043.1

October 7, 2015

Mrs. Emily Hughes
Wilmington District Regulatory Division
U. S. Army Corps of Engineers
69 Darlington Ave.
Wilmington, NC 28403 -1343
Attn: File Number SAW-2011-0194

Re: Comments on the Draft Environmental Impact Statement, Department of Defense, Department of the Army, Corps of Engineers, Installation of a Terminal Groin Structure at the Eastern End of Holden Beach

Dear Mrs. Hughes:

The U.S. Department of the Interior (Department) has reviewed the Draft Environmental Impact Statement (DEIS), Department of Defense, Department of the Army, Corps of Engineers, Installation of a Terminal Groin Structure at the Eastern End of Holden Beach, extending into the Atlantic Ocean, west of Lockwood Folly Inlet located in Brunswick County, North Carolina. We have no comments at this time.

Thank you for the opportunity to comment on this project. I can be reached via email at joyce_stanley@ios.doi.gov or on (404) 331-4524.

Sincerely,

Joyce Stanley, MPA
Regional Environmental Protection Specialist

cc:
Christine Willis – FWS
Gary Lecain – USGS
Anita Barnett – NPS
Robin Ferguson – OSMRE
Chester McGhee – BIA
OEPC – WASH

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
263 13th Avenue South
St. Petersburg, Florida 33701-5505
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F/SER31:KBD

Scott C. McLendon
Chief, Regulatory Division
Wilmington District Corps of Engineers
Department of the Army
69 Darlington Avenue
Wilmington, North Carolina 28403-1343

AUG 3 0 2016

Dear Mr. McLendon:

This letter responds to your request for consultation with us, the National Marine Fisheries Service (NMFS), pursuant to Section 7 of the Endangered Species Act (ESA) for the following action.

Permit Number	Applicant	SER Number	Project Type
SAW-2011-01914	Town of Holden Beach, North Carolina	SER-2016-17731	Terminal groin construction and beach nourishment

Consultation History
We received your letter and Biological Assessment (BA) requesting consultation on January 27, 2016. We received a revised BA on February 10, 2016, and initiated consultation that day

Project Location

Address	Latitude/Longitude	Water body
Holden Beach Island, Brunswick County, North Carolina	33.9146°N, 78.2439°W (North American Datum 1983)	Lockwoods Folly Inlet, Atlantic Ocean

Existing Site Conditions
The project area includes the east end of Holden Beach Island, Lockwoods Folly Inlet, and the Central Reach offshore borrow site that is located 1.8 -3 miles offshore. The purpose of the proposed project is to implement a shore protection project to provide protection to residential structures, infrastructure, and recreational assets. It consists of a 30-year beach nourishment plan and construction of a terminal groin. Chronic erosion has contributed to dune breaching and flooding along the east end of the island and the loss of approximately 27 oceanfront properties since 1993. Sediments in the project area generally consist of sands, silts, and clays occurring in various mixtures. No seagrasses or corals are present.

Figure 1. Holden Beach Island and Lockwoods Folly Inlet project area ((©2016 GoogleEarth)

Project Description

The project includes the construction of a terminal groin perpendicular to the shore at the east end of Holden Beach Island, nourishment of the beach using sand from dredging the Atlantic Intracoastal Waterway (AIWW) at the Lockwoods Folly Inlet or obtaining sand from the Central Reach offshore borrow site, and renourishment every 4 years during a 30-year period. The Central Reach offshore borrow site is not the preferred source of sand due to the high cost of mobilizing an ocean-certified dredge. The purpose of the project is to mitigate chronic erosion on the east end of Holden beach that threatens residences, infrastructure, and recreational assets. The construction of the groin and beach nourishment are designed to address tidal current-induced shoreline changes associated with the continuous ebb channel alignment.

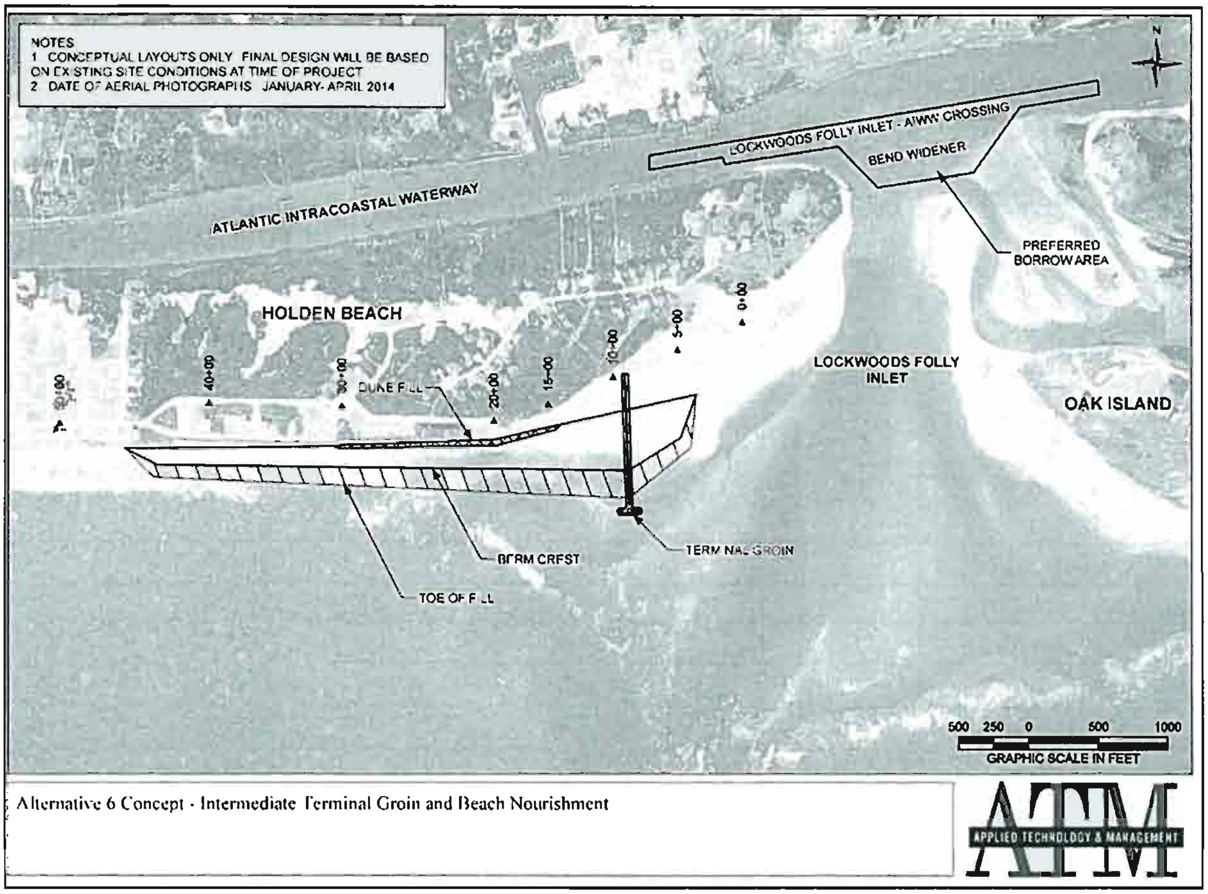


Figure 2. Proposed groin construction and nourishment area (ATM 2016)

The groin would be 1,000 feet (ft) long and would have a 120-ft-long terminal end in the ocean. It would consist of a 700-ft-long segment extending seaward and a 300-ft anchor segment extending landward from the toe of the primary dune. The 700 ft segment would be constructed of rock rubble and would have a crest width of approximately 5 ft and a geo-textile base layer with a width of approximately 40-45 ft. The groin would be composed of loosely placed armor stone on top of a foundation mat or mattress with a crest elevation of +5 ft NAVD. The 4-5 ft diameter armor stone would facilitate the movement of littoral material through the structure while the relative low crest elevation would allow some sediment to pass over the structure during periods of high tide. The groin would be constructed entirely from shore.

The beach nourishment would consist of the placement of 100,000 to 150,000 cubic yards (cy) of sand every 4 years along approximately 0.75 mile of shoreline. The nourishment sand would be dredged from the AIWW where it crosses Lockwoods Folly Inlet or from within the Lockwoods Folly Inlet navigation channel or possibly would be excavated from the existing Central Reach offshore borrow. A cutterhead dredge would be used to excavate the sand required for the nourishment. The sand would be transported to the beachfront via a submerged pipeline. Hopper dredges would be used if the sand is excavated from the Central Reach offshore borrow site.

Construction activities would occur between November 16 and April 30, which is outside of sea turtle nesting season. If a hopper dredge is used, it would conform to a November 16 – March 31 construction window. Construction may be performed on a 24-hour basis. Groin construction and placement of sand is expected to take 4-6 months. Maintenance of the nourishment area is expected to occur on 4-year intervals and would take approximately 12 weeks to accomplish.

Table 1. Action Agency's and NMFS's Effects Determinations[1]

Species	ESA Listing Status	Action Agency Effect Determination	NMFS Effect Determination
Green sea turtle (North and South Atlantic distinct population segment [DPS]) [2]	T	NLAA	NLAA
Kemp's ridley sea turtle	E	NLAA	NLAA
Leatherback sea turtle	E	NLAA	NLAA
Loggerhead sea turtle[3]	T	NLAA	NLAA
Hawksbill sea turtle	E	NLAA	NE
Shortnose sturgeon	E	NLAA	NLAA
Atlantic sturgeon [4]	E	NLAA	NLAA
North Atlantic right whale	E	NLAA	NLAA
Humpback whale	E	NLAA	NLAA

We believe the project will have no effect on hawksbill due to the species' very specific life history strategies, which are not supported at the project site. Hawksbill sea turtles typically inhabit inshore reef and hard bottom areas where they forage primarily on encrusting sponges. There have been no reports of hawksbill sea turtles nesting in the project area.

Critical Habitats

The project is located within Northwest Atlantic loggerhead sea turtle distinct population segment (NWA DPS) LOGG-N-5.

The project is also located in critical habitat for North Atlantic right whale calving. The essential features of calving habitat include calm sea surface conditions, sea surface temperatures of 45-63°F, and water depths of 20-92 ft. The proposed dredging and nourishment would not affect any of these essential features; therefore, we believe the project will not affect the designated critical habitat.

[1] E = Endangered, T = Threatened, NLAA = Not Likely to Adversely Affect, NE = No Effect

[2] In April 2016, the range-wide and breeding population listings of the green sea turtle were removed, and replaced by listing 8 Distinct Population Segments (DPSs) as threatened and 3 DPSs as endangered (81 FR 20057)..

[3] Northwest Atlantic DPS

[4] Carolina DPS

Analysis of Potential Routes of Effects to Listed Species and Critical Habitat
Two species of whales (North Atlantic right and humpback) ,4 species of sea turtles (loggerhead, green, leatherback, and Kemp's ridley) and sturgeon (Atlantic and shortnose) may be found in or near the action area and may be affected by the project. We have identified the following potential adverse effects to these listed species and concluded they are not likely to be adversely affected by the proposed action for the reasons described below.

Whales
North Atlantic right and humpback whales are infrequent visitors to the action area, primarily occurring around the offshore Central Reach borrow site. The USACE has stated that offshore borrow site dredging contracts would incorporate standard conservation measures to minimize the risk of marine mammal collisions; including speed limits (≤10 knots) for dredges and support vessels, 24-hour presence (during active dredging and transit) of protected species observers with at-sea large whale identification experience, and compliance with federal regulations [50 CFR 224.103(c)] prohibiting the approach of any vessel within 500 yards of a right whale. Considering the proposed conservation measures and the limited extent of anticipated dredging at the Central Reach borrow site, it is expected that the risk of collisions would be negligible. Therefore, we believe the potential for encounters is discountable or not likely to occur.

Sea Turtles
Loggerhead, green, leatherback, and Kemp's ridley sea turtles have been sited near the project area and, with the exception of Kemp's ridleys, they are known to nest on Holden Beach. Sea turtles may be injured if they encounter the cutterhead dredging in the borrow area. However, we believe this adverse effect is discountable because these species are likely to move away from the dredging equipment and we expect them to exhibit avoidance behavior. NMFS has previously determined in existing biological opinions (i.e., the South Atlantic Regional Biological Opinion [SARBO] and the Gulf of Mexico Regional Biological Opinion) that non-hopper-type dredging activities, including hydraulic and mechanical-type dredges (including cutterhead and clamshell dredges), are not likely to adversely affect sea turtles, primarily because they are noisy and slow moving, enabling sea turtles to detect and avoid them, or affect only very small areas at one time. The implementation of the proposed dredging window and timing of the beach nourishment (November 16 to April 30, if using a cutterhead or November 16 to March 31, if using a hopper dredge) to avoid the presence of nesting sea turtles will further reduce the risk of encounters and will not occur during nesting season, which begins May 1. In addition, operation of any mechanical construction equipment will cease immediately if a sea turtle is seen within a 50-ft radius of the equipment. Activities will not resume until the protected species has departed the project area of its own volition. Nourishment sand will be transported to the project site via pipeline placed in the upland area. Because the movements of the cutterhead dredge will be limited to the spatially constrained inshore dredging, a dredging window will be implemented, and sand placement on the beach will be via a submerged pipeline, we believe the potential for encounters with sea turtles is discountable or not likely to occur.

Because the proposed project may use a hopper dredge, any sea turtle take associated with the proposed dredging activities would be authorized under the SARBO. Therefore, take by dredging from the Central Reach offshore borrow site will not be analyzed further in this letter. The applicant will comply with all of the measures detailed in the reasonable and prudent measures (RPMs), and terms and conditions, of the SARBO where they are applicable. These measures include, but are not limited to (1) stranding reports, (2) hardbottom buffer zones, and (3) dredge lighting. Additionally, the applicants will comply with any terms and conditions/RPMs that may be put forth in a revised SARBO Biological Opinion.

The construction of the terminal groin will occur concurrent with the nourishment activities and the act of placing material within open water may adversely affect sea turtles; however, construction will be spatially confined and temporary. We believe that sea turtles will be able to avoid the construction area around the terminal groin. In addition, the project area occurs within a segment of North Carolina's shoreline that is experiencing severe erosion with historically low numbers of nest sites relative to other areas with more stable beach areas. Therefore we believe that the likelihood of sea turtles being affected by the proposed groin construction is insignificant.

Sturgeon

Shortnose sturgeon were thought to be extirpated from North Carolina waters until an individual was captured in the Brunswick River in 1987. Subsequent gillnet studies (1989-1993) resulted in the capture of 5 shortnose sturgeon, confirming the presence of a small population in the lower Cape Fear River. Based on its restriction primarily to the portions of rivers above the freshwater-saltwater interface, its occurrence within the project area (i.e., Lockwoods Folly Inlet and within the Atlantic Ocean) is considered extremely unlikely; therefore, likely effects to this species are discountable.

We believe that Atlantic sturgeon may be affected by the dredging in Lockwoods Folly Inlet or the Central Reach borrow area. Atlantic sturgeon may be encountered as they pass through the inlet while leaving or returning to the nearshore ocean waters or while migrating offshore. Adults spend the majority of their lives migrating up and down the coast in nearshore marine waters, only returning to their natal rivers to spawn. Atlantic sturgeon found in the project area are most likely a part of the Carolina Distinct Population Segment (DPS). The Carolina DPS includes all Atlantic sturgeon that are spawned in the watersheds (including all rivers and tributaries) from the Albemarle Sound southward along the southern Virginia, North Carolina, and South Carolina coastal areas to Charleston Harbor. Rivers known to have current spawning populations within the range of the Carolina DPS include the Roanoke, Tar-Pamlico, Cape Fear, Waccamaw, and Yadkin-Pee Dee River. Dredging can impact important habitat features of Atlantic sturgeon as they disturb benthic fauna and alter bottom habitat; however, dredging will be conducted in an area that is highly dynamic and receives constant disturbance of bottom habitat from storm events and strong currents. Because the nearshore areas around Lockwoods Folly Inlet offer an abundance of habitat that will not be affected by the project and is probably more suitable for foraging or resting, we believe the dredging effects associated with the project will be insignificant. Although dredges have been known to impact sturgeon, the proposed inshore dredging is to be performed with a slow-moving cutterhead dredge. NMFS believes that the impacts of this project are minimal given the mobility of the species and its ability to avoid encounters with the dredge. If hopper dredging is conducted at the offshore Central Reach borrow site, it is possible that adult Atlantic sturgeon could be impacted by the dredging; however, it is unlikely that the offshore Central Reach borrow site will be used as Lockwoods Folly Inlet is the preferred location for excavating nourishment sand. In addition, analysis of historical take of ESA-listed species along the South Atlantic Coast indicates that the risk of hopper dredge entrainment is primarily confined to dredging within entrance channels and not borrow areas.

We have also identified the following potential route of effects from physical impacts from construction of the terminal groin to sturgeon and concluded they are not likely to be adversely affected by the proposed construction. Since sturgeon are highly mobile, they can avoid the area of disturbance. Furthermore, the construction equipment will be traveling by land and not be in the water. Therefore, we have determined that the potential impacts associated with the proposed dredging and construction of the terminal groin will be insignificant.

Critical Habitat for Loggerhead NWA DPS
The proposed dredging and groin construction will occur within critical nearshore reproductive habitat for the loggerhead sea turtle (LOGG-N-5), which extends one mile from mean high water (MHW). Nearshore reproductive habitat includes habitat for the hatchling swim frenzy and for females during the inter-nesting period from the shoreline (MHW seaward 1 mile). This nearshore zone is a vulnerable, pivotal transitional habitat area for hatchling transit to open waters, and for nesting females to transit back and forth between open waters and nesting beaches during their multiple nesting attempts throughout the nesting season. The habitat characteristics of this nearshore zone are important in female nest site selection and successful repeat nesting. In addition to nesting beach suitability and proximity to nearshore oceanic currents needed for hatchling transport, habitat suitable for transit between the beach and open waters by the adult female turtle is necessary. Nesting females typically favor beach approaches with few obstructions or physical impediments such as reefs or shallow water rocks, which may make the entrance to nearshore waters more difficult or even injure the female as she attempts to reach the surf zone.

The three physical and biological features essential to loggerhead conservation in this critical habitat unit and their current condition in the project area are described below. The first is nearshore waters directly off the highest density nesting beaches as identified in 78 FR 18000 (March 25, 2013) to 1 mile offshore are essential components to conservation. The project area beach is currently severely eroded and has a history of being an erosional hot spot. It also not located near the highest density nesting beaches, so this action would not affect the nearshore waters in that area, therefore there is no effect to the essential feature. The second is waters that are sufficiently free of obstructions or artificial lighting to allow transit through the surf zone and outward toward open water are essential features to promote loggerhead survival. The dredging would be taking place within Lockwoods Folly Inlet or offshore at the Central Reach borrow site and not in the surf zone or in open water in front of nesting beaches, so there would be no obstructions to the open water from dredging. The terminal groin would be constructed perpendicular to the beach and would not present obstruction toward open waters. The third is waters with minimal manmade structures that could promote predators (i.e., nearshore predator concentration caused by submerged and emergent offshore structures), disrupt wave patterns necessary for orientation, and/or create excessive longshore currents. The construction of the terminal groin could impact sea turtle critical habitat. Yet, the proposed groin is designed as a low-crested, semi-permeable (i.e., "leaky") structure designed to permit seawater and animals to flow over the top and through the structure. It also will allow the longshore transport of sand to occur in a normal manner, so it should not disrupt wave patterns or create excessive longshore currents. It is possible that the groin could cause some predator concentration, but the majority of the rocks comprising the groin will be submerged too deep to accommodate resting seabirds that could prey on hatchlings. NMFS believes that the addition of the terminal groin will improve the condition of the nesting beach overall, and it will not cause a net increase in the likelihood of predator concentration, or cause wave patterns to be modified to the extent that it will disrupt orientation nor cause excessive longshore currents. Beach widening due to sand entrapment behind the terminal groin will result in increasing the amount of available turtle nesting habitat. Once the beach is stabilized and restored, we expect that nesting activity may increase in the project area. For these reasons, NMFS concludes that the effects of the proposed action on loggerhead sea turtle critical habitat are insignificant.

Conclusion

Because all potential project effects to listed species and critical habitat were found to be discountable, insignificant, or may be beneficial we conclude that the proposed action is not likely to adversely affect listed species under NMFS's purview. This concludes your consultation responsibilities under the ESA for species under NMFS's purview. Consultation must be reinitiated if a take occurs or new information reveals effects of the action not previously considered, or if the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat in a manner or to an extent not previously considered, or if a new species is listed or critical habitat designated that may be affected by the identified action. NMFS's findings on the project's potential effects are based on the project description in this response. Any changes to the proposed action may negate the findings of this consultation and may require reinitiation of consultation with NMFS.

We have enclosed additional relevant information for your review. We look forward to further cooperation with you on other projects to ensure the conservation of our threatened and endangered marine species and designated critical habitat. If you have any questions on this consultation, please contact Kay Davy, Consultation Biologist, at (727) 415-9271, or by e-mail at kay.davy@noaa.gov.

Sincerely,

Roy E. Crabtree, Ph.D.
Regional Administrator

Enc.: 1. *Sea Turtle and Smalltooth Sawfish Construction Conditions* (Revised March 23, 2006)
2. *PCTS Access and Additional Considerations for ESA Section 7 Consultations* (Revised March 10, 2015)

File: 1514-22.F.1

SEA TURTLE AND SMALLTOOTH SAWFISH CONSTRUCTION CONDITIONS

The permittee shall comply with the following protected species construction conditions:

a. The permittee shall instruct all personnel associated with the project of the potential presence of these species and the need to avoid collisions with sea turtles and smalltooth sawfish. All construction personnel are responsible for observing water-related activities for the presence of these species.

b. The permittee shall advise all construction personnel that there are civil and criminal penalties for harming, harassing, or killing sea turtles or smalltooth sawfish, which are protected under the Endangered Species Act of 1973.

c. Siltation barriers shall be made of material in which a sea turtle or smalltooth sawfish cannot become entangled, be properly secured, and be regularly monitored to avoid protected species entrapment. Barriers may not block sea turtle or smalltooth sawfish entry to or exit from designated critical habitat without prior agreement from the National Marine Fisheries Service's Protected Resources Division, St. Petersburg, Florida.

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

e. If a sea turtle or smalltooth sawfish is seen within 100 yards of the active daily construction/dredging operation or vessel movement, all appropriate precautions shall be implemented to ensure its protection. These precautions shall include cessation of operation of any moving equipment closer than 50 feet of a sea turtle or smalltooth sawfish. Operation of any mechanical construction equipment shall cease immediately if a sea turtle or smalltooth sawfish is seen within a 50-ft radius of the equipment. Activities may not resume until the protected species has departed the project area of its own volition.

f. Any collision with and/or injury to a sea turtle or smalltooth sawfish shall be reported immediately to the National Marine Fisheries Service's Protected Resources Division (727-824-5312) and the local authorized sea turtle stranding/rescue organization.

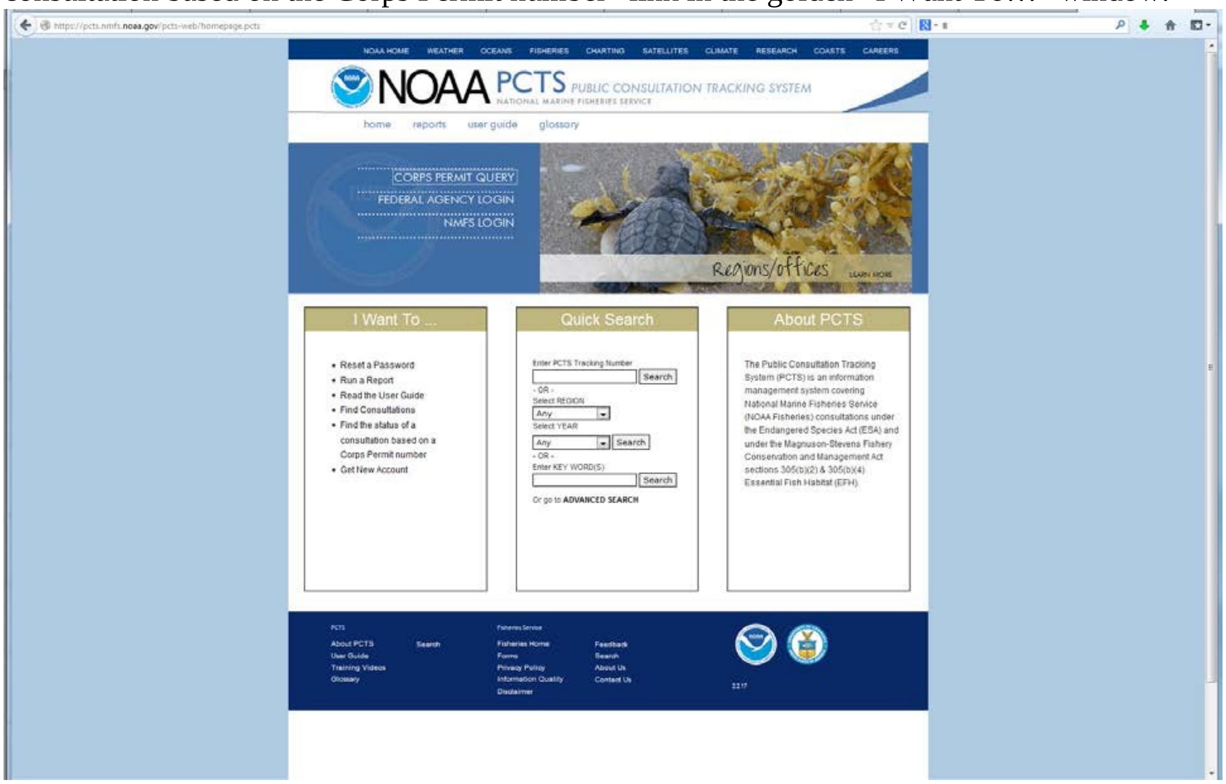
g. Any special construction conditions, required of your specific project, outside these general conditions, if applicable, will be addressed in the primary consultation.

Revised: March 23, 2006

PCTS Access and Additional Considerations for ESA Section 7 Consultations (Revised 03-10-2015)

Public Consultation Tracking System (PCTS) Guidance: PCTS is a Web-based query system at **https://pcts.nmfs.noaa.gov/** that allows all federal agencies (e.g., U.S. Army Corps of Engineers - USACE), project managers, permit applicants, consultants, and the general public to find the current status of NMFS's Endangered Species Act (ESA) and Essential Fish Habitat (EFH) consultations which are being conducted (or have been completed) pursuant to ESA Section 7 and the Magnuson-Stevens Fishery Conservation and Management Act's (MSA) Sections 305(b)2 and 305(b)(4). Basic information including access to documents is available to all.

The PCTS Home Page is shown below. For USACE-permitted projects, the easiest and quickest way to look up a project's status, or review completed ESA/EFH consultations, is to click on either the "Corps Permit Query" link (top left); or, below it, click the "Find the status of a consultation based on the Corps Permit number" link in the golden "I Want To…" window.



Then, from the "Corps District Office" list pick the appropriate USACE district. In the "Corps Permit #" box, type in the 9-digit USACE permit number identifier, with no hyphens or letters. Simply enter the year and the permit number, joined together, using preceding zeros if necessary after the year to obtain the necessary 9-digit (no more, no less) number. For example, the USACE Jacksonville District's issued permit number SAJ-2013-0235 (LP-CMW) must be typed in as 201300235 for PCTS to run a proper search and provide complete and accurate results. For querying permit applications submitted for ESA/EFH consultation by other USACE districts, the procedure is the same. For example, an inquiry on Mobile District's permit MVN201301412 is entered as 201301412 after selecting the Mobile District from the "Corps District Office" list. PCTS questions should be directed to Kelly Shotts at Kelly.Shotts@noaa.gov or (727) 551-5603.

EFH Recommendations: In addition to its protected species/critical habitat consultation requirements with NMFS' Protected Resources Division pursuant to Section 7 of the ESA, prior to proceeding with the proposed action the action agency must also consult with NMFS' Habitat Conservation Division (HCD) pursuant to the MSA requirements for EFH consultation (16 U.S.C. 1855 (b)(2) and 50 CFR 600.905-.930, subpart K). The action agency should also ensure that the applicant understands the ESA and EFH processes; that ESA and EFH consultations are separate, distinct, and guided by different statutes, goals, and time lines for responding to the action agency; and that the action agency will (and the applicant may) receive separate consultation correspondence on NMFS letterhead from HCD regarding their concerns and/or finalizing EFH consultation.

Marine Mammal Protection Act (MMPA) Recommendations: The ESA Section 7 process does not authorize incidental takes of listed or non-listed marine mammals. If such takes may occur an incidental take authorization under MMPA Section 101 (a)(5) is necessary. Please contact NMFS' Permits, Conservation, and Education Division at (301) 713-2322 for more information regarding MMPA permitting procedures.

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Southeast Regional Office
263 13th Avenue South
St. Petersburg, Florida 33701-5505
http://sero.nmfs.noaa.gov

July 29, 2016 F/SER47:KR/pw

(Sent via Electronic Mail)

Colonel Kevin P. Landers Sr., Commander
U.S. Army Corps of Engineers Wilmington District
69 Darlington Avenue
Wilmington, North Carolina 28403-1398

Attention: Kyle Dale

Dear Colonel Landers:

NOAA's National Marine Fisheries Service (NMFS) has reviewed the letter dated June 27, 2016, and the accompanying *Draft Essential Fish Habitat (EFH) Assessment* dated June 2016, pertaining to the *Environmental Impact Statement*, *Holden Beach East End Shoreline Protection Project, Town of Holden Beach, North Carolina* (EFH Assessment) dated June 2016 for Action ID No. SAW-2011-01914. The Town of Holden Beach proposes beach nourishment and installation of a terminal groin with associated fill template to increase beach and shoreline protection in the interest of hurricane protection, storm damage reduction, beach erosion control, and protection of public-trust natural resources for shorelines at the east end of Holden Beach adjacent to Lockwoods Folly Inlet in Brunswick County. In the EFH Assessment, the Wilmington District has made separate affects determinations for each federally managed fishery species in the project area as well as each EFH in the project area. As the nation's federal trustee for the conservation and management of marine, estuarine, and diadromous fishery resources, the NMFS provides the following comments pursuant to authorities of the Fish and Wildlife Coordination Act and the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act).

Description of the Proposed Project
The Town of Holden Beach has experienced chronic oceanfront shoreline erosion over the past 70 years resulting in the loss of waterfront homes and town infrastructure. Erosion rates along the island's easternmost two-mile reach bordering Lockwoods Folly Inlet are among the highest in the state, ranging from three to eight feet per year. Long-term erosion is linked to changes in the orientation and position of the ebb and flood channels through the inlet. Chronic and episodic erosion are also correlated with natural processes of littoral sediment transport, storm related recession, and sea level rise. The Town has been monitoring the shoreline over the past 15 years and estimates net transport of sediment to be 228,000 cubic yards per year to the west. Over the years, the Town has reduced erosion by placing sand on the beach, re-contouring the beach to form protective berms and dunes, and installing temporary sandbags or geotextile groins. These shoreline management strategies have not been successful in providing the long-term shoreline protection sought by the Town.

As waterfront residential structures and properties are continually threatened by a high rate of erosion, the Town seeks to provide protection to existing development and ensure continued use of oceanfront beaches and estuarine shorelines. The Town plans to construct a terminal groin 700 feet in length with a 300-foot shore anchorage section. The groin will include a 120-foot-long T-Head segment centered on the seaward terminus of the main stem. The rubble mound component of the groin will have a crest width of about five feet and a 40-foot base width, and the groin will be constructed using large five-foot diameter granite stones. The Town expects the design of the groin to allow littoral transport of sand over, around, and through the structure by leaving large voids between the rocks. In addition to construction of the groin, the Town will nourish approximately 3,700 feet of shoreline adjacent to the groin with material excavated from the previously permitted borrow area within Lockwoods Folly Inlet Crossing navigation channel and, if needed, from the Central Reach offshore borrow site. To achieve the management objectives, dredging of Lockwoods Folly Inlet and nourishment activities are expected to occur every four years over a 30-year period.

Consultation History
On March 26, 2012, the NMFS provided the Wilmington District with comments on plans to develop the Holden Beach East End Shore Protection Project Environmental Impact Statement (EIS). The NMFS recommended the Wilmington District prepare a formal EFH Assessment for the project separate from the EIS.

Comments of EFH Assessment
The EFH Assessment reviews anticipated environmental impacts within the proposed 1,655-acre project area. The authors describe with depth, detail, and scientific support direct and indirect effects expected to occur within the estuarine and coastal habitats of the project area. Further, the authors provide detailed review of EFH for managed species that occur within the project area and habitats designated by the State of North Carolina as Primary Nursery Area. An effects determination is provided for each habitat type and for each managed fishery species. The focal habitats in the EFH Assessment are the marine water column, shallow sand bottoms, and live/hardbottom habitats. The EFH Assessment also includes descriptions of downstream and far-field impacts to estuarine emergent wetlands, oyster reefs and shell banks, and submerged aquatic vegetation (SAV).

Generalized environmental impacts are expected to be temporary in nature and of short duration (days) following construction and maintenance activities. Impacts from dredging and nourishment activities include an increase in the turbidity and total suspended solids from sediments, silt, and organic materials. High concentrations of suspended solids for extended durations can impair biological productivity and ecological function by clogging fish gills, affecting recruitment of fish and invertebrates (crustaceans and invertebrates), and suppressing growth of SAV and shellfish (e.g., oysters, clams, scallops). Activities such as beach nourishment typically have more severe impacts that take longer periods of time (months and years) for ecological recovery. Ocean beach and estuarine shorelines can be extraordinarily dynamic and resilient ecosystems. These ecosystems are often able to recover quickly despite experiencing extreme disturbance events from storms and hurricanes. Nourishment activities that bury infaunal communities results in direct mortality of many forage species. These infaunal species provide important trophic linkages coupling benthic-pelagic ecosystems. Many of the organisms that utilize these habitats also provide trophic linkages between inshore and offshore populations.

The NMFS previously recommended the EIS and EFH Assessment include characterizations of nursery habitat and larval fish transport associated with Lockwoods Folly Inlet and the barrier island complex that includes Holden Beach and Oak Island. The NMFS appreciates the EFH Assessment recognizing inlets serve as migratory corridors for larvae entering nursery areas and for sub-adults leaving nursery areas for maturation and spawning offshore. The NMFS agrees with the recommendation that environmental windows (seasonal restrictions) be used for timing of any in-water construction and maintenance activities to protect fish during sensitive life stages. The EFH Assessment states the construction, dredging, and maintenance schedule would include a work moratorium for May 1 through November 15 to minimize environmental impacts and provide protections for seasonal migrations of fish and protected species (i.e., sturgeon, sea turtles). Dredging would occur from November 16 through March 31, and groin construction and associated sand placement would occur from November 16 through April 30.

The NMFS believes the EFH Assessment includes a significant improvement in EFH conservation measures over those included in the Draft EIS dated August 2015. Most notably is the description of the construction practices including dredge selection, engineering for terminal groin structure, sediment compatibility for beach nourishment, water quality controls, and habitat mapping. These descriptions complement the environmental modeling, cumulative impact analysis, and sediment transport and shoreline models in the Draft EIS. The NMFS believes the effects determinations, environmental windows, monitoring schedule, and habitat mapping included in the EFH Assessment will significantly improve the Holden Beach East End Shoreline Protection Project. These decision-making tools address opportunities for practicable avoidance and minimization of impacts to EFH and provide measures for adaptive management.

Based on the information provided, the NMFS has no EFH conservation recommendations for the project. The NMFS may provide EFH conservation recommendations in the future based on new information or changes in the project design that show adverse impacts would occur to EFH or federally-managed fishery species.

Thank you for the opportunity to provide these comments on the EFH Assessment, and the NMFS looks forward to further cooperation with this project that is so important for North Carolina. Please direct related questions or comments to the attention of Dr. Ken Riley at our Beaufort Field Office, 101 Pivers Island Road, Beaufort, North Carolina 28516-9722, or at (252) 728-8750.

Sincerely,

Pace Wilber

/ for

Virginia M. Fay
Assistant Regional Administrator
Habitat Conservation Division

cc: COE, Kyle.J.Dahl@usace.army.mil
USFWS, Pete_Benjamin@usfws.gov
NCDCM, Doug.Huggett@ncmail.net
NCDCM, Gregg.Bodnar@ncdenr.gov
EPA, Bowers.Todd@epa.gov
SAFMC, Roger.Pugliese@safmc.net
F/SER4, David.Dale@noaa.gov
F/SER47, Ken.Riley@noaa.gov

North Carolina
Department of Administration

Pat McCrory, Governor Bill Daughtridge, Jr., Secretary

October 7, 2015

Ms. Emily Hughes
Department of the Army
U.S. Army Corps of Engineers
Wilmington District
69 Darlington Avenue
Wilmington, NC 28403

Re: SCH File #16-E-0000-0070; DEIS; Proposed project is for the construction of a terminal groin and supplemental beach nourishment project at the east end of Holden Beach, to the west of the Lockwood Folly Inlet.

Dear Ms. Hughes:

The above referenced environmental impact information has been submitted to the State Clearinghouse under the provisions of the National Environmental Policy Act. According to G.S. 113A-10, when a state agency is required to prepare an environmental document under the provisions of federal law, the environmental document meets the provisions of the State Environmental Policy Act. Attached to this letter for your consideration are the comments made by agencies in the course of this review.

If any further environmental review documents are prepared for this project, they should be forwarded to this office for intergovernmental review.

Should you have any questions, please do not hesitate to call.

Sincerely,

Teresa Matthews

Teresa Matthews
State Environmental Review Clearinghouse

Attachments

Cc: Region O

Mailing Address:
1301 Mail Service Center
Raleigh, NC 27699-1301

Telephone: (919)807-2425
Fax (919)733-9571
State Courier #51-01-00
e-mail state.clearinghouse@doa.nc.gov

Location Address:
116 West Jones Street
Raleigh, North Carolina

North Carolina Department of Environmental Quality

Pat McCrory
Governor

Donald R. van der Vaart
Secretary

MEMORANDUM

TO: Department of Administration
State Clearinghouse

FROM: Lyn Hardison
Division of Environmental Assistance and Customer Service
Permit Assistance & Project Review Coordinator

RE: 16-0070
Draft Environmental Impact Statement
Proposed project is for the construction of a terminal groin and supplement beach nourishment project at the east end of Holden Beach, to the west of the Lockwood Folly Inlet - Brunswick County

Date: October 1, 2015

The Department of Environmental Quality has reviewed the proposal for the referenced project. The comments are attached for the applicant review.

The Department appreciates the cooperative efforts and open communication the applicant has with our agencies and we encourage these efforts to continue as they move forward with the project.

Thank you for the opportunity to respond.

Attachment

NCDENR
North Carolina Department of Environment and Natural Resources

Pat McCrory
Governor

Donald R. van der Vaart
Secretary

MEMORANDUM September 11th, 2015

TO: Lyn Hardison
Environmental Assistance and SEPA Coordinator

FROM: Andrew Haines
Environmental Program Supervisor

THROUGH: Patti Fowler
Shellfish Sanitation & Recreational Water Quality Section Chief

SUBJECT: Draft EIS- Holden Beach East End Terminal Groin and Beach Nourishment
US Army Corps #16-0070

The proposed project includes a dredging and beach nourishment window of November 16 - April 30. The placement of dredged materials along a swimming beach has the potential to cause a localized increase in bacteria concentrations within the waters surrounding the project. Thus, the placement of these dredged materials along the beach any time after March 31st may necessitate that a swimming advisory be issued, notifying the public of the risks associated with swimming in the area. In conjunction with this swimming advisory, notification signs will be placed throughout the project area. Swimming advisories can be avoided by scheduling these types of projects between November 1st and March 31st of a given year, which falls outside of the swimming season.

State of North Carolina
Department of Environment and Natural Resources
INTERGOVERNMENTAL REVIEW - PROJECT COMMENTS

Reviewing Office: WIRO

Project Number 16-0070 Due Date: 9/28/2015
County Brunswick

After review of this project it has been determined that the ENR permit(s) and/or approvals indicated may need to be obtained in order for this project to comply with North Carolina Law. Questions regarding these permits should be addressed to the Regional Office indicated on the reverse of the form. All applications, information and guidelines relative to these plans and permits are available from the same Regional Office.

	PERMITS	SPECIAL APPLICATION PROCEDURES or REQUIREMENTS	Normal Process Time (statutory time limit)
☐	Permit to construct & operate wastewater treatment facilities, sewer system extensions & sewer systems not discharging into state surface waters.	Application 90 days before begin construction or award of construction contracts. On-site inspection. Post-application technical conference usual.	30 days (90 days)
☐	NPDES - permit to discharge into surface water and/or permit to operate and construct wastewater facilities discharging into state surface waters.	Application 180 days before begin activity. On-site inspection. Pre-application conference usual. Additionally, obtain permit to construct wastewater treatment facility-granted after NPDES. Reply time, 30 days after receipt of plans or issue of NPDES permit-whichever is later.	90-120 days (N/A)
☐	Water Use Permit	Pre-application technical conference usually necessary	30 days (N/A)
☐	Well Construction Permit	Complete application must be received and permit issued prior to the installation of a well.	7 days (15 days)
☐	Dredge and Fill Permit	Application copy must be served on each adjacent riparian property owner. On-site inspection. Pre-application conference usual. Filling may require Easement to Fill from N.C. Department of Administration and Federal Dredge and Fill Permit.	55 days (90 days)
☐	Permit to construct & operate Air Pollution Abatement facilities and/or Emission Sources as per 15 A NCAC (2Q.0100 thru 2Q.0300)	Application must be submitted and permit received prior to construction and operation of the source. If a permit is required in an area without local zoning, then there are additional requirements and timelines (2Q.0113).	90 days
☐	Permit to construct & operate Transportation Facility as per 15 A NCAC (2D.0800, 2Q.0601)	Application must be submitted at least 90 days prior to construction or modification of the source.	90 days
☐	Any open burning associated with subject proposal must be in compliance with 15 A NCAC 2D.1900	N/A	60 days (90 days)
☐	Demolition or renovations of structures containing asbestos material must be in compliance with 15 A NCAC 20.1110 (a) (1) which requires notification and removal prior to demolition. Contact Asbestos Control Group 919-707-5950.		
☐	Complex Source Permit required under 15 A NCAC 2D.0800		
☐	The Sedimentation Pollution Control Act of 1973 must be properly addressed for any land disturbing activity. An erosion & sedimentation control plan will be required if one or more acres to be disturbed. Plan filed with proper Regional Office (Land Quality Section) At least 30 days before beginning activity. A fee of $65 for the first acre or any part of an acre. An express review option is available with additional fees.		20 days (30 days)
☐	Sedimentation and erosion control must be addressed in accordance with NCDOT's approved program. Particular attention should be given to design and installation of appropriate perimeter sediment trapping devices as well as stable stormwater conveyances and outlets.		(30 days)
☐	Mining Permit	On-site inspection usual. Surety bond filed with ENR Bond amount varies with type mine and number of acres of affected land. Any are mined greater than one acre must be permitted. The appropriate bond must be received before the permit can be issued.	30 days (60 days)
☐	North Carolina Burning permit	On-site inspection by N.C. Division Forest Resources if permit exceeds 4 days	1 day (N/A)
☐	Special Ground Clearance Burning Permit - 22 counties in coastal N.C. with organic soils	On-site inspection by N.C. Division Forest Resources required "if more than five acres of ground clearing activities are involved. Inspections should be requested at least ten days before actual burn is planned."	1 day (N/A)
☐	Oil Refining Facilities	N/A	90-120 days (N/A)
☐	Dam Safety Permit	If permit required, application 60 days before begin construction. Applicant must hire N.C. qualified engineer to: prepare plans, inspect construction, certify construction is according to ENR approved plans. May also require permit under mosquito control program. And a 404 permit from Corps of Engineers. An inspection of site is necessary to verify Hazard Classification. A minimum fee of $200.00 must accompany the application. An additional processing fee based on a percentage or the total project cost will be required upon completion.	30 days (60 days)

Project Number: 16-0070 Due Date: 9/28/2015			Normal Process Time (statutory time limit)
	PERMITS	SPECIAL APPLICATION PROCEDURES or REQUIREMENTS	
☐	Permit to drill exploratory oil or gas well	File surety bond of $5,000 with ENR running to State of NC conditional that any well opened by drill operator shall, upon abandonment, be plugged according to ENR rules and regulations.	10 days N/A
☐	Geophysical Exploration Permit	Application filed with ENR at least 10 days prior to issue of permit. Application by letter. No standard application form.	10 days N/A
☐	State Lakes Construction Permit	Application fee based on structure size is charged. Must include descriptions & drawings of structure & proof of ownership of riparian property.	15-20 days N/A
☐	401 Water Quality Certification	N/A	60 days (130 days)
☐	CAMA Permit for MAJOR development	$250.00 fee must accompany application	55 days (150 days)
☐	CAMA Permit for MINOR development	$50.00 fee must accompany application	22 days (25 days)
☐	Several geodetic monuments are located in or near the project area. If any monument needs to be moved or destroyed, please notify: N.C. Geodetic Survey, Box 27687 Raleigh, NC 27611		
☐	Abandonment of any wells, if required must be in accordance with Title 15A. Subchapter 2C.0100.		
☐	Notification of the proper regional office is requested if "orphan" underground storage tanks (USTS) are discovered during any excavation operation.		
☐	Compliance with 15A NCAC 2H 1000 (Coastal Stormwater Rules) is required.		45 days (N/A)
☐	Tar Pamlico or Neuse Riparian Buffer Rules required.		
☐	Plans and specifications for the construction, expansion, or alteration of a public water system must be approved by the Division of Water Resources/Public Water Supply Section prior to the award of a contract or the initiation of construction as per 15A NCAC 18C .0300 et. seq. Plans and specifications should be submitted to 1634 Mail Service Center, Raleigh, North Carolina 27699-1634. All public water supply systems must comply with state and federal drinking water monitoring requirements. For more information, contact the Public Water Supply Section, (919) 707-9100.		30 days
☐	If existing water lines will be relocated during the construction, plans for the water line relocation must be submitted to the Division of Water Resources/Public Water Supply Section at 1634 Mail Service Center, Raleigh, North Carolina 27699-1634. For more information, contact the Public Water Supply Section, (919) 707-9100.		30 days

Other comments (attach additional pages as necessary, being certain to cite comment authority)

Division	Initials	No comment	Comments	Date Review
DAQ	DAC	☒		9/15/15
DWR-WQROS (Aquifer & Surface)		☐		/ /
DWR-PWS	n/a	☐		/ /
DEMLR (LQ & SW)	des	☐	E&SC and Stormwater Permits are not necessary for work in the ocean. Any staging area > 1 acre landward of first vegetative line needs permits.	9/11/15
DWM - UST	n/a	☐		/ /

REGIONAL OFFICES

Questions regarding these permits should be addressed to the Regional Office marked below.

☐ **Asheville Regional Office**
2090 US Highway 70
Swannanoa, NC 28778
(828) 296-4500

☐ **Mooresville Regional Office**
610 East Center Avenue, Suite 301
Mooresville, NC 28115
(704) 663-1699

☒ **Wilmington Regional Office**
127 Cardinal Drive Extension
Wilmington, NC 28405
(910) 796-7215

☐ **Fayetteville Regional Office**
225 North Green Street, Suite 714
Fayetteville, NC 28301-5043
(910) 433-3300

☐ **Raleigh Regional Office**
3800 Barrett Drive, Suite 101
Raleigh, NC 27609
(919) 791-4200

☐ **Winston-Salem Regional Office**
585 Waughtown Street
Winston-Salem, NC 27107
(336) 771-5000

☐ **Washington Regional Office**
943 Washington Square Mall
Washington, NC 27889
(252) 946-6481

NORTH CAROLINA STATE CLEARINGHOUSE
DEPARTMENT OF ADMINISTRATION
INTERGOVERNMENTAL REVIEW

COUNTY: BRUNSWICK

H12: OTHER

STATE NUMBER: 16-E-0000-0070
DATE RECEIVED: 09/01/2015
AGENCY RESPONSE: 09/28/2015
REVIEW CLOSED: 10/01/2015

MS CAROLYN PENNY
CLEARINGHOUSE COORDINATOR
DPS - DIV OF EMERGENCY MANAGEMENT
FLOODPLAIN MANAGEMENT PROGRAM
MSC # 4218
RALEIGH NC

SEP 03 2015

REVIEW DISTRIBUTION

CAPE FEAR COG
DENR - COASTAL MGT
DENR LEGISLATIVE AFFAIRS
DEPT OF CULTURAL RESOURCES
DEPT OF TRANSPORTATION
DPS - DIV OF EMERGENCY MANAGEMENT

SEP 2015
RECEIVED
Secretary's Office
DOA

PROJECT INFORMATION

APPLICANT: Department of the Army
TYPE: National Environmental Policy Act
Draft Environmental Impact Statement

DESC: Proposed project is for the construction of a terminal groin and supplemental beach nourishment project at the east end of Holden Beach, to the west of the Lockwood Folly Inlet. - View documents at:
http://www.saw.usace.army.mil/Missions/RegulatoryPermitProgram/MajorProjects

The attached project has been submitted to the N. C. State Clearinghouse for intergovernmental review. Please review and submit your response by the above indicated date to 1301 Mail Service Center, Raleigh NC 27699-1301.

If additional review time is needed, please contact this office at (919)807-2425.

AS A RESULT OF THIS REVIEW THE FOLLOWING IS SUBMITTED: ☐ NO COMMENT ☒ COMMENTS ATTACHED

SIGNED BY: John D. Brubaker

DATE: 10 Sept 2015

North Carolina Department of Public Safety
Emergency Management

Pat McCrory, Governor
Frank L. Perry, Secretary

Michael A. Sprayberry, Director

September 10, 2015

State Clearinghouse
N.C. Department of Administration
1301 Mail Service Center
Raleigh, North Carolina 27699-1301

Subject: Intergovernmental Review State Number: 16-E-0000-0070
Holden Beach Terminal Groin and Supplemental Beach Nourishment

As requested by the North Carolina State Clearinghouse, the North Carolina Department of Public Safety Division of Emergency Management Risk Management reviewed the proposed project listed above and offers the following comment:

44 CFR 60.3.e prohibits man-made alteration of sand dunes and mangrove stands within Zones V1-30, VE, and V on the community's FIRM which would increase potential flood damage. Grading activity within one of these zones shall be accompanied by a hydraulic study to assure there will be no increase in flood damage potential.

Thank you for your cooperation and consideration. If you have any questions concerning the above comments, please contact Dan Brubaker, P.E., CFM, the NC NFIP Engineer at (919) 825-2300, by email at dan.brubaker@ncdps.gov or at the address shown on the footer of this document.

Sincerely,

John D. Brubaker

John D. Brubaker, P.E., CFM
NFIP Engineer
Risk Management

cc: John Dorman, Program Director
John Gerber, NFIP State Coordinator

Rhonda Wooten, Assistant Building Inspector, Holden Beach

File

Nastasha Earle

NORTH CAROLINA STATE CLEARINGHOUSE
DEPARTMENT OF ADMINISTRATION
INTERGOVERNMENTAL REVIEW

COUNTY: BRUNSWICK

H12: OTHER

STATE NUMBER: 16-E-0000-0070
DATE RECEIVED: 09/01/2015
AGENCY RESPONSE: 09/28/2015
REVIEW CLOSED: 10/01/2015

MS CARRIE ATKINSON
CLEARINGHOUSE COORDINATOR
DEPT OF TRANSPORTATION
STATEWIDE PLANNING - MSC #1554
RALEIGH NC

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DEPT OF CULTURAL RESOURCES
DEPT OF TRANSPORTATION
DPS - DIV OF EMERGENCY MANAGEMENT

SEP 2015

PROJECT INFORMATION

APPLICANT: Department of the Army

TYPE: National Environmental Policy Act
Draft Environmental Impact Statement

DESC: Proposed project is for the construction of a terminal groin and supplemental beach nourishment project at the east end of Holden Beach, to the west of the Lockwood Folly Inlet. - View documents at:
http://www.saw.usace.army.mil/Missions/RegulatoryPermitProgram/MajorProjects

The attached project has been submitted to the N. C. State Clearinghouse for intergovernmental review. Please review and submit your response by the above indicated date to 1301 Mail Service Center, Raleigh NC 27699-1301.

If additional review time is needed, please contact this office at (919)807-2425.

AS A RESULT OF THIS REVIEW THE FOLLOWING IS SUBMITTED: ☑ NO COMMENT ☐ COMMENTS ATTACHED

SIGNED BY: Natasha Earle-Young

DATE: 9/11/2015

SEP 2015
RECEIVED
Secretary's Office
DOA

August 31, 2015

DWQ Project # 15-0879
Brunswick County

Town of Holden Beach
Attn: Mr. David Hewett
110 Rothschild Street
Holden Beach, North Carolina 28462

Subject Property: **Holden Beach Terminal Groin**

REQUEST FOR MORE INFORMATION

Dear Mr. Hewett:

The Division of Water Resources (DWR) received a Public Notice issued by the US Army Corps of Engineers on August 28, 2015. An Individual 401 Water Quality Certification will be required for this project (SAW-2011-01914). Please note that the following must be received prior to issuance of a 401 Water Quality Certification.

Additional Information Requested:

1. The 401 Certification cannot be processed until four (4) complete sets of the application and associated maps are received at the DWR Central Office in Raleigh along with the appropriate fee either from the applicant directly or through the North Carolina Coastal Zone Management Program.

Until the information requested in this letter is provided, I will request (by copy of this letter) that the Corps of Engineers place this project on hold. Also, this project will be placed on hold for our processing due to incomplete information (15A NCAC 2H .0507(a)).

Thank you for your attention. If you have any questions, please contact me at 919-807-6360 or karen.higgins@ncdenr.gov or Jennifer Burdette at (919) 807-6364 or jennifer.burdette@ncdenr.gov.

Sincerely,

Karen Higgins

Karen A. Higgins, Supervisor
401 & Buffers Permitting Unit

KAH/*jab*

cc: Dawn York, Dial Cordy & Associates, 201 N Front Street, Ste 601, Wilmington, NC 28401
USACE Wilmington Regulatory Field Office
DWR WiRO file
DWR 401 & Buffer Permitting Unit file

Filename: 150879TOHoldenBeachTerminalGroin(Brunswick)_Hold_ IP_NeedSets_Fee.docx

North Carolina Department of Environmental Quality

Pat McCrory
Governor

Donald R. van der Vaart
Secretary

October 16, 2015

U.S. Army Corps of Engineers – Wilmington District
c/o Emily Hughes, Project Manager
69 Darlington Avenue
Wilmington, NC 28403-1343

Dear Sirs:

The Division of Coastal Management (DCM) has completed our review of the Draft Environmental Impact Statement (DEIS) for the proposed Holden Beach terminal groin project located in Brunswick County, North Carolina. As you are aware, in 2011 the General Assembly of North Carolina enacted Senate Bill 110 (SB 110), which amended the Coastal Area Management Act (CAMA) to allow for the permitting of up to four terminal groins in North Carolina. SB 110 was further amended by Senate Bill 151 (SB 151) in 2013. For communities pursuing a terminal groin project, the amended SB 151 set out several specific requirements that must be met before a CAMA permit can be issued. DCM staff have therefore reviewed the DEIS in light of these requirements, as well as the laws of the CAMA and Dredge and Fill Act, and rules of the Coastal Resources Commission, and we provide the following comments for your consideration.

General Comments

- The Division found the cost estimates and other financial information presented throughout the document difficult to understand and compare between different alternatives. It is recommended that this issue be re-examined during the development of the Final EIS so that data presented can be properly analyzed over varying time periods and between various alternatives.

- Chapter 1.5 - The applicant may want to include the number and condition of structures that have been protected by temporary erosion control structures as a result of erosion.

- Chapter 2 - The applicant should clarify the project limits and sand sources for the Town's existing authorization to renourish the beach-front and the ACOE spoil disposal on the East End.

- Page 2.8 - The applicant should clarify that CAMA major permit #14-02 was recently modified to include an off-shore borrow area, although the Town has yet to utilize this sand source.

- Chapter 5 (5.2.1- Direct and Indirect Impact Analysis- Numerical Modeling) states *"some anthropogenic activities, such as AIWW navigation dredging, were purposely excluded from* *the modeling runs to minimize the potential for masking of project-induced changes."* It would seem that modeling should also be performed to include activities that can be assumed to be continuing as outside the scope of this project but potentially contributing to a cumulative effect on the project area. At a minimum, the potential for these cumulative impacts should be addressed in more detail.

- There are potential errors in some of the figure references. For example, Section 5.3 seems to have an error in a referenced figure. The final sentence in paragraph one refers to survey transects presented in Figure D-9. Figure D-9 shows post-Hurricane Hanna storm damage and not survey transects. Figure D-12 is not referenced in Appendix C. Page D-14 notes that figures D-10 and D-11 have a three survey moving average. D-11 and D-12 identify a moving average in their legends, D-10 does not.

- Figures D-10, D-12 and D-13 reference NGVD29 for elevation, whereas the majority of the DEIS references NAVD88 for elevation. We would question if there is a risk of potential errors if data are mixed in this way?

Inlet Management Plan

It does not appear that the Inlet Management Plan (IMP) contained in Section 6.4 and Appendix C is sufficient to satisfy 113A-115.1(f)(5), which requires the finding that "*The inlet management plan is adequate for purposes of monitoring the impacts of the proposed terminal groin and mitigating any adverse impacts identified as a result of the monitoring*." The following comments should be taken into consideration as the applicant revises the IMP in accordance with the requirements of 113A-115.1(f)(5).

- Appendix C, Subsection 1.0, references SB110 rather than SB151 (SL 2013-384). Please update this reference. This update should also be appied to any other references to SB110 in the document.

- Appendix C, Subsection 2.1, references the "*latest Town survey*" from April 2012 but should be updated to reflect the Town's most recent annual survey.

- Appendix C, Subsection 2.3, describes the beach profile and inlet monitoring schedule, and should specifically include a commitment to also monitor the Oak Island side of the inlet as part of their annual surveys.

- Appendix C, Subsection 2.4, states that *"at the end of 5 years, the applicant will coordinate with regulatory agencies to determine whether additional annual photographs are required"*. The Town should commit to continuing aerial photography for the entirety of the project horizon of the project, but should also acknowledge that future approval may be requested from the Division to shorten, modify, or terminate this monitoring.

- Appendix C, Subsection 2.6, states, *"the shoreline (typically the mean high water line) positions between consecutive surveys will be compared, plotted, and analyzed for mean and* *extreme changes."* More explanation should be given on how the shoreline change analysis would be performed, in which cases the mean high water line would not be used, and how every consistency in the analysis is ensured if other means are used.

- Appendix C, Subsection 3.2, states, *"a 1-year and 2-year post-construction sampling survey will also occur while additional surveys following the 2-year post-construction event may be required, depending on previous results"*. The Town should commit to continuing post-construction sampling for a period of greater than 2 years, unless approval from the Division is first obtained.

- Appendix C, Subsection 5.3 (Paragraph 1), references a depiction of the surveyed transects in Figure D-9, yet shows an image of an eroded dune post-Hurricane Hanna.

- Appendix C, Subsection 5.4 (Thresholds), does not adequately establish the baseline for assessing any adverse impacts due to the project and the thresholds for when the adverse impacts must be mitigated, as required by law in 113A-115.1(e)(5)(b). The baseline and thresholds should be established for both sides of the inlet and should be more comprehensive than applying a single trigger of a 53cy/ft/year loss at one point along the shoreline.

- Chapter 6 (page 6-7) of the DEIS addressing mitigative measures describes the formation of a technical advisory committee (TAC) to review the monitoring data and determine whether any adverse shoreline impacts should be attributed to the project and any appropriate mitigation measures. This proposal is absent from the Inlet Management Plan.

- DCM utilizes long-term shoreline change at a linear rate of feet/year. The applicant proposes a volumetric rate (cubic yards/foot/year) to take into account short-term change. The DCM rate for Station 10+00 is 7ft/year. The applicant proposes that the volumetric rate of 7 cy/ft/yr can be equated to the DCM shoreline change rate of 7ft/yr. More information on how these rates compare would be beneficial.

- Fourteen beach profiles were taken over 12 years as a baseline to determine mitigation thresholds. The small sample size was taken with varying intervals between events, from five months to two years. The analysis determined a standard deviation (SD) of 47.9 cy/ft/yr (Section 5.3) or 46.1 cy/ft/yr (Section 5.4). The SD calculation assumes normal distribution of the data, though no normality test(s) are discussed. Section 5.4 does develop a threshold of the volumetric baseline rate (7 cy/ft/yr) + SD (46.1 cy/ft/yr) > 53 cy/ft/yr erosion rate over three consecutive surveys, though without a normality test describing the data's distribution, it is difficult to determine if the SD is representative. Further information regarding the statistical analysis and how comparable the linear DCM erosion rate and how these rates compare would be beneficial.

- Appendix C outlines the biological monitoring and the development of thresholds that may trigger mitigation.

  Monitoring consists of sample cores, visual observations and sediment samples for three species and associated macroinvertebrates common to the intertidal and supratidal beach habitats. Cores will be sampled for coquina clams and mole crabs, visual observations will be made for ghost crabs, and sediment will be sampled for associated macroinvertebrates. The description of the data to be collected is difficult to interpret. It is recommended that individuals are identified to species, counted and size classed to show abundance and distribution. Ghost crab burrows will be visual counted and evidence of burrow activity will be recorded. It is recommended that the diameter of burrow holes be recorded as well to provide a metric for size distribution. There is no discussion on the methods to collect macroinvertebrate data. It is recommended that individuals be identified to a minimum of lowest taxonomic level possible and abundance recorded.

- There is no mention of larval transport monitoring. The characterization of fish composition and abundance within the project area, a compilation of relevant research regarding larval transport through inlets, especially inlets with hardened structures, and the development of larval transport monitoring methodology is recommended to identify the most highly utilized areas for larval transport and to describe effects of hardened structures on fish life history stages.

- Senate Bill 151 (Session Law 2013-384) requires that the applicant for a terminal groin project address certain financial obligations for the project, including long-term maintenance. In order to ensure that the required financial information is provided in an acceptable fashion, the financial costs associated with the requirements of Senate Bill 151 (Session Law 2013-384) should be included in the DEIS in as detailed a manner as is possible at this stage in the project development process. The Division would therefore request more detailed cost information in the Final EIS. Items of specific interest include:

    - Costs associated with any additional monitoring initiatives.

    - Cost associated with development and operations of the Technical Advisory Committee.

    - With regards to verification of the final financial assurance package, 113A-115.1(e)(6) requires that a financial assurance plan be verified either by the Secretary of the Department of Environmental Quality (DEQ) or by the Coastal Resources Commission (CRC). DCM and the Department have taken the position that the choice of verification pathway (DEQ Secretary or CRC) should fall to the discretion of the applicant. Therefore, as the financial assurance package becomes more detailed and refined, and the project moves closer to the permit application stage, the Division suggests a meeting between the Town and the Division to determine which of the two verification pathways are preferred by the Town.

    - Detailed cost estimates for the full removal of the terminal groin structure should be stated if it is determined that the structure is not functioning as intended, and groin modifications are deemed ineffective in minimizing or eliminating these negative impacts.

- The inclusion of the above-listed financial information into the cost analysis of the terminal groin portions of the alternatives section of the DEIS.

Fisheries-Related Impacts

Alternatives 1, 2, and 3 would be the least impactful to fisheries resources. Under alternative 4, which would utilize inlet management and beach nourishment as shoreline protection, dredging frequency is expected to be every two years. The applicant states that they believe there is no hard bottom within the outer channel footprint, though no surveys have been conducted beyond sediment deposit cores. If this alternative is pursued, it is recommended that a hard bottom survey be conducted to identify any potential hard bottom locations. Coordination with appropriate resource agencies should then be conducted to determine buffers around any hard bottom identified for borrow sites. Due to dredging occurring within the inlet and estuarine waters under alternative 4, it is recommended that a moratorium be implemented on in water work, to include dredging, from April 1st to September 30th. This moratorium reduces the negative effects on critical fish life history activities, to include spawning migrations and nursery functions.

Alternatives 5 and 6 both propose construction of terminal groins, with associated nourishment. Borrow sites include Lockwood Folly Inlet crossing, the bend widener, with Lockwood Folly Inlet and the Central Reach if needed. Dredging for nourishment would occur every four years. The primary fisheries concern with terminal groin projects are potential impacts to larval fish transport. The applicant utilized the Coastal Modeling System (CMS) developed by the USACE to predict the impact on larval transport. The CMS was developed to "predict long-term effects of the alternatives on coastal processes and morphology". The model looks at particle concentrations and change relative to the groin to simulate flow, sediment transport and morphological changes in response to local environmental conditions. There is concern that since the CMS model is designed for sediment transport and not larval transport, the conclusions stated within the DEIS may be unrepresentative of larval transport impacts. Sediment transport models commonly utilize passive transport mechanics based on metrics such as grain size and weight, and how they are effected by environmental processes. Larval transport includes active behavior such as diel migrations within the water column and other ontogenetic behaviors. Further description of the potential for CMS to accurately predict larval transport effects, including any scientific literature, is recommended to fully understand the potential impacts.

The DEIS does not provide an estimation of larval distribution within the proposed location's waterbody, Long Bay. References are instead made to Beaufort Inlet. Terminal groins have the potential to interfere with larval and juvenile passage from spawning grounds to estuarine nursery areas. Obstacles like terminal groins could block the passage of larvae into inlets and reduce recruitment success (Blanton et al. 1999; Churchill et al. 1997; Deaton et al. 2010; Kapolnai et al. 1996). Larval distribution can identify the most highly utilized areas and serve as baseline data to compare larval and juvenile fish monitoring after groin construction.

There is concern the use of hardened structures along high energy shorelines could accelerate erosion along neighboring stretches of the beach due to the alteration of longshore sediment transport. As an example the DEIS states the East End could experience an increase in rip current frequency. An increase in rip current frequency could accelerate erosion along the East End, requiring additional nourishment and altering the foraging grounds for many surf zone species.

As a general comment, throughout the DEIS the applicant references an environmental window of November 16th through April 30th for all operations. This window was chosen to account for beach nourishment and invertebrate recruitment periods, larval ingress and sea turtle and shore bird nesting seasons. Larval ingress in North Carolina is species dependent, but occurs on average throughout the spring. Entrainment of larvae through dredging operations is discussed in the DEIS and is usually mitigated through moratoria. Due to dredging occurring within the inlet and estuarine waters, DCM recommends a moratorium on in water work, to include dredging, from 1 April to 30 September. This moratorium reduces the negative effects on critical fish life history activities, to include spawning migrations and nursery functions. This moratorium is commonly requested by staff and is recommended here in place of the applicant's proposed environmental window.

In closing, the Division of Coastal Management appreciates the opportunity to comment on this project, and we look forward to further discussions on the issues raised in this letter. Please note that internal consistency throughout the document should be verified following any revisions made subject to the above comments. If you have any questions concerning any of these comments, please feel free to contact me at (252) 808-2808 ext. 212.

Sincerely,

Doug Huggett

Doug Huggett
Manager, Major Permits Section
N.C. Division of Coastal Management

Cc: Braxton Davis, DCM
Debbie Wilson, DCM
Holley Snider, DCM

Blanton, J. O., F.E. Werner, A. Kapolnai, B.O. Blanton, D. Knott, and E.L. Wenner. 1999. Wind-generated transport of fictitious passive larvae into shallow tidal estuaries. Fisheries Oceanography 8(2): 210-223. Bowen, M. L., and R. Dolan. 1985. The relationship of Emerita talpoida to beach characteristics. J. Coast. Res. 1: 151–163.

Churchill, J.H., J.O. Blanton, J.L. Hench, R.A. Luettich, Jr. and F.E. Werner. 1997. Flood tide circulation near Beaufort Inlet, North Carolina: Implications for Larval Recruitment. Estuaries. 22:1057-1070.

Deaton, A.S., W.S. Chappell, K. Hart, J. O'Neal, B. Boutin. 2010. North Carolina Coastal Habitat Protection Plan. North Carolina Department of Environment and Natural Resources. Division of Marine Fisheries, NC. 639 pp.

Kapolnai, A., R.E. Werner, and J.O. Blanton. 1996. Circulation, mixing, and exchange processes in the vicinity of tidal inlets. Journal of Geophysical Research 101(14): 253-268.

NORTH CAROLINA STATE CLEARINGHOUSE
DEPARTMENT OF ADMINISTRATION
INTERGOVERNMENTAL REVIEW

COUNTY: BRUNSWICK

H12: OTHER

STATE NUMBER: 16-E-0000-0070
DATE RECEIVED: 09/01/2015
AGENCY RESPONSE: 09/28/2015
REVIEW CLOSED: 10/01/2015

SEP 08 2015
HISTORIC PRESERVATION OFFICE

MS RENEE GLEDHILL-EARLEY
CLEARINGHOUSE COORDINATOR
DEPT OF CULTURAL RESOURCES
STATE HISTORIC PRESERVATION OFFICE
MSC 4617 - ARCHIVES BUILDING
RALEIGH NC

ER 12-0312

A-(NE) JCS/4ff 9-30-15

Due 9/28/15

REVIEW DISTRIBUTION

CAPE FEAR COG
DENR - COASTAL MGT
DENR LEGISLATIVE AFFAIRS
DEPT OF CULTURAL RESOURCES
DEPT OF TRANSPORTATION
DPS - DIV OF EMERGENCY MANAGEMENT

PROJECT INFORMATION

APPLICANT: Department of the Army
TYPE: National Environmental Policy Act
Draft Environmental Impact Statement

DESC: Proposed project is for the construction of a terminal groin and supplemental beach nourishment project at the east end of Holden Beach, to the west of the Lockwood Folly Inlet. - View documents at:
http://www.saw.usace.army.mil/Missions/RegulatoryPermitProgram/MajorProjects

The attached project has been submitted to the N. C. State Clearinghouse for intergovernmental review. Please review and submit your response by the above indicated date to 1301 Mail Service Center, Raleigh NC 27699-1301.

If additional review time is needed, please contact this office at (919)807-2425.

AS A RESULT OF THIS REVIEW THE FOLLOWING IS SUBMITTED: [X] NO COMMENT [ ] COMMENTS ATTACHED

SIGNED BY: Renee Gledhill-Earley

DATE: 10.8.15

SEP 09 2015

October 13, 2015

Via Electronic Mail
Ms. Emily Hughes
U.S. Army Corps of Engineers
69 Darlington Ave.
Wilmington, NC 28403
Emily.b.hughes@usace.army.mil

RE: SAW-2011-01914 Holden Beach East End Shore Protection Project

Dear Ms. Hughes:

Please accept the following comments on the proposed terminal groin project on Holden Beach on behalf of the N.C. Coastal Federation (federation). For the past 33 years the federation has been taking an active role in the protection of North Carolina's coastal water quality, habitat and public beach access. The federation actively supports the preservation and public use of our state's beautiful and productive beaches and inlets as public trust resources for everyone in North Carolina.

The U.S. Corps of Engineers (Corps) does not provide the public and decision-makers with a thorough and comparable analysis of reasonable alternatives, thus confining the public information to narrow, selective and targeted information that supports only the preferred alternative. The National Environmental Policy Act (NEPA) mandates that all alternatives be equally, rigorously evaluated, and that the Environmental Impact Statement (EIS) provides an objective analysis rather than a justification for already made decisions. The Corps does none.

1. Failure to Comply with NEPA

1.1. EIS fails to provide clear and concise information

40 CFR 1502.1. and 1502.2 (c) mandate that EIS be concise, clear and to the point, supported by evidence of analyses. The DEIS is overwhelmingly confusing because it provides data and analyses for different sets of alternatives modeled over different timelines, producing a number of different projections that are not relevant for the proposed project. The DEIS provides cost estimates that are disparately different throughout the document. Finally, the Corps' failure to provide clear information and enable public understanding of the proposed project is exemplified in its failure to disclose the baseline year it uses for the modeling simulations.

1.1.1. Failure to provide the baseline year used in the assessment and modeling of future shoreline changes

The Corps relies on modeling results to justify its choice of the preferred alternative. A range of modeling simulations, discussed further below, shows how the change in shoreline over a period of four years will drive the mean high water mark close to the structures on the east end of the island. Yet, nowhere in the document does the Corps identify the baseline year. Failure to provide this essential piece of information renders the entire document useless given that the reader cannot make any meaningful conclusions based upon the information presented in the document.

1.1.2. Failure to justify evaluation of a 30-year project over 4 years

The EIS states that "long term project performance was investigated using several suites of 4-year simulation runs under various alternatives."[1] This is an unacceptable time span for a project with a life of 30 years. It is clear that the 30-year project life is recognized because the DEIS provides cost and benefit analyses that are projected 30 years into the future, yet no simulations were run for this time span. Similarly, to allow for the equitable comparison and assessment, the Corps needs to model the effects and performance of the proposed project for a period of 30 years or at least use the same timeline it used for other terminal groin proposals. Alternatively, the Corps needs to provide a justification for using a 4-year period.

1.2. Failure to rigorously explore and objectively evaluate all alternatives

In describing the treatment of project alternatives as the heart of the EIS, 40 CFR 1502.14 requires agencies to: (1) rigorously explore and objectively evaluate all alternatives; (2) dedicate substantial treatment to each alternative to allow for evaluation of their comparative merits. The Corps fails to comply with both of these legal requirements.

To allow for the objective, equal and rigorous analysis of all the alternatives the Corps needs to establish objective and comparable set of baseline data, analyses and results for all alternatives. The Corps does none of this.

1.2.1. Contrasting and disparate cost analyses that prevent equitable comparison of alternatives are provided

The DEIS provides two completely different economic analyses that individually provide insufficient information and are at odds with each other. Further, the two analyses provide estimates for completely different sets of alternatives.

The cost assessment in the engineering report states that the cost table (Table 9-8) includes assessment of five alternatives, yet the table lists seven alternatives.[2] In addition, five of these seven alternatives are at odds with the six alternatives presented in the main DEIS document. Further, the DEIS states that this table is

[1] Appx. F, p. 7-16
[2] Appx. F, p. 9-21

based on a table 9-7.[3] Yet, in table 9-7 the DEIS only presents data for five alternatives omitting Alternative 1 and 2, failing to show how it arrived at an estimated 30-year cost for Alternative 2 of $121-166 million.[4] This same Alternative is estimated to cost $5.8 million in the main DEIS document.[5]

Finally the skewed financial analysis provided in the engineering report is demonstrated in the assessment of damages and losses due to the groin. The DEIS falsely states that these factors are not applicable to groins. Further, this analysis does not include the costs for long-term maintenance and monitoring of the groin, implementation of mitigation measures and eventual modification or removal of the groin, actions required by the GS §113A -115.1(e)(5).

The cost and benefit estimates provided in Chapter 5 of the document provide estimates for a different set of alternatives and factors and omit numeric estimates on reduction in tax base and transition costs, among others.

These two disparate and inconsistent, yet individually skewed and insufficient economic analyses illustrate the inadequacy of the DEIS document to provide meaningful and realistic data that would enable objective comparison of all alternatives.

1.2.2. Failure to provide comparable data

The DEIS provides a number of simulated conditions in the engineering report some of which are modeled for 190 days, some for one year, and some for four years, a period that the unjustifiably considered "long term". Yet, none of these conditions are consistently applied to all alternatives. The following is a list of all the simulation options provided in the engineering report, cited directly from the document:[6]

Set 1

Time period: June 2009 – December 2009
Modeling interval length: 190 days

- Baseline no action
- Short groin and 60,000 cy nourishment
- Long groin and 90,000 cy nourishment
- 60,000 cy nourishment
- 90,000 cy nourishment
- Short groin only
- Long groin only
- 1,310,000 cy central reach nourishment
- Outer channel relocation
- Short groin, 60,000 cy nourishment and outer channel relocation

[3] Appx. F, p. 9-18
[4] Appx. F, p. 9-21
[5] DEIS, p. 5-57
[6] Names of alternatives cited directly from the Appx. F

Set 2
Time period: 2004
Modeling interval length: 1 year

- No action
- Sg + Nr
- Sg+NR+INL+BRW

Set 3a
Time period: June 2009 – December 2009
Modeling interval length: 190 days
Location: Area 1&2

- 60,000 cy nourishment only
- Short groin only
- Groin and nourishment
- Channel relocation
- Central reach nourishment
- Groin nourishment channel relocation LWFIX borrow area

Set 3b
Time period: June 2009 – December 2009
Modeling interval length: 190 days
Location: Area 3&4

- 90,000 cy nourishment
- Long groin only
- Groin and nourishment
- Channel relocation
- Central reach nourishment

Set 4
Time period: Unknown
Baseline Bathymetry: 2004-2008
Modeling interval length: one year

- Short groin and 80,000 cy nourishment
- Short groin without a T head and 80,000 cy nourishment
- Short groin 80,000 cy nourishment, bend widener borrow area and outer channel relocation
- Dredged eastern channel
- Wide outer channel dredging and 120,000 cy nourishment

Set 5 - Long-term modeling
Time period: Unknown
Modeling interval length: 4 years

- No action
- Nourishment only
- Short groin and nourishment
- Long groin and nourishment
- Intermediate groin and nourishment

- Intermediate groin only
- Wide outer channel and nourishment

Set 6 - Long term shoreline change analysis
Time period: Unknown
Modeling interval length: 4 years
Modeling location: West, Middle and East Zone

- No action
- Nourishment only
- Short groin and nourishment
- Intermediate groin and nourishment
- Long groin and nourishment

Set 7 - current magnitudes to assess biological resources:
Time period: 2009
Modeling interval length: 190 days

- No action,
- Short groin/nourishment/LVFIX borrow area
- Long groin only

Different and unknown time periods and lengths of the simulations and the multitude of modeled alternatives without practical application prevent any meaningful comparison of the results and their application to the alternatives considered in the DEIS. This charade of simulated alternatives together with the disparate economic analyses epitomizes the futility of the modeling section.

2. Application of inadequate modeling tools for an inadequate time period

To support its choice for the preferred alternative, the Corps relies on two modeling tools – Coastal Modeling System (CMS), Wave-Watch, with Genesis-T as a backup. Both tools are limited in their delivery and cannot be relied on for determining the effects of engineered structures on future shoreline positions and sand volume changes. Basing decisions solely on the results of these tools is a dangerous exercise that puts at risk public trust belonging to the people of North Carolina.

The major limitation with the use of these models is the inability of the modeler to account for "unknown timing, intensity, direction and sequencing of coastal storms".[7] Another limitation of the models is that they usually rely on linear representations of non-linear processes affected by complex and interrelated variables of coastal processes, resulting in unrealistic predictions.

The Corps prevents any meaningful analysis and comparison of data given the disparate timelines of the data used in the analysis:

[7] Pilkey et.al 2013 p. 143

- CMS Modeling configuration uses topographic data from 2009 and a Lockwood Folly River survey from 2008
- CMS Bathymetry of 2009 is shown on an aerial map of 2008
- CMS Net sediment transport is shown for 2004
- SWAN model includes wave data from 1999-2011
- GENESIS-T uses a timeline from 2000-2011

2.1. Insufficient sensitivity analysis and model calibration

The Sensitivity Analysis that is used to determine model configuration was based on thirteen different model runs that were performed for a 2-week interval of an unknown time period. These runs included only seven parameters. Yet, scientists have identified up to forty-two relevant parameters in coastal analyses and modeling, nine of which are always important and seventeen sometimes important.[8]

Similarly, the calibration was performed to water levels and conditions from 2008. A total of ten gauges were deployed for sixteen days, yet the Corps relies on and presents data only from two gauges, one of which resulted in partially incomplete data because it was moved.

Basing its decision on this information, the Corps concludes that "the model results are in good agreement with measured data."[9] The Corps cannot in good faith make this determination. Even if the model run has a successful calibration and verification and agrees with the known event used to calibrate it, the model certainly cannot predict the future. In other words, the results obtained by that specific model run, calibrated and verified for certain conditions of a known period are only *one of hundreds of possible results*. One could obtain all possible future results if one knew not only the intensity and timing of future weather events, but also the sequence of those events, among many other factors. The model results, as presented in the DEIS give users a false sense of confidence and are in fact unreliable in accurately assessing the risk of extraordinary events such as hurricanes.

Finally, the DEIS presents data from current profile surveys and concludes there is a "good correlation between the modeled and measured".[10] However, the data were only collected for two days at three locations. In addition, the three Figures (7-10 – 7-12) only show agreement with regard to direction of the current but not its speed.

GENESIS-T applies even fewer parameters in its application. The DEIS states the model was run for 12 years, yet it shows results only for only year 6 and only for a select number of alternatives. GENESIS-T also shows the success of the current

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[8] Pilkey and Pilkey-Jarvis, 2007
[9] Appx. F, p 7-8
[10] Appx. F, p. 7-8

management strategy (Alternative 1) because it confirms the "overall accretional trend"[11] for most of the Holden Beach shoreline.

Furthermore, GENESIS-T assumes that wave-generated currents dominate longshore sediment transport. It ignores wind-dominated currents and tides that are common on the coast of North Carolina. Finally, as admitted by the Corps, this tool cannot model channel realignment. GENESIS has been critically reviewed as relying on poor assumptions and widespread use of smoothing averages (Young et al. 1995; Thieler et al. 2000). The Corps needs to reject the use of this tool in the DEIS because the tool cannot provide analysis for all the alternatives for the proposed project.

The models used to simulate the effects of the alternatives do not, and cannot, account for the dynamic nature of events of tides, currents, storms, and winds as well as of the order in which these occur. This issue is further compounded by the Corps' use of inadequate, incomplete and contrasting data when running simulations. The Corps needs to re-evaluate the modeling systems employed to compare alternatives, as well as the data used to calibrate and run simulations.

3. Failure to prove that the chosen preferred alternative is the most feasible

As discussed above, the DEIS provides two disparate sets of economic assessments. One is provided in the engineering report and the other in Chapter 5 of the DEIS. Neither of these two documents provides a sound economic analysis of the proposed project. In fact, they only support the notion that economically, the proposed project does not have any merit.

The economic analysis provided in Chapter 5 of the DEIS provides an insufficient cost and benefit analysis of the alternatives. Appendix F provides a completely different economic analysis. This analysis is based on an entirely different set of factors and provides cost estimates based on the costs of projects done in South Carolina.

Table 1 summarizes the cost of each Alternative as well as the number of structures and lots each is projected to protect at the end of four years, according to the DEIS.

[11] Appx .F, p. 7-71

Alternative	Total Cost* (millions)	# of Affected Properties (land only)	# of Affected Properties (structures only)	Total # of Affected Properties
1	$49.5	6	13	19
2	$5.8	9	19	28
3	$58.9	6	13	19
4	$58.7	6	13	19
5	$35.4	5	6	11
6	$36.6	5	11	16

Table 1: Costs and affected properties and structures for each alternative as presented in Chapter 5 of the DEIS
**Denotes sum of construction and maintenance, assessed tax value of affected parcels and infrastructure replacement costs as presented in Chapter 5 of the DEIS*

Table 2 shows comparison of Alternatives relative to Alternative 2. It stands that Alternative 6 would marginally protect only four structures and eight lots more than what would otherwise be affected under Alternative 2.

Alternative	Difference in Total Cost (millions)	# of Affected Properties (land only)	# of Affected Properties (structures only)	Total # of Affected Properties
1	$43.7	-3	-6	-9
2	n/a	n/a	n/a	n/a
3	$53.1	-3	-6	-9
4	$52.9	-3	-6	-9
5	$29.6	-4	-13	-17
6	$30.8	-4	-8	-12

Table 2: Costs and affected properties and structures relative to Alternative 2

The suggested protection would be marginal because as Figure 1 indicates, even if a groin is built, after four years the mean high water line mark (red line) would be in a similar location as it would be under Alternative 2 (Figure 2). Comparing these figures shows that the difference in position of the mean high water line between the two options is negligible.

Figure 1: Projected properties at risk and infrastructure impacts at year four end under Alternative 6[12]

Figure 2: Projected properties at risk and infrastructure impacts at year four end under Alternative 2[13]

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[12] DEIS, p. 5-157

[13] DEIS, p. 5-65

Given that exact locations and sizes of the properties "saved" under Alternative 6 were not identified in the DEIS it was not possible to determine their exact value. For comparison purposes using the assessed value of properties under Alternative 2 (28 properties are valued at $5.18 million[14]) renders that the approximate value of the 12 properties (4 land and 8 structure) that Alternative 6 could only marginally protect is $2.2 million.

In conclusion, the Corps maintains that the best alternative for the proposed project is to spend $30.8 million more in order to protect land and structures valued at $2.2 million. This is unacceptable.

Further relative comparison of alternatives indicates that it would take about $10 million more to implement alternatives 3 and 4 than it would to continue with the currently employed management strategy (Table 3). Yet all three alternatives would render the same number of affected properties – six lots and thirteen structures.

Alternative	Difference in Total Cost (millions)	# of Affected Properties (land only)	# of Affected Properties (structures only)	Total # of Affected Properties
1	n/a	n/a	n/a	n/a
3	$53.1	0	0	0
4	$52.9	0	0	0

Table 3: Comparison of costs and affected properties and structures of Alternatives 3 & 4 relative to Alternative 1.

The negligible difference among the projected modeled alternatives is also shown in the relative comparison of the preferred Alternative 6 and the strategies currently employed by the applicant (Alternative 1). This comparison indicates that the proposed preferred alternative would only marginally protect one property and two houses more than what the current strategies are doing.

Drawing from these relative comparisons it stands that the best and the most financially practicable alternative is for the applicant to allow the natural inlet process to occur and if necessary relocate existing structures. Alternatively, if the applicant is not ready to take this step, the next best solution for the Applicant is to continue with the current strategies explained under Alternative 1.

[14] DEIS, p. 5-67

4. Failure to comply with the federally required Section 7 of the Endangered Species Act

The DEIS fails to fulfill the basic legal requirements to provide a multilateral assessment of the effects on the environment. The proposed project would affect fourteen federally listed species and their critical habitat hence it requires the Corps to consult with expert agencies U.S. Fish and Wildlife Service (USFWS) and National Marine Fishery Service (NMFS). These agencies need to issue Biological Opinion stating their assessment of the effect of the proposed project on the species and their habitat.

50 CFR §402.10 requires Federal agencies to confer with the Service on actions that are likely to jeopardize the continued existence of any proposed species or result in destruction of their habitat at *early stages* in the planning process so that potential conflicts can be identified and resolved. Further, 50 CFR §402.11 describes that the "early consultation is designed to reduce likelihood of conflicts between listed species or critical habitat and proposed action" of Federal agency. Finally, 50 CFR §402.14 requires the Federal agency "to review its actions at an *earliest possible time"* [emphasis added] to determine any possible effects of its proposed action to the enlisted species and their habitat.

The DEIS fails to provide documents to show that the any type of consultation has occurred with the expert agencies. The DEIS also fails to supply the Biological Opinion of expert agencies. Without the Biological Opinion, the public cannot know what the response of the expert agencies to the effects of the proposed project to these species.

The Section 7 Consultation provision was put in place in the ESA so that opinions of all relevant parties are taken into consideration before the public can comment on the project. The Corps needs to comply with the ESA and consult with the USFWS and NMFS to receive their Biological Opinion on the effects of the project on the listed species of Lockwoods Folly Inlet. Without it, the DEIS is incomplete.

Conclusion

For the reasons described above, the Corps cannot issue a Final Environmental Impact Statement for this project. The Corps has failed to comply with the requirements established by NEPA and with other federal laws. The DEIS is replete with deficiencies that must be addressed. Based on the data presented in the DEIS it stands that the most economic option for the town of Holden Beach is Alternative 2. The Corps cannot justify its choice of the preferred alternative. These deficiencies must be fully explained in a supplemental EIS and released for public review and comment.

Thank you for considering these comments. Please contact me at (252) 393-8185 or anaz@nccoast.org if you have any questions regarding their content.

Sincerely,

Ana Zivanovic-Nenadovic
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Cc:

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October 13, 2015

Via U.S. and Electronic Mail
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Re: SAW-2011-01914 Holden Beach East End Shore Protection Project

Dear Ms. Hughes:

Please accept these comments on the Town of Holden Beach's East End Shore Protection Project Draft Environmental Impact Statement ("DEIS"). The Southern Environmental Law Center submits these comments on behalf of the North Carolina Coastal Federation and Audubon North Carolina. As discussed below, the DEIS does not comply with the National Environmental Policy Act ("NEPA"). Moreover, the limited analysis in the DEIS reveals that the only alternative that addresses the Town's long-term erosion issues is Alternative 2: Abandon and Retreat. Not only is Alternative 2 substantially cheaper than any other alternative, it does not have the adverse environmental effects of dredging, beach renourishment, or shoreline hardening. Therefore, none of the alternatives that require a Clean Water Act Section 404 permit can be authorized.

I. The DEIS Analysis Is Inconsistent with Other Terminal Groin Projects.

This is the fourth DEIS the Corps has published analyzing a terminal groin project in North Carolina since 2012. Each uses a different approach to assessing impacts. The Bald Head Island DEIS modeled shoreline change for nine years using primarily the Delft3D model. The Figure Eight Island DEIS modeled shoreline change for five years using the Delft3D model. The Ocean Isle DEIS modeled shoreline change for three years using the Delft3D model. The Figure Eight SEIS modeled shoreline change for five to seven years using the Delft3D model and ten years using the GENESIS model. This DEIS models shoreline change for four years using the CMS model. The Corps has not provided any explanation in these documents regarding why it has been so inconsistent in evaluating substantially similar projects. Failing to explain the different treatment of similar projects is an obstacle to public understanding of the Corps' limited analysis.

Perhaps most troubling regarding this discrepancy is the Corps' apparent deference to third-party consultants regarding the time period to run each model. These consultants are engaged by the project proponents to advocate for the construction of their preferred alternatives. That purpose has been reflected in the approach taken in each EIS. One of the most obvious ways is in the scope of the analysis provided. As discussed in other comment letters and below, the short time periods evaluated by the models cannot account for the long-term indirect and cumulative effects of the proposed terminal groins.

The Corps still has the opportunity to standardize its analysis of these similar projects for the Figure Eight, Ocean Isle, and Holden Beach EISs. We encourage the Corps to do so.

II. The DEIS Only Evaluates 4 Years of a 30-Year Project.

Many of the DEIS's deficiencies stem from its failure to adequately analyze the proposed alternatives. As stated in the DEIS the purpose of the project is to "provide for the short-term and *long-term* protection of residential structures, Town infrastructure, and recreational assets."[1] Yet the document never attempts to analyze the "long-term" effect of the alternatives, instead limiting its analysis to four years.[2] As discussed below, this failure results in a variety of NEPA violations.

A. The DEIS fails to appropriately describe baseline data.

The basic purpose of an EIS is to "to help public officials make decisions that are based on understanding of environmental consequences, and that take actions that protect, restore, and enhance the environment." 40 C.F.R. § 1500.1(c). The alternatives analysis comparing environmental effects of projects is the "heart of the environmental impact statement." 40 C.F.R. § 1502.14. The DEIS fails to provide information necessary to inform decisionmakers or the public about the environmental consequences because it fails to adequately describe baseline data.

Here, truncating the analysis at year 4 deprives the public and decisionmakers of any information regarding the baseline data for years 5 through 30 of the 30-year project, making any analysis of long-term effects of the project impossible.

The Fourth Circuit has made clear that "[w]ithout [accurate baseline] data, an agency cannot carefully consider information about significant environment impacts" and therefore the analysis will "result[] in an arbitrary and capricious decision." *N.C. Wildlife Fed'n v. N. C. Dep't of Transp.*, 677 F.3d 596, 603 (4th Cir. 2012) (quoting *N. Plains Res. Council, Inc. v. Surface Transp. Bd.*, 668 F.3d 1067, 1085 (9th Cir. 2011)). It is fundamental that baseline data for the analysis of environmental impacts be clearly presented. *See Friends of Back Bay v. U.S. Army Corps of Eng's*, 681 F.3d 581, 588 (4th Cir. 2012) ("A material misapprehension of the baseline conditions existing in advance of an agency action can lay the groundwork for an arbitrary and capricious decision."). Without an accurate assessment of baseline conditions, "the [impact statement] process cannot serve its larger informational role, and the public is deprived of [its] opportunity to play a role in the decision-making process." *N.C. Wildlife Fed'n*, 677 F.3d at 603

[1] DEIS at 2-1.
[2] Additional analysis is provided in Appendix F, but that analysis is not consistent with the DEIS. At times it conflicts with the DEIS analysis. In other instances, Appendix F includes analyses that were not attempted in the DEIS or incorporated into the main document. Appendix F cannot cure deficiencies in the DEIS.

(quoting *N. Plains Res. Council, Inc. v. Surface Transp. Bd.*, 668 F.3d 1067, 1085 (9th Cir. 2011)).

B. The DEIS fails to evaluate indirect effects of the terminal groin alternatives.

As described in additional detail below, the analysis of indirect effects of the proposed terminal groin is the most essential analysis in the DEIS. Indirect effects are those that "are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable." 40 C.F.R. § 1508.8. The entire purpose of the proposed terminal groin is to disrupt natural sand transport mechanisms such that it has the effect of slowing erosion. The adverse indirect effects of the proposed terminal groin—due to the disruption of inlet processes—are the key environmental effects that must be analyzed. It is those inlet processes, specifically the formation and existence of dynamic intertidal shoals and flats, which are critical to the wildlife naturally found in the inlet system. Limiting the analysis of indirect effects to four years, for no apparent reason, fails to adequately assess indirect environmental effects of the proposed terminal groin alternatives.

The Corps cannot ignore those indirect effects by limiting its analysis to four years. As the D.C. Circuit stated in *Scientists' Institute for Public Information v. Atomic Energy Commission*:

> The agency need not foresee the unforseeable, but by the same token neither can it avoid drafting an impact statement simply because describing the environmental effects of and alternatives to particular agency action involves some degree of forecasting. And one of the functions of a NEPA statement is to indicate the extent to which environmental effects are essentially unknown. It must be remembered that the basic thrust of an agency's responsibilities under NEPA is to predict the environmental effects of proposed action before the action is taken and those effects fully known. Reasonable forecasting and speculation is thus implicit in NEPA, and we must reject any attempt by agencies to shirk their responsibilities under NEPA by labeling any and all discussion of future environmental effects as "crystal ball inquiry." "The statute must be construed in the light of reason if it is not to demand what is, fairly speaking, not meaningfully possible * * *." But implicit in this rule of reason is the overriding statutory duty of compliance with impact statement procedures to "the fullest extent possible."

481 F.2d 1079, 1092 (D.C. Cir. 1973); *see Northern Plains Resource Council v. Surface Transportation Board*, 668 F.3d 1067 (9th Cir. 2011); *Potomac Alliance v. U.S. Nuclear Regulatory Commission*, 682 F.2d 1030, 1033-34 (D.C. Cir. 1982). As currently drafted, the DEIS does not satisfy NEPA's requirement to evaluate the environmental effects of the alternatives considered.

C. The DEIS fails to provide information necessary for decisionmakers and the public to compare alternatives.

By limiting the analysis to 4 years of a 30-year project, the DEIS fails to provide information to evaluate the full environmental and economic impacts of alternatives across the 30-year period. Evaluating only those four years does not provide the information regarding environmental, economic, or social effects for consideration by the Town, the public, the Corps, or other regulatory and resource agencies. Implicit in the DEIS is the assumption that the Town's preferred alternative would have long-term benefits, but those benefits have not been identified or estimated. As demonstrated in the DEIS, many properties would continue to be adversely affected even with Alternative 6, so the Corps cannot presume that the Town's preferred alternative will be beneficial. Likewise, the Corps cannot assume that the environmental effects of the preferred alternative would be benign. As discussed in more detail below, it is well-established that construction of a terminal groin will result in the degradation of inlet habitats due to the disruption of natural inlet processes. Those effects, which take hold after four years, must be analyzed.

III. The Purpose and Need Must Be Viewed in Proper Context.

As described in the DEIS, the purpose of the project is to "provide for the short-term and long-term protection of residential structures, Town infrastructure, and recreational assets."[3] This purpose and need statement must be put in the proper context. The Applicant's preferred alternative, as discussed in more detail below does not provide for even the "short-term" protection of *all* residential structures, town infrastructure, and recreational assets. Under Alternative 6, erosion would still affect 16 properties, including 11 houses. More than $100,000 in infrastructure would be lost. Further, there is no meaningful distinction between the width of the recreational beach in front of the residential properties under Alternative 6 as compared to any other alternative.[4] As depicted in Figure 5.28, the MHW line in year four of Alternative 6 would be at the back door of numerous properties, and the recreational use of the beach would be eliminated. The only meaningful "recreational beach" would be in close proximity to the terminal groin—a poor substitute for the recreational beach that currently exists on the natural inlet. As described in more detail below, east of the groin, the wide beach that currently exists can be expected to erode substantially.

It is unclear how the Corps intends to evaluate these various impacts as meeting the Purpose and Need because that analysis is unlawfully omitted from the DEIS (and cannot be done based on four years of modeling). What is clear is that the standard cannot be that only alternatives that protect all residential structures, infrastructure, and recreational beach where they currently exist meet the Purpose and Need. None of the alternatives meet that standard. The Corps must evaluate which alternatives provide for long-term protection of property, infrastructure, and recreational opportunities in a way that accounts for the Town's actual economic costs from lost property and the reality of barrier island geology. With that analysis, Alternative 2 is the only reasonable, practicable alternative.

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[3] DEIS at 2-1.
[4] *See id.* at 5-157.

IV. The Proposed Terminal Groin Alternative Would Spend More Than $2,500,000 in the First Four Years to Protect Less Than $19,000 of Tax Revenue.

As described in the DEIS, the only alternative that meets the purpose and need is Alternative 2. It provides the only economical means of ensuring long-term protection for houses, infrastructure, and recreational opportunities on Holden Beach. Further, it is the only fiscally responsible alternative provided.

As described in the DEIS, the cost of initial groin construction and beach fill would be approximately $2,500,000.[5] Despite that expense, 16 properties would be affected by erosion, including 11 houses, in the first 4 years.[6] The total assessed value of those properties is $2,100,000.[7] Based on current tax rate, the Town receives $3,150 annually from the 16 affected properties.[8] Impacts to infrastructure under Alternative 6 would be $101,572 by year 4.[9] The remaining dry sand beach would be to the east of remaining houses or existing infrastructure, not directly in front of the remaining properties.[10]

The DEIS predicts that Alternative 2, by comparison, would affect 28 properties, including 19 houses.[11] The total value of those properties is $5,180,000.[12] Based on current tax rates, the town receives $7,700 annually from the 28 affected properties, $4,620 more than the subset of properties affected by Alternative 6. According to the DEIS, infrastructure impacts under Alternative 2 would be approximately $617,782.[13] By relocating houses and removing infrastructure, allowing natural barrier island beach formation to occur, substantial recreational beach could be maintained and protected under Alternative 2.

Assuming for the time being that replacement value is the appropriate measure of infrastructure costs,[14] the four-year cost to the town of Alternatives 6 and 2 is a factor of three things: the initial construction costs, lost tax revenue from affected properties, and infrastructure costs. Those respective costs are summarized in the Table below. Costs for Alternative 2 are also corrected to reflect that most of the properties are affected under both alternatives and some of the infrastructure is affected under both alternatives.

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[5] *Id.* at 5-156.
[6] *Id.*
[7] *Id.* at 5-159
[8] The current tax rate .15 cents/$100.
[9] 5-159.
[10] *See* 5-157.
[11] 5-64.
[12] 5-67.
[13] 5-67.
[14] We do not concede that "replacement value" of the infrastructure is the proper measure, given that the Town will not replace roads that would be underwater.

	Alternative 6	Alternative 2	Alternative 2 (corrected)[15]
Initial Cost	$2,500,000	$0	$0
Lost Tax Revenue (4-years)	$12,600	$30,800	$18,200
Infrastructure Costs	$101,572	$617,782	$516,210
Total	$2,614,172	$648,532	$534,410

Alternative 2 is, by approximately $2 million, the cheaper alternative over the four-year span evaluated in the DEIS. The disparity between the alternatives is greater when longer-term analysis is provided. Under Alternative 6, costs are expected to balloon to more than $36,000,000 over the next 30 years. Even if Alternative 2 resulted in the abandonment or relocation of all oceanfront properties on Ocean Boulevard East that are east of McCray Street, Alternative 2 is the only economically feasible alternative. Such erosion (which is not given), would potentially affect 13 additional oceanfront properties, 8 of which have houses. The total assessed value of those properties is $4,947,280. The resulting tax revenue paid to Holden Beach for those properties is approximately $7,421 each year. Even adding that lost tax revenue for year 5 through year 30, the total lost tax revenue to the Town is only $423,941.[16] In short, the tax revenue lost by Holden Beach if all 41 of the identified properties are lost is approximately 10% of the estimated cost of Alternative 6.[17] The Town will never recoup tax revenues that justify building the groin.

Moreover, even considering the assessed value of the potentially affected properties does not make Alternative 6 practicable. The total assessed value of the 28 properties potentially affected in the first 4 years of Alternative 2 and the additional 13 potentially affected in the next 24 years is $10,127,280. Holden Beach could buy each of the potentially affected properties three times over and still save more than $3,000,000 compared to the cost of building and maintaining the terminal groin.

The Engineering Analysis makes clear that the erosion experienced by the few properties potentially protected by Alternative 6 is isolated to a limited segment of Holden Beach. As shown in Figure 1-2 of the Engineering Analysis, the long-term erosion rates of 5 and 7 feet/yr are limited to the East End.[18] West of McCray Street, long-term erosion rates are approximately 3.5 ft/yr and quickly decrease to 2 ft/yr. So there is no indication that higher erosion rates experienced in the East End would spread to other parts of Holden Beach under Alternative 2.

[15] Lost tax revenue from properties affected under both alternatives and infrastructure lost under both alternatives have been subtracted from this column.

[16] This amount is based on the loss of tax revenue from properties identified as affected by Alternative 2 for 30 years ($231,000) and the loss of revenue from 13 additional potentially affected properties for 26 years ($192,941).

[17] An even broader analysis cannot make the terminal groin economically rational. Andrew Coburn's 2010 analysis demonstrates that even looking at a broader segment of Holden Beach, the groin would cost far more than the Town revenue it would protect. *See* Andrew Coburn, Western Carolina University, *A Fiscal Analysis of Shifting Inlets and Terminal Groins in North Carolina* (Attachment 1).

[18] *See* Appx. F at 1-2; compare Figure 3-1 (denoting East End project).

The DEIS further demonstrates there is no reason to expect widespread extreme erosion in the future based on inlet movement. As conceded in the DEIS, Lockwood Folley Inlet is very stable.[19] It has not moved significantly since 1938.[20] Although the orientation of the inlet has changed, aerial photography in Appendix I demonstrates that fluctuations in inlet alignment have not resulted in substantial changes to the island's shoreline. Therefore, removing residential structures and infrastructure built on the most erosive part of the island—allowing natural processes to restore the beach in that area—is the only viable means of providing long-term protection.

V. The DEIS's Modeling Analysis Is Not Clearly Explained.

The modeling analysis included in the DEIS contains several deficiencies. First, it is unclear what shoreline data the model relies on as year 0.[21] Because the purpose of the DEIS is to evaluate the environmental effect of each alternative on existing environmental conditions, it is critical that the modeling analysis use the most up-to-date information available. The DEIS does not appear to specify the date of shoreline data used in its analysis, undermining the entire analysis.

Moreover, the DEIS does not reconcile its analysis with the analysis presented in Appendix F. The only references to Appendix F in Chapter 5 are with respect to alternatives not carried forward for detailed analysis[22] and sand source characteristics.[23] Given that it appears that the DEIS modeling analysis relies to some extent on Appendix F,[24] the relation of the analyses in the documents should be more fully explained.

Finally, the model result for Alternative 2, an erosion rate of 20 ft/yr,[25] must be explained. Appendix F variously describes the long-term erosion rate as 5-7 ft/yr[26] and approximately 10 ft/yr.[27] It appears, therefore, that the model significantly overestimates the rate of erosion under Alternative 2.

VI. The DEIS Fails to Adequately Assess Environmental Effects of the Proposed Terminal Groin.

The DEIS is required to evaluate all reasonably foreseeable environmental effects of each alternative. It fails to do so in both its assessment of indirect effects and cumulative effects. For those reasons, the DEIS violates NEPA.

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[19] *Id.* at 4-3.
[20] *Id.*
[21] *See id.* at 5-4 (describing modeling).
[22] *Id.* at 5-1.
[23] *Id.* at 5-38.
[24] *Id.* at 5-125, 5-126, 5-127 (including figures prepared by ATM).
[25] *Id.* at 5-10
[26] *See* Appx F at 1-2 (showing DCM long-term erosion rates); 4-10, Figure 4-6 (depicting erosion rates less than 7.5 ft/yr).
[27] *Id.* at 4-3, Figure 4-1 (showing past erosion west of the groin at approximately 10 ft/yr between 1983 and 2000).

A. The DEIS does not evaluate indirect effects.

Indirect effects are those that "are caused by the action and are later in time or farther removed in distance, but are still reasonably foreseeable." 40 C.F.R. § 1508.8. "[A]n environmental effect is 'reasonably foreseeable' if it is 'sufficiently likely to occur that a person of ordinary prudence would take it into account in reaching a decision.'" *Mid-States Coalition for Progress v. Surface Transp. Bd.*, 345 F.3d 520, 549 (2003). The indirect effects of terminal groins are well documented. The Corps' Coastal Engineering Manual describes groins as: "...probably the most misused and improperly designed of all coastal structures."[28] It recognizes that "[o]ver the course of some time interval, accretion causes a positive increase in beach width updrift of the groin. Conservation of sand mass therefore produces erosion and a decrease in beach width on the downdrift side of the groin." A Division of Coastal Management Report that preceded the CRC's terminal groin study found that, at Oregon Inlet, "[t]he six miles of [Pea Island] shoreline south of the terminal groin fillet that was monitored continues to erode at rates that range from slightly more to slightly less than the pre-terminal groin shoreline erosion rates, in spite of frequent dredging and beach nourishment efforts."[29] With respect to Fort Macon, the report concluded that "[w]ithout constant beach nourishment, the terminal groin would no longer perform as observed historically and, potentially fail altogether."[30]

It is well-established that terminal groins destroy inlet habitat that is essential for shorebirds, waterbirds, and other species adapted to those dynamic environments. The N.C. Coastal Resources Commission's Final Terminal Groin Study recognized that terminal groins modify inlet processes in such a way that they substantially eliminate existing habitat.

As the CRC described in its 2010 Terminal Groin Study, "the barrier islands and associated inlets on which many waterbirds depend are being severely altered by attempts to stabilize beaches and dunes. Habitats associated with inlets are particularly valuable to coastal birds (Harrington 2008) and as such, should be afforded extra protection."[31] The CRC has recognized what is well-known, that early successional birds such as terns (Larida spp.), black skimmers (*Rhychops niger*), Wilson's plovers (*Chadrius wilsonia*), piping plovers, and American oystercatchers depend on inlet habitats for survival.[32] Piping plovers, in particular, "depend on the natural barrier island and inlet processes that create and maintain broad flats and intertidal areas, overwash zones, and maintain early successional habitat."[33]

One of the primary threats to these species is loss of inlet habitat through shoreline hardening. The Terminal Groin Study found that "[s]tabilization of inlets is considered a serious threat to piping plovers because it can lead to a net loss of suitable habitat."[34] "The construction

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[28] U.S. Army Corps of Engineers, Coastal Engineering Manual at 3-59 (Aug. 1, 2008).
[29] N.C. Division of Coastal Management, North Carolina's Terminal Groins at Oregon Inlet and Fort Macon: Descriptions and Discussions at 7 (2008) (Attachment 2).
[30] *Id.* at 17.
[31] Terminal Groin Study at III-8.
[32] *Id.* at III-9.
[33] *Id.* at III-12.
[34] *Id.* at III-13.

of a terminal groin, beach nourishment, and dune construction prevents overwash and contributes to a loss of habitat for breeding and non-breeding waterbirds, including piping plovers."[35]

The Recovery Plan for the critically endangered Great Lakes piping plover population states that "[i]nlet dredging and artificial structures, such as breakwalls and groins, can eliminate breeding and wintering areas and alter sedimentation patterns leading to the loss of nearby habitat."[36] The 5-year Status Review for Piping Plover states: "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 and groins, can eliminate wintering areas and alter sedimentation patterns leading to the loss of nearby habitat."[37] The Status Review concludes: "Habitat loss and degradation on winter and migration grounds from shoreline and inlet stabilization efforts, both within and outside of designated critical habitat, remain a serious threat to all piping plover populations."[38]

The piping plover status report discusses the impacts of groins and inlet stabilization on these key elements:

> Inlet stabilization with rock jetties and associated channel dredging for navigation alter the dynamics of longshore sediment transport and affect the location and movement rate of barrier islands (Camfield and Holmes 1995), typically causing downdrift erosion. Sediment is then dredged and added back to islands which subsequently widen. Once the island becomes stabilized, vegetation encroaches on the bayside habitat, thereby diminishing and eventually destroying its value to piping plovers. Accelerated erosion may compound future habitat loss, depending on the degree of sea-level rise. Unstabilized inlets naturally migrate, re-forming important habitat components, whereas jetties often trap sand and cause significant erosion of the downdrift shoreline. These combined actions affect the availability of piping plover habitat (Cohen et al. 2008).[39]

That degradation of habitat has been observed at North Carolina terminal groins. The Terminal Groin Study recognized that "the Pea Island Fillet is rapidly evolving which jeopardizes the overall nesting habitats for many of the species."[40] At Fort Macon, the shoreline "does not appear to be suitable for either colonial nesters or shorebirds based on preliminary analysis of historical aerial photographs and available historical shorebird and colonial waterbird data."[41]

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[35] *Id.* at III-19.
[36] U.S. Fish & Wildlife Service, Recovery Plan for the Great Lakes Piping Plover (Charadrius melodus) (September 2003) at 23.
[37] U.S. Fish & Wildlife Service, Piping Plover (Charadrius melodus) 5-Year Status Review: Summary and Evaluation (2009) at 31.
[38] *Id.* at 39.
[39] *Id.*
[40] Terminal Groin Study at III-34.
[41] *Id.* at III-58.

Those adverse impacts are heightened in shallow-draft inlets such as Lockwoods Folly. The CRC's study concluded that "[t]he relative impact of these structures on adjacent areas is likely increased when sited next to natural or minimally managed shallow-draft inlets."[42]

Yet despite these well-established effects of terminal groins, the DEIS adopts the unsupported position that any and all effects of the proposed groin would be revealed by year four of the modeling. That assumption must be supported. It is "reasonably foreseeable" that Alternative 6 will affect inlet processes and impede the development of essential intertidal and shoal habitat beyond year 4 as modeled. The CRC has not only recognized as much, it has stated that those effects are even more likely to occur in this situation. Therefore, it is inescapable that "a person of ordinary prudence" would evaluate the effect of the terminal groin alternatives on inlet habitat well beyond year 4 of the proposed terminal groin.

B. The DEIS must evaluate cumulative impacts of Alternative 6 combined with proposed terminal groins at Figure Eight Island, Ocean Isle, other inlets in North Carolina, and the in-construction terminal groin at Bald Head Island.

A "[c]umulative impact is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions." 40 C.F.R. § 1508.7. In the DEIS, the Corps identifies the projects considered in its cumulative impacts analysis.[43] Excluded from that list are existing modified inlets described in the Terminal Groin Study, the in-progress terminal groin at Bald Head Island, or the two other terminal groin projects currently under consideration by the Corps. Given the known impacts of terminal groins and the increasing rarity of natural inlets, the Corps must evaluate the hardening of this inlet in the overall context of available inlet habitat. The birds displaced by the construction of the proposed terminal groin cannot go elsewhere, because inlet shorelines along the entire North Carolina coast are increasingly being sandbagged or hardened. The North Carolina General Assembly recently increased the cap for terminal groins in the state, meaning that the Corps is likely to soon have two additional terminal groin proposals before it. The cumulative effect of these projects on inlet-dependent wildlife is significant and must be considered.[44]

The DEIS further errs by concluding that there are no cumulative impacts to the Inlet Complex based on a finding that there are no direct or indirect effects from Alternatives 5 and 6.[45] That finding is erroneous based on the unlawful analysis of indirect effects of the project.

VII. The DEIS Does Not Provide Information Required to Satisfy the 404(b)(1) Guidelines.

The purpose of the DEIS in this context is to provide information for the Corps to conduct its required analysis under Section 404 of the Clean Water Act. Because of its failure to

[42] *Id.* VII-5.
[43] DEIS at 5-5.
[44] *See* Letter from W. Golder, Audubon NC, to M. Sugg, USACE (Sept. 14, 2015) (Attachment 3).
[45] *See* DEIS at 5-132-33.

adequately evaluate direct, indirect, and cumulative impacts, this DEIS fails to meet that goal. For the reasons described above, the analysis of environmental impacts based on a terminal-groin-oriented analysis does not provide the objective evaluation necessary to complete that analysis. The DEIS does not "consider[] the alternatives in sufficient detail to respond to the requirements of these Guidelines" discussed below and it is "necessary to supplement these NEPA documents with this additional information." 40 C.F.R. § 230.10(4).

Under the Clean Water Act, the Corps is only able to permit the least environmentally damaging practicable alternative ("LEDPA"). Practicable means "available and capable of being done after taking into consideration cost, existing technology, and logistics." 40 C.F.R. § 230.3(q). Although the Corps has not defined practicability in the DEIS—thereby unlawfully denying the opportunity for public comment on that essential element of the analysis—it is apparent that each alternative is practicable.

The alternatives fall into two categories. The first includes the non-structural alternatives, whose environmental impacts – dredging, smothering benthic organisms, altered beach profile, etc. – vary by degree. The second category includes the terminal groin alternatives, whose unique environmental impacts – hardening of the shoreline, loss of overwash areas, etc. – are permanent.

In its application of the 404(b)(1) Guidelines, the Corps must evaluate "the nature and degree of effect that the proposed discharge will have, individually and cumulatively, on the characteristics at the proposed disposal sites." 40 C.F.R. § 230.11(a). That effect is measured by how the discharges change the "physical, chemical, and biological characteristics of the substrate" and affect "bottom-dwelling organisms at the site by smothering immobile forms or forcing mobile forms to migrate." 40 C.F.R. § 230.20(b).

The analysis of these factors reveals a clear divide. The non-structural alternatives—with the exception of Alternative 2—will have varying degrees of impact on infaunal communities in both the dredged areas and the nourished areas. Unlike any of the non-structural alternatives, however, the terminal groin alternatives will permanently alter the characteristics of the inlet. The intertidal areas lost in the area that would be impacted by the terminal groin will not redevelop, eliminating the possibility that the benthic organisms buried or displaced could repopulate the area. The groin alternatives will fundamentally change the nature of the eastern end of the island, eliminating overwash areas and permanently altering substrate and eliminating habit for benthic organisms. Alternatives 5 and 6 are the most environmentally damaging alternatives when evaluated under the factors in 40 C.F.R. § 230.20.

The Corps must also evaluate "the nature and degree of effect that the proposed discharge will have individually and cumulatively on water, current patterns, circulation including downstream flows, and normal water fluctuation." 40 C.F.R. § 230.11(b). These effects are measured by the "adverse changes" that occur in "[l]ocation, structure, and dynamics of aquatic communities; shoreline and substrate erosion and deposition rates; [and] the deposition of suspended particulates." 40 C.F.R. § 230.23(b).

As with impacts to substrate, Alternative 2 clearly has the least environmental impact on the aquatic communities and deposition of suspended particles. It would not adversely affect aquatic communities and would continue to allow deposition of suspended particles on the overwash areas at the eastern end of the island (as would the other non-structural alternatives). By comparison, the terminal groin alternatives would permanently displace aquatic communities at the eastern end of the island and eliminate overwash, cementing the accompanying adverse environmental impacts.

The Corps' consideration of the fluctuation of normal water level must include consideration of "modifications [that] can alter or destroy communities and populations of aquatic animals and vegetation, . . . modify habitat, reduce food supply, restrict movement of aquatic fauna, destroy spawning areas, and change adjacent, upstream, and downstream areas." 40 C.F.R. § 230.24.

For the reasons described above and the impacts on the benthic communities, Alternative 2 has the least environmental impact. Alternative 2 would have no adverse environmental effect on wet beach habitat, adjacent dry beach habitat, and back beach habitat. Other non-structural alternatives would similarly have temporally limited environmental impacts to these habitats. Alternatives 5 and 6 would have significant, permanent impacts to these areas. These alternatives would eliminate wet beach habitats and the associated benthic organisms, significantly modify dry beach habitats, and result in dense vegetation of what are now sparsely vegetated back beach habitats. They would therefore have the greatest adverse impacts of any of the alternatives.

In addition to the Corps' endangered and threatened species analysis under the ESA, it must also consider listed species under the 404(b)(1) Guidelines. The Corps must compare alternatives based on their potential impact on "nesting areas, protective cover, adequate and reliable food supply and resting areas for migratory species." 40 C.F.R. § 230.30(b)(2).

Alternative 2 and the other non-structural alternatives would maintain habitat for piping plover on Holden Beach and allow habitat for piping plover and other shorebirds and waterbirds in Lockwoods Folly Inlet.

Finally, the Corps must consider "the loss or change of breeding and nesting areas, escape cover, travel corridors, and preferred food sources for resident and transient wildlife species associated with the aquatic system." 40 C.F.R. § 230.32(b).

Construction of Alternative 5 or 6 would eliminate habitat for all shorebirds that rely on relatively unvegetated back beach, wet beach, and intertidal habitats. Therefore, the adverse effects described above for piping plover are likely to be felt by red knots and other shorebirds.

It is clear from the DEIS that under the 404(b)(1) Guidelines, the Corps cannot permit either Alternative 5 or 6. All would have significantly greater environmental impact than Alternative 2. Based on the available information, it appears that Alternative 2 is the LEDPA and is the only alternative that can be permitted by the Corps.

VIII. Conclusion

For the reasons described above, the DEIS does not comply with NEPA. Because the deficiencies are so significant, they cannot be remedied in a final EIS. We request that the Corps issue a revised or supplemental DEIS that addresses the shortcomings of this document, specifically the limited scope of the modeling analysis and resulting failure to adequately assess reasonably foreseeable indirect and cumulative impacts of the proposed project. If the Corps makes a permitting decision based on the information provided in the DEIS, it must deny the requested Clean Water Act Section 404 permit. It is clear that Alternative 2 is not only the least environmentally damaging practicable alternative, it is substantially more economical for the Town of Holden Beach over the short and long term.

Please contact me at (919) 967-1450 or ggisler@selcnc.org if you have any questions regarding these comments.

Sincerely,

Geoffrey R. Gisler /RGD

Geoffrey R. Gisler
Senior Attorney

GRG/rgd
Enclosures

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October 12, 2015

Via U.S. and Electronic Mail
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Re: SAW-2011-01914 Holden Beach East End Shore Protection Project

Ms. Hughes:

Please accept these comments on behalf of the National Audubon Society's North Carolina State Office regarding the draft Environmental Impact Statement (DEIS) for the project known as "Holden Beach East End Shore Protection Project."

The Town of Holden Beach's preferred alternative is to construct a ~1,000 foot-long terminal groin on the east end of Holden beach and a beach nourishment regime that would place ~120,000-180,000 cy of sand on the East End beach extracted from Lockwood Folly AIWW Inlet Crossing borrow site. This alternative, as well as other alternatives that include the construction of a terminal groin or any other hard structure (Alternative 5), the stabilization of the inlet through channelization (Alternative 4), beach nourishment activities (Alternatives 1, 3, 4, 5, and 6), or the dredging or other removal of sand from Lockwood Folly Inlet or the associated ebb and flood tidal deltas (Alternatives 1, 3, 4, 5, and 6) will have significant and lasting negative direct, indirect, and cumulative impacts on birds and other wildlife that depend on the dynamism of mid-Atlantic coastal inlets at critical points in their life cycles. Additionally, for the applicant's preferred alternative (Alternative 6), the models used in the DEIS show that East End beach will continue to experience erosion even with the construction of a terminal groin.

The DEIS takes the "make them go somewhere else" approach when addressing the impact of the preferred alternative and most of the other alternatives on birds. It perpetuates the common misconception that breeding and non-breeding shorebirds and waterbirds have alternative places to go when habitat is lost and that, because birds have wings, they will simply move somewhere else. The truth is, the birds are already occupying alternative locations. They have been relentlessly forced to abandon high-quality habitats throughout their range because of habitat loss and degradation. Shorebirds like Piping Plovers, as well as terns and skimmers are now confined to a small fraction of the habitat once available to them, and if alternative locations were available, the birds would already be there. This is reflected in the elevated conservation status of many of the species that depend on inlets and barrier islands, including those that depend on Lockwood Folly Inlet; nearly all are state listed, federally listed, listed as species of conservation concern, or similarly designated in documents such as the U.S. Shorebird Conservation Plan (Brown *et al.* 2001).

<u>Geophysical Impacts of Terminal Groins, Other Hard Structures, and Beach Renourishment</u>: In order to assess environmental impacts, it is necessary to accurately describe how terminal groins and other coastal engineering projects affect inlets and adjacent beaches. The DEIS fails to cite the applicable, most recent scientific literature and fails to accurately describe the impacts a terminal groin, beach renourishment, and inlet channelization would have on Lockwood Folly Inlet and adjacent areas. Some of the impacts that are insufficiently addressed are the narrowing of downdrift oceanfront beach, loss of sediment from the inlet system, impacts to spits at ends of adjacent islands, loss of critical wildlife habitat, and cumulative impacts of the alternatives.

Terminal groins are designed to interrupt longshore transport of sand. It is well documented that terminal groins actually accelerate erosion of the shoreline downdrift of the structure (McDougal *et al.* 1987, Kraus *et al.* 1994, Bruun 1995, Cleary and Pilkey 1996, Komar 1998, McQuarrie and Pilkey 1998, Pilkey *et al.* 1998, Brown and McLachlan 2002, Greene 2002, USACE 2002, Morton 2003, Morton *et al.* 2004, Basco and Pope 2004, Speybroeck *et al.* 2006, Rice 2009, Riggs *et al*. 2009, Riggs and Ames 2011, Ells and Murray 2012, Knapp 2012, Pietrafesa 2012, Berry *et al.* 2013), which in turn requires regular replenishment of sand to compensate for sand loss (Hay and Sutherland 1988, Bruun 1995, McQuarrie and Pilkey 1998, French 2001, Galgano 2004, Basco 2006, Riggs *et al.* 2009, Riggs and Ames 2011, Pietrafesa 2012).

An open letter on the subject of downdrift erosion signed by 43 of the leading coastal geologists in the U.S. states:

The negative impact of groins and jetties on downdrift shorelines is well understood. When they work as intended, sand moving along the beach in the so-called downdrift direction is trapped on the updrift side, causing a sand deficit and increasing erosion rates on the downdrift side. This well-documented and unquestioned impact is widely cited in the engineering and geologic literature (Young *et al.* undated).

Fenster and Dolan (1996) found that inlets in Virginia and North Carolina exert influence over adjacent shorelines up to 5.4-13.0 km away and that they are a dominant factor in shoreline change for up to 4.3 km. Permanently modifying Lockwood Folly Inlet through construction of a terminal groin, or through channelization (Nordstrom 2000), will significantly increase the erosion rate on the downdrift shoreline of Holden Beach. Longshore currents run predominantly westward in the area of East End beach, placing nearly all of the oceanfront homes on Holden Beach in danger from accelerated erosion, should a terminal groin be built.

The DEIS forecasts a four-year interval for beach renourishment for all alternatives that include a terminal groin (Alternatives 5 and 6). Despite the well-known downdrift impact of terminal groins, the DEIS does not address the likelihood that in response to the terminal groin, the beach will narrow farther to the west and require additional and more frequent beach renourishment over the years. The proposed four-year interval for beach renourishment is also questionable given that Wrightsville Beach, Masonboro Island, Mason Inlet, southern Figure 8 Island, Oregon Inlet, and Ft. Macon, just to name a few, are dredged and replenished more frequently than four-year intervals. **The near certainty that Holden Beach will need to mine sand from Lockwood Folly Inlet and replenish the downdrift beach on Holden Beach more frequently than every four years has not been accurately assessed in the DEIS**.

Downdrift effect can be seen elsewhere in North Carolina where terminal groins have been installed. At Fort Macon, three years after the completion of the terminal groin a beach renourishment project occurred because the groin itself was exacerbating erosion, and from 1973-2007, seven renourishment projects have occurred at Fort Macon at the cost of nearly $45 million (Pietrafesa 2012).

Riggs and Ames (2011) also provide an excellent review of the impacts of the modifications to Oregon Inlet. To minimize impacts of the Oregon Inlet terminal groin on the downdrift shoreline of Pea Island, sediment from routine Oregon Inlet channel dredging has been placed either directly on the Pea Island beach or in shallow nearshore disposal area near northern Pea Island (Riggs and Ames 2011). Human efforts have only temporarily slowed the process of shoreline recession in a small portion of northern Pea Island by the regular addition of dredged sand at a very high cost, but each new beach nourishment project has quickly eroded away (Riggs and Ames 2009, Riggs *et al.* 2009). Based on several studies, the data strongly suggests that the terminal groin itself is contributing to the accelerated erosion and shoreline recession problems on Pea Island (Riggs and Ames 2003, 2007, 2009; Riggs *et al.* 2008, 2009; Mallinson *et al.* 2005, 2008, 2010; Culver *et al.* 2006, 2007; Smith *et al.* 2008).

In addition to impacts on downdrift shorelines, hard structures at inlets permanently remove sand from the inlet system, reducing or eliminating shoal systems from affected inlets (Pilkey *et al.* 1998) and accelerating the loss of saltmarsh in the vicinity of the inlet (Hackney and Cleary 1987). The loss of saltmarsh at Lockwood Folly Inlet would have significant negative impacts on fisheries, other wildlife, recreation, small businesses, and the local economy. **These impacts and the loss of saltmarsh resulting from removal of sand from Lockwood Folly Inlet have not been assessed for the preferred or other alternatives in the DEIS.**

The loss of ebb and flood tidal shoals is illustrated clearly by the case of Masonboro Inlet. A terminal groin was installed on the north end of Masonboro Island; construction of the groin was completed in April 1981 (Cleary and Marden 2009). At the time, the north end of the island featured an extensive sand spit, wide beach, and extensive flood and ebb tidal deltas (Figure 2). In less than one year following the completion of the terminal groin, the spit at the north end of Masonboro Island vanished, and the amount of intertidal shoals in the inlet, already diminished by other coastal engineering projects, had decreased as well. Downdrift of the terminal groin, Masonboro Island's oceanfront beach formed the expected fillet immediately adjacent to the terminal groin, while narrowing significantly along the downdrift beach.

The DEIS also fails to address the cumulative impacts of sand mining and the proposed terminal groin at Lockwood Folly Inlet on the adjacent downdrift beach. The regular removal of sand from Lockwood Folly Inlet and the proposed terminal groin at the East End beach would disrupt the longshore transport of sand and potentially threaten Holden Beach—the adjacent downdrift shoreline—and the real estate thereon.

There are at least 100 published studies that address the impacts of terminal groins on inlets, beaches, and natural resources. The majority (78%) of peer-reviewed literature we collected regarding the impacts of hard structures at inlets concluded that terminal groins do not function in the manner presented in the DEIS and cause more harm than good. The wealth of literature on the impacts of terminal groins is not discussed nor cited in the DEIS. A complete review of the relevant literature is necessary to accurately and objectively evaluate all alternatives presented in the DEIS.

<u>Impacts to Birds</u>: Natural, unmodified coastal inlets are essential to many shorebird species (sandpipers, plovers, and their allies), as well as other coastal species because they provide the variety of habitat types these species require at critical times of their annual and lifecycles. Inlets have expansive, low-energy intertidal flats which are rich with invertebrate prey that wintering and migrating shorebirds require to fuel their migratory flights, sustain them during winter, and support adults and chicks during the nesting season. Inlets have open, sandy spits that serve as resting and roosting sites that shorebirds need to rest, digest, and conserve energy; and they have open or sparsely vegetated sandy habitat that many shorebird species, as well as terns and skimmers require for nesting. (Gochfeld and Burger 1994, Thompson *et al.* 1997, Elliott-Smith and Haig 2004, Nol and Humphrey 2012).

Shorebird communities require habitat heterogeneity to meet their basic and varied fundamental needs for survival, which is why unmodified inlets containing a mosaic of habitat types are essential to sustaining shorebird communities (VanDusen *et al.* 2012). Many shorebird species breed in the far north in order to exploit the seasonal abundance of food resources and they stopover around inlets during migration in order to refuel before continuing migration (Colwell 2010). Proximity between foraging and roosting sites has been found to be a key element in determining habitat suitability and use for shorebird species such as the Piping Plover (Cohen *et al.* 2008), Dunlin (*Calidris alpina*) (Dias *et al.* 2006), Red Knot (Rogers *et al.* 2006), and others. In short, natural inlets provide all the resources and habitats shorebirds require in a small geographic area and at the locations essential to meeting their spatial and temporal energetic needs. These resources are generally not available or not sufficient to meet the energetic needs of shorebirds at other coastal features.

Reflecting this fact, the occurrence and numbers of shorebirds that use coastal habitats in the southeastern U.S. is greater at inlets than most other coastal features. Seven shorebird species: the Threatened Piping Plover (*Charadrius melodus*) and the Threatened Red Knot (*Calidris canutus rufa*), as well as Black-bellied Plovers (*Pluvialis squatarola*), Ruddy Turnstones (*Arenaria interpres*), Snowy Plovers (*Charadrius alexandrinus*), Western Sandpipers (*Calidris* *mauri*), and Wilson's Plovers (*Charadrius wilsonia*) are significantly more abundant at inlets indicating that Piping Plovers have a small home range during the non-breeding season and use a variety of habitats throughout the tidal cycle (Drake *et al.* 2001, Rabon 2006, Cohen *et al.* 2008, Maddock *et al.* 2009). Foraging activity is strongly associated with mud or sandflats (Nicholls and Baldassarre 1990), and roost sites are most used by Piping Plovers when located within close proximity to foraging areas (Cohen *et al.* 2008). Piping Plovers also exhibit strong site fidelity both during the same year and across several years (Drake *et al.* 2001, Noel and Chandler 2006). These characteristics demonstrate that Piping Plovers depend on very specific places that with these habitats, and that these places are important year after year as the same birds return to them every migration or winter. than other coastal habitats (Harrington 2008). Multiple studies support the significance of inlets to birds, designating inlets as essential habitat by Red Knots, as well as breeding and non-breeding Piping Plovers (Nicholls and Baldassarre 1990, Harrington 2008, Kisiel 2009a, 2009b, Riggs *et al.* 2009, Niles *et al.* 2010, Maslo *et al.* 2011, USFWS 2012a, 2013).

Piping Plovers: Piping Plovers are an excellent example of a species that relies on inlet-associated habitats throughout the year. During nesting, Piping Plovers are often associated with natural coastlines, including unmodified inlets and overwash fans. In New Jersey, Piping Plovers nest primarily near inlets, particularly those that were not stabilized with structures: 70.6% of all Piping Plover pairs nested closer to an unstabilized inlet than a stabilized inlet (Kisiel 2009a, 2009b). Piping Plovers in North Carolina also exhibit a pattern of nesting near inlets, and the majority of Piping Plover nests in Cape Hatteras National Seashore and Cape Lookout National Seashore were located near inlets (NPS 2014a, 2014b), largely because suitable nesting habitat does not exist elsewhere on the coast.

Piping Plovers spend up to nine months out of the year away from nesting grounds (Elliott-Smith and Haig 2004). During this time, Piping Plovers engage in two essential behaviors, foraging and roosting (resting). A core wintering area or stopover site must provide habitat suitable for roosting, typically backshore above the high-tide line, and foraging, typically wet sand in low-energy intertidal areas that support invertebrates such polychaetes which are an important prey item for wintering and migrating Piping Plovers (Elliott-Smith and Haig 2004).

There is a robust body of peer-reviewed scientific literature showing use of inlets and associated low-energy intertidal flats by Piping Plovers, particularly migrating or wintering Piping Plovers (Haig and Oring 1985, Johnson and Baldassarre 1988, Nicholls and Baldassarre 1990), indicating that Piping Plovers have a small home range during the non-breeding season and use a variety of habitats throughout the tidal cycle (Drake *et al.* 2001, Rabon 2006, Cohen *et al.* 2008, Maddock *et al.* 2009). Foraging activity is strongly associated with mud or sandflats (Nicholls and Baldassarre 1990), and roost sites are most used by Piping Plovers when located within close proximity to foraging areas (Cohen *et al.* 2008). Piping Plovers also exhibit strong site fidelity both during the same year and across several years (Drake *et al.* 2001, Noel and Chandler 2006). These characteristics demonstrate that Piping Plovers depend on very specific places that with these habitats, and that these places are important year after year as the same birds return to them every migration or winter.

Modification of Inlets and Beaches: Despite the importance of natural inlets to birds such as the Piping Plover, **inlets are one of the most anthropogenically altered features on the coast**. In North Carolina, 85% of inlets have been modified, and 57% of Atlantic coast inlets in the migration and winter range of the Piping Plover have been modified, including 43% that have been stabilized with hard structures (Rice 2012a). At least 32% of sandy beach habitat in the winter range of the Piping Plovers has received beach nourishment (Rice 2012b), which causes direct mortality of the infaunal prey these birds consume in order to survive.

The cumulative impacts of the preferred alternative has not been accurately assessed in the DEIS. A cumulative impact is the "…impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions." The cumulative impacts of terminal groin construction along the coast of North Carolina and along the Atlantic Coast of the U.S. have been one of the most significant contributing factors to the loss of habitat for birds that rely on inlets at critical times of their life and annual cycles.

Many shorebird populations, especially the many species that occur at inlets, are declining and are of conservation concern (Brown *et al.* 2001, Winn *et al.* 2013). Loss or degradation of habitat, including that associated with coastal engineering projects, is identified as a primary threat in all shorebird conservation and management planning documents, including those addressing Piping Plovers and Red Knots. The cumulative impacts of the loss and degradation of habitats that are essential to inlet-dependent wildlife jeopardizes the recovery of federally-listed species, threatens the existence of federally-listed species, and contributes to the decline of state-listed species, none of which are evaluated in the DEIS.

Impacts on Infauna: The DEIS overlooks impacts of the alternatives on the infaunal community (species that live within the sediment) at East End beach and consistently marginalizes and understates impacts to these organisms. The infaunal community is comprised of multiple different species that have variable recovery rates. The DEIS treats the infaunal community as a single species and states, "Reported rates of recovery have been rapid when highly compatible beach fill sediments were used and spring larval recruitment periods were avoided" (p. 5-29). The DEIS repeatedly uses the terms "short-term," "rapid recovery," and "rapid recolonization" (for examples, see pages 5-29, 5-30, 5-35, 5-44, 5-93) when addressing the impacts to the infaunal community, which is misleading because some organisms take up to four years to recover (Jaramillo *et al.* 1987, Peterson *et al.* 2014).

The majority of peer-reviewed literature demonstrates that infaunal species are negatively impacted by beach nourishment, and that the length of time for recovery varies by species (Hayden and Dolan 1974, Jaramillo *et al.* 1987, Rakocinski *et al.* 1996, Peterson *et al.* 2000a, Peterson *et al.* 2000b, Bishop *et al.* 2006, Dolan *et al*. 2006, Peterson *et al.* 2006, Bertasi *et al.* 2007, Colosio *et al.* 2007, Cahoon *et al.* 2012, Leewis *et al.* 2012, Schlachler *et al.* 2012, Viola *et al.* 2013, Manning *et al.* 2014, Petersen *et al.* 2014). In North Carolina, *Emerita talpoida* (mole crab) abundance recovered within months on nourished beaches compared to control beaches, but *Donax* spp. (coquina clam) and amphipods did not recover within the time frame of the study (Peterson *et al.* 2006). Peterson *et al.* (2014) monitored the recovery of a sandy beach community for 3-4 years following nourishment and documented that haustoriid amphipods (small crustaceans) and *Donax* spp. had reduced densities for 3-4 years following nourishment, *E. talpoida* had lower densities for 1-2 years following nourishment, and ghost crabs had lower abundances for four years.

For all alternatives except Alternative 2, beach nourishment is proposed. Historically, East End beach was nourished every two years. For the preferred Alternative 6 and all other alternatives that include a terminal groin, the DEIS states that nourishment will occur every four years. However, at inlets where terminal groins were constructed, the beach nourishment cycle is every 1-4 years (Riggs *et al.* 2009, Riggs and Ames 2011, Pietrafesa 2012). Pea Island was renourished every year from 1990-2004, and Fort Macon was renourished every 2-6 years from 1973-2007 (Pietrafesa 2012). If some species of the infaunal community recover in 3-4 years, the cumulative impact to the infaunal community due to nourishment at such sites is that the community cannot recover before the next nourishment cycle. In some cases, local extinction of benthic species has occurred (Colosio *et al.* 2007).

The compaction of sand by heavy machinery and changes in grain size and shape, permeability, and penetrability are other common results of beach nourishment that impact infaunal organisms (Greene 2002, McLachlan and Brown 2006). Further, though timing of activity is important to avoid periods of larval recruitment, all work is assumed to take place within existing environmental windows. The potential for additional impacts both from more frequent nourishments and out-of-season nourishments should be addressed by the DEIS.

Beach nourishment degrades beach habitats, thus decreasing densities of invertebrate prey for shorebirds. Each shorebird species has its own foraging microhabitat as well as its own feeding techniques. Shorebirds that collect food from specific depths beneath the sand can no longer rely on food from traditional habitats on nourished beaches (Peterson *et al.* 2006). This will negatively impact species that often forage in oceanfront intertidal and swash habitats, specifically Sanderlings (Macwhirter *et al.* 2002), Willets (Lowther *et al.* 2001), and the threatened Red Knot (Baker *et al.* 2013). Speybroeck *et al.* (2006) documented that the mortality of just one species of polychaete due to nourishment resulted in decreased abundances of foraging Sanderlings. Piping Plovers forage less on oceanfront beaches than other habitats during non-breeding months (Haig and Oring 1985, Cohen *et al.* 2008), but they have been documented foraging occasionally on oceanfront beaches. Therefore, renourishment activities also affect this Piping Plover foraging habitat.

Decreased abundances of shorebirds after nourishment may be due to decreased foraging area, decreased prey densities, and the occurrence of coarse sediments further reducing foraging habitat (Peterson *et al.* 2006). Coastal armoring caused beach widths to narrow significantly in southern California, which resulted in the loss of intertidal habitat available to macroinvertebrates, and, therefore, the abundance of macroinvertebrates decreased (Dugan and Hubbard 2006, Dugan *et al.* 2008). The diversity and abundance of shorebirds on beaches was positively correlated with the diversity and abundance of macroinvertebrate prey, and since a decline in prey was observed, a decrease in foraging shorebirds, gulls, and other seabirds was also observed (Dugan and Hubbard 2006, Dugan *et al.* 2008). **These authors concluded that**

increasing coastal armoring accelerates beach erosion and increases ecological impacts to sandy beach communities.

Any hard structure placed in a coastal environment modifies physical processes there, and these changes will impact the species composition, abundance, and structure of invertebrate communities, and therefore birds that consume these prey will also be impacted. Hard-engineered structures are thought to be responsible for the loss of more than 80% of sandy beach shorelines globally (Brown and McLachlan 2002). Additionally, the placement of a terminal groin as called for in Alternatives 5 and 6, will result in the loss of the spit on the east end of Holden Beach. Although it's been stated above, it bears repeating that the modeling reported for Alternatives 5 and 6 indicate that a significant amount of sediment would be lost from the system, resulting in the loss of habitat, primarily low-energy shoals and sandbars which provide habitat for a variety of benthic invertebrates that are consumed by shorebirds and fishes.

Despite this, the DEIS preferred Alternative (6) and most other alternatives assert few impacts on infauna, and impacts that are acknowledged are marginalized: "Simultaneous losses of intertidal benthic infauna along both reaches may have minor adverse effects on surf zone fishes and shorebirds; however, such effects would be confined to the benthic community recovery period and would not carry over to subsequent nourishment events. Therefore, any spatially-crowded cumulative impacts on surf zone fishes and shorebirds under Alternative 1 would be short term and localized" (p. 5-36-37).

Every recovery or management plan that pertains to species of shorebirds that use the coast recognizes the importance of infaunal organisms and their habitats. These species include the Piping Plover (USFWS 1996a, 2001, 2003, 2009), Red Knot (USFWS 2013), Sanderling (Payne 2010), and Dunlin (Fernández *et al.* 2010).

Audubon North Carolina conducted an extensive review of literature regarding the impacts of hardened structures and beach fill activities with a focus on scientific, peer-reviewed articles. We found 43 peer-reviewed articles and included three reports regarding the impacts of renourishment on benthic organisms. Of these 46 documents, 34 (74%) found an impact to one or more species of benthic organism, 4 (9%) found no impact, and 8 (17%) were ambiguous or found equivocal results.

Of the peer-reviewed, scientific articles that found an impact to infaunal organisms, only two (Rakocinski *et al.* 1996, Burlas *et al.* 2001) are cited in the DEIS. Burlas *et al.* 2001 is a monitoring report written by the USACE and is not peer-reviewed. The results of Rakocinski *et al.* 1996, were not accurately reported by the DEIS because relevant findings were omitted. The authors studied the impacts of a beach and profile nourishment project on the Gulf coast of Florida for approximately two years following the initial beach fill event. The DEIS states, "Rakocinski et al. (1996) also reported relatively rapid recovery (≤1 year) of nearshore benthic communities following a beach nourishment project in FL (p. 5-29)." However, the DEIS does not mention that the same study also found that the dominant species of amphipod and a dominant species of polychaete had not recovered within that same time frame and that the amphipod did not recover until two years after the beach renourishment. Like the mole crab, amphipods and polychaetes are common shorebird prey items.

In its treatment of impacts to the infauna, the DEIS relies nearly exclusively on outdated literature that is generally not peer-reviewed, and it omits the many recent, peer-reviewed scientific papers that are available on the subject. Peterson and Bishop (2005) suggested that weaknesses in nourishment studies are due to studies being conducted by project advocates with no peer review process and the duration of monitoring being inadequate to characterize the fauna before and after nourishment. Thus, uncertainty surrounding biological impacts of nourishment can be attributed to the poor quality of monitoring studies, not an absence of impacts.

<u>Impacts on Sea Turtles</u>: Threatened loggerhead sea turtles (*Caretta caretta*) nest along the length of North Carolina's coast, including on Holden Beach and Oak Island. Information on the impacts of hard structures to sea turtles is extremely limited, but the few studies that exist found negative impacts to sea turtles. Lamont and Houser (2014) documented that loggerhead turtle nest site selection is dependent on nearshore characteristics, therefore any activity that alters the nearshore environment, such as the construction of groins or jetties, may impact loggerhead nest distribution. Loggerhead nesting activity decreased significantly in the presence of exposed pilings, and a 41% reduction in nesting occurred where pilings were present (Bouchard *et al.* 1998). In a study of the impact of coastal armoring structures on sea turtle nesting behavior, Mosier (1998) demonstrated that fewer turtles emerged onto beaches in front of seawalls than onto adjacent, non-walled beaches, and of those that did emerge in front of seawalls, more turtles returned to the water without nesting. Loggerhead sea turtle nests on North Carolina beaches increased in number as distance from hard structures including piers and terminal groins increased (Randall and Halls 2014). Studies in Florida have also found avoidance behavior and decreased hatching success associated with a managed inlet (Herren 1999).

Beach renourishment also negatively impacts loggerhead sea turtle nesting. Renourishment can cause beach compaction, which can decrease loggerhead nesting success, alter nest chamber geometry, and alter nest concealment, and nourishment can create escarpments, which can prevent turtles from reaching nesting areas (Crain *et al.* 1995). Nourishment can decrease survivorship of eggs and hatchlings by altering characteristics such as sand compaction, moisture content, and temperature of the sand (Leonard Ozan 2011), all of which are variables that can affect the proper development of eggs. The success of incubating eggs may be reduced when the sand grain size, density, shear resistance, color, gas diffusion rates, organic composition, and moisture content of the nourished sand is different from the natural beach sand (Nelson 1991). Negative impacts from beach renourishment include decreases in nesting activity and decreases in hatching success due to the use of incompatible material, sand compaction, and suboptimal beach profile (NMFS and USFWS 1991).

Sea turtles may be impacted by construction on beaches or dredge equipment, especially when work takes place outside the environmental window for sea turtles. During the spring and summertime construction phase of the Bald Head Island terminal groin, an adult female was trapped inside the construction zone for one day and a nest was destroyed when it was dug up by construction equipment (Sarah Finn pers. com. 2015). Pipeline and other obstructions placed on the beach may obstruct hatchling emergences or impede their path to the ocean (NMFS and

USFWS 1991). Hopper and cutterhead dredges may also kill sea turtles during dredge work (NMFS and USFWS 1991). The loggerhead sea turtle recovery plan emphasizes that the only beneficial impacts of nourishment are in cases where beaches are so highly eroded, there is “a complete absence of dry beach” (NMFS and USFWS 1991).

The DEIS does not address the impacts to sea turtles should beach renourishment intervals turn out to be similar to those at other North Carolina inlets with hardened structures, rather than at the four-year intervals it forecasts. Nesting activity on nourished beaches decreased for one to three years following a nourishment event due to changes in the sand compaction, escarpment, and beach profile (NMFS and USFWS 1991, Steinitz *et al.* 1998, Trindell *et al.* 1998, Rumbold 2001, Brock *et al.* 2009). The DEIS also does not address the impacts to sea turtle nesting should the east end of Holden Beach experience downdrift erosion that would narrow the beach west of the groin where nesting occurs. The loggerhead recovery plan does include these negative impacts: “In preventing normal sand transport, these structures accrete updrift beaches while causing accelerated beach erosion downdrift of the structures [groins and jetties] (Komar 1983, Pilkey *et al.* 1984, National Research Council 1987), a process that results in degradation of sea turtle nesting habitat” (NMFS and USFWS 1991).

Impacts on Fishes: Fishes would be negatively impacted by the construction of a terminal groin and the subsequent beach nourishment projects at Lockwood Folly Inlet in the following ways: 1) the groin would interrupt larval transport through the inlet, therefore impacting recruitment; 2) the native fish community would be replaced with a completely different structure-associated fish community; and 3) surf zone fishes would suffer from direct mortality. Hard structures reduce the successful passage of fish larvae from the open ocean to the estuarine nurseries they inhabit until reaching maturity (Hettler and Barker 1993, Pilkey *et al.* 1998). Inlets are critical pathways for adult fishes to get to offshore spawning sites and larvae immigrate through inlets to get to estuarine nurseries (Able *et al.* 2010).

Many surf zone fishes are larval and juvenile individuals that benefit from the shallow water nursery habitat because it provides refuge from predators and foraging areas (Layman 2000). Due to their early weak swimming ontogenetic stage, fish larvae are not adapted for high mobility in response to habitat burial or increased turbidity levels. Studies have shown that beach nourishment degrades the important swash-zone feeding habitat for both probing shorebirds and demersal surf fishes (Quammen 1982, Manning *et al.* 2013, VanDusen *et al.* 2014). Surf habitats with hardened structures typically support a different community of fishes and benthic prey. Impacted species would include Atlantic menhaden, striped anchovy, bay anchovy, rough silverside, Atlantic silverside, Florida pompano, spot, Gulf kingfish, and striped mullet. Florida pompano and Gulf kingfish use the surf zone almost exclusively as a juvenile nursery area and as juveniles, they are rarely found outside the surf zone (Hackney *et al.* 1996). The dominant benthic prey for pompano and kingfish were coquina clams (*Donax*) and mole crabs (*Emerita*). Despite the fact that fishes in the surf zone are adapted to a high energy environment, rapid changes in their habitat can still cause mortality and other negative impacts. **There are documented negative impacts of renourishment on some of the invertebrates (especially mole crabs and coquinas) that are major foods of the fishes (Reilly 1978, Baca *et al.* 1991); therefore, negative impacts could be indirectly transferred to the surf zone fish community.**

Manning *et al.* (2013) states:

Beach nourishment can degrade the intertidal and shallow subtidal foraging habitats for demersal surf fishes by three major processes: (1) inducing mass mortality of macrobenthic infaunal prey through rapid burial by up to 1 m or more of dredged fill materials; (2) modifying the sedimentology of these beach zones through filling with excessive proportions of coarse, often shelly sediments that are incompatible with habitat requirements of some important benthic invertebrates, such as beach bivalves; and (3) incorporating into the beach fill excessive quantities of fine sediments in silt and clay sizes, which can induce higher near-shore turbidity during periods of erosion as onshore winds or distant storms generate wave action, thereby inhibiting detection of prey by visually orienting fishes. The opinion repeated in many environmental impact statements and environmental assessments that marine benthic invertebrates of ocean beach habitats are well adapted to surviving the sediment deposition of beach nourishment because of evolutionary experience with frequent erosion and deposition events associated with intense storms and high waves is unsupportable. A recent review of the literature on impacts of storms on ocean-beach macrofauna (Harris et al. 2011) reveals that about half the studies report massive reductions of beach infaunal populations after storms.

Conclusion: A unique ecological community exists at Lockwood Folly Inlet that is connected to the base of the food chain. The base of the food chain (infaunal community) requires 1-4 years to recover from a nourishment event, and that has not been the case at the East End beach. If the base of the food chain is absent or largely absent due to nourishment activities every two years, then the organisms that consume them, like birds and fishes, will not be present either. The DEIS fails to make this connection.

Alternatives 1, 3, 4, 5, and 6 as presented in the DEIS would negatively impact birds, as well as infauna, fishes, and sea turtles.

The DEIS omits the vast majority of the ample body of scientific literature that is available to describe the well-known and accepted physical impacts of terminal groins and beach fill. It then fails to accurately describe the direct, indirect, and cumulative impacts that these activities would have on biological resources within Lockwood Folly Inlet, particularly the Piping Plover. Instead, adverse impacts to Piping Plovers, Red Knots, and other bird species are largely dismissed or ignored. The best, most recent data and peer-reviewed literature available to assess those impacts are omitted or misrepresented, and the recommendations of multiple management and recovery plans, including USFWS recovery plans, are largely disregarded.

Alternatives 1, 3, 4, 5, and 6 as presented in the DEIS would jeopardize the recovery and/or persistence of the Great Lakes breeding population of Piping Plover, the Atlantic coast breeding population of Piping Plover, Seabeach Amaranth, and Red Knot; and a terminal groin would permanently eliminate habitats for these species listed under the Endangered Species Act without any chance of restoration or reformation in other areas. The alternatives in the DEIS that involve hard structures or channelization (Alternatives 4, 5, and 6) at Lockwood Folly Inlet should be permanently removed from further consideration and other alternatives should be considered.

Alternative 2, as presented in the DEIS, is the only alternative in the DEIS that can and should be considered. We urge the Corps to reject all other alternatives presented in the DEIS and consider non-destructive, long-term and economically feasible solutions for the Town of Holden Beach.

Thank you for the opportunity to comment on this important project. Please do not hesitate to contact me if you have questions or concerns.

Sincerely,

Walker Golder
Deputy Director

Attachment 1

A Fiscal Analysis of Shifting Inlets and Terminal Groins in North Carolina

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Executive Summary

North Carolina contains some of the most unique and biologically rich coastal ecosystems in the United States, providing immeasurable aesthetic, habitat, recreational and economic benefits. In order to successfully - and equitably - balance long-term environmental and sustainability needs with short-term economic development concerns, state and local coastal management policies, rules and laws must be both technically and fiscally-sound.

Nowhere is this more evident than at North Carolina's tidal inlets where these dynamic natural features, once used to lure economic development, are now considered the primary threat to the very development they were used to attract.

In response to the risk shifting inlets pose to static economic development, NC coastal communities and property owners typically rely on three mechanisms to protect vulnerable coastal property: 1) Beach restoration 2) Inlet channel realignment and 3) Sandbags.

Beach restoration involves the import and emplacement of sand on an eroding beach in order to artificially stabilize inlet and ocean shorelines. Inlet channel realignment modifies the position and orientation of an inlet's main ebb channel in an effort to reduce impacts and erosion rates along adjacent shorelines. Sandbags are a temporary measure intended to provide short-term protection to imminently threatened structures until a more "permanent" solution can be implemented.

A fourth approach, now being actively promoted by some in North Carolina, is the use of terminal groins: shore-perpendicular erosion control structures made of rock or steel placed at the ends of islands near dynamic coastal inlets.

Session Law 2009-479 in 2009 instructed the NC Coastal Resources Commission (CRC) to study the feasibility and advisability of terminal groins as erosion control devices. The study, completed in April 2010 at a cost of $280,000, included an assessment of the potential economic impacts of shifting inlets to the state, local governments and the private sector from erosion due to shifting inlets, but failed to provide compelling evidence regarding the economic or fiscal benefits of terminal groins.

As a follow-up to that study, the Program for the Study of Developed Shorelines (PSDS) at Western Carolina University examined the economic role of coastal property at ten North Carolina tidal inlets (Bogue, New River, New Topsail, Rich, Mason, Carolina Beach, Cape Fear, Lockwood Folly, Shallotte and Tubbs) to evaluate the potential fiscal costs of property loss as well as fiscal benefits of terminal groins in ten coastal municipalities (Emerald Isle, North Topsail Beach, Topsail Beach, Wrightsville Beach, Carolina Beach, Bald Head Island, Caswell Beach, Oak Island, Holden Beach and Ocean Isle Beach), five coastal counties (Carteret, Onslow, Pender, New Hanover and Brunswick) and one private island (Figure 8 Island).

Based on this study, PSDS has determined that:

1) Assessed value does not reflect the potential fiscal impacts of shifting inlets to the state or local governments from erosion due to shifting inlets,
2) The fiscal benefits of protecting property at-risk to shifting inlets are small compared to the costs of protection,
3) The use of terminal groins would provide limited fiscal and economic benefits to state taxpayers and local communities and
4) Long-term costs of a terminal groin exceed potential long-term benefits at every developed NC inlet.

This analysis indicates that, even ignoring environmental concerns, terminal groins are not a fiscally-sound strategy for dealing with coastal property at-risk to shifting inlets and, due to their limited fiscal benefits, the expenditure of state funds for groin construction/maintenance is bad public policy.

1) Assessed value does not accurately reflect the fiscal contribution investment property at-risk to shifting inlets makes to North Carolina's coastal municipal and county economies

According to the CRC terminal groin study, the purpose of the economic assessment component of the study was to assess economic value within areas around developed inlets called 30-year risk areas (30 YRAs) that contain a level of risk approximately equal to the risk indicated by setbacks in adjacent oceanfront areas, as well as the economic value of properties in 30 YRAs having temporary sandbag protection (Table 1).

Table 1: North Carolina 30-Year Risk Areas

1. Emerald Isle/Bogue Inlet	8. Bald Head Island/Cape Fear Inlet
2. North Topsail Beach/New River Inlet	9. Caswell Beach/Cape Fear Inlet
3. Topsail Beach/New Topsail Inlet	10. Oak Island/Lockwood Folly Inlet
4. Figure 8 Island/Rich Inlet	11. Holden Beach/Lockwood Folly Inlet
5. Figure 8 Island/Mason Inlet	12. Holden Beach/Shallotte Inlet
6. Wrightsville Beach/Mason Inlet	13. Ocean Isle Beach/Shallotte Inlet
7. Carolina Beach/Carolina Beach Inlet	14. Ocean Isle Beach/Tubbs Inlet

A number of components of economic value within these 30 YRAs were considered including residential property, commercial property, government property, road infrastructure, waterline infrastructure, sewer infrastructure, property tax base and revenues and recreation and environmental value. The greatest potential economic impact of shifting inlets, according to the CRC study, is to residential property, which the study quantifies in terms of assessed value.

But an economic assessment that focuses almost exclusively on assessed coastal property value - the dollar value of an asset assigned by a public tax assessor for the purposes of taxation - is misleading because changes in value do not accurately reflect actual fiscal impacts coastal counties, municipalities and the state may experience as a result of shifting inlets.

Taxation or, more specifically, ad valorem tax revenue based on assessed value and generated by residential property, does, however, reflect the potential fiscal impacts various levels of government may experience due to shifting inlets along the North Carolina coast.

Ad valorem taxes comprise an average of about 57% of all revenue collected by North Carolina coastal county and municipal governments (Table 2). From the perspective of a public entity such as a coastal municipality or county, the potential loss of ad valorem (and to a similar extent occupancy and sales) tax revenue generated by at-risk residential coastal property represents an accurate and meaningful way to quantify the tangible costs of shifting inlets.

Table 2: NC Coastal Municipal and County Ad Valorem Tax Revenue

Jurisdiction	Budget Year	General Fund (GF) Revenue	Ad Valorem Tax Revenue	Ad Valorem Tax Revenue as a % of GF Revenue
Bald Head Island	FY 2010/11	$8,246,160	$6,815,618	83%
Carolina Beach	FY 2009/10	$8,203,250	$4,125,000	50%
Caswell Beach	FY 2010/11	$1,011,618	$547,000	54%
Emerald Isle	FY 2010/11	$7,016,691	$3,437,423	49%
Holden Beach	FY 2009/10	$2,417,773	$1,507,023	62%
Kill Devil Hills	FY 2009/10	$12,035,612	$5,278,985	44%
Kitty Hawk	FY 2009/10	$5,721,795	$2,476,750	43%
Kure Beach	FY 2010/11	$2,891,452	$1,538,914	53%
Nags Head	FY 2009/10	$11,292,993	$4,490,743	40%
North Topsail Beach	FY 2010/11	$3,339,166	$1,903,186	57%
Oak Island	FY 2010/11	$11,341,185	$6,472,902	57%
Ocean Isle Beach	FY 2010/11	$4,156,762	$2,349,000	57%
Sunset Beach	FY 2009/10	$4,748,773	$2,213,468	47%
Surf City	FY 2010/11	$5,887,153	$3,120,586	53%
Topsail Beach	FY 2010/11	$2,092,670	$1,314,690	63%
Wrightsville Beach	FY 2008/09	$7,722,822	$2,644,346	34%
Brunswick County	FY 2010/11	$136,232,066	$100,331,000	74%
Carteret County	FY 2010/11	$74,918,385	$43,290,000	58%
Currituck County	FY 2010/11	$44,028,000	$24,936,000	57%
Dare County	FY 2010/11	$99,244,631	$49,309,278	50%
New Hanover County	FY 2010/11	$253,919,849	$158,778,525	63%
Onslow County	FY 2010/11	$163,799,539	$70,261,500	43%
Pender County	FY 2009/10	$49,261,230	$30,238,766	61%
Municipal and County Combined Total		**$919,529,575**	**$527,380,703**	**57%**

Ad valorem tax rates for coastal municipalities and counties adjacent to a developed coastal inlet in North Carolina are $.1559/$100 and $.4455/$100 respectively (Table 3). <u>The loss of a residential coastal property assessed at $1 million, therefore, would result in an annual loss of $6,014 in ad valorem tax revenue [$1,000,000/100 * (.1559 +.4455)] - or just 0.6% of the property's $1 million assessed value.</u>

Table 3: NC Coastal Municipal and County Ad Valorem Tax Rates

Municipality	FY 2010-11 Tax Rate
Bald Head Island	0.2700
Carolina Beach	0.1750
Caswell Beach	0.1300
Emerald Isle	0.0800
Holden Beach	0.0690
North Topsail Beach	0.2355
Oak Island	0.1400
Ocean Isle Beach	0.0900
Topsail Beach	0.3100
Wrightsville Beach	0.0800
AVERAGE	**0.1559**

County	FY 2010-11 Tax Rate
Brunswick County	0.3050
Carteret County	0.2300
New Hanover County	0.4525
Onslow County	0.5900
Pender County	0.6500
AVERAGE	**0.4455**

According to the CRC study, 1,983 residential properties with an assessed value of about $1.4 billion are within the state's fourteen 30 YRAs. While losing all at-risk properties is unlikely, the potential fiscal impact to North Carolina's coastal municipalities and counties would be $7,127,087 - the combined local and county ad valorem tax revenue these properties currently generate but would not in the future (Table 4). Over 30 years, using a discount rate of 3% and price appreciation rate of 5%, the loss of 1,983 at-risk coastal properties would result in a loss of ad valorem tax revenue totaling about $292 million - or about 25% of assessed value.

Table 4: Properties "At-Risk" to Shifting Inlets

Municipality	Year	Total Ad Valorem Tax Revenue Collected	"At-Risk" Properties	Ad Valorem Tax Revenue Generated by At-Risk Properties
Bald Head Island	FY 2010/2011	$6,815,618	323	$1,017,647
Carolina Beach	FY 2009/2010	$4,125,000	39	$60,776
Caswell Beach	FY 2010/2011	$547,000	100	$135,483
Emerald Isle	FY 2010/2011	$3,437,423	96	$71,560
Figure 8 Island	N/A	N/A	114	N/A
Holden Beach	FY 2009/2010	$1,507,023	343	$207,756
North Topsail Beach	FY 2010/2011	$1,903,186	376	$157,356
Oak Island	FY 2010/2011	$6,472,902	102	$181,335
Ocean Isle Beach	FY 2009/2010	$2,349,000	124	$54,931
Topsail Beach	FY 2010/2011	$1,314,690	184	$103,165
Wrightsville Beach	FY 2008/2009	$2,644,346	182	$83,863
		$31,116,188	**1983**	**$2,073,872**
County				
Brunswick County	FY 2010/2011	$100,331,000	992	$2,705,286
Carteret County	FY 2010/2011	$43,290,000	96	$205,735
New Hanover County	FY 2010/2011	$158,778,525	335	$1,531651
Onslow County	FY 2010/2011	$70,261,500	376	$394,224
Pender County	FY 2009/2010	$30,238,766	184	$216,313
		$402,899,791	**1983**	**$5,053,209**
Total Ad Valorem Tax Revenue generated by properties in 30 YRA				**$7,127,087**

The use of assessed value grossly overstates the value of coastal property at risk to, and the potential fiscal impacts of, shifting inlets, thereby resulting in the misperception that much more is at risk than actually is.

Using ad valorem tax revenue rather than assessed value provides a pragmatic approach for evaluating the true value of “at-risk” properties as well as estimating the potential fiscal impact state, county and municipal economies could experience as a result of shifting inlets.

An issue that should be considered when evaluating the value of coastal property at risk to shifting inlets, but not discussed in the CRC report or this white paper, is the contribution public policies and actions such as state and federally-subsidized insurance and shore protection projects make to assessed values and, ultimately, ad valorem tax revenue.

2) The fiscal benefits of protecting investment property at-risk to shifting inlets are small compared to the costs of protection

While ad valorem, sales and occupancy tax revenue is critical for maintaining the economic viability of coastal North Carolina, an analysis of 30 YRAs at ten NC tidal inlets shows that the contribution residential properties at-risk to shifting inlets make to North Carolina’s coastal municipal and county economies is insignificant.

Table 5 shows the contribution residential property at risk to shifting inlets makes at the municipal and county level. While coastal counties have more than twice the amount of ad valorem tax revenue at risk than coastal municipalities ($5,053,216 vs. $2,073,872), the relative importance of ad valorem tax revenue generated by at-risk property is greater for municipalities than counties. For example, the total loss of all at-risk residential properties in the Caswell Beach/Cape Fear 30 YRA would eliminate $135,483 - nearly 25% of the municipal ad valorem tax revenue collected by Caswell Beach. Brunswick County’s loss of $317,865 in county ad valorem tax revenue - 2.3 times more than Caswell Beach – represents only 0.32% of its ad valorem tax revenue.

Table 5: Assessed Value of, and Ad Valorem Tax Revenue Generated by, At-Risk Coastal Properties by 30 YRA

Community	County	Inlet	Assessed Value of At-Risk Property	2010 Municipal Ad Valorem Tax Revenue Generated by At-Risk Properties	2010 County Ad Valorem Tax Revenue Generated by At-Risk Properties
Bald Head Island	Brunswick	Cape Fear	$310,732,000	$1,017,647	$947,733
Carolina Beach	New Hanover	Carolina Beach	$34,729,000	$60,776	$161,664
Caswell Beach	Brunswick	Cape Fear	$104,218,000	$135,483	$317,865
Emerald Isle	Carteret	Bogue	$89,450,000	$71,560	$205,735
Figure 8	New Hanover	Rich	$163,186,000	N/A	$759,631
Figure 8	New Hanover	Mason	$46,408,941	N/A	$216,034
Holden Beach	Brunswick	Lockwood Folly	$27,240,000	$18,796	$83,082
Holden Beach	Brunswick	Shallotte	$273,855,000	$188,960	$835,258
North Topsail Beach	Onslow	New River	$66,817,693	$157,356	$394,224
Oak Island	Brunswick	Lockwood Folly	$109,900,000	$181,335	$335,195
Ocean Isle Beach	Brunswick	Shallotte	$25,069,000	$22,562	$76,460
Ocean Isle Beach	Brunswick	Tubbs	$35,966,000	$32,369	$109,696
Topsail Beach	Pender	New Topsail	$33,279,000	$103,165	$216,314
Wrightsville Beach	New Hanover	Mason	$84,710,027	$83,863	$394,325
			$1,405,560,661	**$2,073,872**	**$5,053,216**

Of the ten municipalities with a 30 YRA, only three have more than 10% of their ad valorem tax base in a 30 YRA: Caswell Beach: 24.8%, Bald Head Island: 14.9% and Holden Beach: 12.5%. The remaining municipalities have an average of 3.2% of their ad valorem tax base in a 30 YRA. No coastal county has more than 1% of its ad valorem tax base in a 30 YRA (Table 6).

Table 6: The Contribution of At-Risk Coastal Properties to Ad Valorem Tax Revenue by 30 Year Risk Area

Community	Inlet	County	2010 Municipal Ad Valorem Tax Revenue Generated by At-Risk Properties	% of Municipal Ad Valorem Tax Revenue At-Risk	2010 County Ad Valorem Tax Revenue Generated by At-Risk Properties	% of County Ad Valorem Tax Revenue At-Risk
Bald Head Island	Cape Fear	Brunswick	$1,017,647	14.9%	$947,733	0.96%
Carolina Beach	Carolina Beach	New Hanover	$60,776	1.5%	$161,664	0.10%
Caswell Beach	Cape Fear	Brunswick	$135,483	24.8%	$317,865	0.32%
Emerald Isle	Bogue	Carteret	$71,560	2.1%	$205,735	0.46%
Figure 8	Rich	New Hanover	N/A	N/A	$759,631	0.48%
Figure 8	Mason	New Hanover	N/A	N/A	$216,034	0.14%
Holden Beach	Lockwood Folly	Brunswick	$18,796	1.2%	$83,082	0.08%
Holden Beach	Shallotte	Brunswick	$188,960	12.5%	$835,258	0.85%
North Topsail Beach	New River	Onslow	$157,356	8.3%	$394,224	0.54%
Oak Island	Lockwood Folly	Brunswick	$181,335	2.8%	$335,195	0.34%
Ocean Isle Beach	Shallotte	Brunswick	$22,562	1.0%	$76,460	0.08%
Ocean Isle Beach	Tubbs	Brunswick	$32,369	1.3%	$109,696	0.11%
Topsail Beach	New Topsail	Pender	$103,165	7.8%	$216,314	0.70%
Wrightsville Beach	Mason	New Hanover	$83,863	3.2%	$394,325	0.25%
			$2,073,872		**$5,053,216**	

In order to provide an assessment of the current or imminently at-risk property due to potential erosion from shifting inlets, the CRC study identified properties having temporary sandbag protection. These properties are considered at imminent risk, rather than at risk over a 30-year period. Properties located immediately adjacent to erosion control sandbag locations, or between two nearby sandbag locations, were considered to be Imminent Risk Properties (IRPs). Sandbag locations on ocean facing or inlet-facing beaches within the 30 YRAs were considered to be inlet IRPs.

Of the state's 1,983 properties within a 30 YRA, 204 (10.3%) are classified as an inlet IRP (Table 7). These properties have an assessed value of $89.6 million and generate $445,767/year in municipal ($102,244) and county ($343,523) ad valorem tax revenue (Table 8).

Table 7: Imminent Risk Properties Within 30-Year Risk Areas

Community	Inlet	County	At-Risk Properties	Imminent Risk Properties (IRP)	IRPs as a % of At-Risk Properties
Bald Head Island	Cape Fear	Brunswick	323	22	6.8%
Carolina Beach	Carolina Beach	New Hanover	39	0	0.0%
Caswell Beach	Cape Fear	Brunswick	100	0	0.0%
Emerald Isle	Bogue	Carteret	96	13	13.6%
Figure 8 Island	Rich	New Hanover	89	16	18.0%
Figure 8 Island	Mason	New Hanover	25	0	0.0%
Holden Beach	Lockwood Folly	Brunswick	150	32	21.3%
Holden Beach	Shallotte	Brunswick	193	0	0.0%
North Topsail Beach	New River	Onslow	376	37	9.8%
Oak Island	Lockwood Folly	Brunswick	102	0	0.0%
Ocean Isle Beach	Shallotte	Brunswick	85	24	28.2%
Ocean Isle Beach	Tubbs	Brunswick	39	3	7.7%
Topsail Beach	New Topsail	Pender	184	57	31.0%
Wrightsville Beach	Mason	New Hanover	182	0	0.0%
		TOTAL	**1983**	**204**	**10.3%**

Table 8: Summary of Imminent Risk Properties (IRP)

# Imminent Risk Properties (IRP)	204
% of all Properties in 30 YRA that are IRP	10.3%
Assessed Value of IRPs	$89,610,211
2010 Municipal Tax Revenue generated by IRPs	$102,244
2010 County Tax Revenue generated by IRPs	$343,523
Total 2010 Tax Revenue generated by IRPs	$445,767

As table 9 shows, the loss of all imminent risk properties, a more plausible scenario than the loss of all at-risk properties, would result in an insignificant loss of municipal and county ad valorem tax revenue in every 30 YRA:

- Bald Head Island has $35,920 in municipal ad valorem tax revenue at imminent risk in the Bald Head Island/Cape Fear 30 YRA – the most of any NC coastal municipality. This amount, however, represents only 0.55% of the town's total ad valorem tax revenue.
- New Hanover County has $120,881 in county ad valorem tax revenue considered in imminent risk in the Figure 8/Rich 30 YRA – the most of any NC coastal county. This amount represents only 0.08% of the ad valorem tax revenue collected by the county in 2010.
- Topsail Beach is the only municipality with more than 1% of its ad valorem revenue classified as being in imminent risk. Pender County is the only county with even 0.1% of its ad valorem tax revenue in imminent risk.

Table 9: Contribution of IRPs to Ad Valorem Tax Revenue by 30 Year Risk Area

Community	Inlet	County	2010 Municipal Ad Valorem Tax Revenue Generated by IRPs	% of Municipal Ad Valorem Tax Revenue in Imminent Risk	2010 County Ad Valorem Tax Revenue Generated by IRPs	% of County Ad Valorem Tax Revenue in Imminent Risk
Bald Head Island	Cape Fear	Brunswick	$35,920	0.55%	$33,452	0.03%
Carolina Beach	Carolina Beach	New Hanover	$0	0.00%	$0	0.00%
Caswell Beach	Cape Fear	Brunswick	$0	0.00%	$0	0.00%
Emerald Isle	Bogue	Carteret	$11,500	0.34%	$33,062	0.07%
Figure 8	Rich	New Hanover	$0	0.00%	$120,881	0.08%
Figure 8	Mason	New Hanover	$0	0.00%	$0	0.00%
Holden Beach	Lockwood Folly	Brunswick	$12,024	0.79%	$53,152	0.05%
Holden Beach	Shallotte	Brunswick	$0	0.00%	$0	0.00%
North Topsail Beach	New River	Onslow	$6,863	0.35%	$17,193	0.02%
Oak Island	Lockwood Folly	Brunswick	$0	0.00%	$0	0.00%
Ocean Isle Beach	Shallotte	Brunswick	$2,312	0.10%	$7,835	0.01%
Ocean Isle Beach	Tubbs	Brunswick	$5,760	0.24%	$19,520	0.02%
Topsail Beach	New Topsail	Pender	$27,865	2.11%	$58,428	0.19%
Wrightsville Beach	Mason	New Hanover	$0	0.00%	$0	0.00%
			$102,244		**$343,523**	

3) The use of terminal groins would provide limited fiscal and economic benefits to state taxpayers and local coastal communities

Because the CRC study leaves the efficacy of constructing terminal groins at developed North Carolina inlets unresolved, it is difficult to accurately quantify the long-term fiscal benefits terminal groins may or may not produce over a period of 30 years.

It is possible, however, to make two assumptions about terminal groins based on the study:

1. All IRPs in North Carolina will be lost over the next 30 years without terminal groins and
2. If they work intended, terminal groins may protect IRPs for the next 30 years.

Because the effectiveness of terminal groins beyond IRPs is highly uncertain, IRPs represent at-risk coastal properties most likely to benefit from terminal groins and the continued generation of municipal and county ad valorem tax revenue by IRPs within 30 YRAs is the primary fiscal benefit of constructing a terminal groin in a 30 YRA.

In the Ocean Isle Beach/Shallotte Inlet 30 YRA, for example, the primary annual benefit of constructing a terminal groin is $10,147 - the combined municipal and county ad valorem tax revenue currently generated by 24 IRPs in this 30 YRA. Over 30 years, using a discount rate of 3% and price appreciation rate of 5%, the primary fiscal benefit of constructing a terminal groin in Ocean Isle Beach at Shallotte Inlet is $415,633 (Table 10).

Table 10 shows that the estimated annual primary fiscal benefit of constructing a terminal groin in each of the state's 30 YRAs is $445,767. Over 30 years, using a discount rate of 3% and price appreciation rate of 5%, the primary fiscal benefit of constructing terminal groins in all 30 YRAs (even though six have no IRPs) is $18,259,148. Note that this table includes only municipal and county ad valorem tax revenue due to the small number of impacted properties (204) and limited contribution of other revenue sources.

Table 10: Primary Fiscal Benefit of a Terminal Groin by 30 Year Risk Area

Community	Inlet	County	2010 Municipal Ad Valorem Tax Revenue Generated by IRPs	2010 County Ad Valorem Tax Revenue Generated by IRPs	2010 Combined Ad Valorem Tax Revenue Generated by IRPs	NPV of Ad Valorem Tax Revenue Generated by IRPs Over 30 Years
Bald Head Island	Cape Fear	Brunswick	$35,920	$33,452	$69,372	$2,841,560
Carolina Beach	Carolina Beach	New Hanover	$0	$0	$0	$0
Caswell Beach	Cape Fear	Brunswick	$0	$0	$0	$0
Emerald Isle	Bogue	Carteret	$11,500	$33,062	$44,562	$1,825,313
Figure 8	Rich	New Hanover	$0	$120,881	$120,881	$4,951,430
Figure 8	Mason	New Hanover	$0	$0	$0	$0
Holden Beach	Lockwood Folly	Brunswick	$12,024	$53,152	$65,176	$2,669,687
Holden Beach	Shallotte	Brunswick	$0	$0	$0	$0
North Topsail Beach	New River	Onslow	$6,863	$17,193	$24,056	$985,362
Oak Island	Lockwood Folly	Brunswick	$0	$0	$0	$0
Ocean Isle Beach	Shallotte	Brunswick	$2,312	$7,835	$10,147	$415,633
Ocean Isle Beach	Tubbs	Brunswick	$5,760	$19,520	$25,280	$1,035,499
Topsail Beach	New Topsail	Pender	$27,865	$58,428	$86,293	$3,534,664
Wrightsville Beach	Mason	New Hanover	$0	$0	$0	$0
			$102,244	**$343,523**	**$445,767**	**$18,259,148**

4) Long-term costs of a terminal groin exceed potential long-term benefits at every developed NC inlet

The CRC study estimates the initial cost of constructing a 1,500-foot terminal groin, similar in size to the structure currently at Fort Macon, to be $10,850,000 with total annual maintenance costs of about $2,250,000. Using a 3% discount rate and price appreciation rate of 5%, the estimated total cost of constructing and maintaining one terminal groin in North Carolina over 30 years is approximately $54,950,993.

This amount is more than ten times greater than the potential long-term fiscal benefit of constructing a groin at Figure 8/Rich Inlet ($4,951,430) and about three times greater than the combined long-term benefit of constructing terminal groins at all fourteen 30 YRAs ($18,259,148).

Given the CRC study and an evaluation of other terminal structures, a scenario in which terminal groins protect only IRPs over a 30-year period is rational. However, due to uncertainty in the efficacy of terminal groins, PSDS also assessed a “best-case” scenario in which the benefits of terminal groins extend to every at-risk property within every 30 YRA for 30 years.

In this scenario, long-term costs are projected to exceed potential long-term benefits (measured by the continued generation of ad valorem tax revenue) in every 30 YRA except Bald Head Island/Cape Fear (Table 11). It should be noted that the potential fiscal benefits of constructing and maintaining a terminal groin at Bald Head Island over a period of 30 years are split almost equally between Bald Head Island ($41,684,034) and Brunswick County ($38,820,273).

Table 11: Estimated "Best-Case" Fiscal Benefit of a Terminal Groin by 30 Year Risk Area

Community	Inlet	County	2010 Municipal Ad Valorem Tax Revenue Generated by all At-Risk Properties	2010 County Ad Valorem Tax Revenue Generated by all At-Risk Properties	2010 Total Ad Valorem Tax Revenue Generated by all At-Risk Properties	NPV of Ad Valorem Tax Revenue Generated by all At-Risk Properties Over 30 Years
Bald Head Island	Cape Fear	Brunswick	$1,017,647	$947,733	$1,965,380	$80,504,307
Carolina Beach	Carolina Beach	New Hanover	$60,776	$161,664	$222,440	$9,111,408
Caswell Beach	Cape Fear	Brunswick	$135,483	$317,865	$453,348	$18,569,674
Emerald Isle	Bogue	Carteret	$71,560	$205,735	$277,295	$11,358,334
Figure 8	Rich	New Hanover	N/A	$759,631	$759,631	$31,115,391
Figure 8	Mason	New Hanover	N/A	$216,034	$216,034	$8,849,010
Holden Beach	Lockwood Folly	Brunswick	$18,796	$83,082	$101,878	$4,173,044
Holden Beach	Shallotte	Brunswick	$188,960	$835,258	$1,024,218	$41,953,190
North Topsail Beach	New River	Onslow	$157,356	$394,224	$551,580	$22,593,374
Oak Island	Lockwood Folly	Brunswick	$181,335	$335,195	$516,530	$21,157,684
Ocean Isle Beach	Shallotte	Brunswick	$22,562	$76,460	$99,022	$4,056,059
Ocean Isle Beach	Tubbs	Brunswick	$32,369	$109,696	$142,065	$5,819,152
Topsail Beach	New Topsail	Pender	$103,165	$216,314	$319,479	$13,086,241
Wrightsville Beach	Mason	New Hanover	$83,863	$394,325	$478,188	$19,587,150

Discussion

Assessed property values do not reflect the potential costs of shifting inlets to coastal municipalities, counties or the state. Ad valorem tax revenue generated by at-risk coastal property represents a more realistic and accurate way to quantify the potential fiscal impacts a North Carolina coastal county or municipality might expect as a result of shifting inlets.

The assessed value of 1,983 properties at-risk to shifting inlets in North Carolina is approximately $1.4 billion. Losing every at-risk property, however, would translate into an annual loss of $7,127,087 in county and municipal ad valorem tax revenue – a figure that is 0.5% of assessed value. Over 30 years, using a discount rate of 3% and price appreciation rate of 5%, the NPV of this statewide loss is $292 million.

While $7,127,087 in annual lost ad valorem tax revenue seems significant, it represents less than 5% of municipal ad valorem tax revenue and 0.37% of county ad valorem tax revenue collected by NC coastal communities and counties containing a developed in 2010.

Of the state's 1,983 at-risk properties, 204 are classified as Imminent Risk Properties (IRPs). These properties represent 0.45% of coastal municipal ad valorem tax revenue and 0.04% of coastal county ad valorem tax revenue collected in 2010.

IRPs also represent the primary beneficiaries of terminal groins, and the continued generation of ad valorem tax revenue by IRPs resulting from the emplacement of terminal groins can be used to quantify the potential fiscal benefits of terminal groins.

Using IRPs as a proxy to estimate the impacts of terminal groins, annual municipal benefits range from $0 in seven locations (Carolina Beach/Carolina Beach Inlet, Caswell Beach/Cape Fear Inlet, Figure 8/Rich Inlet, Figure 8/Mason Inlet, Holden Beach/Shallotte Inlet, Oak Island/Lockwood Folly Inlet and Wrightsville Beach/Mason Inlet) to $35,920 in Bald Head Island.

Annual County benefits using IPRs as a proxy range from $0 in six locations (Carolina Beach/Carolina Beach Inlet, Caswell Beach/Cape Fear Inlet, Figure 8/Mason Inlet, Holden Beach/Shallotte Inlet, Oak Island/Lockwood Folly Inlet and Wrightsville Beach/Mason Inlet) to $120,881 in Figure Eight Island.

The NPV of ad valorem tax revenue generated by IRPs and assumed to be protected by a terminal groins over 30 years, using a discount rate of 3% and price appreciation rate of 5%, ranges from $0 in six locations (Carolina Beach/Carolina Beach Inlet, Caswell Beach/Cape Fear Inlet, Figure 8/Mason Inlet, Holden Beach/Shallotte Inlet, Oak Island/Lockwood Folly Inlet and Wrightsville Beach/Mason Inlet) to $4,951,430 at Figure Eight Island/Rich Inlet.

The annual fiscal benefit of constructing and maintaining a terminal groin at every developed NC inlet, in terms of protecting municipal and county ad valorem tax revenue generated by IRPs, is $445,767. The NPV of this ad valorem tax revenue over 30 years, using a discount rate of 3% and price appreciation rate of 5%, is $18,259,148.

When the protective benefits of terminal groins are extended to all 1,983 at-risk properties, the NPV potential fiscal benefits (over the next 30 years) range from about $4 million at Ocean Isle Beach/Shallotte Inlet to about $80.5 million at Bald Head Island/Cape Fear.

The cost of constructing and maintaining one terminal groin in North Carolina over 30 years, using a discount rate of 3% and price appreciation rate of 5%, is estimated by the NC CRC to be $54,900,993. When put in proper context, the cost of constructing and maintaining a terminal groin exceeds potential fiscal benefits at every North Carolina inlet.

Summary of Findings

- Assessed property value is not an accurate metric for quantifying the fiscal impacts of chronic erosion and coastal storm impacts and should not be used to justify the expenditure of public funds for erosion control measures.
- A fiscal analysis of tax revenue impacts to NC coastal municipalities, counties and the state is a sound methodology by which to evaluate the potential impacts of shifting inlets as well as potential costs and benefits of constructing and maintaining terminal groins.
- The average annual fiscal impact, in terms of property tax revenue, of losing a $1 million coastal property in NC is $6,014.
- The combined impact of losing a coastal property at-risk to shifting inlets in NC is about 0.6% of the property's assessed value.
- 1,983 residential coastal properties are considered at-risk to shifting inlets in NC.
- Properties at-risk to shifting inlets represent about 9% of all municipal and county ad valorem tax revenue collected coast-wide in 2010.
- Of the ten NC municipalities adjacent to a shifting inlet only Caswell Beach, Bald Head Island and Holden Beach have more than 10% of their ad valorem tax base at risk to shifting inlets. The remaining coastal municipalities have an average of 3.2% of their ad valorem tax base at-risk to shifting inlets.

- Of the 1,983 coastal properties at risk to shifting inlets, 204 (10.3%) are classified as being in imminent risk.
- Properties in imminent risk to shifting inlets represent about 0.08% of all municipal and county ad valorem tax revenue collected coast-wide in 2010.
- The CRC study estimates the cost of constructing and maintaining one terminal groin in North Carolina over 30 years to be approximately $54,950,993.
- Using IRPs as a proxy for estimating the impacts of terminal groins, annual fiscal benefits of constructing a terminal groin at every developed NC inlet is $445,767. Over 30 years, the primary fiscal benefit of constructing a terminal groin at every developed inlet is $18,259,148.
- Terminal groins are not a fiscally-sound strategy for dealing with coastal property at-risk to shifting inlets
- The limited fiscal benefits produced by terminal groins do not justify the expenditure of state funds.

North Carolina's Terminal Groins at Oregon Inlet and Fort Macon

Descriptions and Discussions

Oregon Inlet Terminal Groin

<u>Introduction/Background</u>

Oregon Inlet was created by a hurricane on September 8, 1846. The inlet separates Bodie Island to the north and Pea Island/Hatteras Island to the south (Figure 1). For the purpose of this report, Pea Island/Hatteras Island will be referred to as the Pea Island National Wildlife Refuge (PINWR).

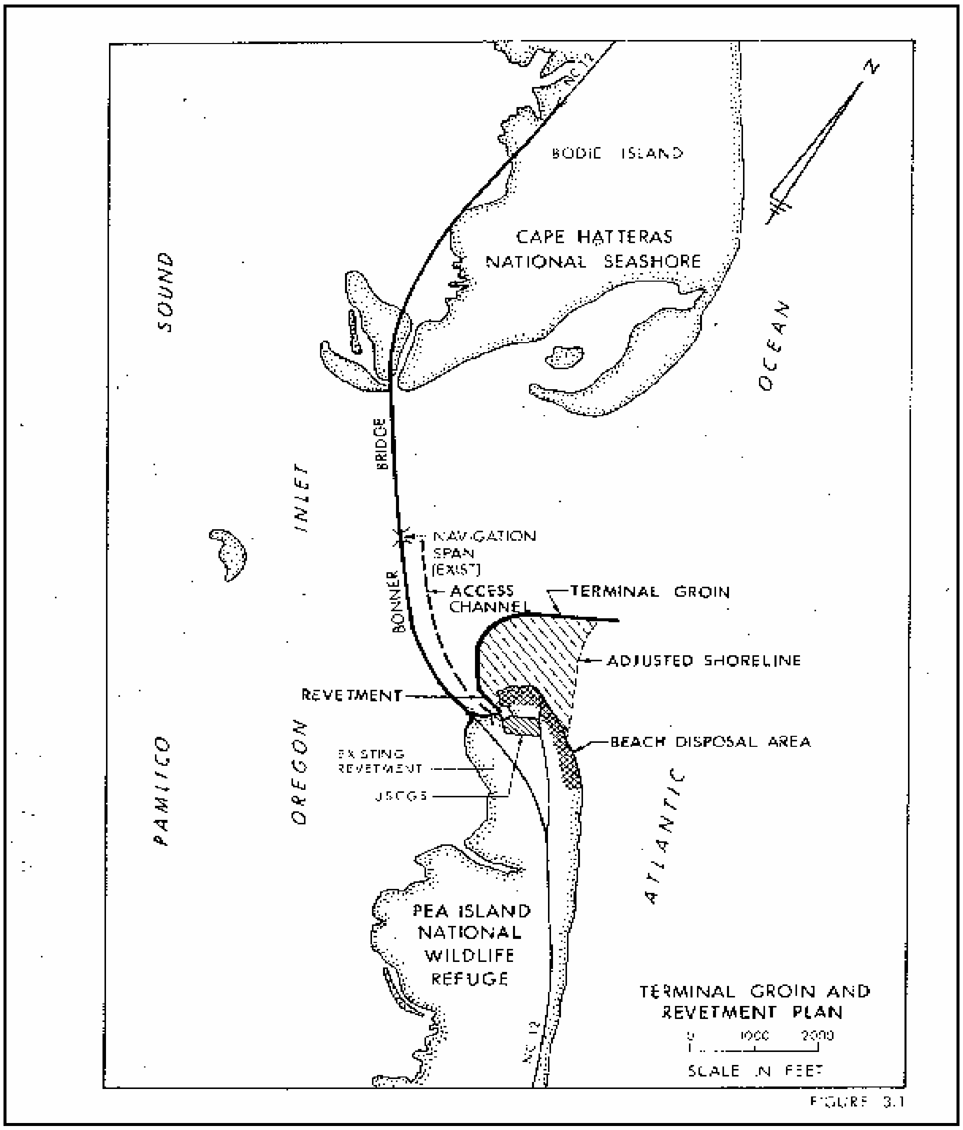

Figure 1. Location of Oregon Inlet and Terminal groin.

As with most natural tidal inlets, Oregon Inlet has had a history of dynamic change and migration since it's opening, having migrated more than 2 miles south of its original location. Because of the constantly shifting features of Oregon Inlet (Figure 2), the existing Herbert C. Bonner Bridge has been a maintenance issue for the North Carolina Department Of Transportation (NCDOT) since it was constructed in 1962. This highly turbulent area requires the US Army Corps of Engineers (USACE) to spend approximately five million dollars per year for dredging the Oregon Inlet channel. The USACE is only able to maintain the authorized 14-foot depth of the channel, on average about 25% of the time (Bill Dennis Pers Comm 2008). Shoreline change rates along both sides of the inlet are highly erosive with long-term rates of –5 ft to –17 ft/yr (Dennis and Miller 1993). The persistent southward Oregon Inlet migration has resulted in shorter-term erosion rates documented from 1981-1988, of approximately 180 ft/yr (Dennis and Miller 1993). Moreover, between April 1988 and March 1989, the erosion at the northern end of PINWR occurred at a rate of 1,150 ft/year. During one severe "nor'easter" in March 1989, the northern end of PINWR eroded 350 to 400 feet southward. This series of storms created the potential of destroying the southern abutment of the Bonner Bridge and severing the land transportation link between Bodie Island and PINWR. NCDOT data from 2002 show an average daily traffic of 5,400 vehicles per day with the highest daily traffic volume being 14,270 vehicles on Saturday, July 6. To ensure the Highway 12 transportation corridor was not lost, the USACE utilized engineering and design analysis of navigation jetties for Oregon Inlet in conjunction with the Manteo Shallowbag Bay project (NCDOT 1989) to design a terminal groin for the northern end of PINWR. The terminal groin was designed to be a portion of and incorporated into the jetties if and when they were constructed. The terminal groin construction was financed by the Federal Highway Administration with any maintenance and monitoring to be completed by the NCDOT.

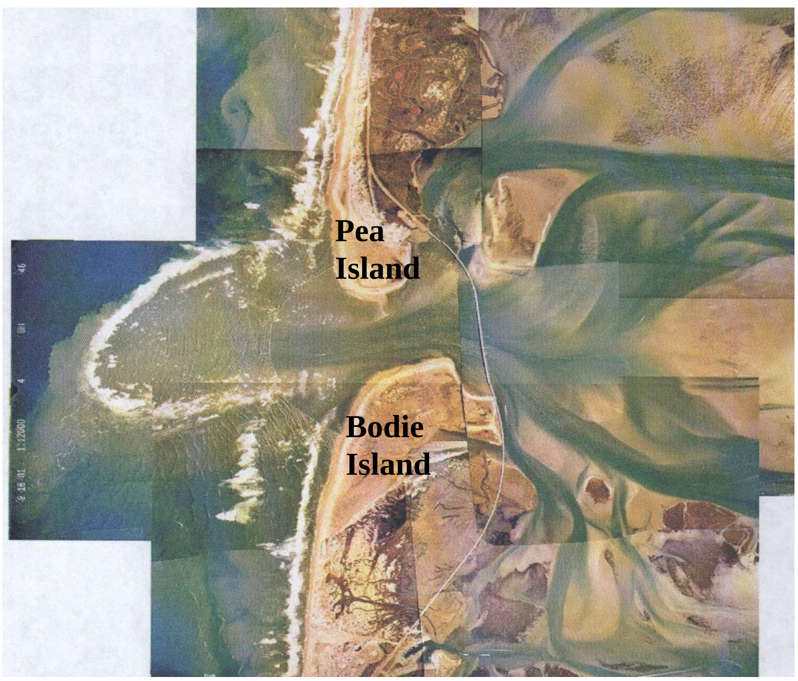

Figure 2. Dramatic aerial view of Oregon Inlet. Note the extensive sand bodies on the ocean (left) and sound side (right).

Terminal Groin Structure and Construction Description

The terminal groin at Oregon Inlet is located on the southern side of the inlet along the north end of the PINWR (Figure 1). The project consists of a terminal groin and revetment (3,125 and 625 feet long, respectively) starting at the US Coast Guard Station bulkhead. The groin extends from the bulkhead in a northwest direction, curving 90 degrees towards the northeast, and then straightening out again to be perpendicular with the natural inlet shoreline of PINWR. This alignment places the groin near the position that the north point of PINWR occupied in April 1985. An accretionary fillet was designed to impound sediment transported alongshore towards the inlet in order to provide enough wave sheltering for protection of the southern Bonner Bridge abutment. Once filled, the areal extent of this fillet was planned to be 60 acres. The groin was designed to withstand a still water level of eight feet above mean sea level (msl) and waves between 9 and 15 feet. The groin ranges in width between 110 to 170 feet at the base and 25 feet at the landward end to 39 feet at the seaward end. The design elevation ranged between 8 and 9.5 feet above msl (NCDOT 1989). Toe protection on the inlet side of the groin is provided by a 43 feet wide single layer of armor stone on top of a layer of core material (NCDOT 1989). Construction began in 1989 and was completed in October 1991 at a cost of 13.4 million dollars (1991 dollars).

The freestanding nature of the terminal groin in a position mimicking the 1985 shoreline relied on the natural coastal processes to deposit sediment along its landward (southern) side. For example, sediment transported towards the structure would begin to occupy the fillet until its design capacity was exceeded, at which point sediment would be transported around the end of the structure and towards the inlet. Therefore, the principal of a terminal groin is a temporary interruption of the sediment pathways with normal restoration of sediment pathways once the terminal groin fillet was impounded to capacity and sediment moved around the structure.

Although the net sediment transport direction at Oregon Inlet is from the north to the south, a substantial south-to-north component also exists in this area. 1992 estimates used for design and construction purposes by the USACE assumed an average northward transport (toward the inlet from PINWR) of 611,000 cubic yards with the southward transport (from Bodie Island) to be 1,473,000 cubic yards.

Terminal Groin Monitoring and Local Impacts

A monitoring program, developed by the USACE, NC DOT and the US Fish and Wildlife Service (USFWS), was required as part of the USACE permit by the Department of the Interior. Specifically the permit required that the six miles of shoreline south of the groin be monitored (Overton and Fisher 2007), and that the structure be designed to ensure that any accretion within the terminal groin fillet was not at the expense of the erosion along downdrift beach shorelines. Any adverse impacts above the historical erosion rates for this area would be mitigated by beach nourishment provided by NCDOT (Overton 2007). The monitoring program, which has been in place since construction, includes aerial photography, flown every other month and immediately after severe storms, as well as bi-annual seasonal (spring and autumn) field surveys during high tide, the NC DOT completes the flights and surveys, and the shoreline analysis is contracted to North Carolina State University (NCSU).

Whenever possible, dredged material from Oregon Inlet is to be placed on PINWR to mitigate the naturally occurring high erosion rates. Based on the most recent erosion data calculated by the North Carolina Division of Coastal Management (NCDCM), the long-term averages (50-60 years) for the 6 miles of shoreline south of the terminal groin range from 16 to 6.5 feet per year.

The quantity and disposal location(s) of sediment derived from dredging of the channel beneath the navigation span of Bonner Bridge and/or the ocean sand bar between August 31, 1989 and November 3, 2005 is shown in Table 1.

Table 1: Dredging activities for Oregon Inlet from August 31, 1989 through November 3, 2005.

Disposal Method/Location	**Quantity (cubic yards)**
Offshore	522,799
Nearshore of PINWR (1.5 miles south, 16-20 ft water depth)	2,100,390
Piped to PINWR Beaches	4,914,920
Placed on a Disposal Island	167,258
Total	7,705,367
Total possible to affect PINWR	7,015,310

Inlet Migration and Sediment Bypassing

The inlet has persistently migrated southward since it opened in 1846, albeit with considerable variability. Alternate widening and narrowing of the inlet, due to hurricanes and northeasters, have accompanied this southward movement. Moreover, the channel throat has also undergone significant changes in both position and alignment. The channel has tended to follow two basic alignments, one approximately perpendicular to the adjacent shorelines (indicative of post-storm periods), and the other a more northerly alignment almost parallel to the shore (storm-free periods) (Figure 3.) (Sheldon et al. 1992). The latter description occurs when the north shoulder of the inlet (i.e., the southern end of Bodie Island) is in the form of an elongated spit, and the channel tends to rotate towards a more northerly alignment. As the inlet alignment changes, the inlet cross-section changes as well. A narrow and deep cross-section with steep banks occurs in relatively storm-free periods, while a shallow channel with wide overbanks occurs after stormy periods.

The construction of the terminal groin at the north end of PINWR does alter the natural processes described above at Oregon Inlet. With the PINWR groin in place, the migration of the north end of PINWR has ceased because the terminal groin immobilizes the south shoulder of the inlet. Therefore, future changes in inlet widths, channel depths, and channel orientations may not be in strict accordance with established historical norms. The inlet's stability, updrift and downdrift erosion rates are highly dependent on the natural bypassing of material across the inlet. Unfortunately, with or without the terminal groin, natural bypassing is not efficient at Oregon Inlet (Miller et al. 1996). The causes for this decrease in downdrift bypassing efficiency (producing downdrift shoreline erosion) include: periodic increases of sediment immediately updrift of Oregon Inlet causing accretion along southern Bodie Island, the renewed use of hopper dredges to maintain the navigation channel across the ocean bar removing sediment out of the nearshore system; and high retention rates of sand in the sound caused by frequent water circulation changes from storms. All of these factors influence Oregon Inlet's ability to bypass sediment downdrift.

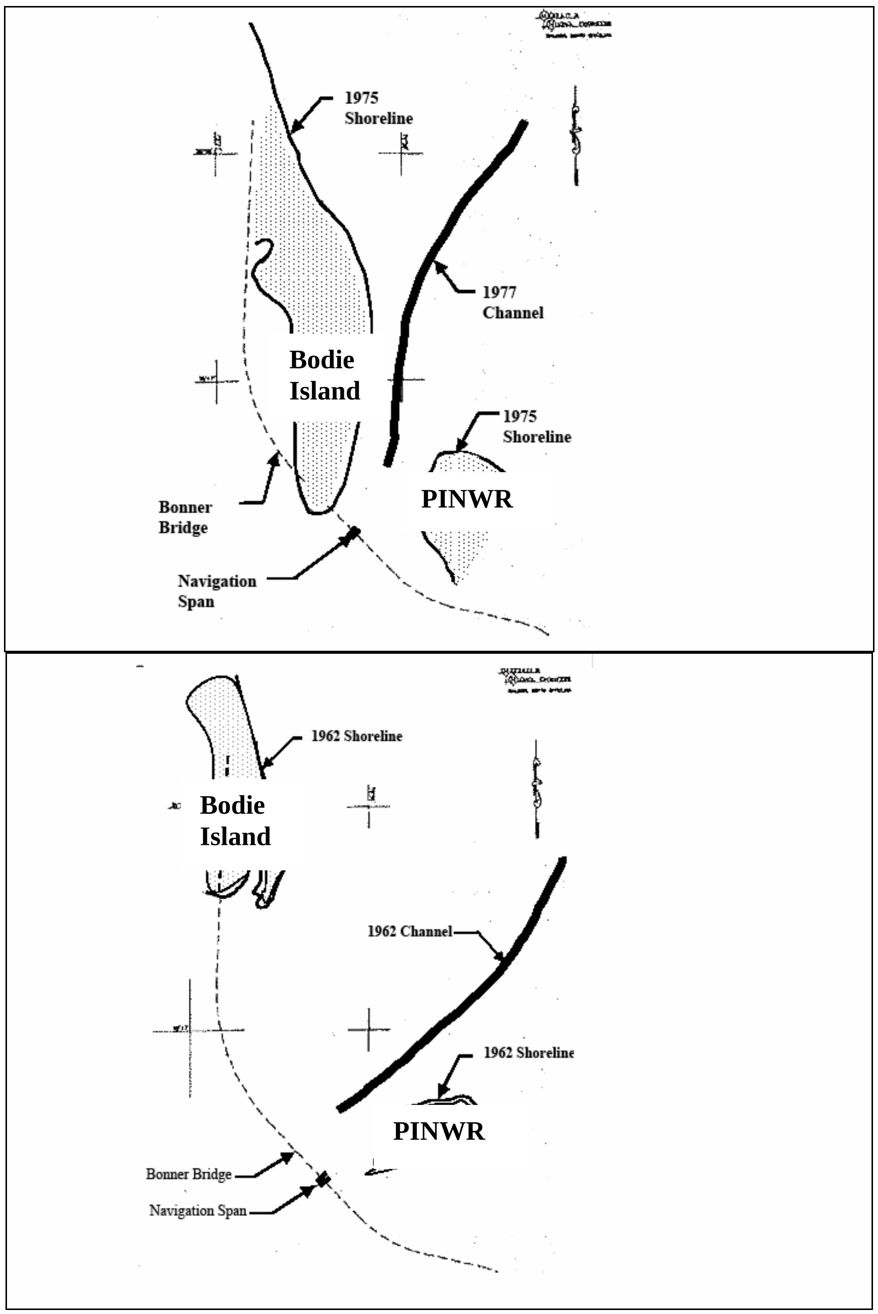

Figure 3. Top picture (1975) is indicative of pre-storm configurations of the Barrier Islands and channel orientation. Bottom picture (1962) is a typical post-storm configuration. (Sheldon et al 2000)

Shoreline Changes and Downdrift Impacts (1990-2006)

The USACE conducted a study in 1993 (Dennis and Miller 1993) of the pre- and post-construction shoreline changes in order to assess the overall impact of the terminal groin on the northern end of PINWR. The study assessed the shoreline up to four miles south of the terminal groin and reviewed five years of pre-construction and 2.5 years of post-construction data. The 50-acre fillet became impounded to capacity two years after the terminal groin entered the water (Jan 1990 to Jan 1992). This fairly short-term effect was attributed to a number of factors: (1) the fairly large south to north (toward the terminal groin) sediment transport rate of 611,000 cy/yr; (2) in the fall of 1991, the rate of northward sediment transport was greatly accelerated to 202,900 cy/month, due to two very large storms (1991 Halloween storm, and January 1992 storm); and (3) the placement of approximately 470,000 cy of fill material on to the PINWR beach from April to November of 1991. All of these factors contributed to positive impacts (i.e. oceanfront accretion) along an area that was approximately two miles south of the terminal groin. For the remaining two miles of shoreline to the south of this area, there has been no generalized trend in the shoreline response. In other words, the measured shoreline changes appear to be within the range of natural variability for this area. Similar findings over an area of six miles south of the terminal groin were reported by monitoring conducted by NCDOT (Overton, et al. 1996)

Inlet Navigation Morphological Changes

Joyner et al in 1998, conducted a study of the post-stabilization morphology of Oregon Inlet. The investigation examined data from the USACE and NCDOT programs from October 1989 through April 1997, to determine the relationship between the growth of the Bodie Island spit to the north and the resulting bathymetric changes in the inlet. This study provided insight as to the expected changes in configuration of the main inlet channel as the southern migration of Bodie Island spit approached the terminal groin along northern PINWR. Changes in the inlet's bathymetric configuration were observed in both the inlet width and orientation. Accretion of the spit on Bodie Island and the location of the terminal groin were responsible for a change in location and orientation of the main channel section. The shifting of the channel became noticeable in April 1995, which coincided with the beginning of a significant widening of the Bodie Island spit at the bridge. The shift of the channel bayward (landward) required a rotation of the inlet channel section, since the terminal groin remained fixed at the southern extent of the inlet. The inlet channel continued to move bayward and orient it self in a more northerly direction. Channel deepening also occurred along with its lateral migration. In order to maintain a constant cross-sectional area, a narrowing inlet must become deeper to accommodate the same discharge volume (also known as tidal prism). The data shows that this has happened since the terminal groin was constructed. According to Joyner et al. (1998), Oregon Inlet exhibited changes as expected with the stabilization of a single side of a tidal inlet.

Structure Maintenance

There has not been any maintenance needed to date on the Oregon Inlet terminal groin. Any maintenance that becomes necessary is to be conducted by the North Carolina Department of Transportation with potential federal funding from the Federal Highway Administration.

Summary and Conclusions

The terminal groin has stopped the southerly migration of Oregon Inlet and protected the base of the southern end of the Herbert C. Bonner Bridge. The terminal groin has impounded sediment resulting in a fillet with an approximate area of 50 acres.

The six miles of PINWR shoreline south of the terminal groin fillet that was monitored, continues to erode at rates that range from slightly more to slightly less than the pre-terminal groin shoreline erosion rates, in spite of frequent dredging and beach nourishment efforts.

Approximately 7.7 million cubic yards of sediment have been dredged from Oregon Inlet and mined from the terminal groin fillet to be either deposited on the PINWR beaches or in the nearshore ocean environment from one to six miles south of the terminal groin.

The main navigation channel has shifted laterally and has deepened to adjust to the reduced inlet width between the northern side of Bodie Island and the stabilized downdrift side of PINWR.

The consequences of this continued channel migration south are problematic for the maintenance of a navigation channel within the current fixed navigation span of the bridge, and require increased frequencies of channel dredging.

Locking an inlet in place with a terminal groin takes away the natural self-adjusting mechanisms that inlets possess (e.g., sediment bypass across the inlet, migration and depth change of the channel(s) within the inlet, shoreline migration along the inlet, changes in ebb tidal delta morphology). One of the most observable effects is the impact to sediment bypassing between the adjacent shorelines, and the exchange of sediment to the shoals that lie on the ocean side (ebb-tidal delta) and the estuarine side (flood-tidal delta). Overall, the sum of all coastal processes active within an inlet, and how these processes affect the transport and storage of sediment, are extremely important in not only how inlets function but also to the long-term survival and evolution of the barrier islands.

Over time, potentially within the next 10-20 years, and with continued southward migration of the Bodie Island spit, the main channel in Oregon Inlet may migrate against the terminal groin structure itself. If this were to occur, the result would be severe scour and an increase in the maintenance necessary to preserve the threatened integrity of the structure itself.

Beaufort Inlet/Fort Macon Terminal Groin

Introduction/Background

Beaufort Inlet has been continuously open since 1585, although the exact year of its creation is unknown (Payne 1985). Beaufort Inlet's adjacent beaches, Bogue Banks (west) and Shackleford Banks (east), are south facing beaches. The Bogue Banks area is sheltered somewhat from the damaging effects of winter extratropical nor'easters because of the very large shoal complex of Cape Lookout that lies approximately 12 miles to the east (Figure 4). Beaufort Inlet is utilized as part of the commercial navigation project connecting the Atlantic Ocean to the waterways of the NC State Ports' Morehead City (MHC) harbor and the Town of Beaufort (Figure 5). Improvements for navigation at Beaufort Inlet began in 1911 when a 300-ft wide channel was dredged through the ebb tidal shoal to a depth of –20 ft. In 1936, the outer bar channel was deepened to –30 ft and widened to 400 feet, and the channel location became fixed at this time. In 1997, the channel was dredged to -47 feet and 450 feet wide along the outer channel for approximately 2.5 miles. Interior channels and the Port of MHC are maintained at –45 ft depth. Since 1911, the navigation project channel depth and width has steadily increased, hastening the erosion along Beaufort Point (western side of inlet). Property in this area includes the historical Fort Macon, which was incorporated into the State Park system in 1924. In 2007, 1.2 million guests made the park the most visited State Park in the State. Erosion control structures have been a common occurrence adjacent to Beaufort Inlet since the construction of Fort Macon from 1829 to 1834. Around Fort Macon, there have been approximately 25 "hardened" erosion control structures including groins, breakwaters, timber cribbing, revetments, sand-fencing, and seawalls as well as numerous beach nourishment projects ("soft" erosion control). When emplaced, a hardened shoreline was deemed necessary to save Fort Macon from being lost to the sea (Figure 6).

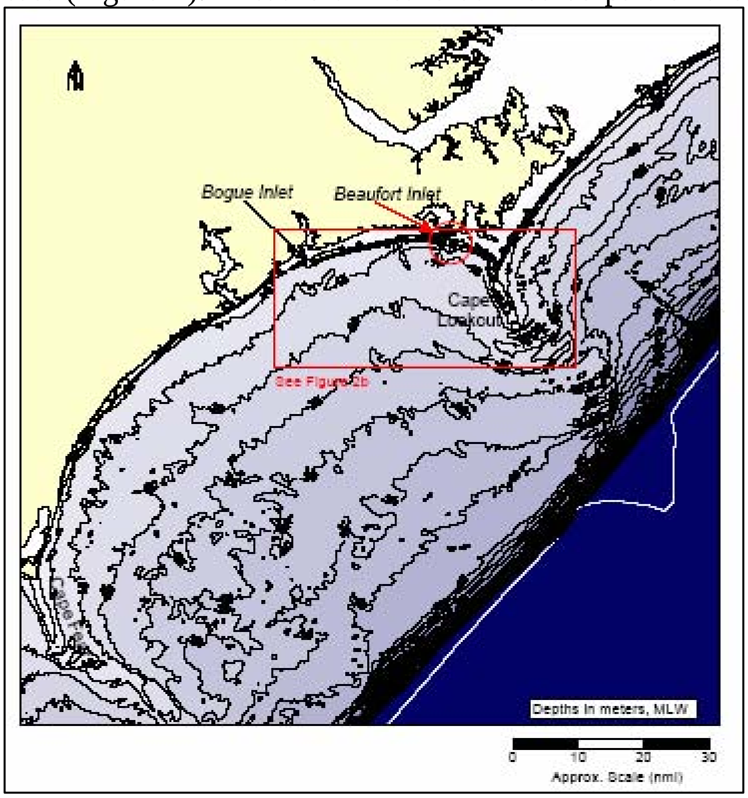

Figure 4. Location of Beaufort Inlet in proximity to Cape Lookout shoals (Olsen and Associates, 2004)

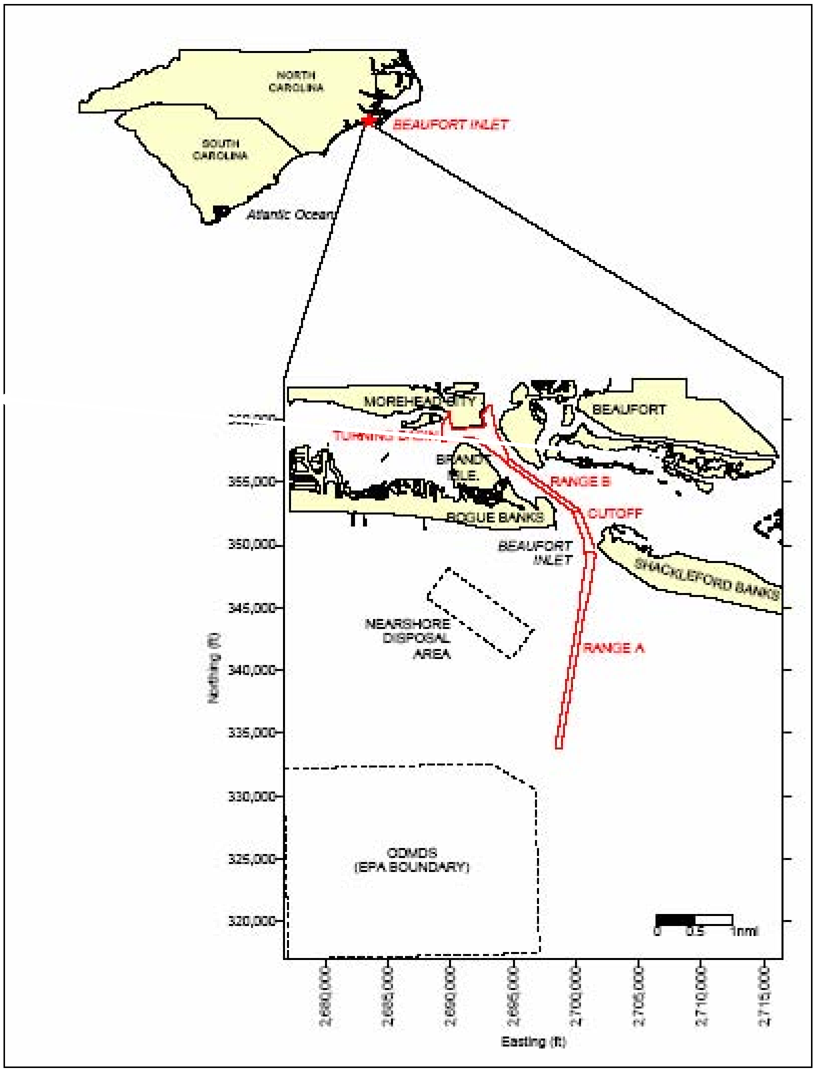

Figure 5. Location of federal navigation channel (red dotted line) in Morehead City and adjacent to Beaufort (Olsen and Associates, 2004)

Figure 6. Picture of Fort Macon terminal groin under construction from Nov 1961, and showing all the hard structures placed around the perimeter to try and offset the shoreline erosion.

In 2004, a study was prepared by Jacksonville, Florida-based Olsen Associates for Carteret County entitled "Regional Sand Transport Study: Morehead City Harbor Federal Navigation Project." A plethora of information regarding the impacts of construction and maintenance of the navigation channel on the inlet and the adjacent barrier island complex of Bogue and Shackleford banks was detailed and quantified. The pre- (prior to 1936) and post-navigation project changes in the inlet morphology and adjacent shorelines helped establish a better understanding of the active coastal processes in the area and what effect, if any, the terminal groin at Fort Macon could have in stopping this erosion. The results discussed herein are taken mostly from their report.

Structure Description and Local Impacts

The construction of the Fort Macon terminal groin, revetment, and seawall was completed in three phases. The first phase began in 1961 and featured the construction of a seawall, revetment, and a portion of the terminal groin that, due to financial constraints, was only built to a length of 720 feet at an elevation of six feet instead of nine and excluded the structure's top armor layer. The revetment (250 feet) and seawall (530 feet) were constructed along the dune bank starting just north of the present-day Fort Macon parking lot in a southeastern direction.

Phase two began in 1965 and extended the groin by an additional 410 feet oceanward. An additional groin was constructed west of the revetment due to extensive erosion on the back, or sound side, of the island and its impact to the US Coast Guard Station. Beach fill (93,000 cubic yards) was also placed on the beach between the present day bathhouse and boardwalk region and the terminal groin.

The third and final phase began in August 1970, extended the terminal groin by an additional 400 feet to a total length of 1,530 feet. A stone groin, 480 feet long, was built near the bathhouse in an effort to stabilize beach fill placed in the area. Another 100,000 cubic yards of sand was placed in the bathhouse and boardwalk area for erosion mitigation.

The total cost of the terminal groin, beach fill, seawall, and revetment was $1,348,000 (1960s dollars). The two-thirds Federal cost share was $894,000.

A study completed by the USACE Wilmington District (USACE 1970) on possible placement of jetties at Beaufort Inlet discusses the impacts of the terminal groin between 1961 and 1970. According to that report, the terminal groin was functioning somewhat as a littoral barrier, with some sand passing through voids in the structures. By 1968, the fillet was full and sand was bypassing the outer end of the structure. Erosion had continued near the boardwalk and bathhouse area (approximately 7,000 feet west of the terminal groin) and is the reason for the additional groin placement during the third phase of construction. The volume of the westward accretion of sediment that began to occur when the fillet reached capacity was not calculated by the USACE in their 1970 investigation, but was determined not to have any effect on shoaling in the Port of MHC. DCM has approximated from a series of ortho-photographs dating back from 1962 – 2004, that the shoreline has migrated seaward approximately 400 feet over the past 40 years.

Inlet Morphological Changes

Records prior to 1839 indicate that the direction of the main ebb channel within the inlet had varied from somewhat west of south to southeast (USACE 1962). The inlet channel naturally migrated between the two islands. To illustrate this point, the locations of the inlet channel from a number of time periods between 1850 and 1960 are shown in Figure 7. Sand was exchanged between the adjacent shorelines and the inlet, and bypassed across the bar. The sediment transport movement was east to west, bypassing approximately 94,000 cy/yr, and the ebb shoal gained volume at a net rate of approximately 200,000 cubic yards per year. The inlet morphology was broader in nature with a semi-symmetrical ebb tidal shoal extending out into 10 to 15 feet of water (Figure 8).

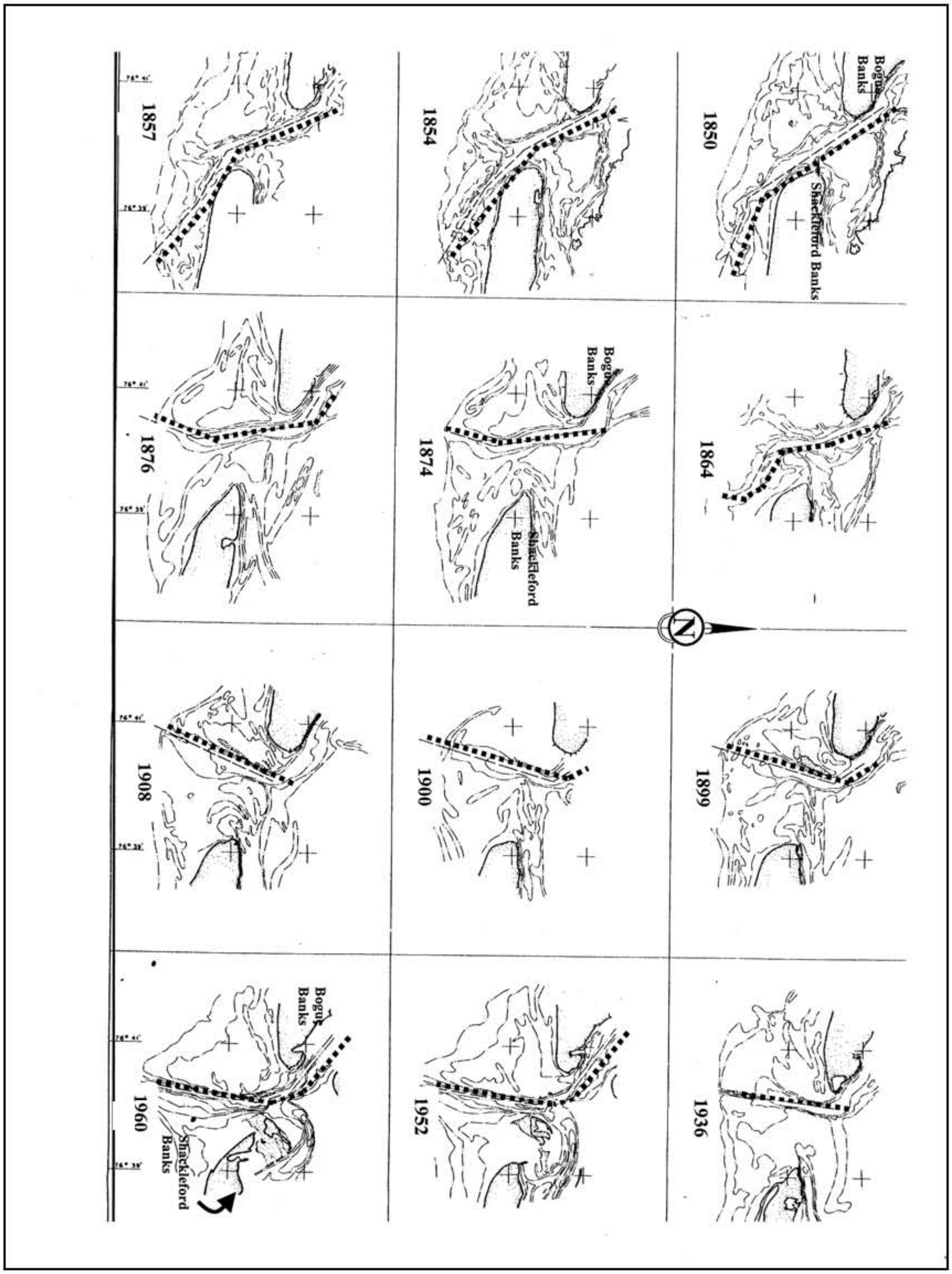

Figure 7. Various locations of the inlet channel from 1850 – 1908 (pre-project) and 1936-1960 (post project) (Modified from USACE 1962)

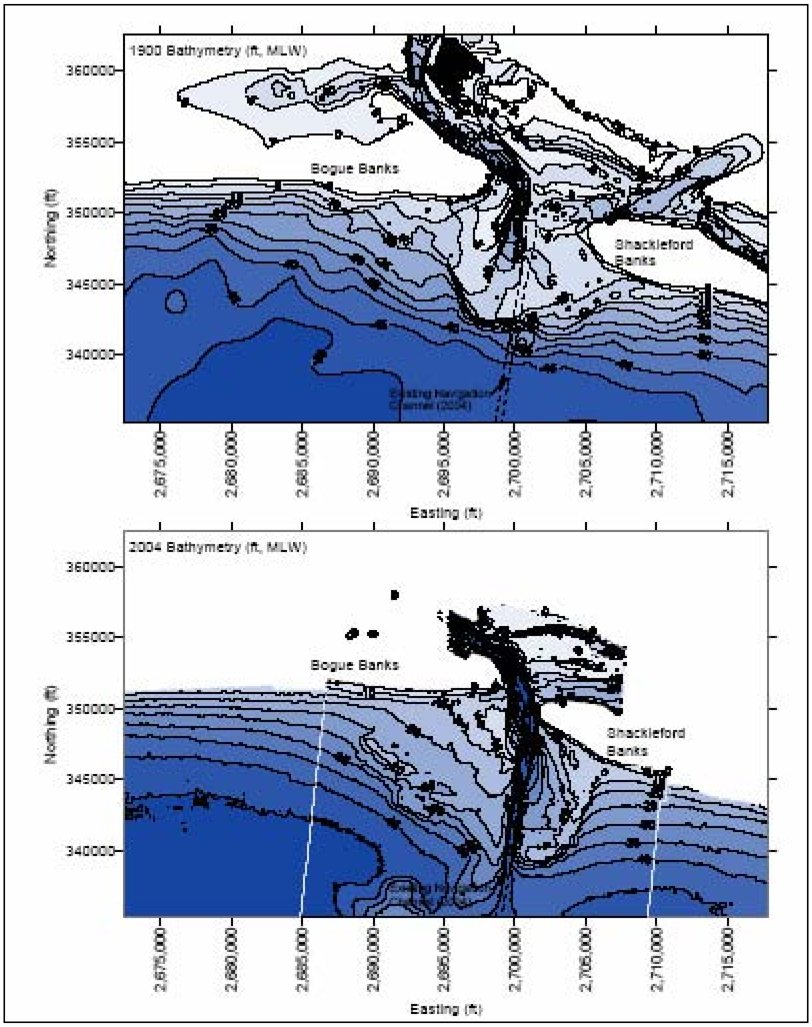

Figure 8. Differences in the shape of the inlet morphology from pre-project condition (1900) and Post project conditions (2004) (Olsen and Associates, 2004)

In contrast to the pre-project conditions (prior to 1936), the ebb tidal shoal is now much more elongated and non-symmetrical. The controlling depth through the inlet is now at 47 feet, extending seaward for approximately 2.5 miles. The seaward extent of the ebb shoal and ocean bar is influenced entirely by the seaward terminus of the navigation channel, and the channel precludes any natural sand bypassing across the inlet. The channel serves as a huge trap for any littoral material transported to the inlet from adjacent beaches. Currently, once the material is deposited into the channel it cannot be removed from the channel by natural processes, rather, it has to be removed by dredging during navigation maintenance operations. The removal of sediment from the inlet system at a volume in excess of the rate of longshore sediment transport has resulted in deflation or erosion of the ebb tide delta (USACE 2001) and deepening of the offshore beach profiles adjacent to the west side of the inlet along Bogue Banks (Figure 9; Olsen and Associates 2004).

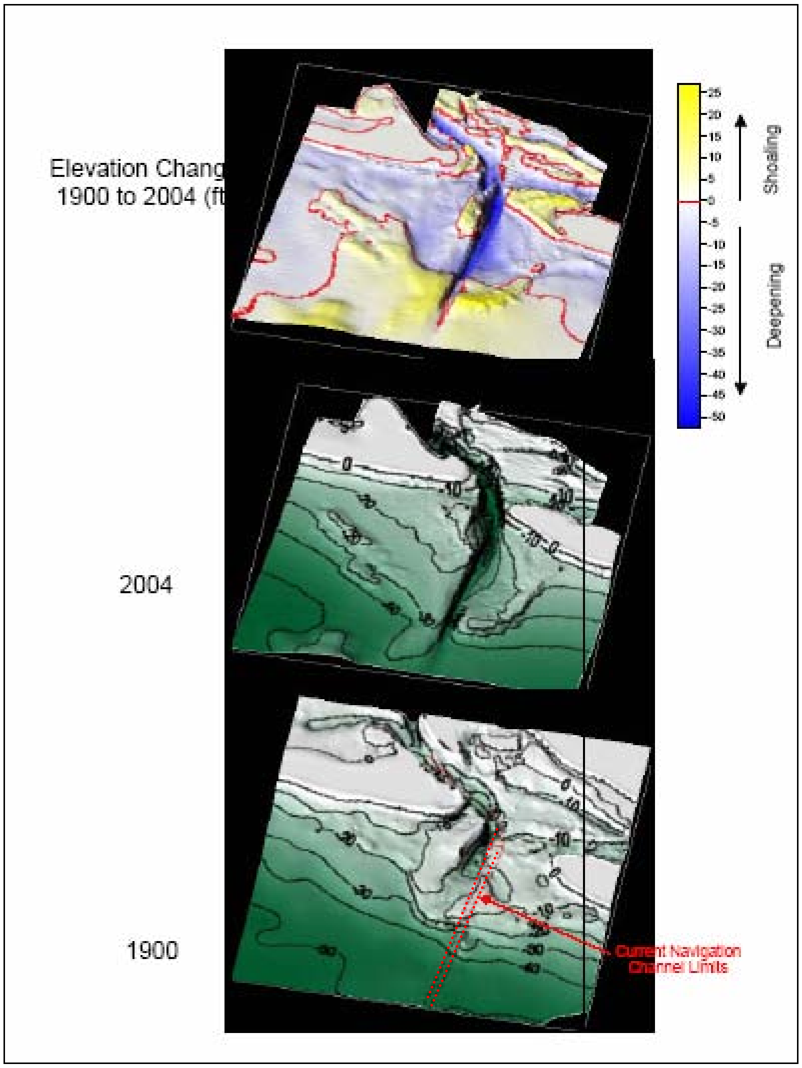

Figure 9. With the amount of material being removed from the inlet system by dredging exceeding the rate of longshore sediment transport, the result is deflation or erosion of the ebb tide delta (Olsen and Associates, 2004)

The deepening of the ebb tidal delta and offshore beach profiles has increased the wave energy along the western side of the channel along the Bogue Banks/Fort Macon area (Figure 10). This increase along Bogue Banks was three times greater than along Shackleford Banks. Future increases in wave energy are predicted, based upon the continued deflation of the ebb tidal shoal. This increase in wave energy will undoubtedly have an adverse impact on navigation and increase the wave energy within the inner harbors and sound including portions of the Rachel Carson National Estuarine Research Reserve (Olsen and Associates 2004).

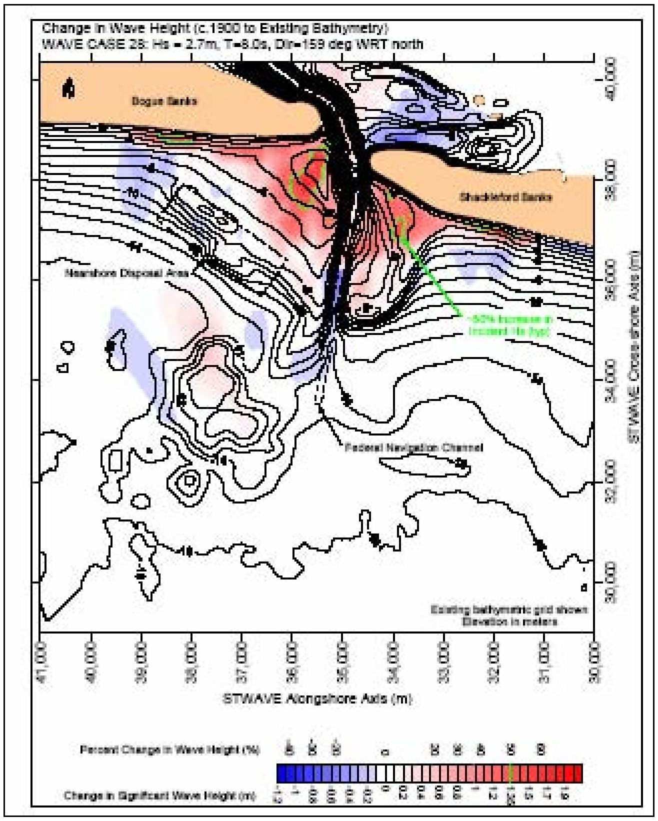

Figure 10. The deepening of the ebb tidal delta and offshore beach profiles has increased the wave energy along both sides of the channel

Sediment Transport and Shoreline Changes

The net littoral drift transport found along both Shackleford and Bogue Banks is east to west. However, at the east end of Bogue Banks, within 2.4 miles of Beaufort Inlet, there is a nodal point (a net easterly reversal) in sediment transport directed towards the inlet. The general location of this point is near the Triple S and Oceanna Piers in Atlantic Beach, although seasonal variation of its exact location occurs. The sediment that moves back towards Beaufort Inlet (east of this nodal point) is captured by the navigation channel and, thus, becomes unavailable for westward transport as it would in a natural system. This sediment deficit results in erosion on the inlet's western shoreline.

Prior to navigation improvements spanning 1876 to 1933, Beaufort Inlet was migrating in an eastward direction. During the first 40 years after navigation improvements from (i.e., 1933 to 1974), the migratory trend reversed, and Bogue Banks retreated rapidly back toward its 1876 location. Efforts were made to stabilize the inlet's eastern shoreline and protect Fort Macon with hardened structures. Between 1974 and 1994, beach disposal of inner harbor dredged material has resulted in a fairly stable Bogue Banks shoreline. Since 2004, the sand spit at Fort Macon has advanced along and into the western bank of the navigation channel inside the inlet throat, suggesting the terminal groin is now very inefficient at trapping sediment (Figures 11 and 12).

Figure 11. As nourished sand is put on the beach, the sand moves toward the inlet and through the terminal groin to just inside the western edge of Beaufort Inlet.

Figure 12. Sand spit growth showing the inability of the terminal groin to trap sediment.

Summary and Conclusions

Existing structures along Fort Macon include a terminal groin east of the fort and a relic groin field along the oceanfront and inlet throat shorelines. The low elevation and porous nature of these structures allow significant quantities of sand to be transported into the inlet resulting in persistent deposition of sand along the west bank of the inlet.

Ten years of shoreline change data (1997 to 2007) provided by Carteret County show no shoreline change along the five miles of oceanfront west of the groin. Since 2002, approximately 600,000 cubic yards were placed along this stretch of beach. This beach fill, at least in part, accounts for the “no net change” in shoreline position.

The ebb shoal deflation over time has exasperated the erosion along the Fort Macon side of the inlet. This loss of sediment volume steepened the nearshore beach profiles that, in turn, increased the wave energy reaching the coast and inner harbor area. Erosion of the shorelines adjacent to the inlet occurs as the inlet attempts to move sediment into the inlet to establish equilibrium and maintain its own sediment balance. Overall, Beaufort Inlet’s historical sediment bypassing capability, and its ability to maintain some form of stability/equilibrium with its adjacent shorelines, has been impeded, if not totally lost, by the additional trapping effect of the USACE-maintained navigation channel through the inlet.

The placement of sediment along the shoreline to the west of the inlet is still required for the Fort Macon State Park area, without which the vulnerability of Fort Macon to the forces of nature would be increased. The terminal groin and other hard structures, by themselves, would not be able to provide adequate protection to coastal hazards such as storms, tides and sea level rise. Without constant beach nourishment, the terminal groin would no longer perform as observed historically and, potentially fail altogether.

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Audubon NORTH CAROLINA

September 14, 2015

Via U.S. and Electronic Mail
Mr. Mickey Sugg
U.S. Army Corps of Engineers
69 Darlington Ave.
Wilmington, NC 28403
Mickey.T.Sugg@usace.army.mil

RE: Figure Eight Island Shoreline Management Project – SAW-2006-41158

Dear Mr. Sugg:

Please accept these comments on behalf of the National Audubon Society's North Carolina State Office regarding the draft Supplemental Environmental Impact Statement (SEIS) for the project known as "Figure Eight Island Shoreline Management Project."

The Figure 8 Island Homeowners Association Board of Director's (HOA) preferred alternative is to construct a ~1,500 foot-long terminal groin on the northern end of Figure 8 Island and to periodically renourish approximately one mile of oceanfront beach and approximately 1,500 feet of back barrier shoreline with sand obtained from adjacent Nixon Channel and three upland spoil islands located at the junction of Nixon Channel and the Atlantic Intracoastal Waterway. This alternative, as well as all other alternatives that include the construction of a terminal groin or any other hard structure (Alternatives 5A-5D), the stabilization of the inlet through channelization (Alternative 3), beach renourishment activities (Alternatives 1, 3-5D), or the dredging or other removal of sand from Rich Inlet or the associated ebb and flood tidal deltas (Alternatives 1, 3-5D) will have significant and lasting negative direct, indirect, and cumulative impacts on birds and other wildlife that depend on the dynamism of mid-Atlantic coastal inlets at critical points in their life cycles.

After reviewing the document and appendices, we find that the SEIS:

1. Fails to consider negative biological impacts of the preferred alternative and other proposed alternatives on federally listed species, state-listed species, Critical Habitat for a federally listed species, and essential habitats for state and federally listed species.
2. Fails to accurately describe the negative physical impacts of a terminal groin (Alternatives 5A-5D), beach renourishment, dredging, and inlet channelization (Alternative 3) on habitats for state and federally listed species.
3. Draws significant conclusions based on questionable models that have already failed to predict current conditions, that the SEIS itself admits should not be used to predict future

conditions, and that experts in the field have stated are being misused in this application.
4. Lacks the basic legal requirements to proceed.
5. Omits or distorts relevant, peer-reviewed, and significant research and data regarding impacts of terminal groins and other engineering practices, as proposed, on wildlife, wildlife habitats, and the physical properties of the project area; and omits the conclusions and recommendations of every relevant Threatened and Endangered species recovery plan.

We believe the SEIS does not satisfy the basic requirements of NEPA and cannot proceed, and no Final Environmental Impact Statement can be issued. Furthermore, due to the numerous, egregious errors and omissions in the SEIS, we recommend that the SEIS be rejected until such a time that the most basic information regarding the alternatives and impacts can be accurately and objectively presented for review and the legal requirements for the project to proceed have been satisfied.

We are also seriously concerned that data used throughout the SEIS and upon which many conclusions are drawn, are not available for public or peer review. For example, a report that was cited several times in the SEIS, "Cleary, W.J. 2009. Rich Inlet: History and inlet related oceanfront and estuarine shoreline changes. Final report submitted to Figure Eight Beach Homeowners Association. 61 p.", does not exist. Audubon North Carolina contacted Dr. Cleary, CP&E, USACE, and the Figure 8 Island HOA in an attempt to obtain a copy of this report, yet no one could or would produce it, even though it was stated CP&E could answer questions about the content of the report. We were informed by Dr. Cleary, the author, that the report and the data were deliberately "destroyed" when he retired.

The SEIS consistently takes the "make them go somewhere else" approach when addressing the impact of the preferred alternative and most of the other alternatives on birds. It perpetuates the common misconception that breeding and non-breeding shorebirds and waterbirds have alternative places to go when habitat is lost and that, because birds have wings, they will simply move somewhere else. Truth is, the birds are already occupying alternative locations. They have been relentlessly forced to abandon high-quality habitats throughout their range because of habitat loss and degradation. Shorebirds like Piping Plovers, as well as terns and skimmers are now confined to a small fraction of the habitat once available to them, and if alternative locations were available, the birds would already be there. This is reflected in the elevated conservation status of many of the species that depend on inlets and barrier islands, including those that depend on Rich Inlet; nearly all are state listed, federally listed, listed as species of conservation concern, or similarly designated in documents such as the U.S. Shorebird Conservation Plan (Brown *et al.* 2001).

The SEIS is a public document and transparency is essential. All data, modeling, reports, literature cited, and any other information used in preparation of the draft SEIS should be made available to the public for review and analysis. It is clear that the SEIS was not prepared by the responsible federal agency, and it is equally clear that it has not been reviewed for accuracy, environmental impacts, reasonable alternatives, or completeness. As such, the draft SEIS should be rejected.

Rich Inlet
Rich Inlet is one of approximately 20 inlets in North Carolina. It is located in southeastern North Carolina between privately developed Figure 8 Island to the south and undeveloped Hutaff Island to the north. Rich Inlet is one of the most stable inlets in the state, having **remained in the same general location for the past two centuries** (Cleary and Marden 1999). The inlet connects with the Atlantic Intracoastal Waterway through Nixon Channel on its south side and Green Channel on its north. Major features in the inlet include extensive ebb and flood tidal deltas and dynamic sandy spits at the north end of Figure 8 Island and south end of Hutaff Island, which have accreted and eroded periodically throughout its recorded history (SEIS Appendix A, Subappendix B, Cleary and Marden 1999). Rich Inlet is also one of the least modified inlets in the state; aside from periodic dredging in Nixon Channel, it has been allowed to exist naturally, unlike the majority of inlets in the state (Rice 2012a). Rich Inlet is part of the Lea-Hutaff Important Bird Area (Golder and Smalling 2011) and is within Piping Plover Critical Habitat Unit NC-11 which includes Lea-Hutaff Island and the emergent shoals and sandbars within Rich Inlet (USFWS 2001).

Private Property: Prior to addressing environmental impacts and other considerations, it is necessary to evaluate if the proposed project can be legally constructed.

Similar to the 2012 draft environmental impact statement (DEIS), the SEIS does not demonstrate that the HOA has acquired the easements necessary to construct its preferred alternative. Until such rights have been acquired, this process should be halted and public funds should cease to be used to evaluate a project that cannot legally proceed.

The preferred alternative in the DEIS was a terminal groin that crossed an estimated 15 lots, all of which are privately owned and none of which are owned by the HOA. HOAs do not have the authority to condemn property, so easements are required for construction to occur on all affected properties. Such easements on all properties were not obtained in 2012 and have not since been obtained.

In Alternative 5D, the preferred alternative in the 2015 SEIS, and Alternative 5C, the HOA relocates the terminal groin approximately 420 feet north of its original proposed position. Alternatives 5A and 5B keep the terminal groin in its original location. According to the SEIS, the change was “based upon the potential complications in obtaining all the necessary easements for constructing 5A and 5B, as some of the property owners on the extreme north end of the island were concerned about the position and alignment of Alternatives 5A and 5B” (p. 64).

An examination of the location of the terminal groin in the preferred alternative shows that the groin would still cross about 10 privately owned lots (Figure 1). There is no evidence within the SEIS that the HOA has obtained rights to construct a terminal groin across private property. Easements are only mentioned once elsewhere in the document, in order to state that “the obtaining of an easement for the construction of a terminal groin” was an issue identified in the 2007 scoping process (p. 9).

Figure 1. The terminal groin proposed in Alternative 5D and property lines obtained from New Hanover County's property tax department.

Geophysical Impacts of Terminal Groins, Other Hard Structures, and Beach Renourishment: In order to assess environmental impacts, it is necessary to accurately describe how terminal groins and other coastal engineering projects affect inlets and adjacent beaches. The SEIS fails to cite the applicable, most recent scientific literature and fails to accurately describe the impacts a terminal groin, beach renourishment, and inlet channelization would have on Rich Inlet and adjacent areas. Some of the impacts that are insufficiently addressed are the narrowing of downdrift oceanfront beach, loss of sediment from the inlet system, impacts to spits at ends of adjacent islands, loss of critical wildlife habitat, and cumulative impacts of the alternatives, among others. The model outcomes and the predicted results of the preferred alternative—a spit persisting on the north end of Figure 8 Island—are not seen at any other inlet on the U.S. Atlantic coast.

Terminal groins are designed to interrupt longshore transport of sand. It is well documented that terminal groins actually accelerate erosion of the shoreline downdrift of the structure (McDougal *et al.* 1987, Kraus *et al.* 1994, Bruun 1995, Cleary and Pilkey 1996, Komar 1998, McQuarrie and Pilkey 1998, Pilkey *et al.* 1998, Brown and McLachlan 2002, Greene 2002, USACE 2002, Morton 2003, Morton *et al.* 2004, Basco and Pope 2004, Speybroeck *et al.* 2006, Rice 2009, Riggs *et al*. 2009, Riggs and Ames 2011, Ells and Murray 2012, Knapp 2012, Pietrafesa 2012, Berry *et al.* 2013), which in turn requires regular replenishment of sand to compensate for sand loss (Hay and Sutherland 1988, Bruun 1995, McQuarrie and Pilkey 1998, French 2001, Galgano 2004, Basco 2006, Riggs *et al.* 2009, Riggs and Ames 2011, Pietrafesa 2012).

An open letter on the subject of downdrift erosion signed by 43 of the leading coastal geologists in the U.S. states:

The negative impact of groins and jetties on downdrift shorelines is well understood. When they work as intended, sand moving along the beach in the so-called downdrift direction is trapped on the updrift side, causing a sand deficit and increasing erosion rates on the downdrift side. This well-documented and unquestioned impact is widely cited in the engineering and geologic literature (Young *et al.* undated).

Fenster and Dolan (1996) found that inlets in Virginia and North Carolina exert influence over adjacent shorelines up to 5.4-13.0 km away and that they are a dominant factor in shoreline change for up to 4.3 km. Permanently modifying Rich Inlet through construction of a terminal groin, or through channelization (Nordstrom 2000), will significantly increase the erosion rate on the downdrift shoreline of Figure 8 Island. Longshore currents run predominantly north to south in the area of Figure 8 Island, placing nearly all of the oceanfront homes on Figure 8 Island in danger from accelerated erosion, should a terminal groin be built.

The SEIS forecasts a five-year interval for beach renourishment for all alternatives that include a terminal groin (Alternatives 5A-D). Despite the well-known downdrift impact of terminal groins, the SEIS does not address the very real likelihood that in response to the terminal groin, the beach will narrow farther to the south and require additional and more frequent beach renourishment over the years. The proposed five-year interval for beach renourishment is also questionable given that Wrightsville Beach, Masonboro Island, Mason Inlet, southern Figure 8 Island, Oregon Inlet, and Ft. Macon, just to name a few, are dredged and replenished more frequently than five-year intervals. **The near certainty that Figure 8 Island will need to mine sand from Rich Inlet and replenish the downdrift beach on Figure 8 Island more frequently than every five years has not been accurately assessed in the preferred or other alternatives presented in the SEIS**.

Downdrift effect can be seen elsewhere in North Carolina where terminal groins have been installed. At Fort Macon, which the SEIS cites as a success, three years after the completion of the terminal groin a beach renourishment project occurred because the groin itself was exacerbating erosion, and from 1973-2007, seven renourishment projects have occurred at Fort Macon at the cost of nearly $45 million (Pietrafesa 2012).

The SEIS also cites Oregon Inlet, NC as an example of a successful terminal groin project that has not "caused adverse impacts to the shoreline" (p. 232). One need only drive Highway 12 along Pea Island to see the fallacy of this conclusion. Riggs and Ames (2011) also provide an excellent review of the impacts of the modifications to Oregon Inlet.

The SEIS relies exclusively on one source—Overton (2011) and personal communications with Overton—to make this assertion. Recent and relevant literature is available, and the conclusions are different than those cited in the SEIS. To minimize impacts of the Oregon Inlet terminal groin on the downdrift shoreline of Pea Island, sediment from routine Oregon Inlet channel dredging has been placed either directly on the Pea Island beach or in shallow nearshore disposal area near northern Pea Island (Riggs and Ames 2011). Human efforts have only temporarily slowed the process of shoreline recession in a small portion of northern Pea Island by the regular addition of dredged sand at a very high cost, but each new beach nourishment project has quickly eroded away (Riggs and Ames 2009, Riggs *et al.* 2009). Based on several studies, the data strongly suggests that the terminal groin itself is contributing to the accelerated erosion and shoreline recession problems on Pea Island (Riggs and Ames 2003, 2007, 2009; Riggs *et al.* 2008, 2009; Mallinson *et al.* 2005, 2008, 2010; Culver *et al.* 2006, 2007; Smith *et al.* 2008).

In addition to impacts on downdrift shorelines, hard structures at inlets permanently remove sand from the inlet system, reducing or eliminating shoal systems from affected inlets (Pilkey *et al.* 1998) and accelerating the loss of saltmarsh in the vicinity of the inlet (Hackney and Cleary 1987). The loss of saltmarsh at Rich Inlet would have significant negative impacts on fisheries, other wildlife, recreation, small businesses, and the local economy. **These impacts and the loss of saltmarsh resulting from removal of sand from Rich Inlet have not been assessed for the preferred or other alternatives in the SEIS.**

The loss of ebb and flood tidal shoals is illustrated clearly by the case of Masonboro Inlet. A terminal groin was installed on the north end of Masonboro Island; construction of the groin was completed in April 1981 (Cleary and Marden 2009). At the time, the north end of the island featured an extensive sand spit, wide beach, and extensive flood and ebb tidal deltas (Figure 2). In less than one year following the completion of the terminal groin, the spit at the north end of Masonboro Island vanished, and the amount of intertidal shoals in the inlet, already diminished by other coastal engineering projects, had decreased as well (Figure 2). Downdrift of the terminal groin, Masonboro Island's oceanfront beach can be seen forming the expected fillet immediately adjacent to the terminal groin, while narrowing significantly along the downdrift beach.

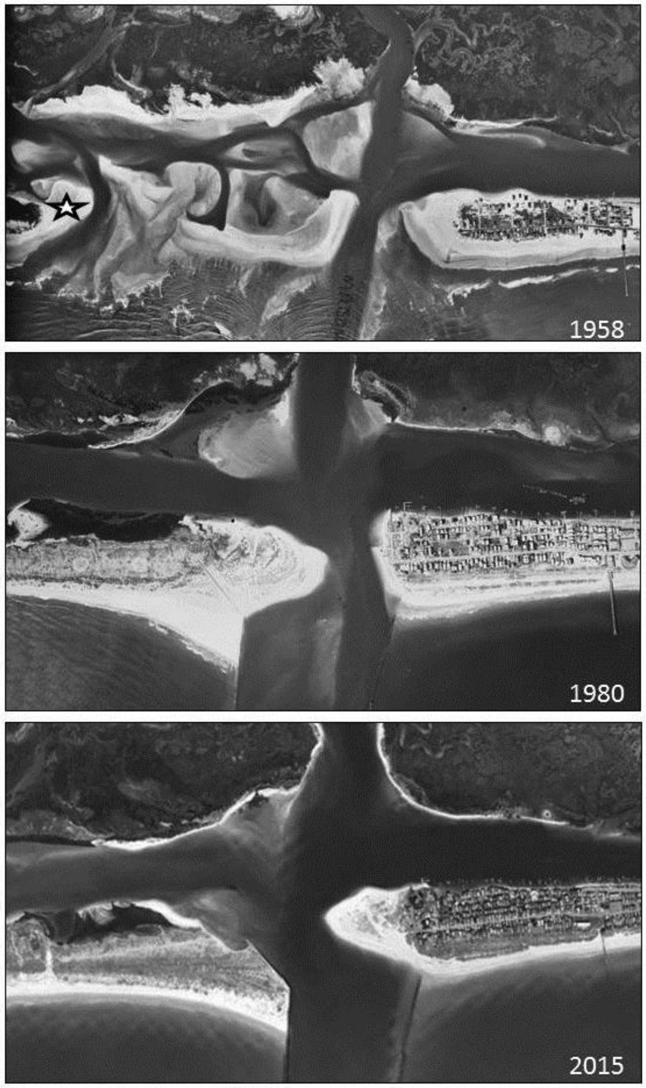

Figure 2. Masonboro Inlet before and after the installation of a terminal groin on the north end of Masonboro Island. The star represents the north end of Masonboro Island.

This situation is analogous to the proposed terminal groin on Figure 8 Island. Not only would the shoals and the sand spit be lost from the north end of Figure 8 Island, but oceanfront beach narrowing would occur downdrift of the groin, placing nearly all oceanfront homes and real estate at risk and increasing the need for more frequent beach renourishment projects.

Despite predictions of losses of shoals and other intertidal habitats in modeling for Alternatives 5A-C under 2012 conditions (see summary table on p. 202), the SEIS predicts that the result of Alternative 5D under 2012 conditions will be the persistence of a smaller spit north of the terminal groin (Figure 5.45b on p. 261). The SEIS states, "The sand spit on the north end of Figure Eight Island experienced some erosion under Alternative 5D, but the mean high water shoreline did not reach the terminal groin" (p. 261). Meanwhile, the modeling reported for Alternatives 5A-5C under 2012 conditions predict that the spit would disappear, resulting in the loss of about 35 acres of current intertidal habitat.

This is a gross underestimate of the amount of habitat that will be lost under all alternatives that include a terminal groin (Alternatives 5A-5D). **The amount of habitat that will be lost is actually approximately 241 acres of high quality habitat that supports shorebirds, including two federally-listed species, plus additional saltmarsh.** The habitat lost would be primarily low-energy shoals and sandbars which provide habitat for a variety of benthic invertebrates that are essential food for shorebirds and fishes, and the sandy spit which is prime nesting habitat. Such a loss constitutes the some of the highest quality habitat in the entire Rich Inlet complex. This disparity in the predicted fate of the spit on the north end of Figure 8 Island is not explained in the SEIS.

This calls into question the utility of the Delft3D models in predicting the responses of Rich Inlet to the placement of a terminal groin or the channelization of the inlet. In comments responding to the 2012 DEIS, experts cited "inappropriate use of models" as one of the major flaws in the document. In practice, the Delft3D models produced with 2006 data failed to accurately predict the state of the inlet in 2012. It is not clear how results that have been proven to be inaccurate can be used to assess environmental impacts, calculate costs, or make any other determinations regarding the proposed project.

Furthermore, in order to see how hard structures affect habitat in real life, we used Google Earth to examine the U.S. Atlantic and Florida Gulf coasts for inlets with one or more hard structures. We found 144 inlets with one or more hard structures; 124 had a terminal groin or a jetty. None of the 124 inlets had a spit extending from the terminal groin or jetty into the inlet as predicted in some of the Delft3D models. In addition, only 26 of the inlets with terminal groins or jetties had apparent intertidal shoals. Reality suggests that if a terminal groin is installed on the north end of Figure 8 Island, whether it is 400 feet to the north or the south, or 200 feet longer or shorter, intertidal habitat will be permanently lost, along with the spit on Figure 8 Island.

The SEIS also fails to address the cumulative impacts of sand mining and the proposed terminal groin at Rich Inlet, and the frequent sand mining at Mason Inlet, on the adjacent downdrift beach. The regular removal of sand from both inlets and the proposed terminal groin at Rich Inlet would disrupt the longshore transport of sand and potentially threaten Wrightsville Beach—the adjacent downdrift shoreline—and the real estate thereon.

There are at least 100 published studies that address the impacts of terminal groins on inlets, beaches, and natural resources. The majority (78%) of peer-reviewed literature we collected regarding the impacts of hard structures at inlets concluded that terminal groins do not function in the manner presented in the SEIS and cause more harm than good. The wealth of literature on the impacts of terminal groins is not discussed nor cited in the SEIS. A complete review of the relevant literature is necessary to accurately and objectively evaluate all alternatives presented in the SEIS.

Biological Impacts of Terminal Groins, Other Hard Structures, and Beach Renourishment:
<u>The SEIS is extraordinarily flawed in its treatment of environmental impacts to birds.</u> The SEIS fails to accurately and objectively describe the environmental impacts of the alternatives, especially the HOA's preferred alternative on birds and essential habitats for birds. In particular,

the SEIS:

- inaccurately summarizes and in some cases omits entirely the vast majority of the scientific literature that is available regarding birds;
- misrepresents, misinterprets, and otherwise fails to accurately summarize data provided by relevant agencies and organizations;
- inaccurately summarizes the direct, indirect, and cumulative impacts to state and federally listed bird species and omits key state-listed species;
- inaccurately summarizes the impacts on habitats for shorebirds, waterbirds, and other wildlife, including severe and permanent adverse impacts to the NC-11 Piping Plover Critical Habitat Unit;
- ignores and disregards the pertinent recommendations of leading scientists, including those made in U.S. Fish and Wildlife Service (USFWS) Threatened and Endangered species recovery plans;
- relies on dubious models that were not intended for this application in order to predict how habitat in Rich Inlet would respond to the alternatives; and
- presents an extraordinary number of factual errors.

Eight alternatives are presented in the SEIS. Four alternatives (5A-5D) include terminal groins that would, as described in the section above, permanently eliminate habitats for nesting, migrating, and wintering birds, and would threaten state and federally listed species. Seven alternatives (1, 3, 4, 5A, 5B, 5C, and 5D) include sand mining in Rich Inlet, primarily in Nixon Channel, that would directly and/or indirectly eliminate foraging habitat required by migrating and wintering shorebirds, threaten nesting habitat for birds, and threaten state and federally listed species. Seven alternatives (1, 3, 4, 5A, 5B, 5C, and 5D) include beach fill, in which dredged material would be placed on oceanfront beach. Placement of dredged sand would adversely impact foraging habitats used by migrating and wintering shorebirds by directly killing their prey species and removing their prey species' habitat.

Therefore, Alternatives 1, 3, 4, 5A, 5B, 5C, and 5D have significant direct, indirect, and cumulative adverse impacts on habitats used by state and federally listed species, including migrating, wintering, and nesting Piping Plovers (federally Threatened), migrating Red Knots (federally Threatened), and other species of shorebirds, as well as negative impacts on nesting terns and Black Skimmers (all beach-nesting species nesting on Figure 8 Island are state-listed with the exception of the Willet).

Natural, unmodified coastal inlets are essential to many shorebird species (sandpipers, plovers, and their allies), as well as other coastal species because they provide the variety of habitat types these species require at critical times of their annual and lifecycles. Inlets have expansive, low-energy intertidal flats which are rich with invertebrate prey that wintering and migrating shorebirds require to fuel their migratory flights, sustain them during winter, and support adults and chicks during the nesting season. Inlets have open, sandy spits that serve as resting and roosting sites that shorebirds need to rest, digest, and conserve energy; and they have open or sparsely vegetated sandy habitat that many shorebird species, as well as terns and skimmers require for nesting. (Gochfeld and Burger 1994, Thompson *et al.* 1997, Elliott-Smith and Haig

2004, Nol and Humphrey 2012).

Shorebird communities require habitat heterogeneity to meet their basic and varied fundamental needs for survival, which is why unmodified inlets containing a mosaic of habitat types are essential to sustaining shorebird communities (VanDusen *et al.* 2012). Many shorebird species breed in the far north in order to exploit the seasonal abundance of food resources and they stopover around inlets during migration in order to refuel before continuing migration (Colwell 2010). Proximity between foraging and roosting sites has been found to be a key element in determining habitat suitability and use for shorebird species such as the Piping Plover (Cohen *et al.* 2008), Dunlin (*Calidris alpina*) (Dias *et al.* 2006) and Red Knot (Rogers *et al.* 2006), and others. In short, natural inlets provide all the resources and habitats shorebirds require in a small geographic area and at the locations essential to meeting their spatial and temporal energetic needs. These resources are generally not available or not sufficient to meet the energetic needs of shorebirds at other coastal features.

Reflecting this fact, the occurrence and numbers of shorebirds that use coastal habitats in the southeastern U.S. is greater at inlets than most other coastal features. Seven shorebird species: the Threatened Piping Plover (*Charadrius melodus*) and the Threatened Red Knot (*Calidris canutus rufa*), as well as Black-bellied Plovers (*Pluvialis squatarola*), Ruddy Turnstones (*Arenaria interpres*), Snowy Plovers (*Charadrius alexandrinus*), Western Sandpipers (*Calidris mauri*), and Wilson's Plovers (*Charadrius wilsonia*) are significantly more abundant at inlets than other coastal habitats (Harrington 2008). Multiple studies support the significance of inlets to birds, designating inlets as essential habitat by Red Knots, as well as breeding and non-breeding Piping Plovers (Nicholls and Baldassarre 1990, Harrington 2008, Kisiel 2009a, 2009b, Riggs *et al.* 2009, Niles *et al.* 2010, Maslo *et al.* 2011, USFWS 2012a, 2013).

<u>Piping Plovers</u>: Piping Plovers are an excellent example of a species that relies on inlet-associated habitats throughout the year. During nesting, Piping Plovers are often associated with natural coastlines, including unmodified inlets and overwash fans. In New Jersey, Piping Plovers nest primarily near inlets, particularly those that were not stabilized with structures: 70.6% of all Piping Plover pairs nested closer to an unstabilized inlet than a stabilized inlet (Kisiel 2009a, 2009b). Piping Plovers in North Carolina also exhibit a pattern of nesting near inlets, and the majority of Piping Plover nests in Cape Hatteras National Seashore and Cape Lookout National Seashore were located near inlets (NPS 2014a, 2014b), largely because suitable nesting habitat does not exist elsewhere on the coast.

Piping Plovers spend up to nine months out of the year away from nesting grounds (Elliott-Smith and Haig 2004). During this time, Piping Plovers engage in two essential behaviors, foraging and roosting (resting). A core wintering area or stopover site must provide habitat suitable for roosting, typically backshore above the high-tide line, and foraging, typically wet sand in low-energy intertidal areas that support invertebrates such polychaetes which are an important prey item for wintering and migrating Piping Plovers (Elliott-Smith and Haig 2004).

There is a robust body of peer-reviewed scientific literature showing use of inlets and associated low-energy intertidal flats by Piping Plovers, particularly migrating or wintering Piping Plovers (Haig and Oring 1985, Johnson and Baldassarre 1988, Nicholls and Baldassarre 1990), and indicating that Piping Plovers have a small home range during the non-breeding season and use a variety of habitats throughout the tidal cycle (Drake *et al.* 2001, Rabon 2006, Cohen *et al.* 2008, Maddock *et al.* 2009). Foraging activity is strongly associated with mud or sandflats (Nicholls and Baldassarre 1990), and roost sites are most used by Piping Plovers when located within close proximity to foraging areas (Cohen *et al.* 2008). Piping Plovers also exhibit strong site fidelity both during the same year and across several years (Drake *et al.* 2001, Noel and Chandler 2006). These characteristics demonstrate that Piping Plovers depend on very specific places that with these habitats, and that these places are important year after year as the same birds return to them every migration or winter.

<u>Critical Habitat Unit NC-11 for Wintering Piping Plovers</u>: Rich Inlet and the north end of Figure 8 Island are within the NC-11 Critical Habitat Unit for wintering Piping Plovers (Figure 3). By eliminating the spit on the north end of Figure 8 Island and interfering with natural sediment transport throughout the inlet system, the preferred alternative would severely and adversely impact the Critical Habitat Unit, eliminating approximately 60% (241 acres) of the total primary constituent elements of habitat for Piping Plovers in Rich Inlet and at least 25% of all the primary constituent elements of habitat for Piping Plovers in Critical Habitat Unit NC-11. The preferred alternative, as well as Alternatives 5A-5D, would not only destroy essential foraging and roosting habitat in the Critical Habitat Unit NC-11, but also prevent such habitats from forming again. All other alternatives besides Alternative 2, would also result in negative impacts to Piping Plovers and Critical Habitat Unit NC-11.

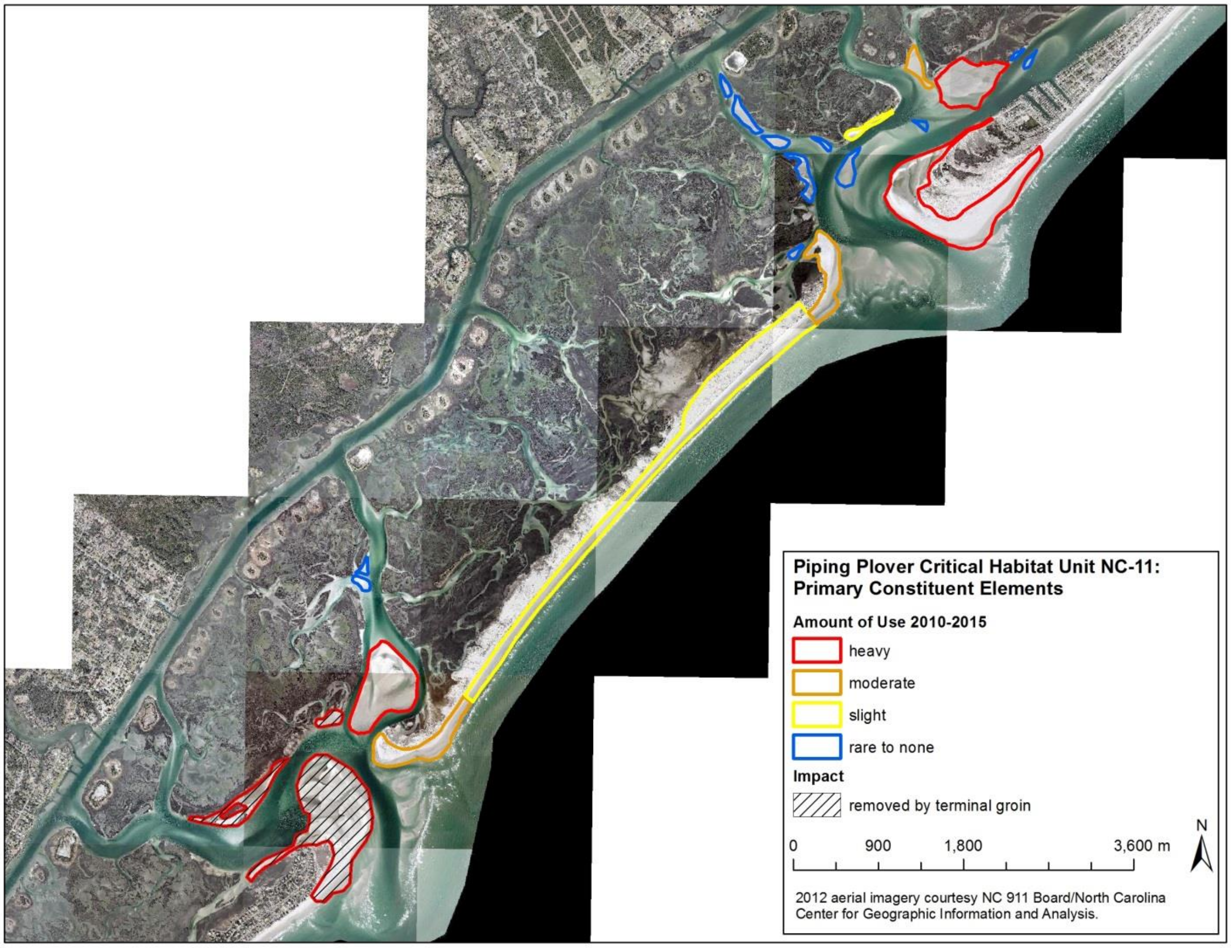

Figure 3. Primary constituent elements of habitat in NC-11 Critical Habitat Unit and rates of Piping Plover use during 2010-2015 (heavy: seen on appropriate tide approximately >75% of visits; moderate: seen on appropriate tide approximately 25%-50% of visits; slight: seen on appropriate tide approximately <25% of visits; rare to none: not seen or seen fewer than 5 visits in a year).

The NC-11 Critical Habitat Unit is described as follows:

Unit NC–11: Topsail. 451 ha (1114 ac) in Pender County and Hanover County. The entire area is privately owned. This unit extends southwest from 1.0 km (0.65 mi) northeast of MLLW of New Topsail Inlet on Topsail Island to 0.53 m (0.33 mi) southwest of MLLW of Rich Inlet on Figure Eight Island. It includes both Rich Inlet and New Topsail Inlet and the former Old Topsail Inlet. All land, including emergent sandbars, from MLLW on Atlantic Ocean and sound side to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. In Topsail Sound, the unit stops as the entrance to tidal creeks become narrow and channelized (USFWS 2001).

Critical habitat is defined the Endangered Species Act (ESA) as

the specific areas within the geographical area occupied by a species, at the time it is listed in *accordance with the provisions of section 4 of this Act, on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and (ii) specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the provisions of section 4 of this Act, upon a determination by the Secretary that such areas are essential for the conservation of the species* (Section 3 (5) (A)).

Primary constituent elements (PCEs) of critical habitat for the Piping Plover

are the habitat components that support foraging, roosting, and sheltering and the physical features necessary for maintaining the natural processes that support these habitat components. The primary constituent elements are: (1) Intertidal sand beaches (including sand flats) or mud flats (between annual low tide and annual high tide) with no or very sparse emergent vegetation for feeding. In some cases, these flats may be covered or partially covered by a mat of blue-green algae. (2) Unvegetated or sparsely vegetated sand, mud, or algal flats above annual high tide for roosting. Such sites may have debris or detritus and may have micro-topographic relief (less than 20 in (50 cm) above substrate surface) offering refuge from high winds and cold weather. (3) Surf-cast algae for feeding. (4) Sparsely vegetated backbeach, which is the beach area above mean high tide seaward of the dune line, or in cases where no dunes exist, seaward of a delineating feature such as a vegetation line, structure, or road. Backbeach is used by plovers for roosting and refuge during storms. (5) Spits, especially sand, running into water for foraging and roosting. (6) Salterns, or bare sand flats in the center of mangrove ecosystems that are found above mean high water and are only irregularly flushed with sea water. (7) Unvegetated washover areas with little or no topographic relief for feeding and roosting. Washover areas are formed and maintained by the action of hurricanes, storm surges, or other extreme wave actions. (8) Natural conditions of sparse vegetation and little or no topographic relief mimicked in artificial habitat types (e.g., dredge spoil sites) (USFWS 2008).

Of these seven PCEs, only two, salterns and artificial habitat such as dredge spoil, are not found in Rich Inlet. It is important to note that in the context above, "beaches" are oceanfront or sound side and include intertidal flats and sandbars.

The ESA requires that actions are funded, authorized, or carried out by federal agencies are "not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species" (Section 7 (a) (2)). According to the USFWS,

The key factor related to the adverse modification determination is whether, with implementation of the proposed Federal action, the affected critical habitat would remain functional (or retain the current ability for the PCEs to be functionally established) to serve its intended conservation role for the species. Activities that may destroy or adversely modify critical habitat are those that alter the physical and biological features to an extent that appreciably reduces the conservation value of critical habitat for the piping plover […]

These activities include, but are not limited to: (1) Actions that would significantly and detrimentally alter the hydrology of tidal flats. (2) Actions that would significantly and *detrimentally alter inputs of sediment and nutrients necessary for the maintenance of geomorphic and biologic processes that insure appropriately configured and productive systems. (3) Actions that would introduce significant amounts of emergent vegetation (either through actions such as marsh restoration on naturally unvegetated sites, or through changes in hydrology such as severe rutting or changes in storm or wastewater discharges). (4) Actions that would significantly and detrimentally alter the topography of a site (such alteration may affect the hydrology of an area or may render an area unsuitable for roosting). 5) Actions that would reduce the value of a site by significantly disturbing piping plovers from activities such as foraging and roosting (including levels of human presence significantly greater than those currently experienced). (6) Actions that would significantly and detrimentally alter water quality, which may lead to decreased diversity or productivity of prey organisms or may have direct detrimental effects on piping plovers (as in the case of an oil spill). (7) Actions that would impede natural processes that create and maintain washover passes and sparsely vegetated intertidal feeding habitats* (USFWS 2008).

When critical habitat was designated for wintering Piping Plovers, the USFWS specifically addressed the fact that habitats they depend upon are dynamic:

These habitat components are a result of the dynamic geological processes that dominate coastal landforms throughout the wintering range of piping plovers. These geologically dynamic coastal regions are controlled by processes of erosion, accretion, succession, and sea-level change. The integrity of the habitat components depends upon daily tidal events and regular sediment transport processes, as well as episodic, high-magnitude storm events; these processes are associated with the formation and movement of barrier islands, inlets, and other coastal landforms. By their nature, these features are in a constant state of change; they may disappear, only to be replaced nearby as coastal processes act on these habitats. Given that piping plovers evolved in this dynamic system, and that they are dependent upon these ever-changing features for their continued survival and eventual recovery, our critical habitat boundaries incorporate sites that experience these natural processes and include sites that may lose and later develop appropriate habitat components (USFWS 2001).

<u>Impact of the Proposed Project on Piping Plover Critical Habitat PCEs</u>: The HOA's preferred alternative includes actions 1, 2, 4, 5, and 7 above. As a result, all of the PCEs found in Rich Inlet would be adversely impacted by the HOA's preferred alternative, as well as by Alternatives 1, 3, 4, 5A, 5B, and 5C.

As explained above, the consequences of different management practices (e.g., dredging, beach fill, hard structures [jetties, groins, sea walls, and breakwaters], and coastal development) can lead to extensive changes in coastal and inlet habitats, resulting in a permanent loss of habitat that birds require for nesting, foraging, and roosting. Terminal groins permanently eliminate habitat that Piping Plovers rely on throughout the year and prevent the formation of new habitats. Dredging and beach nourishment cause disturbances to both borrow and placement sites and cause significant changes in habitat structure that can lead to decreased diversity and abundance in invertebrate species that shorebirds prey upon. Channelization of inlets in order to maintain a particular channel alignment has similar effects on bird habitats.

The construction of a terminal groin at Rich Inlet and alternatives that include channelization of the inlet will permanently and adversely impact critical habitat for Piping Plovers, and threaten the Endangered Great Lakes breeding population and the recovery of the Threatened Atlantic breeding population. **The USACE should not permit an action that would degrade high-quality habitat in a critical habitat unit and jeopardize either the survival or recovery of a species.**

Breeding Sites of Banded Piping Plovers Found at Rich Inlet: Piping Plovers nest in three breeding populations: the Great Plains, Great Lakes, and Atlantic coast. All Piping Plovers are considered Threatened in their non-breeding rage. The Great Lakes breeding population is Endangered, and the Atlantic coast and Great Plains breeding populations are Threatened. Banded Piping Plovers seen at Rich Inlet represent all three nesting populations. A total of 43 uniquely banded individual Piping Plovers were observed at Rich Inlet during January 2007-September 2015. These birds were banded in Michigan, South Carolina, New York, Canada, North Dakota, North Carolina, Wisconsin, Virginia, and the Bahamas and resighted throughout their breeding and non-breeding range. The greatest number of banded Piping Plovers (29 individuals) documented at Rich Inlet were from the Endangered Great Lakes breeding population; 9 were from the Atlantic coast population, 4 were from the Great Plains population, and 1, which was banded in the Bahamas, was not seen on its breeding grounds. More recently, from September 2009-September 2015, we documented 38 individuals (9 Atlantic coast, 25 Great Lakes, 3 Great Plains, and 1 unknown) (Audubon North Carolina unpublished data).

The Endangered Great Lakes breeding population consisted of between 55-73 breeding pairs from 2010-2015 (Vincent Cavalieri pers. com.), with an average of 64 pairs or 128 breeding adults. Between January 2007 and September 2015, Audubon North Carolina documented at least 29 banded individuals from the Endangered Great Lakes breeding population (Addison and McIver 2014, Audubon North Carolina unpublished data). It is highly likely that more individuals from the Great Lakes breeding population depend on Rich Inlet during migration and winter, because it is highly unlikely weekly surveys document every individual that utilizes Rich Inlet during migration, and sub-adults in the Great Lakes are banded with identical “brood marker” bands therefore distinguishing individuals is not possible. Furthermore, an estimated 5% of the Great Lakes population is not banded.

The importance of Rich Inlet to the Endangered Great Lakes breeding population of Piping Plovers cannot be overstated. Based on published rates of adult survival, juvenile survival, fledging success, and detectability, we estimate that Rich Inlet supports between 18% and 24% of the Great Lakes breeding population.

Modeling shows that Piping Plover populations in general (Calvert *et al.* 2006, Brault 2007) and the Great Lakes population in particular (Wemmer *et al.* 2000) are most sensitive to small variations in adult survivorship. In the Atlantic coast population, modeled decreases of 5% in first-year plovers and 10% in after-first-year adult plovers found high probabilities of the population going extinct within 100 years, even with a very high productivity rate of 1.5 fledglings/pair (Melvin and Gibbs 1994). The authors found such declines could be caused by one or more of several factors, including declines in availability of high-quality winter and migration habitat and increased human disturbance on wintering grounds (Melvin and Gibbs

1994). In the New England and Canadian population of Piping Plovers, modeling found that that populations' growth rate was most affected by adult annual survivorship. A 1% decline in annual adult survival would have to be offset by a 2.25% increase in productivity—an unrealistic goal—in order to prevent impacts to the population's growth rate (Brault 2007). Population growth rates modeled among eastern Canadian breeding Piping Plovers were also found to be sensitive to small changes in adult and post-fledging survival (Calvert *et al.* 2006).

Modeling specific to the Great Lakes population produced similar findings. In a habitat-based population model of the Great Lakes population, when productivity rates and habitat capacity were high, decreasing adult or fledging survivorship by 20% resulted in never achieving the recovery goal of 100 breeding pairs, and the probability of the population persisting for 100 years dropped to 0; conversely, increasing those rates by 20% resulted in 100% of model runs meeting the recovery goal (Wemmer *et al.* 2001). The authors point out that increasing productivity as well as increasing adult survival are challenging, but both are necessary for the population's survival.

Conditions on wintering grounds can impact fitness and productivity during spring migration and the subsequent nesting season, in addition to affecting survival (Fernandez *et al.* 2003, Baker *et al.* 2004, Norris *et al.* 2004, Morrison *et al.* 2007). Since adults spend the majority of the year away from nesting sites, habitat availability and quality during migration and winter are important factors in the survival and recovery of Piping Plovers, especially for the small, Endangered Great Lakes population. Adversely impacting the NC-11 Critical Habitat Unit by removing 60% of the foraging habitat, plus additional roosting habitat from Rich Inlet where significant numbers of Piping Plovers stop over and winter, and preventing any future chance of this habitat being restored, would threaten the Great Lakes population's prospect for recovery.

The five-year status review of the Piping Plover states:

The most consistent finding in the various population viability analyses (PVAs) conducted for piping plovers (Ryan et al. 1993, Melvin and Gibbs 1996, Plissner and Haig 2000, Wemmer et al. 2001, Larson et al. 2002, Calvert et al. 2006, Brault 2007) is the sensitivity of extinction risk to even small declines in adult and/or juvenile survival rates. […]

Calvert et al. (2006) found that changes in productivity (% increase in chicks fledged per pair) required to attain long-term growth rates in eastern Canada would be approximately threefold the change required in adult apparent survival (% increase in annual survival of adults). Similarly, modeling by Brault (2007) for the New England and Eastern Canada recovery units indicated that a 1% reduction in annual adult survival would need to be offset by a 2.25% increase in fledglings produced in order to maintain a stable population. Progress toward recovery would be quickly slowed or reversed by even small sustained decreases in survival, and it would be difficult to increase current fecundity levels sufficiently to compensate for widespread long-term declines in survival (USFWS 2009).

In addition to the 29 banded Great Lakes population individuals, additional banded individuals from the Atlantic coast and Great Plains populations have been seen at Rich Inlet (Audubon North Carolina unpublished data). Though the Atlantic coast population is larger than the Great

Lakes population, proportionally very few birds from the Atlantic breeding population have been banded. A range-wide band resight study found that Piping Plovers using the southeast coast during non-breeding months are predominantly from the Atlantic and Great Lakes breeding populations (Gratto-Trevor *et al.* 2009).

The population of Atlantic coast breeding Piping Plovers averaged 1,836 pairs or 3,672 breeding adults from 2008-2012 (the most recent years for which final data is available) (USFWS 2010, 2011, 2012b). The peak, single survey counts of Piping Plovers at Rich Inlet in fall 2014 and 2015 (38 and 44, respectively) comprise more than 1% of the Atlantic breeding population of Piping Plovers (Addison and McIver 2014, Audubon North Carolina unpublished data). This qualifies the Rich Inlet complex as a Wetland of International Importance under the Ramsar Convention and a site of hemispheric significance by the Western Hemisphere Shorebird Network.

Peak migration counts do not reflect the total number of individual Piping Plovers that depend on habitats at Rich Inlet. Most individuals using Rich Inlet during migration to refuel, rest and gain sufficient energetic reserves to make the next leg of migration that may carry them to breeding areas or wintering areas. Stopover duration can vary from just a few days to as much as one month (Noel and Chandler 2005; Stucker and Cuthbert 2006). Surveys conducted weekly during migration surveys at Rich Inlet indicated that stopover duration for the majority of banded Piping Plovers was one week or less during spring (99.1%) and fall (63.2%). The mean number of non-breeding Piping Plovers that depend on Rich Inlet based on stopover duration of one week for calendar years 2011-2015 is estimated at 256 individuals (range 96-443).

At Rich Inlet, from 2010-2014 the total number of Piping Plovers was greatest during fall migration, but the species is present every month of the year (Addison and McIver 2014). Seasonal use of Rich Inlet by Piping Plovers during the most recent years (2014 and 2015) is presented in Figure 4.

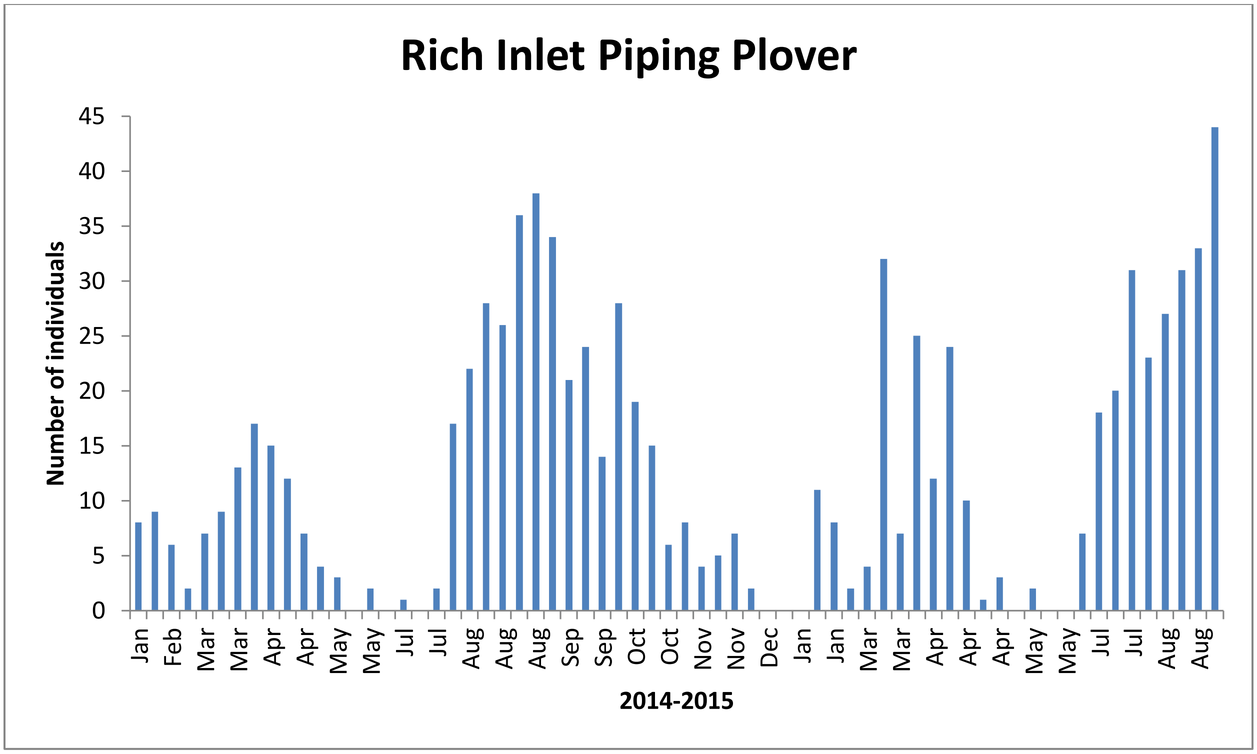

Figure 4. Abundance of Piping Plovers at Rich Inlet during 2014 and 2015.

Piping Plovers used all areas of Rich Inlet, but most often utilized sheltered, low-energy shoals, bay beaches, inlet spits, and sandbars on the sound side of the inlets for foraging (75.2%), and when foraging, Piping Plovers strongly favored the intertidal zone (89.1% of observations) (Addison and McIver 2014). Primary foraging sites were the sound side of the spit at the north end of Figure 8 Island and Green Shoal, which is located in Green Channel opposite Hutaff Island. Piping Plovers preferred to roost in habitat (backshore and old wrack) and in landscapes (ocean beach or inlet spit) that were most likely to have sandy substrate. The primary roost site was on the spit on the north end of Figure 8 Island. **Most of these habitats would be lost from Rich Inlet if a terminal groin were built; even Green Shoal could be affect by loss of sediment from the system of by additional sand mining, if, as is likely, oceanfront beach narrowing requires more frequent beach renourishments**.

Red Knots: At Rich Inlet, 2010-2014, Red Knots were observed in the greatest numbers during spring migration (Addison and McIver 2014). Peak counts in 2014 and 2015 were 253 and 190, respectively (Addison and McIver 2014, Audubon North Carolina unpublished data). During January 2007-2015, banded Red Knots were observed on 60 occasions, representing at least 28 individuals (Addison and McIver 2014, Audubon North Carolina unpublished data). Individuals were banded in Florida, Delaware, New Jersey, Massachusetts, and Argentina and resighted in Ontario, Massachusetts, New Jersey, Delaware, North Carolina, South Carolina, Georgia, and Florida.

Importance of Rich Inlet to Nesting Birds: Rich Inlet is also important to nesting birds. The shorebird and waterbird species that nest at Rich Inlet include Least Tern, Common Tern, Black Skimmer, Gull-billed Tern (historically), Wilson's Plover, Piping Plover, American

Oystercatcher and Willet. All of these species with the exception of the Willet require open, sandy, sparsely vegetated habitats for nesting. These habitats occur on spits at the ends of barrier islands, such as the spit on the north end of Figure 8 Island, and on overwash fans where storms push dunes backwards, creating wide, sandy areas along the length of barrier islands. Historically, prior to the development of many barrier islands, overwash fans were more common, as buildings, roads, and other developments were not present to block their formation following hurricanes or nor'easters. The limitations on the formation of overwash fans makes inlet spits essential to nesting birds as few alternatives exist. This is reflected in southern North Carolina where, from New River Inlet south to Brunswick County, little quality beach-nesting bird habitat exists due to hardened structures at inlets, channelization of inlets, other coastal engineering projects, and development.

The north end of Figure 8 Island has provided some of the best nesting habitat in southern North Carolina the past several years. American Oystercatchers, Piping Plovers, Wilson's Plovers and 840 pairs of Least Terns nested on the north end of Figure 8 Island in 2014. The Least Tern colony represented nearly all of southern North Carolina's Least Tern population and was the largest on record in North Carolina in 41 years of record-keeping; additionally, it represented 26% of the state's nesting Least Terns (NCWRC Colonial Waterbird Database). This year, two pairs of Piping Plovers nested on the north end of Figure 8 Island (Schweitzer 2015). Other nesting species were not counted in 2015, as it was not a state census year, but another large colony of Least Terns formed there. The peak count of Least Tern adults in the area was 816, suggesting approximately 400 pairs (Audubon North Carolina unpublished data). Common Terns, American Oystercatchers, and Wilson's Plovers also nested there in 2015.

No terns or skimmers have nested on the north end of Masonboro Island since 1989, though prior to the construction of the jetty there, a large amount of suitable habitat supported large nesting colonies of Least Terns, Common Terns, and Black Skimmers (NCWRC Colonial Waterbird Database). A similar pattern is found at all inlets with terminal groins.

<u>Importance of Rich Inlet to all Birds</u>: A total of 90 species of birds were observed at Rich Inlet from January 2010-September 2014, including 25 species of shorebirds (sandpipers, plovers, and their relatives) (Addison and McIver 2014). One additional species, the Snowy Plover, was observed in 2015, for a total of 91 species observed at Rich Inlet (Audubon North Carolina unpublished data). **Of these 91 species, 28 (31%) are of conservation concern, either as federally listed species, state-listed species, or identified as declining or otherwise vulnerable by various watch lists.**

Birds use Rich Inlet in large numbers throughout the year (Figure 5). Migrating birds pass through from late February to late May; wintering birds arrive as early as mid-July and stay as late as late May; nesting birds begin to arrive in March and remain through August. Annual peak counts from 2010-2015 occurred in the spring, winter, and fall, and were as great as 3,532 birds seen on one occasion (Addison and McIver 2014, Audubon North Carolina unpublished data). From January 2010-September 2014, a total of 228,823 birds were observed at Rich Inlet (Addison and McIver 2014).

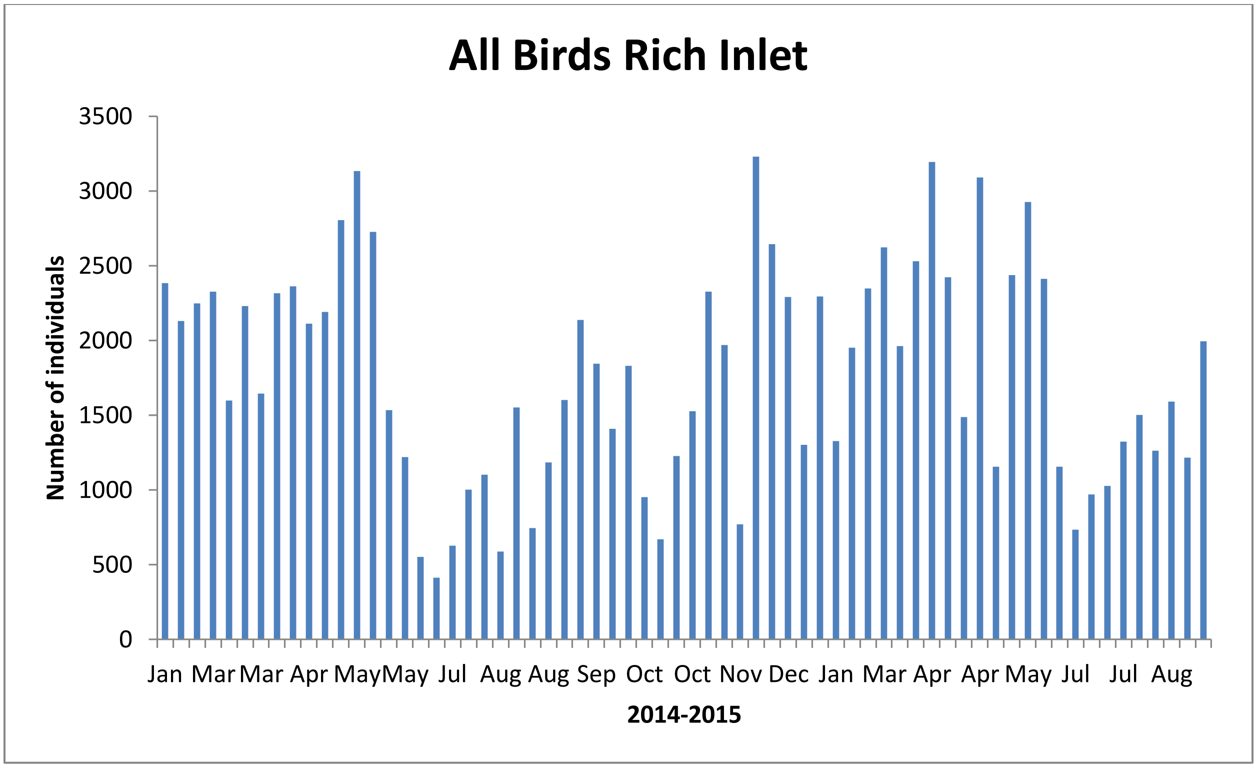

Figure 5. Abundance of all birds at Rich Inlet from the most recent surveys (2014-2015).

Modified vs. Unmodified Inlets: Audubon North Carolina has conducted weekly (during migration) and bi-weekly (during winter) bird surveys at New Topsail Inlet, Rich Inlet, Mason Inlet, and Masonboro Inlet. Since Rich Inlet is a relatively unmodified, natural inlet and Masonboro Inlet is significantly modified with two hard structures and regular dredging, we wanted to determine if birds use the two inlets in the same manner. We also wanted to compare Rich Inlet with the relocated and artificially stabilized Mason Inlet. In order to provide the most recent data for these comments, we compared survey results between Rich Inlet and Mason and Masonboro Inlets for the period from January 2014-September 2015.

For all birds, shorebirds, and Red Knots observed during January 2014-September 2015, significant differences occurred between Rich, Mason and Masonboro Inlets (Kruskal-Wallis test, $p<0.001$). Pairwise multiple comparison tests indicated that significantly more birds, shorebirds, and Red Knots were observed at Rich Inlet than Mason and Masonboro Inlets (Dunn's test, $p<0.05$).

For Piping Plovers observed during January 2014-September 2015, significant differences occurred between the three inlets (Kruskal-Wallis test, $p<0.001$). Pairwise multiple comparison tests indicated that significantly more Piping Plovers were observed at Rich Inlet compared to highly modified Mason and Masonboro Inlets (Dunn's test, $p<0.05$). The numbers of Piping Plovers observed at Masonboro Inlet and Mason Inlet were not statistically different.

It is readily apparent from analysis of the survey data that birds, shorebirds, Red Knots, and Piping Plovers in particular all rely on Rich Inlet to a significantly greater extent than they rely on the two nearby modified inlets. Because Piping Plovers exhibit site fidelity (Drake *et al.* 2001, Noel and Chandler 2006, Addison and McIver 2014) and use small core home ranges during the winter months (Drake *et al.* 2001), the importance of specific inlets such as Rich Inlet to individuals is magnified even more, since they are unlikely to move between inlets and because they return to the same site year after year.

<u>Modification of Inlets and Beaches</u>: Despite the importance of natural inlets to birds such as the Piping Plover, **inlets are one of the most anthropogenically altered features on the coast**. In North Carolina, 85% of inlets have been modified, and 57% of Atlantic coast inlets in the migration and winter range of the Piping Plover have been modified, including 43% that have been stabilized with hard structures (Rice 2012a). At least 32% of sandy beach habitat in the winter range of the Piping Plovers has received beach nourishment (Rice 2012b).

Many shorebird populations, including those of many species that occur at inlets, are declining and are of conservation concern (Brown *et al.* 2001, Winn *et al.* 2013). **Loss or degradation of wintering habitat, including that associated with coastal engineering projects, is identified as a primary threat in all shorebird conservation and management planning documents, including those addressing Piping Plovers and Red Knots.**

For example, the impacts of terminal groins and modifications of inlets are specifically addressed in the five-year status review for the Piping Plover:

Inlet stabilization/relocation
Many navigable mainland or barrier island tidal inlets along the Atlantic and Gulf of Mexico coasts are stabilized with jetties, groins, or by seawalls and/or adjacent industrial or residential development (see section WM 2.2.1.4 summary of studies documenting piping plover reliance on inlet habitats). Jetties are structures built perpendicular to the shoreline that extend through the entire nearshore zone and past the breaker zone (Hayes and Michel 2008) to prevent or decrease sand deposition in the channel. Inlet stabilization with rock jetties and associated channel dredging for navigation alter the dynamics of longshore sediment transport and affect the location and movement rate of barrier islands (Camfield and Holmes 1995), typically causing downdrift erosion. Sediment is then dredged and added back to islands which subsequently widen. Once the island becomes stabilized, vegetation encroaches on the bayside habitat, thereby diminishing and eventually destroying its value to piping plovers. Accelerated erosion may compound future habitat loss, depending on the degree of sea-level rise. Unstabilized inlets naturally migrate, re-forming important habitat components, whereas jetties often trap sand and cause significant erosion of the downdrift shoreline. These combined actions affect the availability of piping plover habitat (Cohen et al. 2008).

Sand mining/dredging
Sand mining, the practice of extracting (dredging) sand from sand bars, shoals, and inlets in the nearshore zone, is a less expensive source of sand than obtaining sand from offshore shoals for beach nourishment. Sand bars and shoals are sand sources that move onshore over time and act as natural breakwaters. Inlet dredging reduces the formation of exposed ebb and flood tidal shoals considered to be primary or optimal piping plover roosting and foraging habitat. Removing these sand sources can alter depth contours and change wave refraction as well as

cause localized erosion (Hayes and Michel 2008).

Exposed shoals and sandbars are also valuable to piping plovers, as they tend to receive less human recreational use (because they are only accessible by boat) and therefore provide relatively less disturbed habitats for birds. We do not have a good estimate of the amount of sand mining that occurs across the piping plover wintering range, nor do we have a good estimate of the number of inlet dredging projects that occur. […]

Groins
Groins (structures made of concrete, rip rap, wood, or metal built perpendicular to the beach in order to trap sand) are typically found on developed beaches with severe erosion. Although groins can be individual structures, they are often clustered along the shoreline. Groins act as barriers to longshore sand transport and cause downdrift erosion, which prevents piping plover habitat creation by limiting sediment deposition and accretion (Hayes and Michel 2008). These structures are found throughout the southeastern Atlantic Coast, and although most were in place prior to the piping plover's1986 ESA listing, installation of new groins continues to occur (USFWS 2009).

The impact of projects, such as proposed in Alternatives 1, 3, 4, and 5A-5D in this SEIS, on Threatened Red Knots is addressed specifically in the "Status of the Red Knot in the Western Hemisphere":

NC: Along the coast, threats to migrant and wintering Red Knot habitat include beach stabilization works (nourishment, channel relocation, and bulkhead construction), and housing development. [Note: Terminal groins and hardened structures were illegal in NC at the time when this paper was published.]

FL: Shoreline hardening, dredging, and deposition, including beach-nourishment activities, are significantly altering much of Florida's coastline. … Furthermore, the impacts on Red Knots and other shorebirds is [sic] not well known but is thought to be significant (Niles *et al.* 2008).

The Red Knot was listed as Threatened under the Endangered Species Act in November 2014. One of the primary factors in its listing was "U.S. shoreline stabilization and coastal development" (USFWS 2013):

In addition to directly eliminating red knot habitat, hard structures interfere with the creation of new shorebird habitats by interrupting the natural processes of overwash and inlet formation. Where hard stabilization is installed, the eventual loss of the beach and its associated habitats is virtually assured (Rice 2009, p. 3), absent beach nourishment, which may also impact red knots as discussed below. Where they are maintained, hard structures are likely to significantly increase the amount of red knot habitat lost as sea levels continue to rise (USFWS 2013).

Beach renourishment and inlet channelization are also cited as threats to Red Knots because they impact prey availability, habitat suitability, and habitat formation (USFWS 2013).

<u>Factual Errors and Other Inaccuracies Regarding Impacts to Birds</u>: Because accurate information

is a prerequisite for accurately assessing environmental impacts and meeting NEPA standards, we will highlight some of the most serious factual and other errors and omissions within the SEIS. In general, the overwhelming number of errors in the SEIS calls into question the validity and credibility of the entire document, and on that basis alone should exclude the document from being released to the public for review. Some of the more egregious factual errors are present as Appendix 1.

Impacts on Infauna: The SEIS largely overlook impacts of the alternatives on the infaunal community (species that live within the sediment) at Rich Inlet and Figure 8 Island, and consistently marginalizes and understates impacts to these organisms. The infaunal community is comprised of multiple different species that have variable recovery rates. The SEIS treats the infaunal community as a single species and states, "In general, the recolonization of these infaunal species typically tends to occur within the order of several months, which depends greatly on the compatibility of the material used for nourishment" (p. 282). The SEIS repeatedly uses the terms "short-term" and "resilient" (for examples, see pages 102, 268, 269, 279, 282, 318, 319, 320, 332, 337, 341, 367, 369, 393, 394) when addressing the impacts to the infaunal community, which is misleading because some organisms take up to four years to recover (Jaramillo *et al.* 1987, Peterson *et al.* 2014).

The majority of peer-reviewed literature demonstrates that infaunal species are negatively impacted by beach nourishment, and that the length of time for recovery varies by species (Hayden and Dolan 1974, Jaramillo *et al.* 1987, Rakocinski *et al.* 1996, Peterson *et al.* 2000a, Peterson *et al.* 2000b, Bishop *et al.* 2006, Dolan *et al*. 2006, Peterson *et al.* 2006, Bertasi *et al.* 2007, Colosio *et al.* 2007, Cahoon *et al.* 2012, Leewis *et al.* 2012, Schlachler *et al.* 2012, Viola *et al.* 2013, Manning *et al.* 2014, Petersen *et al.* 2014). In North Carolina, *Emerita talpoida* (mole crab) abundance recovered within months on nourished beaches compared to control beaches, but *Donax* spp. (coquina clam) and amphipods did not recover within the time frame of the study (Peterson *et al.* 2006). Peterson *et al.* (2014) monitored the recovery of a sandy beach community for 3-4 years following nourishment and documented that haustoriid amphipods (small crustaceans) and *Donax* spp. had reduced densities for 3-4 years following nourishment, *E. talpoida* had lower densities for 1-2 years following nourishment, and ghost crabs had lower abundances for four years.

For all alternatives except Alternative 2, beach nourishment is proposed. Historically, north Figure 8 Island was nourished in 1983, 1993, 1997, 2001, 2005, 2009, and 2011. For the preferred Alternative 5D and all other alternatives that include a terminal groin, the SEIS states that nourishment will occur every five years. However, at inlets where terminal groins were constructed, the beach nourishment cycle is every 1-4 years (Riggs *et al.* 2009, Riggs and Ames 2011, Pietrafesa 2012). Pea Island was renourished every year from 1990-2004, and Fort Macon was renourished every 2-6 years from 1973-2007 (Pietrafesa 2012). If some species of the infaunal community recover in 3-4 years, the cumulative impact to the infaunal community due to nourishment at such sites is that the community cannot recover before the next nourishment cycle. In some cases, local extinction of benthic species has occurred (Colosio *et al.* 2007).

The compaction of sand by heavy machinery and changes in grain size and shape, permeability, and penetrability are other common results of beach nourishment that impact infaunal organisms

(Greene 2002, McLachlan and Brown 2006). Further, though timing of activity is important to avoid periods of larval recruitment, all work is assumed to take place within existing environmental windows. However, beach renourishment projects took place in the region outside these widows in 2014 and 2015, and the firm that prepared the SEIS has also authored a white paper proposing the expansion of environmental windows into months when infaunal recruitment occurs (Hackney *et al.* 1996). The potential for additional impacts both from more frequent renourishments and out-of-season renourishments should be addressed by the SEIS.

Beach nourishment degrades beach habitats, thus decreasing densities of invertebrate prey for shorebirds. Each shorebird species has its own foraging microhabitat as well as its own feeding techniques. Shorebirds that collect food from specific depths beneath the sand can no longer rely on food from traditional habitats on nourished beaches (Peterson *et al.* 2006). This will negatively impact species that often forage in oceanfront intertidal and swash habitats, specifically Sanderlings (Macwhirter *et al.* 2002), Willets (Lowther *et al.* 2001), and the Threatened Red Knot (Baker *et al.* 2013). Speybroeck *et al.* (2006) documented that the mortality of just one species of polychaete due to nourishment resulted in decreased abundances of foraging Sanderlings. Piping Plovers forage less on oceanfront beaches than other habitats during non-breeding months (Haig and Oring 1985, Cohen *et al.* 2008), but they have been documented foraging occasionally on oceanfront beaches at Rich Inlet (Addison and McIver 2014). Therefore, renourishment activities also affect this Piping Plover foraging habitat.

Decreased abundances of shorebirds after nourishment may be due to decreased foraging area, decreased prey densities, and the occurrence of coarse sediments further reducing foraging habitat (Peterson *et al.* 2006). Coastal armoring caused beach widths to narrow significantly in southern California, which resulted in the loss of intertidal habitat available to macroinvertebrates, and, therefore, the abundance of macroinvertebrates decreased (Dugan and Hubbard 2006, Dugan *et al.* 2008). The diversity and abundance of shorebirds on beaches was positively correlated with the diversity and abundance of macroinvertebrate prey, and since a decline in prey was observed, a decrease in foraging shorebirds, gulls, and other seabirds was also observed (Dugan and Hubbard 2006, Dugan *et al.* 2008). **These authors concluded that increasing coastal armoring accelerates beach erosion and increases ecological impacts to sandy beach communities.**

The SEIS states:

Nelson (1985) indicates that organisms that reside in intertidal zones are more adaptable to fluctuations in their environment, including high sediment transport and turbidity levels. This may support the reasoning for some organisms to withstand burial up to 10 cm. Other studies reported by Maurer (National Research Council, 1995) supported the burial capabilities of nearshore species, which found that these species are capable of burrowing through sand up to 40 cm (p. 269).

Even if some of the infauna can survive burial up to 10-40 cm, nearly all bird species that utilize Rich Inlet would not have access to prey at those depths.

Any hard structure placed in a coastal environment modifies physical processes there, and

these changes will impact the species composition, abundance, and structure of invertebrate communities, and therefore birds that consume these prey will also be impacted. Hard-engineered structures are thought to be responsible for the loss of more than 80% of sandy beach shorelines globally (Brown and McLachlan 2002). Additionally, the placement of a terminal groin as called for in Alternatives 5A-5D, will result in the loss of the spit on the north end of Figure 8 Island. Although it's been stated above, it bears repeating that the modeling reported for Alternatives 5A-5C all indicate that a significant amount of sediment would be lost from the system, resulting in the loss of 241 acres of habitat, primarily low-energy shoals and sandbars which provide habitat for a variety of benthic invertebrates that are consumed by shorebirds and fishes. Such a loss constitutes more than half (60%) of such habitats currently in Rich Inlet. For reasons not explained, the preferred alternative, 5D, does not forecast such a loss.

Despite this, the SEIS preferred Alternative (5D) and most other alternatives assert few impacts on infauna, and impacts that are acknowledged are marginalized: "there may be less inlet flats and/or shoals than pre-construction conditions in certain areas, but there also may be more of these habitats in other areas" (p. 429).

Every recovery or management plan that pertains to species of shorebirds that use the coast recognizes the importance of infaunal organisms and their habitats. These species include the Piping Plover (USFWS 1996a, 2001, 2003, 2009), Red Knot (USFWS 2013), Sanderling (Payne 2010), and Dunlin (Fernández *et al.* 2010).

Audubon North Carolina conducted an extensive review of literature regarding the impacts of hardened structures and beach fill activities with a focus on scientific, peer-reviewed articles. We found 43 peer-reviewed articles and included three reports regarding the impacts of renourishment on benthic organisms. Of these 46 documents, 34 (74%) found an impact to one or more species of benthic organism, 4 (9%) found no impact, and 8 (17%) were ambiguous or found equivocal results.

Of the 43 peer-reviewed, scientific articles that found an impact to infaunal organisms, only two (Peterson *et al.* 2000 and Rakocinski *et al.* 1996) are cited in the SEIS. Peterson *et al.* (2000a) was cited in order to make a general statement about the biomass of mole crabs and coquinas: "Therefore, mole crabs and coquina clams dominate the benthic infaunal community due to their biomass (Peterson *et al.* 2000a)" (p. 128). The conclusions of the paper, however, were omitted from the SEIS and are significant and relevant to an evaluation of the impacts of all alternatives except Alternative 2.

Our studies of the ecological consequences of beach nourishment and bulldozing demonstrate large short-term effects on dominant species of beach macro-invertebrates. Abundances of both Emerita talpoida *and* Donax spp. *were 86-99% lower on nourished beaches in late June-early July, 5 and 10 weeks after cessation of nourishment (Figure 3). This is a season of the year when abundances of both of these dominant species of burrowing macro-invertebrates are typically at their maximum (Diaz, 1980; Leber 1982) and when they are providing the important ecosystem service of feeding abundant surf fishes (Leber, 1982; Delancey, 1989) and ghost crabs (Wolcott 1978). This transfer of energy to higher trophic levels was almost certainly dramatically reduced* *by nourishment. Our short-term observation period does not suffice to allow estimation of the length of time over which this tertiary production was diminished* (Peterson *et al.* 2000).

The results of the other scientific paper that was cited, (Rakocinski *et al.* 1996), were not accurately reported by the SEIS because relevant findings were omitted. The authors studied the impacts of a beach and profile nourishment project on the Gulf coast of Florida for about two years following the initial beach fill event. The SEIS states, "Rakocinski *et al.* (1996) found that the mole crab populations exhibited a pattern of initial depression after being covered by sediment but fully recovered in less than one year after beach nourishment." However, the SEIS does not mention that the same study also found that the dominant species of amphipod and a dominant species of polychaete had not recovered within that same time frame and that the amphipod did not recover until two years after the beach renourishment. Like the mole crab, amphipods and polychaetes are common shorebird prey items. Further, the SEIS use the authors' summaries of nearshore (0-100 m) and offshore (125-825 m) impacts:

Various macrobenthic responses attributable to beach restoration included: decreased species richness and total density, enhanced fluctuations in those indices, variation in abundances of key indicator taxa, and shifts in macrobenthic assemblage structure. […] *Considerable macrobenthic recovery was apparent during the study, although macrobenthic recovery remained indeterminate in some places.* […] *One long-term impact of beach nourishment at several nearshore stations was the development of assemblages characteristic of deep nearshore profiles. This implied that typical shallow-water macrobenthic assemblages characteristic of the usual dissipative beach morphometry was reduced after beach nourishment to a narrower zone like that of a reflective beach morphometry.*[…] *Two long-term negative impacts of beach restoration at offshore stations included impacts from both beach nourishment and profile nourishment. After beach nourishment, macrobenthic assemblage structure shifted at intermediate seaward distances for roughly 6 km parallel with the shoreline, probably in response to increased silt/clay loading. Macro-benthic impacts from silt/clay loading still were evident at the end of the study, more than two years after beach nourishment* (Rakocinski *et al.* 1996).

Two of the three reports that found an impact to benthic organisms were cited in the SEIS (Hackney *et al.* 1996 and Reilly and Bellis 1983), but their findings were only used to populate a table illustrating presence and recruitment periods of surf zone invertebrates in the South Atlantic Bight (Hackney *et al.* 1996) and to describe a direct impact of dredging: "Recruitment of invertebrate larvae, growth of filter feeding invertebrates, and visual foraging for prey by adult fish are also affected by turbidity from dredging" (Reilly and Bellis 1983).

The SEIS uses reports and other documents that were not peer-reviewed to make several assertions regarding the duration and severity of impacts to benthic organisms:

Some negative effects from covering the existing dry beach include the immediate mortality of macro invertebrates such as ghost crabs and with the potential of sand compaction from heavy equipment. However, these communities are expected to recover within the order of months to more than one year (National Research Council, 1995; Carter and Floyd, 2008) allowing several years of recovery time prior to any subsequent renourishment event (p. 336).

The macrobenthic communities of the intertidal and nearshore subtidal environments were sampled during the construction of the jetties and once again five (5) years later. Comparison of species abundance between years and among localities (updrift and downdrift) suggested no widespread impacts to macrobenthic fauna were attributable to jetty construction" (Knott *et al.* 1984) (p. 368).

Carter and Floyd (2008) is a report prepared by CP&E, and Knott *et al.* (1984) is a report written by the USACE. The report results include community composition data and seasonality of dominant species; pre- and post-project abundance is not included in the body of the report, but is one of six appendices (counting Appendices 6a-e as one appendix). The appendices were not supplied when the document was requested. The findings of these reports are not consistent with findings of readily available peer-reviewed scientific literature.

In its treatment of impacts to the infauna, the SEIS relies nearly exclusively on outdated literature that is generally not peer-reviewed, and it omits the many recent, peer-reviewed scientific papers that are available on the subject. The SEIS's reliance on non-peer-reviewed reports and other gray literature is troubling, and this has been recognized as such by experts in the field. Peterson and Bishop (2005) suggested that weaknesses in nourishment studies are due to studies being conducted by project advocates with no peer review process and the duration of monitoring being inadequate to characterize the fauna before and after nourishment. Thus, uncertainty surrounding biological impacts of nourishment can be attributed to the poor quality of monitoring studies, not to an absence of impacts.

We find it extraordinary that in a 513-page SEIS and over 2,000 additional pages of appendices only two peer-reviewed scientific articles are cited in reference to infauna—and that one is not cited to report its findings. It is equally troubling that a good-faith effort to accurately and fully describe and discuss the impacts these actions would have on the infaunal community would fail to actually describe the results of the only other peer-reviewed article it did reference.

<u>Impacts on Seabeach Amaranth</u>: Seabeach amaranth (*Amaranthus pumilus*) is a federally **Threatened** plant historically found on Atlantic beaches from Massachusetts to South Carolina; it currently occurs in New York, New Jersey, Delaware, Virginia, North Carolina, and South Carolina (USFWS 2007). It is found on barrier island beaches where it occurs in sparsely vegetated areas on overwash fans, the accreting ends of barrier islands, and the toe of foredunes.

Seabeach amaranth was listed due to its extirpation from two-thirds of its historic range and its vulnerability to threats including the construction of beach stabilization structures, beach erosion, beach grooming, pedestrian and vehicular traffic, and consumption by insects and feral animals. Of these threats, habitat loss and degradation resulting from coastal engineering were considered the most serious (USFWS 1996b, USFWS 2007).

Because of its reliance on dynamic, newly formed habitat and its inability to persist in heavily vegetated areas, according to its recovery plan, it "appears to need extensive areas of barrier island beaches and inlets, functioning in a relatively natural and dynamic manner, allowing it to move around in the landscape, occupying suitable habitat as it becomes available" (USFWS 1996b). Therefore, attempts to stabilize shorelines that lead to vegetative succession are detrimental to seabeach amaranth. Due to these needs,

Attempts to halt beach erosion in the Carolinas and New York through beach hardening (sea walls, jetties, groins, bulkheads, etc.) appear invariably to destroy habitat for seabeach amaranth. Simply put, any stabilization of the shoreline is detrimental to a pioneer, upper beach annual, whose niche of "life strategy" is the colonization of unstable, unvegetated, or new land and which is unable to compete with perennial grasses. […] Groins have mixed effects on seabeach amaranth. Immediately upstream from a groin, accretion sometimes provides or maintains, at least temporarily, habitat for seabeach amaranth; immediately downstream, erosion usually destroys seabeach amaranth habitat. [...] In the long run, groins (if they are successful) stabilize upstream beach, allowing succession to perennials, rendering even the upstream side only marginally suitable for seabeach amaranth (USFWS 1996b).

In addition to these problems, "jetties and terminal groins may prevent the movement of seabeach amaranth seeds along the beach (by blocking blowing sand) or in the water (by affecting longshore current at the micro level" (USFWS 2007).

According to the SEIS, seabeach amaranth has been documented on Figure 8 Island in six of the nine years from 2002-2010; no plants were found in 2008 and 2009, and no data was collected in 2006 (p. 161). As many as 768 plants were found on the island during those years, and plants were located within the permit area in 2002, 2003, 2004, 2005, and 2010 (p. 162-170). The SEIS presents no data from 2011-2015. In the early to mid-2000s the spit at the north end eroded and was replaced with intertidal shoals. It was following 2011 that the north end of Figure 8 Island again transitioned from a shoal complex to an attached spit that remained emergent more regularly than the shoals, creating dry, sandy habitat that seabeach amaranth colonizes. Since recent, relevant data was lacking, we surveyed from the north end of Figure 8 Island. We found 262 seabeach amaranth plants, concentrated in the area north of the location proposed for a terminal groin in Alternative 5D.

The SEIS mischaracterizes the impacts that the alternatives would have on seabeach amaranth. Regarding impacts to seabeach amaranth from Alternative 2, the SEIS states:

Seabeach amaranth prefers overwash flats at accreting ends of islands and lower foredunes and upper strands of non-eroding beaches; these preferred habitats are located on the middle and southern portions of Figure Eight Island. As mentioned in Chapter 4, seabeach amaranth is an effective sand binder, building dunes where it grows. Due to lack of long-term protection against storm influenced damage, negative cumulative impacts to the dune-stabilizing seabeach amaranth, and subsequently the dune communities at Figure Eight Island in general, are expected (p 294).

Seabeach amaranth's preferred habitats are found in some years along the length of Figure 8 Island, as demonstrated by its distribution in 2004 and 2005 (p. 164-165). However, as can be seen in Figure 6, it also prefers accreting ends of islands, which is habitat the construction of a terminal groin would remove. Second, storms are natural events that can create or maintain habitat suitable for seabeach amaranth. An 18-year review of rangewide data did not find a correlation between population size and tropical storm or hurricane activity (Rosenfeld *et al.* 2006), suggesting that seabeach amaranth **does not need** "protection" from these events. The five-year review found that impacts of beach renourishment, which is included in all alternatives but Alternative 2, are not fully known, but that in cases where beaches have severely eroded back to sea walls, buildings, or dense vegetation it may create wider, vegetation-free beaches that seabeach amaranth can colonize; however, work during outside environmental windows, which is becoming more common in North Carolina, can bury living plants (USFWS 2007).

Figure 6. The locations of Seabeach Amaranth plants found during surveys that occurred from September 3-7, 2015.

In its discussion of impacts to seabeach amaranth from alternatives that include the construction of a terminal groin, the SEIS attempts to compensate for the loss of a natural inlet spit and associated dry sandy habitat. For example:

As discussed for Alternative 5B, the Delft3D 5-year model simulation for Alternative 5D indicated erosion is expected to occur on the north side of the terminal groin potentially affecting the habitat for nesting turtles, seabeach amaranth, and shorebirds. The location of the groin structure is situated near the transition point from oceanfront dry beach to inlet dry beach habitats, but is 420 feet closer to the inlet throat than Alternative 5B. The increased area of dry beach on the south side of the groin as a result of nourishment as well as the retention of sediment within the accretion fillet will result in positive indirect impacts including the increased habitat for nesting sea turtles, resting and nesting shorebirds, and seabeach amaranth (p. 433).

It is not clear how much wide, vegetation-free beach would persist south of the terminal groin, as downdrift erosion is likely to cause narrowing of the oceanfront beach on Figure 8 Island. Further, the stabilization of the fillet adjacent to the terminal groin would result in vegetative succession and the likelihood that seabeach amaranth would be crowded out by other species. Therefore, the habitat lost by the removal of the spit would not be compensated for.

In order to mitigate for potential impacts to seabeach amaranth, the SEIS proposes monitoring (p. 451). Monitoring in and of itself does not affect negative impacts, and no remedies are proposed if negative impacts should be detected.

We are also concerned that the SEIS does not cite the recovery plan or status review for seabach amaranth and only cites the 1993 final rule for its listing in order to describe its colonization of dynamic, newly formed habitats (p. 161).

<u>Impacts on Sea Turtles</u>: Threatened loggerhead sea turtles (*Caretta caretta*) nest along the length of North Carolina's coast, including on Figure 8 Island, which is adjacent to the LOGG-N-04 critical habitat unit. Information on the impacts of hard structures to sea turtles is extremely limited, but the few studies that exist found negative impacts to sea turtles. Lamont and Houser (2014) documented that loggerhead turtle nest site selection is dependent on nearshore characteristics, therefore any activity that alters the nearshore environment, such as the construction of groins or jetties, may impact loggerhead nest distribution. Loggerhead nesting activity decreased significantly in the presence of exposed pilings, and a 41% reduction in nesting occurred where pilings were present (Bouchard *et al.* 1998). In a study of the impact of coastal armoring structures on sea turtle nesting behavior, Mosier (1998) demonstrated that fewer turtles emerged onto beaches in front of seawalls than onto adjacent, non-walled beaches, and of those that did emerge in front of seawalls, more turtles returned to the water without nesting. Loggerhead sea turtle nests on North Carolina beaches increased in number as distance from hard structures including piers and terminal groins increased (Randall and Halls 2014). Studies in Florida have also found avoidance behavior and decreased hatching success associated with a managed inlet (Herren 1999).

Beach renourishment also negatively impacts loggerhead sea turtle nesting. Renourishment can cause beach compaction, which can decrease loggerhead nesting success, alter nest chamber geometry, and alter nest concealment, and nourishment can create escarpments, which can prevent turtles from reaching nesting areas (Crain *et al.* 1995). Nourishment can decrease survivorship of eggs and hatchlings by altering characteristics such as sand compaction, moisture content, and temperature of the sand (Leonard Ozan 2011), all of which are variables that can affect the proper development of eggs. The success of incubating eggs may be reduced when the sand grain size, density, shear resistance, color, gas diffusion rates, organic composition, and moisture content of the nourished sand is different from the natural beach sand (Nelson 1991). Negative impacts from beach renourishment include decreases in nesting activity and decreases in hatching success due to the use of incompatible material, sand compaction, and suboptimal beach profile (NMFS and USFWS 1991).

Sea turtles may be impacted by construction on beaches or dredge equipment, especially when work takes place outside the environmental window for sea turtles. During the spring and summertime construction phase of the Bald Head Island terminal groin, an adult female was trapped inside the construction zone for one day and a nest was destroyed when it was dug up by construction equipment (Sarah Finn pers. com. 2015). Pipeline and other obstructions placed on the beach may obstruct hatchling emergences or impede their path to the ocean (NMFS and USFWS 1991). Hopper and cutterhead dredges may also kill sea turtles during dredge work (NMFS and USFWS 1991). The loggerhead sea turtle recovery plan emphasizes that the only beneficial impacts of nourishment are in cases where beaches are so highly eroded, there is "a complete absence of dry beach" (NMFS and USFWS 1991).

Although the SEIS states that beach renourishment activities would take place outside of the sea turtle nesting season, in both 2014 and 2015 beach renourishment projects extended far into the nesting season exposing sea turtles not only to interference during nesting emergences but also to hazards from active dredges (NMFS and USFWS 1991). The possibility that beach renourishment will take place during nesting season is not discussed in the SEIS, although in addition to the now commonplace exceptions to the environmental windows, the CRC has actively been pursuing the expansion of the windows.

The SEIS does not address the impacts to sea turtles should beach renourishment intervals turn out to be similar to those at other North Carolina inlets with hardened structures, rather than at the five-year intervals it forecasts. Nesting activity on nourished beaches decreased for one to three years following a nourishment event due to changes in the sand compaction, escarpment, and beach profile (NMFS and USFWS 1991, Steinitz *et al.* 1998, Trindell *et al.* 1998, Rumbold 2001, Brock *et al.* 2009). The SEIS also does not address the impacts to sea turtle nesting should Figure 8 Island experience downdrift erosion that would narrow the beach south of the groin where, as maps in the SEIS (p. 146-155) show, nesting occurs. Unlike the SEIS, the loggerhead recovery plan does include these negative impacts: "In preventing normal sand transport, these structures accrete updrift beaches while causing accelerated beach erosion downdrift of the structures [groins and jetties] (Komar 1983, Pilkey *et al.* 1984, National Research Council 1987), a process that results in degradation of sea turtle nesting habitat" (NMFS and USFWS 1991).

Finally, the SEIS does not cite the recovery plan or the status review for the Threatened loggerhead sea turtle. Such documents are blueprints for conservation of listed species, and we are seriously concerned that the SEIS apparently overlooked and does not cite these documents.

<u>Impact on Fishes</u>: **No mention of direct or indirect mortality or other impacts on fishes was made in the SEIS other than acknowledging that increased turbidity would clog fish gills.** Fishes would be negatively impacted by the construction of a terminal groin and the subsequent beach nourishment projects at Rich Inlet in the following ways: 1) the groin would interrupt larval transport through the inlet, therefore impacting recruitment; 2) the native fish community would be replaced with a completely different structure-associated fish community; and 3) surf zone fishes would suffer from direct mortality. Hard structures reduce the successful passage of fish larvae from the open ocean to the estuarine nurseries they inhabit until reaching maturity (Hettler and Barker 1993, Pilkey *et al.* 1998). Inlets are critical pathways for adult fishes to get to offshore spawning sites and larvae immigrate through inlets to get to estuarine nurseries (Able *et al.* 2010).

Many surf zone fishes are larval and juvenile individuals that benefit from the shallow water nursery habitat because it provides refuge from predators and foraging areas (Layman 2000). Due to their early weak swimming ontogenetic stage, fish larvae are not adapted for high mobility in response to habitat burial or increased turbidity levels. Studies have shown that beach nourishment degrades the important swash-zone feeding habitat for both probing shorebirds and demersal surf fishes (Quammen 1982, Manning *et al.* 2013, VanDusen *et al.* 2014). Surf habitats with hardened structures typically support a different community of fishes and benthic prey. Impacted species would include Atlantic menhaden, striped anchovy, bay anchovy, rough silverside, Atlantic silverside, Florida pompano, spot, Gulf kingfish, and striped mullet. Florida pompano and Gulf kingfish use the surf zone almost exclusively as a juvenile nursery area and as juveniles, they are rarely found outside the surf zone (Hackney *et al.* 1996). The dominant benthic prey for pompano and kingfish were coquina clams (*Donax*) and mole crabs (*Emerita*). Despite the fact that fishes in the surf zone are adapted to a high energy environment, rapid changes in their habitat can still cause mortality and other negative impacts. **There are documented negative impacts of renourishment on some of the invertebrates (especially mole crabs and coquinas) that are major foods of the fishes (Reilly 1978, Baca *et al.* 1991); therefore, negative impacts could be indirectly transferred to the surf zone fish community.**

Manning *et al.* (2013) states:

Beach nourishment can degrade the intertidal and shallow subtidal foraging habitats for demersal surf fishes by three major processes: (1) inducing mass mortality of macrobenthic infaunal prey through rapid burial by up to 1 m or more of dredged fill materials; (2) modifying the sedimentology of these beach zones through filling with excessive proportions of coarse, often shelly sediments that are incompatible with habitat requirements of some important benthic invertebrates, such as beach bivalves; and (3) incorporating into the beach fill excessive quantities of fine sediments in silt and clay sizes, which can induce higher near-shore turbidity during periods of erosion as onshore winds or distant storms generate wave action, thereby inhibiting detection of prey by visually orienting fishes. The opinion repeated in many environmental impact statements and environmental assessments that marine benthic invertebrates of ocean beach habitats are well adapted to surviving the sediment deposition of beach nourishment because of evolutionary experience with frequent erosion and deposition events associated with intense storms and high waves is unsupportable. A recent review of the *literature on impacts of storms on ocean-beach macrofauna (Harris et al. 2011) reveals that about half the studies report massive reductions of beach infaunal populations after storms.*

Recreational Impacts and Take of Public Trust Resources: Alterations to Rich Inlet as proposed by the preferred alternative and most other alternatives would negatively impact opportunities for human recreation at Rich Inlet and the enjoyment of public trust resources that belong to all citizens of North Carolina.

Rich Inlet is currently a favorite destination for local boaters, anglers, and beachcombers. These user groups often make use of the extensive Figure 8 Island spit and associated shoals and sandbars. They also anchor on the narrow bay beach on the sound side of Figure 8 Island and in various locations on Hutaff Island. Should a terminal groin be constructed at Rich Inlet, these recreational resources would be diminished. There would be fewer place to anchor and due to impacts on fishes and birds, opportunities for fishing and nature watching would be decreased. The SEIS promotes the wider oceanfront beach it forecasts on Figure 8 Island as an increase of recreational area for the public, but as a private island, Figure 8 Island is only accessible to the public by boat, and boaters use the spit on Figure 8 Island and associated shoals, as well as the sound side beach at Nixon Channel, not the oceanfront beach so it would be of little to no benefit to the general public.

SEIS Fails to meet NEPA Standards: The SEIS does not conform to NEPA guidelines in multiple regards, making it inadequate as a tool to assess environmental impacts.

NEPA is intended to ensure that all major projects that involve federal funding, work by the federal government, or federal permits evaluate environmental impacts rigorously and objectively when undertaking projects that have will have environmental impacts. This legislation guides the environmental impact statement process. Section 1500.1 of NEPA states:

NEPA procedures must insure that environmental information is available to public officials and citizens before decisions are made and before actions are taken. The information must be of high quality. Accurate scientific analysis, expert agency comments, and public scrutiny are essential to implementing NEPA. Most important, NEPA documents must concentrate on the issues that are truly significant to the action in question, rather than amassing needless detail.

As has been described in detail above, the SEIS does not utilize accurate scientific analysis or demonstrate expert knowledge in its evaluation of the alternatives. Instead, the document contains numerous factual errors, repeated misrepresentations and misuse of data, a biased literature review, and inaccurate summaries of impacts. It is a skewed vehicle that appears to be designed to promote the HOA's preferred alternative, not an objective evaluation of the alternatives presented. Therefore, the SEIS does not "rigorously explore and objectively evaluate all reasonable alternatives" (Section 1502.14), and the "professional integrity, including scientific integrity" (Section 1502.24) of the SEIS is fatally compromised.

NEPA also states that "text of final environmental impact statements […] shall normally be less than 150 pages and for proposals of unusual scope or complexity shall normally be less than 300 pages" (Section 1502.7). Even excluding the extraneous sections not within NEPA's required contents, the SEIS is 477 pages. The entire SEIS is 513 pages and includes an additional 2,229 pages of appendices. The language of both the main body of the SEIS and appendices does not conform to Section 1502.8: “Environmental impact statements shall be written in plain language and may use appropriate graphics so that decision makers and the public can readily understand them.”

Improper Notice of Intent and Scoping: The preferred alternative, a terminal groin, was not mentioned in the February 26, 2007 Notice of Intent and it was not included the scoping meetings (Appendix A of the SEIS), which took place when hardened structures were illegal in North Carolina. It is unclear, therefore, how a terminal groin could be included in this project.

Costs Are Not Accurately Represented: The SEIS does not accurately report the costs of the alternatives, biasing its cost estimates by conflating value with cost and cherry-picking data to make the HOA’s preferred alternative appear to be the least costly.

The North Carolina Coastal Resources Commission estimated the cost of constructing and maintaining one terminal groin in North Carolina over 30 years to be around $55,000,000 (NCCRC 2010). Meanwhile, a tax revenue-based accounting of the fiscal implications of the construction of terminal groins found that the costs of constructing and maintaining a terminal groin exceeds potential fiscal benefits at every developed North Carolina inlet (Coburn 2011). In order to make the cost of implementing the HOA’s preferred alternative more appealing, the SEIS had to omit, overestimate, or underestimate costs associated with other alternatives, primarily Alternative 2. It also overstates the current threats in order to justify the construction of a terminal groin in the first place.

Currently, no properties that might be protected by a terminal groin on Figure 8 Island are threatened. Despite this, the SEIS uses outdated aerial imagery (e.g. Figure 3.1 p. 32) and calls houses “imminently threatened” (e.g. Figure 2.7 p. 25) to give this impression. In the early 2000s, 19 houses along the oceanfront of the island received sandbags as the beach in front of them narrowed. Another house on the soundside at Nixon Channel also has sandbags, but its situation is independent of the beachfront homes, and a terminal groin would have no bearing on its status. One house has been moved to another lot, leaving 18 houses with sandbags; however, contrary to what the SEIS states, the sandbags are no longer providing protection because the beach has naturally widened as the inlet channel shifted naturally.

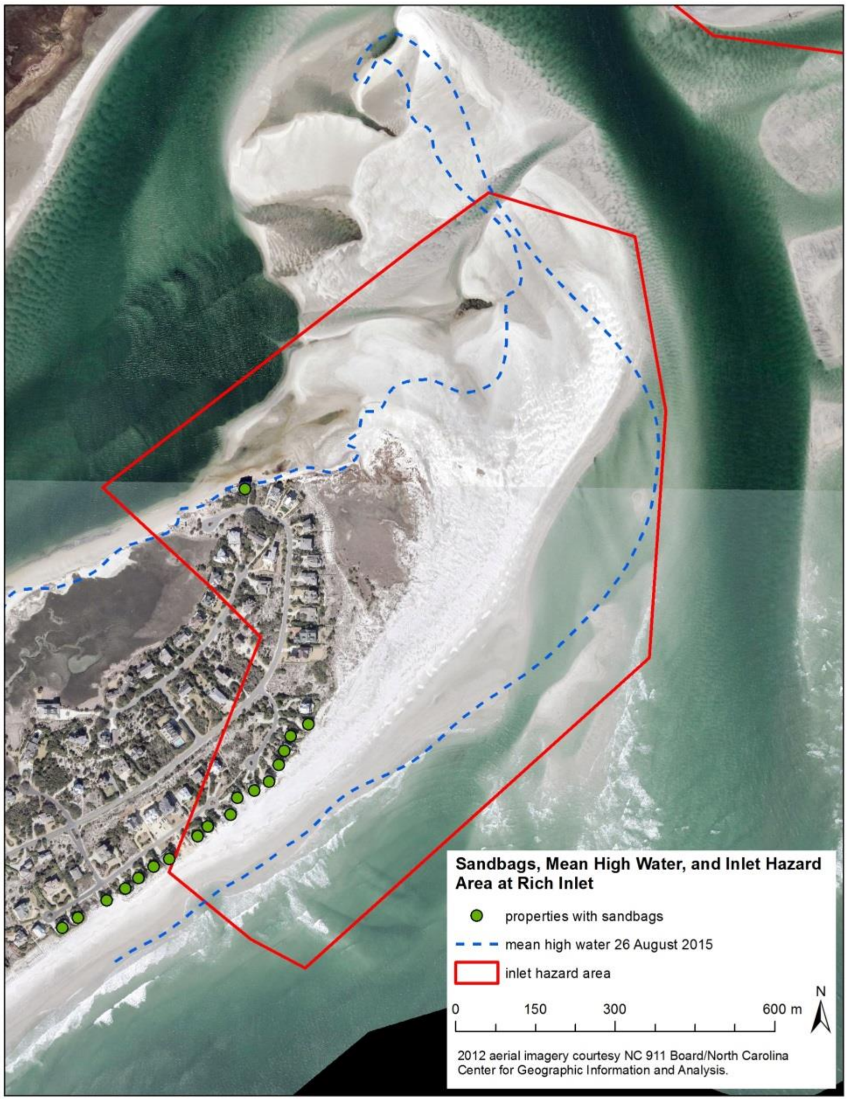

Figure 7. Houses with sandbags on the north end of Figure 8 Island.

In order to lower projected costs of beach fill activities, the SEIS optimistically forecasts five-year intervals for beach renourishment events following the installation of a terminal groin. Beaches near Fort Macon and Oregon Inlet require renourishment at more frequent intervals than the SEIS predicts, and nearby Wrightsville Beach and the south end of Figure 8 Island receive sand every three or four years. Using the SEIS's cost per nourishment, shorter beach fill intervals would increase costs by $2.5 to $3 million per event, or over $10 million over a 30-year period, greatly increasing the cost of a terminal groin.

Further, in Tables 3.11a and 3.11b (p. 96), the SEIS states that there will be a $0 cost for long-term erosion damages for Alternatives 3-5D. A zero dollar amount in the Long-Term Erosion Damages & Response Cost column is inaccurate, given the downdrift effects of terminal groins. Potential damage to properties from downdrift erosion is not discussed in the SEIS. Fenster and Dolan (1996) found an area of inlet influence between 5.4 km and 13.0 km, and Riggs and Ames (2011) found increased rates of erosion over 6 miles (9.6 km) south of Oregon Inlet following minor and major alterations to the inlet and report erosion hot spots up to 12 miles (19.3) south of the inlet. Even the smaller areas of influence cover substantial oceanfront shoreline and pose a risk to many more properties than the beach fill footprint in Alternative 5D would address (Figures 8 and 8). The SEIS also relies on beach fill to repair accelerated erosion near the western terminus of the terminal groin (clearly visible on Masonboro Island) that would threaten three houses and four vacant lots.

Figure 8. Extent of shoreline within the range of inlet influence found by Fenster and Dolan (1996).

Figure 9. Potentially impacted shoreline on the north end of Figure 8 Island.

The SEIS vastly overstates the risks associated with its non-preferred alternatives. For example, the SEIS uses atypical worst-case erosion rates to assume that 40 houses will be at risk over the next 30 years—over twice as many more than the 19 oceanfront homes that received sandbags when the beach was in its narrowest condition—and that all but 10 of the 40 would be demolished instead of relocated (p. 34). However, even its own consultant's report (Appendix B, Sub-appendix A) found that from 1938-2007, on Figure 8 Island, "net progradation has characterized the past seven decades of oceanfront shoreline change" (p. 56). Therefore, it is also possible that no houses would have to be moved or demolished in the next 30 years. What is most likely, however, is that some houses would eventually need to be moved in response to natural barrier island shoreline change. Though the SEIS does not consistently report the number of unbuilt lots available on Figure 8 Island—80 or 93—with scores of lots available, 76 of which are waterfront (p. 33), if a future change at the inlet necessitates relocating, lots could be purchased without much trouble.

The SEIS also persistently conflates value with cost in its estimates. The tax-assessed value of property that might be lost due to erosion or demolition is not the same as the cost to construct and maintain a terminal groin or carry out beach renourishment. For example, a cost of $4.7 million for damage to roads and infrastructure it predicts will wash away under Alternative 2. However, even if roads on the north end of the island were lost, there would be no cost, as they would not be rebuilt in the water. Similarly, the cost of Alternative 2 includes $16.9 million, the tax-assessed value of the 30 houses that the SEIS projects will be demolished, and $38.3 million for the value of the projected lost land. The only actual costs Alternative 2 includes is $1.4 to demolish the 30 houses and $2.4 million to relocate the 10 houses for a total cost of $3.8 million, orders of magnitude less than the $63.7 million in Tables 3.12a and 3.12b (p. 96-97). Even if the cost of purchasing new lots for relocated homes were accounted for—the 16 lots that were listed in 2013 cost an average of $1.5 million (p. 301)—the cost would come in under the cost of a terminal groin, if a reasonable number of houses were projected to be relocated.

Finally, there is also no predicted loss of tax revenue for Alternatives 3-5D. If a terminal groin is installed, the aesthetic value of the lots at the north end of the island would be diminished by replacing a natural beach view with loss of beach and a rock pile in the viewshed and replacing the shoreline with large boulders. This could affect tax-assessed value which could decrease tax revenue. Similarly, tax revenue is projected to be lost in Alternatives 1 and 2 due to loss of houses, but the increases in tax revenue from previously vacant lots, should houses be relocated, are not taken into account.

Conclusion: Alternatives 1, 3, 4, and 5A-5D as presented in the SEIS would negatively impact many species of birds, as well as infauna, fishes, and sea turtles. The SEIS in its current form does not carry out the functions required by NEPA. It fails to provide an objective, scientific evaluation of environmental impacts, fails to accurately describe the biological resources in the project area, obfuscates the financial costs of the alternatives, fails to address key legal requirements, and throughout contains misleading and factually incorrect information that prevents a real assessment of the proposed project. These flaws are so egregious and so systemic that the document appears to have been written in order to arrive at the conclusions desired by the HOA rather than to objectively evaluate environmental impacts and give due consideration to all reasonable alternatives.

In particular, as regards biological impacts to the naturally functioning Rich Inlet system, a stable inlet that has remained in the same general location for the past two centuries, the SEIS omits or misrepresents the vast majority of the ample body of scientific literature that is available to describe the well-known and accepted physical impacts of terminal groins and beach fill. It then fails to accurately describe the direct, indirect, and cumulative impacts that these activities would have on biological resources within Rich Inlet, particularly the Piping Plover. Instead, adverse impacts to Piping Plovers, Red Knots, and other bird species are largely dismissed or ignored. The best, most recent data and peer-reviewed literature available to assess those impacts are omitted, misrepresented, or misused, and the recommendations of multiple management and recovery plans, including USFWS recovery plans, are largely disregarded.

Alternatives 1, 3, 4, and 5A-5D as presented in the SEIS would jeopardize the recovery and/or persistence of the Great Lakes breeding population of Piping Plover, the Atlantic coast breeding population of Piping Plover, Seabeach Amaranth, and Red Knot; and a terminal groin would permanently eliminate habitats for these species listed under the Endangered Species Act without any chance of restoration or reformation in other areas. Alternatives 1, 3, 4, and 5A-5D as presented in the SEIS would jeopardize state populations of Least Terns, Black Skimmers, and American Oystercatchers, among other species.

Lastly, the SEIS fails to acknowledge the human impacts: the impacts to public trust resources that belong to every citizen of North Carolina.

The SEIS should be rejected by the permitting agencies and the alternatives that involve hard structures or channelization at Rich Inlet should be permanently removed from further consideration.

Sincerely,

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Appendix 1:
Factual Errors and Other Inaccuracies Regarding Impacts to Birds: Because accurate information is a prerequisite for accurately assessing environmental impacts and meeting NEPA standards, we will highlight some of the most serious factual and other errors and omissions within the SEIS. In general, the overwhelming number of errors in the SEIS calls into question the validity and credibility of the entire document, and on that basis alone should exclude the document from being released to the public for review.

1. The SEIS cites major conservation planning documents such as the U.S. Shorebird Conservation Plan and Atlantic population Piping Plover recovery plan, but it uses these documents only to establish basic facts about the species' range and biology. The threats, recommendations, and conclusions within these documents are not cited.

All USFWS Piping Plover conservation documents plans cite the need to protect Piping Plover habitat from both the direct and indirect impacts of shoreline stabilization, inlet dredging, and beach maintenance. The Piping Plover Atlantic Coast Population Revised Recovery Plan (USFWS 1996) states, "Loss and degradation of habitat due to development and shoreline stabilization have been major contributors to the species' decline." It cites the cumulative effects of structures that "cause significant habitat degradation by robbing sand from the downdrift shoreline" as well as more localized impacts at the sites of these structures. It recommends the discouragement of stabilization projects and suggests creation or enhancement of habitat in affected areas as mitigation. These conclusions are not referenced in the SEIS. Instead, it uses the recovery plan to cite the Piping Plover's use of overwash habitats (p. 124, 125), its listing status (p. 172), and its nest construction and clutch size (p. 172).

The Recovery Plan for the Great Lakes Piping Plover, which the SEIS does not reference, states:

Beach stabilization and 'nourishment' projects also degrade the quality of beach habitat for piping plovers and other coastal species. To ensure adequate habitat for survival, reproduction and recovery, natural processes within the ecosystems piping plovers utilize must be protected (USFWS 2003).

The Piping Plover (*Charadrius melodus*) 5-Year Review: Summary and Evaluation identifies sand placement projects, inlet stabilization/relocation, sand mining/dredging, groins, and seawalls and revetments as threats to Piping Plovers.

Habitat loss and degradation remains very serious threats to Atlantic Coast piping plovers, especially in the New York-New Jersey and Southern recovery units. Artificial shoreline stabilization projects perpetuate conditions that reduce carrying capacity and productivity and exacerbate conflicts between piping plovers and human beach recreation. As discussed in section AC 2.5.3.5, many activities that artificially stabilize barrier beaches will further exacerbate threats from projected sea-level rise (USFWS 2009).

The review also explains the importance of high-quality stopover and wintering habitat in the context of a small population that spends most of its annual cycle away from nesting grounds:

Piping plover populations are highly vulnerable to even small declines in survival rates of adults and fledged juveniles. Population growth gained through high productivity on the breeding grounds will be quickly reversed if survival rates or breeding fitness decline due to stressors experienced during the two-thirds of the annual cycle spent in migration and wintering. Although management of threats in the nonbreeding range has begun to increase in recent years, considerably more attention and effort are required (USFWS 2009).

Other shorebird species conservation plans are clear about the importance of non-breeding habitat. The U.S. Shorebird Conservation Plan is cited twice in the SEIS, on p. 104 to substantiate use of salt marsh habitat for foraging by shorebirds and on p. 176 in reference to the conservation status of the Wilson's Plover. Other examples include:

To safeguard Dunlin populations, we have to protect the interconnected chains of wetlands they depend upon from further deterioration and disappearance. Because adult survival is a critical variable in determining population size of [long-lived] migratory shorebirds, it is very important to maintain and secure high-quality habitats (Fernández et al. 2010)

and

Habitat loss has particularly significant implications for Sanderlings during migration—a time when they must put on fat to fuel their long flights—and also in winter (stressful weather). The potential cost during migration is clear: without enough fuel (fat), Sanderlings may not be able to complete the next leg of their journey, may arrive on breeding grounds with too few resources to breed, or may not survive. On the wintering grounds (e.g., California, North Carolina, and Peru), many individuals exhibit strong site fidelity and spend most of their time (or return to) the same 5- to 10-kilometer stretch of beach year after year (Myers et al. 1979a, Connor et al. 1981, Myers et al. 1988, Dinsmore et al. 1998). Thus, the loss of even small stretches of coastline could alter social dynamics of local winter populations, with potentially harmful (although currently unknown) consequences (Payne 2010).

2. The SEIS does not accurately assess impacts to birds. Most critically, it fails to consider cumulative impacts. Cumulative impacts to birds in and around Rich Inlet would be the continued loss of habitat due to repeated beach fill activities and the permanent removal of shoals and the spit on the north end of Figure 8 Island. The natural inlet system needed to sustain wintering Piping Plover critical habitat would be lost, and the carrying capacity for shorebirds, including Piping Plovers, and nesting terns and skimmers in the region would be diminished. Typically, when a groin fails, it is not removed, but additional structures are constructed, thus impacting even more habitat.

Cumulative impacts not only ripple through time, but through geography. Comparable habitats elsewhere in North Carolina are few. After New Topsail Inlet, the next closest comparable inlet to Rich Inlet is Ophelia Inlet on Cape Lookout National Seashore, 100 miles north. To the south, the next best Piping Plover habitat is in Cape Romain, SC, approximately 150 miles south. Humans are not creating new habitat for birds to use in North Carolina or indeed on the Atlantic

Flyway, only removing habitat that birds need to survive through coastal engineering projects such as the proposed groins on Ocean Isle Beach and Holden Beach, the proposed groin on Kiawah Island, SC and, farther afield, the response to Hurricane Sandy on Long Island, NY.

Currently 14% of the U.S. shoreline has been hardened, 66% of which has occurred along the south Atlantic and Gulf coasts (Gittman *et al.* 2015), 57% of Atlantic coast inlets in the migration and winter range of the Piping Plover have been modified, and at least 32% of beaches have received fill (Rice 2012b). Currently, 72% of Atlantic and Gulf coast states permit hard structures at inlets (Titus 2000). If inlets continue to be stabilized one by one, the cumulative impact will be that eventually there will be no suitable high-quality inlet habitat left on the Atlantic coast. Whether this habitat is taken piecemeal by one project at a time or all at once, the result will be the same: Piping Plovers, Red Knots, and other shorebirds will no longer have the habitat they need to survive, and recovery of listed species will be impossible.

The SEIS fails to accurately characterize indirect impacts. In all of its assessments of indirect impacts to shorebirds, the SEIS predicts that of intertidal flats and shoals will be reduced (Table 5.1, p. 202), but it declines to state that loss of this habitat will have a significant negative impact on wintering and migrating shorebirds such as the Piping Plover that require these habitats for foraging and survival. This omission is most evident in the discussion of the HOA's preferred alternative, indicating a bias towards the HOA's desired outcome, not an objective evaluation of the facts.

For example, although intertidal habitat would be lost under Alternatives 5A-D as well as under Alternative 3, the SEIS neglects to mention these negative impacts to Piping Plovers, Red Knots, and other birds in its discussion of its preferred alternative. However, the statement below is as true for Alternatives 5A-D as it is for Alternative 3:

These impacts will result in the conversion of intertidal flats and shoals to alternate habitat types; namely subtidal habitat in the dredged area and dry beach habitat in the dike construction area; consequently removing the infaunal community residing in these areas. The removal of this habitat and the encompassed infaunal community is expected to negatively affect various foraging bird species, including piping plovers and the red knot, who utilize the intertidal flats and shoals for feeding in this location (p. 311).

Finally, the Summary of Impacts Table (Appendix E) relies on the highly questionable predictions of the Delft3D models, and does not accurately describe negative impacts to birds, infaunal organisms, or habitat. Many impacts are simply left off of the table.

3. The SEIS mischaracterizes birds' habitat use in several ways. First, states repeatedly that the creation of stabilized dunes and dry beach habitats will benefit a variety of species of birds. However, the preparers and reviewers misunderstand the habitat that terns, skimmers, and shorebirds at Rich Inlet require for nesting, as well as where shorebirds roost within inlets.

The SEIS states, "This stabilization measure [the creation of a dune] will allow for long term growth and development of dune vegetation and provide habitat for roosting, foraging and nesting shorebirds" (p. 362). To the contrary, overwash fans and elevated inlet spits constitute the best habitat for beach-nesting birds, such as Least Terns, Common Terns, Black Skimmers, American Oystercatchers, and Wilson's Plovers, which are found on Figure 8 Island (Gochfeld and Burger 1994, Thompson *et al.* 1997, Nisbet 2002, Corbat and Bergstrom 2000, Nol and Humphrey 2012). This is because they are sparsely vegetated or bare and maintained in that state through natural processes. Within three to five years without overwash, dune vegetation will become too dense and eliminate or significantly degrade nesting habitat (Parnell and Shields 1990). Roosting shorebirds also prefer elevated but open areas that allow them to see the approach of predators. They do not roost within dune systems or seek vegetation. When assessing impacts to birds, the SEIS fails to make the connection between stabilizing the north end of Figure 8 Island, vegetative succession, and the loss of nesting and roosting habitat for shorebirds during both the breeding and non-breeding season that will result from the construction of a terminal groin and other actions proposed in the SEIS.

Second, the SEIS repeatedly attempts to substitute the dry beach habitat currently found on the large spit on the north end of Figure 8 Island for oceanfront beach that it predicts will be maintained or created by a terminal groin (p. 426). However, these two habitats are not interchangeable. The inlet spit dry beach provides habitat for nesting and roosting birds, and there is also a large amount of intertidal zone for foraging on the sound side. If the spit is removed by a terminal groin, the oceanfront dry beach on the south side of the groin will not be suitable habitat for the birds. Shorebirds at Rich Inlet prefer to roost on spits, where they are far away from dunes and other features that would block their view of avian or other predators. Most of the nesting at Rich Inlet also takes place on the spit.

Third, the SEIS misrepresents Piping Plover habitat use in various ways. When the Delft3D model predicts an increase in beach width or oceanfront beach, either on Hutaff or Figure 8 Island, the SEIS attempts to emphasize the importance of wide beaches to Piping Plovers: "As shown by research, wintering plovers on the Atlantic coast prefer wide beaches in the vicinity of inlets (Nicholls and Baldassarre 1990, Wilkinson and Spinks 1994)" (p. 354).

However, Nicholls and Baldassarre (1990) found that wide beaches were a significant predictor of Piping Plover presence on the Gulf Coast, not the Atlantic coast, and differentiated between the more important predictive factors for Piping Plover occupancy on the Atlantic coast—the number of large inlets and passes, the presence of mudflats, and the number of tidepools—and the Gulf coast—beach width, number of small inlets, and beach area.

Similarly, Wilkinson and Spinks (1994) found Piping Plovers were on open sandy beaches near inlets, but the SEIS does not examine the factors that attract Piping Plovers to the vicinity of inlets. There is a growing body of peer-reviewed scientific literature emphasizing habitat heterogeneity at inlets and use of inlet-associated low-energy intertidal flats, particularly by migrating or wintering Piping Plovers (Haig and Oring 1985, Johnson and Baldassarre 1988, Nicholls and Baldassarre 1990), and indicating that Piping Plovers use a variety of habitats throughout the tidal cycle within a small home range during the non-breeding season (Drake *et al.* 2001, Rabon 2006, Cohen *et al.* 2008, Maddock *et al.* 2009).

The SEIS misreports the results of Audubon North Carolina's Rich Inlet report (Addison and McIver 2014a) when it states:

A review of data collected by Audubon North Carolina for piping plover between 2008 and 2014 showed that piping plovers have continued to utilize the habitats within the Rich Inlet complex despite the natural modifications over time. Specifically, of the seven landscape types where piping plovers were observed foraging within this area, the oceanfront beach in proximity to the inlet was the second most utilized habitat type for foraging piping plovers (Addison and McIver, 2014) (p. 275).

The seven landscape types listed in the report were ocean beach, bay beach, inlet spit, ebb shoal island, flood shoal island, sandbar, and tidal creek/lagoon. However, many of these landscape types provide the same habitat type: intertidal habitat. The SEIS does not mention the report's results on habitat use, which documented far more observations on landscapes that provided low-energy intertidal habitats (75.2% of Piping Plover observations) than high-energy intertidal habitat on oceanfront beaches. Those are the habitats that a terminal groin would have the greatest negative impact on.

Additionally, asserting that because Piping Plovers have used Rich Inlet even though it changes naturally over time has no bearing on whether they would be able to use it if significant amounts of foraging and roosting habitat were permanently lost due to the construction of a terminal groin or the channelization of the inlet. The accretion of the spit at the north end of Figure 8 Island has improved habitat in Rich Inlet, which is reflected by the increase in Piping Plover sightings at Rich Inlet; peak counts in 2013, 2014, and 2015 are greater than they have been in previous survey years (Addison and McIver 2014a and Audubon North Carolina unpublished data).

4. The SEIS does not correctly describe the timing of birds' use of Rich Inlet. The SEIS states:

Under Alternative 5D, the groin and beach nourishment construction activity may stress shorebirds, including the endangered piping plover, from foraging along the intertidal flats that are located in close proximity of the construction area. However, as shown with the channel relocation project in New River Inlet discussed in Alternative 3 and 5A, during-construction bird monitoring revealed continual bird use of the inlet resources as dredging and inlet beach activity was in operation. As with that project, construction for Alternative 5D will take place between November 16th and March 31st when some migratory bird species are not present and bird populations are at their lowest (p. 428).

Because it does not acknowledge the seasonal patterns of inlet use by migrating and wintering shorebirds, the SEIS cannot accurately assess impacts of wintertime construction activities. Such activities would directly impact migrating and wintering shorebirds, including the Piping Plover, whose spring migration numbers peak in March or April, and which overwinters at Rich Inlet (Addison and McIver 2014). Other species that winter at Rich Inlet include Dunlin (peak November-March count: 1,446), Short-billed Dowitcher (peak November-March count: 384), Semipalmated Plover (peak November-March count: 250), and Black-bellied Plover (peak November-March count: 164) (Addison and McIver 2014). From fall 2009-spring 2015, average November 16-March 31 counts were higher by 9-48% than average counts during the rest of the year in all years but one (Audubon North Carolina unpublished data). A substantial portion of this data was provided to CP&E during the previous DEIS process.

5. Several figures in Addison and McIver (2014) are interpreted incorrectly in the SEIS. Correctly represented, the figures in the report show that Piping Plovers used the spit on the north end of Figure 8 Island throughout the study period (2010-2014) and that the spit was used for foraging and roosting. However, the SEIS repeatedly treats the dots as actual numbers of Piping Plovers. This misrepresentation is used to state that the habitats used by birds on the north end of Figure 8 Island and the south end of Hutaff Island are comparable and interchangeable, and that the loss of the spit on Figure 8 Island will not impact birds because they will move to Hutaff Island: "Like the Figure Eight side of the inlet, Hutaff's southern spit has been shown by the Audubon North Carolina 5-year survey data to be heavily used for foraging and roosting by piping plover" (p. 354).

In order to determine whether birds used north Figure 8 Island to the same degree as Hutaff Island, we statistically compared the mean numbers of Piping Plovers, Red Knots, and all shorebirds observed at these two locations from 2010-2015. Significantly more Piping Plovers, Red Knots, shorebirds, and all birds were observed on north Figure 8 Island than Hutaff Island during 2010-2015 (Mann-Whitney test, $p<0.001$). This indicates that Hutaff Island is not equivalent to the north end of Figure 8 Island since significantly more Piping Plovers, Red Knots, shorebirds, and birds used north Figure 8 Island.

6. The SEIS fails to include the recent return of nesting Piping Plovers to the north end of Figure 8 Island, does not report the most recent 2015 nesting numbers, and includes Piping Plovers nesting outside of the project area which has the effect of minimizing the relative significance of the north end of Figure 8 Island to nesting Piping Plovers.

The NCWRC collects data for a statewide nesting Piping Plover census every year. Neither the single pair of Piping Plovers that nested on north Figure 8 Island in 2014 nor the two pairs of Piping Plovers that nested in 2015 are reported (Schweitzer 2015, Schweitzer and Abraham 2014). Instead, about nesting Piping Plovers, the SEIS states:

The UNCW, NCWRC, Audubon North Carolina and partners have conducted piping plover surveys of the project area during various seasons since 1987. There are three areas that have been monitored, Figure Eight Island, Rich Inlet and Hutaff Island. Only one (1) breeding pair, observed in 1996, has been located on Figure Eight Island. Hutaff Island, however, appears to be an important breeding area based upon the annual observations of breeding pairs. Since 1989, the peak number of breeding pairs observed on Hutaff was five (5) (Cameron pers. comm., 2007) (p. 172-173).

Dating back to 2003, no Piping Plovers have been reported nesting on Hutaff Island within the project area. The project area includes only a small portion of Hutaff Island. Piping Plover nesting on Hutaff Island occurred farther north and has not occurred at all since 2013.

7. The SEIS misrepresents the results of monitoring that took place at Mason Inlet following the relocation and channelization of Mason Inlet. Accurately understanding the impacts of other inlet management projects are essential to assessing potential impacts at Rich Inlet. The SEIS states:

It should be noted that inlet intertidal flats and shoals are not fixed stationary habitats, and are considered to be ephemeral and dynamic in natural conditions. Consequently, bird resources are known to adjust to these changes. This ability for birds to adjust is also known after man-induced changes as shown in the Mason Inlet Relocation Project (p. 430).

The relocation and maintenance of the Mason Inlet channel within a prescribed corridor through dredging at a three-year interval has had negative impacts to nesting birds at that inlet. In 2013, the most recent year of productivity monitoring for nesting birds, productivity was very low. Only 7% of nests hatched and no chicks survived (Gilstrap *et al.* 2013), far below what is considered "moderately successful" (0.25-0.5 fledglings/pair) (Burger 1984).

Figure 1 illustrates how the stabilization of Mason Inlet impacted nesting birds on the north end of Wrightsville Beach. Because the inlet was stabilized and spits were not allowed to form, erode away, and reform, vegetative succession eventually overtook the open, sandy habitat that was used by Least Terns and other beach-nesting birds. Without suitable habitat, the inlet became largely unsuitable for nesting birds. The effects on other nesting species (Black Skimmer, Common Tern, American Oystercatcher, and Wilson's Plover) were similar. Though yearly data from the south end of Figure 8 Island are not available, no large numbers of birds nested there since the relocation project took place (NCWRC Colonial Waterbird Database).

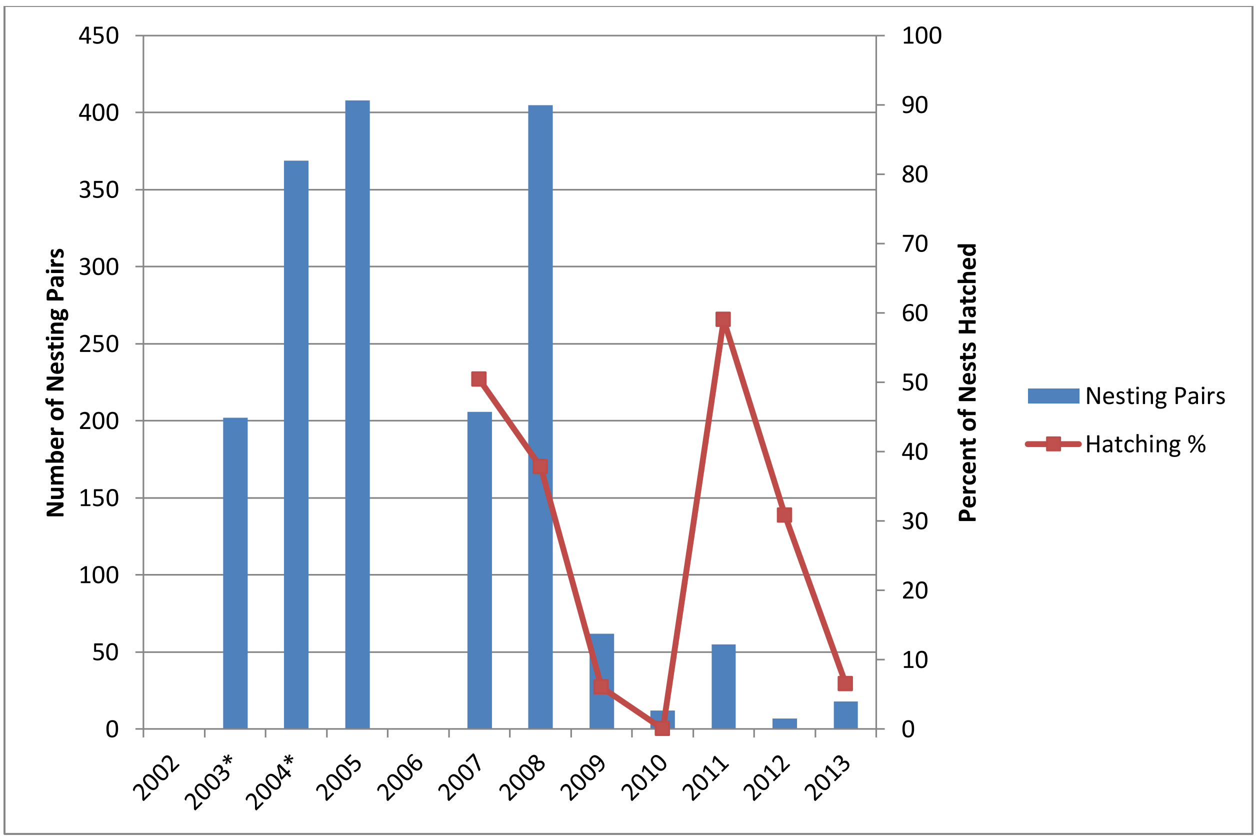

Figure 1. Least Tern nesting pairs and productivity at the north end of Wrightsville Beach, 2002-2013. *Total nests found annually.

In summarizing the overall outcome of the project, it was concluded that "given the continued degradation of the habitat that shore and waterbirds require for nesting, along with the extremely low hatching success and no chicks surviving to fledge, the Mason Inlet Waterbird Management Area currently provides poor-quality habitat for nesting terns, skimmers and shorebirds" (Gilstrap *et al.* 2013).

8. The SEIS makes large claims with no publications or other data to support its assertions. For example:

On-going monitoring along the North Carolina coastline by private, local, and State entities has shown the presence of shorebirds continuing to use the oceanfront beach resources. This is occurring even with more recent beach fill activities and the presence of existing structures. Much of this can be attributed to more public awareness of the species, an expected shortened recovery time for their benthic community food source, the presence of adjacent undisturbed protected beaches, and the inclusion of beach fill moratoriums. These factors are also part of the Figure Eight proposal and if implemented, should reduce any potential cumulative impacts on shorebird resources (p. 27).

Accurate baseline information for birds using oceanfront beach is lacking for most of the state's developed beaches and does not show what the SEIS asserts (S. Schweitzer pers. com. 2015). The rest of the paragraph is also incorrect since there is no moratorium mentioned in the SEIS for placement of beach fill as part of the Figure 8 Island project, the firm producing the report was directly involved in the North Topsail Island beach renourishment project that occurred during the environmental window for birds and sea turtles, and no reason to expect shorter infaunal recovery times is provided.

9. The SEIS inaccurately downplays the conservation status of the shorebirds it considers, citing a 2006 report from the North Carolina Natural Heritage Program: "All shorebirds considered for the purpose of this CEA, with the exception of the piping plover, are globally ranked as G4 (apparently globally secure) or G5 (globally secure)" (Appendix F, p. 16), ignoring several other assessments such as North Carolina NCWRC, the Partners in Flight Watchlist, and U.S. Shorebird Conservation Plan which consider state populations as well as hemispheric populations and do not draw the same conclusions.

10. The SEIS does not address avoidance or mitigation in a meaningful way, and it does not present a robust monitoring protocol. Instead, after selecting an alternative that would significantly and permanently adversely impact Piping Plover, Red Knot, and other wildlife habitat, it proposes:

The University of North Carolina at Wilmington (UNCW), under the direction of Dr. David Webster, conducts shorebird and colonial waterbird monitoring throughout the year along the beachfront of Figure Eight Island and the areas surrounding Mason and Rich Inlet. In addition, Audubon North Carolina has monitored the Rich Inlet complex which includes Figure Eight Island's northern spit since 2008. These monitoring efforts are expected to continue for the foreseeable future (Webster, pers. comm.) (p. 450).

Monitoring is not mitigation. Further, monitoring one side of an inlet, as Dr. Webster does, is not adequate to assess impacts to birds. Monitoring does nothing to minimize adverse impacts to resources. Without thresholds for unacceptable impacts and a detailed, enforceable, feasible plan to reverse those impacts, monitoring does little to no good.

Holden Beach East End Shore Protection Project (Terminal Groin)

EIS Review

The Town of Holden Beach has submitted an Environmental Impact Statement (EIS) to the Wilmington District Army Corps of Engineers (USACE) for the construction of a terminal groin and an independent 30-year beach nourishment plan. The plan addresses chronic erosion on the east end of Holden Beach and proposes to protect public and private property including businesses, homes, public utilities, roads, and recreational areas. The Town of Oak Island supports the efforts to protect and preserve the Holden Beach shoreline and community through the use of a terminal groin and beach fill. However, potential impacts in the form of direct erosional catalysts or indirect conduits that may potentially affect shoreline stabilization efforts for Oak Island must be considered. Lockwood's Folly Inlet (LFI) separates Oak Island from the east end of Holden Beach and provides a significant influence for sediment transport trends between both islands. Therefore, both towns should review any potential change to the inlet dynamics planned as part of the project.

Holden Beach's preferred alternative for the East End Shore Protection Project consists of a 1,000 ft intermediate length T-head groin and beach fill. The structure location falls approximately 1,500 ft from LFI at approximate station 10+00 along the USACE baseline. The beach fill template extends westward from approximate USACE baseline station 5+00, east of the groin structure, to approximate station 45+00. Approximately 700-ft of the groin structure extends seaward of the primary dune with the remaining 300-ft providing an anchor system into and landward of the primary dune system. The T-head on the seaward limit of the structure extends approximately 60-ft in a perpendicular direction on either side of the groin. Granite rock on the order of 4' to 5' diameter will comprise the structure and T-head feature.

The terminal groin will consist of an approximate 25% void ratio and a lowered crest elevation to facilitate a reduced sediment transport across the structure, but not a complete elimination. To further limit blockage of the estimated 150,000 cy/yr migrating eastward off Holden Beach into LFI, sand placement will occur immediately updrift of the groin to form a 'fillet'. The sand placement portion of the plan consists of hydraulically dredging between 100,000 and 150,000 CY from the bend widner located at the AIWW crossing in LFI. The LFI navigation channel and the Central Reach offshore borrow site provide alternate borrow sources for the project. The plan estimates a 4-year maintenance interval for sand placement. The 'fillet' is designed to fill the sediment cell expected to be blocked or anchored by the terminal groin. Theoretically, by constructing the 'fillet' the same sediment budget that existed prior to the project will continue post construction. However, the 'fillet' will change the shoreline orientation and wave approach angle among other key components influencing sediment transport. Thus, the true modified transport rate will not be known until after project construction.

Holden Beach has proposed to monitor shoreline on Oak Island to identify if negative erosional impacts occur. Semi-annual monitoring reports will provide a shoreline and volumetric change analysis for the beach strand extending approximately 4,400 feet from LFI to roughly 500 ft east of 66th Place West. Surveys covering six (6) transects will provide the monitoring data for the analysis. The transects extend from the primary dune out to an elevation of -25 ft NAVD88 along profiles designated as Oak 1 through Oak 5. (Two (2) transects extend from Oak 1 along different azimuths in LFI.) However, the full transects will only be surveyed during annual monitoring events. Semi-annual monitoring events will only cover the transects out to wading depth or approximately -6 ft NAVD88. Additional survey data covering the AIWW bend widner and crossing through LFI, in addition to the LFI navigation channel, will be obtained from the USACE or surveyed separately for inclusion in the monitoring analysis.

Potential concerns over the project include the following:

- Establishment of a technical advisory committee (TAC) to review monitoring results of the project is not required until after construction has commenced.
- The plan does not provide a direct procedure or threshold for qualifying if negative impacts occur on the west end of Oak Island.
- Monitoring timeframes are not specified.
- No guaranteed funding source is available for mitigation efforts, if required.
- The plan cites 3 separate borrow sources that may impede the Town of Oak Island's shore protection efforts if reservations prohibit or limit Oak Island's use.
- Holden Beach is proposing to use Oak Island's shorebird monitoring data without contributing financially or otherwise to its completion.
- Evaluation of any potential impact that may occur from using the offshore borrow source is not included.

The following sections discuss the concerns listed above.

The Technical Advisory Committee (TAC) Is Not Required Until After Construction Has Commenced

Section 6.4 proposes to form a TAC to review monitoring data to verify that project related impacts may/may not have occurred. However, the TAC only has to form prior to completion of the terminal groin construction. This opens the door for potential delays in forming the TAC and does not provide Oak Island reasonable assurances of the committee's incorporation.

Establishing the TAC well before construction provides all parties ample time to become familiar with the project and helps to ensure fair representation for all parties in the development of monitoring thresholds. This also eliminates one additional task to complete while construction is on-going. Typically, the construction process requires substantial time resources for quality assurance review and inspection. Thus, forming the TAC prior to construction will alleviate an additional task requirement when the construction review process may be the most time consuming.

Threshold for Qualifying if Negative Impacts Occur on the West End of Oak Island

From the projects Inlet Management Plan (IMP) included in Appendix C, characteristics describing the 4,400 ft shoreline zone monitored on Oak Island will form the basis for determining if impacts have occurred. However, the IMP does not reference specific volumetric or shoreline change thresholds proposed for determining if impacts occur. Failure to provide a specific threshold prior to construction may facilitate a prolonged decision making process to determine if project related impacts occur. As noted in Appendix F GENESIS-T modeling, Oak Island may or may not experience a sediment deficiency due to the terminal groin trapping eastward transport from Holden Beach to Oak Island.

A threshold of exceeding the 2012 – 2015 average annual shoreline or volumetric change for a period of three (3) consecutive years within the initial six (6) year post construction period may provide a resolution. The volumetric change comparison would extend from the seaward toe of the primary dune to the depth of closure (DOC) for the complete Oak Island zone. The shoreline analysis would compare trends occurring at MHW, but may also include additional contours. The analysis should only utilize surveys conducted in the spring (March through May) of each year to eliminate seasonal fluctuations. The TAC should also have authority to suggest or recommend supplementing or revising the threshold requirements for establishing if negative impacts occur. The TAC should work with the USACE and DCM regulatory staff to initiate any changes to the threshold requirements.

Monitoring Timeframes Not Specified

Appendix C states Holden Beach will survey the beachfront on Oak Island twice per year in efforts to determine if negative impacts have occurred. However, the surveys will only extend across the complete active profile (-25 ft NAVD88) during annual events, with the semi-annual events terminating at wading depth (-6 NAVD88). Also, the appendix does not provide a specific timeframe (fall or spring) to correspond with an annual event or semi-annual event.

In efforts to capture the most reliable monitoring data, the surveys should be conducted during the same time period each year and should cover the same area. The survey plan should state when surveys will be conducted and all surveys should extend to -25 ft NAVD88 or beyond the Depth of Closure (DOC). Generally, monitoring surveys commence in the spring of each year. This helps to eliminate seasonal fluctuations observed in shoreline movement and allows a direct annual comparison with previous surveys. Semi-annual surveys may be conducted during the fall of each year to collect a balanced illustration of the annual shoreline influences.

No Guaranteed Funding Source Available for Mitigation Efforts

Section 6.4 specifies the Town of Holden Beach will fund all mitigation efforts through the Beach, Parks, Access and Recreation/Tourism Fund (BPART). However, Holden Beach also proposes to fund the construction and maintenance of the terminal groin project through the BPART. The EIS does not provide an available balance or escrow account established for the sole purpose of potential mitigation requirements. Based on the BPART's previous funding efforts described throughout the EIS, a reasonable conclusion suggests the fund maintains an adequate balance for any potential mitigation. However, no guarantee exists to provide any potential mitigation if the project maintenance or future construction costs exceed the BPART's available balance.

Requiring the prioritization of all mitigation efforts ahead of maintenance or future construction efforts provides an additional assurance that funds will be available.

The Plan Cites 3 Separate Borrow Sources that may Impede the Town of Oak Island's Shore Protection Efforts if Reservations Prohibit or Limit Oak Island's Use

Section 3.1.6 states a nourishment volume up to approximately 150,000 CY would be required to maintain the 'fillet' and protective beach along the project shoreline. The LFIX and AIWW bend widener serves as the preferred borrow source but the LFI navigation channel and the Central Reach offshore borrow source provide alternate sources. Based on the Holden Beach – Beach Management Plan (Appendix D) an estimated 625,000 CY may also be necessary to fulfill the nourishment requirements for the remainder of the island every 4 years. Coupled with the estimated western transport quantity of 228,000 cy/yr (Section 3.0), this equates to an annual volumetric reduction of approximately 420,000 cy/yr. The components of LFI may not be able to sustain this level of volumetric change and still provide adequate material for nourishing Oak Island.

Concerns with sediment needs exist for Oak Island given the recent shoreline behavior that necessitate clarification of the Holden Beach nourishment plan. The list below provides the requested clarifications.

- If the LFIX and AIWW bend widener provide the preferred borrow source, under what condition(s) will LFI navigation channel or Central Reach borrow source be used?

- Are any circumstances expected where a volume greater than 150,000 CY every 4 years will be needed?

To provide a fair and equivalent sediment source for both Oak Island and Holden Beach, perhaps only half of the available volume from any LFI or navigation channel borrow source (including the AIWW bend widner) should be available for either town. Evidence would be needed to show an equivalent volume of beach compatible material remained in the respective borrow source as the volume proposed for removal. To help support an equal distribution, the volume comparison should account for equivalent grain size characteristics between the volume removed and the volume left in place.

In addition, the use of any borrow source within the LFI system should also be agreed upon by Oak Island, or at a minimum the TAC. Both Oak Island and Holden Beach have a vested interest in identifying the most suitable sand resources within LFI for shoreline initiatives. This would reduce the potential for using a questionable borrow source such as the outer inlet channel in the LFI ebb shoal proposed under alternative 4. Oak Island agrees, use of the designated borrow source under alternative 4 may create adverse impacts for both Holden Beach and Oak Island. A more centralized channel borrow source may be advantageous for both towns.

Use of Oak Island Shore Bird Monitoring Data with No Financial Contribution

Section 6.5 states the Town of Oak Island's shorebird monitoring data will be used to satisfy monitoring requirements for the Town of Holden Beach. Although the Town of Oak Island remains open and amenable to sharing data, Oak Island cannot assume the responsibility of collecting data to serve the purposes of Holden Beach. Prior to accepting Holden Beach's proposal to use data collected by Oak Island there should be an understood agreement between the two town's establishing the responsibilities of each. This may involve a partnering opportunity to collaboratively collect the necessary shorebird data or some other agreement to share resources. However, with no agreement in place Oak Island shall not assume the responsibility of collecting data for the purposes of Holden Beach.

Potential Impacts from Using Offshore Borrow Source Not Included

The Town of Oak Island provided initial comments to the USACE in a letter dated March 23, 2012. The comments included concerns over use of the offshore Central Reach borrow area and potential impacts to the Oak Island shoreline and alignment of LFI. The EIS document does not appear to address the concerns listed in the March 23rd letter. A comprehensive decision regarding this project's path forward must include the analysis of all proposed project alternatives to fully understand the potential impacts. The list below provides the referenced concerns from the March 23, 2012 letter.

- Are impacts to the Oak Island shoreline likely from the proposed dredging of the Central Reach borrow source?
- Will dredging of the Central Reach borrow source alter the symmetry of the ebb-tidal delta complex or channel alignment in LFI?
- What is the potential and timeframe estimated for the recharge of the Central Reach borrow source?

The comments above represent the concerns cited for the Town of Oak Island in reference to the Holden Beach East End Shore Protection Project. Again, Oak Island fully supports Holden Beach's initiative to utilize a terminal groin and beach fill for shoreline stabilization. However, the thorough review of any proposed action that may impact the adjacent LFI system or Oak Island shoreline must be completed and understood prior to moving forward. Your time on this project is appreciated, and please let me know if there are additional questions.

Sincerely,
Town of Oak Island

Tim Holloman
Town Manger

Sincerely,
Town of Oak Island

Tim Holloman
Town Manger

Holden Beach East End Shore Protection Project

Meeting with Town of Oak Island

January 29, 2016

10:30 am

Attendees: Fran Way, Johnny Martin, Robert Neal, Todd Roessler, David Hewett, Christy Ferguson, Tim Holloman

Todd thanked everyone for coming. The Town of Holden Beach has reviewed the Town of Oak Island's comments (attached) and would like to come to a resolution today.

The purpose of today's meeting is reach consensus on the Town of Oak Island's comments and concerns regarding the Town of Holden Beach's East End Shore Protection Project and Inlet Management Plan.

Town of Oak Island's Concerns

Inlet Management Plan

- The Inlet Management Plan (IMP) was developed to establish thresholds and baseline. The Draft IMP set up one profile for baseline. We would like to expand a baseline to capture each profile. What survey data will it be based on?
- Fran indicated that sediment transport around the Lockwood Folly Inlet (LFI) and the groin will not impact Oak Island's (OI's) shoreline, but with that said Holden Beach (HB) will monitor the west end of OI and east end of HB. The Town of HB is proposing monitoring stations as shown in the Draft IMP (new figure D-3). The Town of HB needs OI's blessing to go to DCM and indicate there is an agreement. The approved Bald Head Island Inlet Management Plan was used as a template to establish thresholds.
- Analysis (volume – out to depth of closure (-15) such as Oak 1 – 7) will include monitoring stations on Oak Island and Holden Beach. Official triggers would be based on stations: Oak 3, 4, 5, 6.
- Technical Advisory Committee (TAC) – would include an engineer representing Oak Island and would be formulated prior to construction. The TAC would also include an engineer from the USACE.

Cleary studies/transects only go to MLW. His data will be used (transects 9 and 10 line up with Oak 5 and 6) to serve as a baseline.

Same baseline/thresholds as Bald Head proposed. Ocean Isle is using aerial photography to monitor changes. Oak Island would like to use volumetric change to show the whole picture. A large change in MHW could equate to not a large change when reviewing the entire profile. Need the full picture to determine impacts. Beneficial to Holden Beach. Pattern on OI is erosional on west end. 2012 is baseline – HB has been surveying since then. OI could share survey data within the area to incorporate into the trigger analysis.

Threshold would be 50% trigger of baseline – mitigation triggered is the TAC is formed and evaluate. Data is limited with respect to below MLW and would be consideration of evaluation of threshold data.

HB will do volumetric calculations. MHW threshold + volume calculations. TAC's discretion would be to determine that 2 years of data would be needed prior to determination. The TAC will evaluate all factors including storms, ebb channel changes. Given the small structure, impacts will likely be small.

OI is in favor of project moving forward.

Funding for COE representation would need to come from Holden Beach.

OI will review the revised IMP and determine if changes are sufficient.

Volume thresholds won't be identified now due to limited data. Semi-annual monitoring is going on now to wading depths. ATM will continue aerial photography. DCM proposes to conduct long-term monitoring (30 years?). Annual monitoring will always continue Oak 1 – 7. Will OI continue surveying the oceanfront? OI is currently working on an island-wide feasibility study. Annual profile surveys will be conducted but to what extent is unsure at this point. Sharing data will be best case.

HB annually collects data along 48 profiles from Shallotte to LFI – every 1,000 feet.

HB is permit holder for the groin – by perpetuating the surveys and engineered beach – a storm event causing erosion could provide for FEMA reimbursement.

East Coast Engineering (Chris Stanley) is used for HB. Geodynamics and TI Coastal is used for OI.

OI will place material east of the inlet hazard area and therefore surveys would stop at Oak 5.

Monitoring timeframes is spring and fall – first 6 years will be every 6 months, then annual after indefinitely. Annual surveys are always in the spring.

Funding source for mitigation – if mitigation is required/prioritized in front of nourishment – if funding came after nourishment then money wouldn't be available. Mitigation is preferential over future beach renourishment if the TAC determines that?

Shorebird monitoring – will discuss further once it is determined if bird monitoring. Dawn will call Kathy Matthews to discuss this issue further. Ask if Oak Island's monitoring can be reduced after first year?

Fillet – terminal groin will maintain shoreline orientation and not change it. Modeling proves that.

Borrow area(s) – need for volumes greater than 150,000 cy. OI wants to continue conversation to develop sand management strategies and determine greatest need.

How does COE make the decision to beneficially place AIWW material on Holden Beach every time? Has the COE ever placed material on OI via beneficial use? Matter of cost and convenience to the COE? OI wouldn't mind adding in funds to alternate use. OI has never asked because there hadn't been a need. HB has needed it more in the past.

OI will ask the COE to help clean out mouth of Eastern Channel when they conduct the AIWW bend widener. HB has one-time permits to help maintain the bend widener. There have been 2 bend widener projects – first time the COE funded fully, the second time HB funded the delta to receive material from bend widener. HB utilized existing CAMA Major to modify and a GP 291. Approximately 100,000 cy was placed.

OI has an existing CAMA Major permit and a GP 291 to place material – they could modify to include an additional borrow source from the AIWW bend widener. Approximately 100,000 cy is deposited in the bend widener every year – therefore the two towns could share the resource every 2 years – piggyback on the COE's maintenance event. Benefits to both towns to approach the COE together to utilize the resource.

OI – across 9 miles – volumetric need based on little data – 125,000 cy/year – 1,000,000 every 8 years. Multiple borrow sources as well as inlet management in LFI. Jaybird and Frying Pan are on the table but Jaybird has been contentious as it relates to changes in shoreline on Caswell Beach. An initial project would be needed (several million yards) to reach a 10-year level of protection – vary across island and would include the entire island. Maintain level of protection. Sources of 2 million cy are diverse, could include Central Reach.

LFI would be maintenance material for the west end of the beach. Timeframe for initial project would be 4-5 years.

Confirmation that there is enough material in the TG's main borrow source within the AIWW LFIX. On a normal year 150,000 will be enough to maintain the fillet, it is likely there will be additional material to be shared between the Towns if a need arises.

Central Reach Borrow Area – under what conditions would be required to utilize. Mobilization would be too high as it would require a larger dredge. Upland material would be priority – just for the TG project. The Central Reach project's main borrow source is the central reach borrow area - $16-18 million project.

The LFI is not included in the East End Shore Protection Project – just the AIWW LFIX.

Central Reach borrow area is in 35 feet of water, approximately 2-3 miles offshore. Cuts are shallow. Similar studies indicate that Long Bay is sand starved. Discussions were had with OI and HB to discuss the central reach borrow area and potential concerns/impacts.

OI submitted a letter to COE in 2011 but letter was not provided to HB. ATM provide additional data to determine changes to wave heights if central reach borrow area would be dredged. Incorporate additional information from similar studies, i.e. Myrtle Beach.

The Central Reach project already evaluated this in the CAMA Major permit and ATM will provide a paragraph in response to this concern.

Central Reach borrow area recharge will be relatively slow due to depth and location. OI understands and agrees. Similar to Jay Bird shoal where it was dredged for Bald Head's private project. Dredge cuts still show up, no sloughing has occurred. Increased wave energy of 1 – 2% on Caswell Beach has occurred. Caswell Beach should receive the next sand allotment in 2017, approximately 300,000 cy of material. Sand Management Plan is still proposed and not final.

Sand sources within the LFI – under normal condition, there will be enough material to meet the needs of HB and OI. HB is open to future discussions to proactively manage sand needs. The TAC will be formulated to support this strategy.

Dawn will summarize meeting minutes and provide to the group and will serve as a baseline response to the Town to reach an agreement on concerns.

TG construction has no timeframe at this time. A permit is needed first. Central Reach project is already permitted. TG construction will be approximately $2 million and funding is in place. East end of beach is hanging on, no dune currently exists in front of Amazing Grace.

VIA Electronic Mail

March 11, 2016

Tim Holloman, Town Manager
Town of Oak Island
4601 E. Oak Island Drive
Oak Island, NC 28465

RE: Holden Beach East End Shore Protection Project: Updated Draft Inlet Management Plan

Dear Mr. Holloman,

The Town of Holden Beach is pleased to have received the Town of Oak Island's comments on the Draft EIS for the proposed East End Shore Protection Project, and we appreciate your willingness to sit down with us on January 29th at Holden Beach's Town Hall to openly discuss your concerns and come to a resolution that we can all support moving forward. Based on our discussion, we have summarized the principal concerns below to ensure we document agreed-upon updates to the Lockwoods Folly Inlet Management Plan. We feel confident that based on our discussions regarding the Town of Oak Island's comments, dated October 7, 2015, we have reached consensus and resolved the following concerns:

Town of Oak Island Concern: The terminal groin and fillet will alter the orientation of the shoreline and the wave approach angle and influence sediment transport into Lockwoods Folly Inlet.

Consensus: The Town of Holden Beach will monitor the west end of Oak Island and the east end of Holden Beach. Monitoring stations as agreed upon are detailed in the revised Inlet Management Plan.

Town of Oak Island Concern: Borrow sources and extent of use.

Consensus: 1) The main borrow source for the terminal groin fillet is the AIWW Lockwoods Folly Inlet Crossing. It was confirmed that the volume of material deposited annually is sufficient to provide a shared resource for the two Towns as needs arise; 2) The management of Lockwoods Folly Inlet is not included in the preferred alternative for the Holden Beach East End Shore Protection Project; and 3) Central Reach borrow area recharge will be relatively slow due to depth and geographic location. Wave energy will not change on Oak Island if the Central Reach borrow area is dredged.

TOWN OF HOLDEN BEACH / 110 ROTHSCHILD STREET / HOLDEN BEACH / NORTH CAROLINA
(910) 842-6488 / Fax (910) 842-9315 / http://www.hbtownhall.com

Town of Oak Island Concern: Sand Allocation

Consensus: Under normal conditions, there will be enough material to meet the needs of Holden Beach and Oak Island. Holden Beach is open to future discussions to proactively manage sand needs in a manner that will meet the needs of both Towns. A Technical Advisory Committee will be formed to advance this strategy.

Town of Oak Island Concern: Inlet Management Plan

Consensus: The attached revised Draft Inlet Management Plan incorporates the following specific measures as discussed and agreed upon on the 29th of January: 1) A Technical Advisory Committee will be formed prior to the implementation of the proposed East End Shore Protection project; 2) volume and shoreline change thresholds are addressed; 3) monitoring survey timeframes are established; and 4) funding sources for mitigation are identified.

Representatives of the Town of Holden Beach met with the NC Division of Coastal Management to discuss the above agreed-upon measures and ensure that the revised Inlet Management Plan will address their concerns as well as those of the Town of Oak Island. We believe the proposed updates to the Inlet Management Plan adequately address your concerns and will provide for the protection of Oak Island once a terminal groin is constructed on the east end of Holden Beach.

Thank you for your support.

Sincerely,
The Town of Holden Beach

David W. Hewett

David Hewett

Enclosure

cc: Johnny Martin

April 6, 2016

Mr. David Hewett
Town Manager
Town of Holden Beach
110 Rothschild Street
Holden Beach, NC 28462

Re: **Comments on Revised Inlet Management Plan for Holden Beach Terminal Groin Draft EIS**

Dear Mr. Hewett,

The Town of Oak Island appreciates the opportunity to comment on the revised inlet management plan provided by the Town of Holden Beach for the Terminal Groin Draft EIS. We have reviewed the revised plan and find that it has addressed all the previous comments provided by the Town of Oak Island. As for the Draft EIS, the only remaining issue that needs to be addressed is the addition of a few sentences outlining the reasons why use of the offshore borrow site is not expected to cause increased wave energy to reach the Oak Island shoreline.

Again, the Town of Oak Island appreciates the opportunity to comment on this project and strongly supports the approval of a terminal groin on Holden Beach. We appreciate our relationship with the Town of Holden Beach and look forward to continuing to share data and the precious sediment resources adjacent to both our islands.

If you have any questions, please do not hesitate to contact me at (910) 201-8004.

Sincerely,

Lisa P. Stites

Lisa P. Stites
Interim Town Manager
Town of Oak Island
(910) 201-8004

Maria Waddell

From: Hughes, Emily B SAW <Emily.B.Hughes@usace.army.mil>
Sent: Tuesday, October 13, 2015 8:53 AM
To: Dawn York
Subject: FW: [EXTERNAL] Hard structure on Holden Beach (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

Good Morning!

-----Original Message-----
From: Sandra Brooks-Mathers [mailto:sandra.roseum@gmail.com]
Sent: Saturday, October 10, 2015 11:54 AM
To: Hughes, Emily B SAW
Subject: [EXTERNAL] Hard structure on Holden Beach

I am a regular visitor to beautiful, quiet Holden Beach, a haven for humans, shorebirds and other plant and animal coastal residents. I urge you to seek an alternative plan to building a hardened structure that will certainly harm essential estuarine waters, marine fisheries, and endangered piping plover and sea turtle nesting sites. There are alternative methods to preventing erosion that should be explored for Holden Beach and would create less economic and environmental damage.

Respectfully,
Sandra Brooks-Mathers
Chapel Hill, NC

Sent from my iPad

Classification: UNCLASSIFIED
Caveats: NONE

Maria Waddell

From: Hughes, Emily B SAW <Emily.B.Hughes@usace.army.mil>
Sent: Tuesday, October 13, 2015 8:57 AM
To: Dawn York
Subject: FW: [EXTERNAL] Holden Beach Draft EIS comment (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

I believe this guy also spoke at the PH...

-----Original Message-----
From: RichWe@aol.com [mailto:RichWe@aol.com]
Sent: Sunday, October 11, 2015 7:45 PM
To: Hughes, Emily B SAW
Cc: holden3@ec.rr.com; sklapheke@mindspring.com
Subject: [EXTERNAL] Holden Beach Draft EIS comment

Sunday, October 11, 2015 7:45 PM

The State of North Carolina recognizes that state ownership of the beach ends at the Mean High Water (MHW) line.

The proposed terminal groin (Alternative # 6) is designed to be built with attachment to the "primary dune".
Section 5.4.6
"The main stem of the intermediate terminal groin would include a 700-ft-long segment extending seaward from the toe of the primary dune and a ~300-ft anchor segment extending landward from the toe of the primary dune."

The "primary dune" is landward of the Mean High Water (MHW) line. Therefore the dune is on "private" property, not state property. Therefore there can be no attachment/construction to the "primary dune" without the approval of the property owner.

Richard S. Weigand
359 Serenity Lane
Holden Beach, NC 28462-1902

910 / 842-8659   House

Classification: UNCLASSIFIED
Caveats: NONE

Maria Waddell

From: Hughes, Emily B SAW <Emily.B.Hughes@usace.army.mil>
Sent: Friday, October 09, 2015 1:08 PM
To: Dawn York
Subject: FW: [EXTERNAL] Holden Beach terminal groin project. (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

-----Original Message-----
From: Queennasa@aol.com [mailto:Queennasa@aol.com]
Sent: Friday, October 09, 2015 12:41 PM
To: Hughes, Emily B SAW
Subject: [EXTERNAL] Holden Beach terminal groin project.

Dear Ms Hughes,

I'd like to submit my comments in support of the proposed terminal groin project for Holden Beach.

I believe this is the best strategy to prevent shoreline erosion. I also believe this project will also protect infrastructure, roads, wildlife as well as the beaches and dunes.

Could you send me any updated information relating to this project?

Thank you

Diana Willard
230 Ocean Blvd East
Holden Beach, N.C.
28462

Classification: UNCLASSIFIED
Caveats: NONE

Maria Waddell

From: Hughes, Emily B SAW <Emily.B.Hughes@usace.army.mil>
Sent: Tuesday, October 13, 2015 9:30 AM
To: Dawn York
Subject: FW: [EXTERNAL] Holden Beach terminal groin project (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

-----Original Message-----
From: Willardte@aol.com [mailto:Willardte@aol.com]
Sent: Monday, October 12, 2015 10:17 PM
To: Hughes, Emily B SAW
Subject: [EXTERNAL] Holden Beach terminal groin project

My name is Terry Willard and own a home on Holden Beach and I am in favor of the terminal groin project. But whether others are for or against, all should read this groundbreaking study just published this year by UNC Wilmington and Duke University, and funded by the National Science Foundation, to examine the correlation between property values, coastal economies, and federal beach nourishment subsidies. http://uncw.edu/research/BeachNourishmentSubsidies.html

The gist is in this era of federal budget tightening the Feds are under pressure to eliminate beach nourishment subsidies that represent about 65% of the cost. If this happens property values will plummet dramatically and coastal economies will suffer. The study says "This would be analogous to the bursting of a bubble." Remember 2008!

I see the terminal groin project as an alternative too, and hedge against, an uncertain and unfavorable economic scenario out of our control that could snowball quickly if the Feds stop funding the majority of the cost of beach nourishment. The terminal groin project calculated a $40 million saving over 30 years, but if the Feds stop paying for 2/3 of the cost, the saving could be 2 to 3 times greater and we take control of our beach, property values, and local economy!

Please read this NC study and then judge for yourself.

Best to all,

Classification: UNCLASSIFIED
Caveats: NONE

Maria Waddell

From: Hughes, Emily B SAW <Emily.B.Hughes@usace.army.mil>
Sent: Friday, October 02, 2015 8:34 AM
To: Skip Klapheke
Cc: Dahl, Kyle J SAW; Dawn York
Subject: RE: [EXTERNAL] Comment re: Holden Beach DEIS (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

Thank you Skip. It was a pleasure meeting you at the Public Hearing. Your comments have been received and added to the record. You're interest in this project is much appreciated.

Sincerely,

Emily Hughes

U.S. Army Corps of Engineers
Wilmington District
Environmental Resources Section
69 Darlington Avenue
Wilmington, North Carolina 28403

Office: (910) 251-4635

-----Original Message-----
From: Skip Klapheke [mailto:sklapheke@mindspring.com]
Sent: Friday, October 02, 2015 8:16 AM
To: Hughes, Emily B SAW
Subject: [EXTERNAL] Comment re: Holden Beach DEIS

At the public hearing held at Holden Beach on September 24, 2015, it was apparent that there was general lack of familiarity with Present Value analysis. Since relative cost is, and should be, a key determinate in deciding how to proceed, failure to appreciate that the Present Value of the alternatives is far more important than nominal cost will inevitably lead to incorrect conclusions.

The study needs to make this point clearly, and the firm conducting the study, should take the time to educate the decision makers that the Present Value of the alternatives needs to be the basis of any financial comparison.

Skip Klapheke

704 365 6774

Classification: UNCLASSIFIED
Caveats: NONE

Rec'd 9/24/15

Comments in response to the Holden Beach Draft Environmental Impact Statement (DEIS)

Dated August 19, 2015

"Skip"

by Charles Klapheke of 342 Serenity Lane, Holden Beach, North Carolina

Sklapheke@mindspring.com

Summary Comments

This study is not sufficient to allow a well-informed discussion of the proposed alternatives. The DEIS omits any analysis of well over 50% of the Holden Beach portion of the affected project area. The financial presentation contains significant errors. The model, upon which so much of the study relies, if similar to the models used in prior studies, has proven unable to predict erosion patterns or even sand movement. Some specifics follow.

Perceived Shortcomings and Omissions of the Study

- NONE of the six alternatives permanently addresses the east end erosion issue. Whatever approach is taken will require continuous funding. Alternatives 5 and 6 commit the Town to a 30-year plan with all the inherent costs, tax impacts, and visual degradation regardless of outcome. Even worse, the structures proposed in alternatives 5 and 6 are required to be removed at the Town's expense in the event of negative outcomes, resulting in costs for both construction and removal with potentially no benefit. Alternatives 1, 2, 3, and 4, however, allow for periodic review and adjustments or easy change of course, including reconsideration of alternatives 5 or 6 if the desired results are not achieved. Perhaps the best approach is to evaluate the success of other efforts underway elsewhere before the Town makes such a substantial, not easily reversible commitment, especially since the recent action by the Legislature indicates that all of the studied alternatives will remain viable options.

- The statement that the groin field built during the 1970's was "effective and efficient" is a huge leap. There are analysis available that indicated that the accretion of sand during this time was more likely related to the position of the inlet channel.

- All the alternatives speak to the impact on the houses near the eastern end of McCray Street. The number of impacted properties varies from 11 under alternative 6 to 28 under alternative 2. The tax base affected varies from $.995MM under alternative 5 to $5.18MM under alternative 2. However the document is silent as to the impact to 8 oceanfront homes, 4 oceanfront lots, infrastructure, and recreational amenities on Serenity Lane. These homes and the neighborhood will experience substantial aesthetic and tax impacts from any alternative, but certainly from alternatives 5 and 6. There is also scant mention of the potential impact to the homes and beaches at the western end of Oak Island.

- Using the figures in the study (which are very questionable) the alternative recommended—alternative 6 (Intermediate terminal groin)—improves on Alternative 1 (Status quo) by positively affecting only three additional parcels. For these additional parcels the Town will spend an additional $3.52MM (PV) and forgo any flexibility for the foreseeable future.

- The study suggests that a terminal groin would enhance the recreational value of the beach front properties by adding width to the beach. It also states that there is an increase in rip tide potential, serious erosion east of any hard structure during severe storms, and the addition of a rocky bottom for fish habitat. These positions are not consistent, at least from a swimmer's perspective.

- Table 5.4 projects the beach width decreasing for alternatives 1, 3, or 4 even though under all three alternatives the beach was renourished in year two.

- The study mentions as a risk the spatial and temporal conflicts surrounding implementation of any of the alternatives. There are fiscal conflicts also. Any of the alternatives will contend for tax dollars with other, equally significant projects, such as:
    - The Central Reach Nourishment project—Initial cost of $10-15MM, and $10-15MM every ten years thereafter;
    - Water main replacement;
    - Road Maintenance; and
    - Sewer system upgrades and maintenance.

- There are several hundred pages describing all the biology that is potentially impacted by this project, including 14 species on the federal endangered list and 11 species on the state list. However, there does not appear to be any conclusion as to the impact of this project on any of the named species. This is incongruous with the fact that virtually all dredging is scheduled around habitat nesting activity and walking is even discouraged in nesting areas during certain times of the year.

- The financials of the alternatives may be correct, but it is unlikely. Without credible numbers any evaluation is impossible. Consider:
    - Alternatives 5 and 6 have the same exact costs and PV although the groin in alternative 6 is 7% longer.
    - The PV of alternatives 3, 4, 5, and 6 are exactly the same even though alternatives 3 and 4 cost $55.5MM and alternatives 5 and 6 cost $34.41MM.
    - Alternatives 3 and 4, very different projects, cost exactly the same.
    - The tables containing summaries of the cost estimates do not consistently reflect the estimates in the detail discussion nor do the estimates appear correct, e.g.
        - The summary table lists infrastructure costs of $101,572 for alternative 6, but the text states the cost at $80,455, with a PV of $86,408-92,019. Obviously, the PV cannot be more than the total cost, and it is not clear what this is for, since alternative 6 is supposed to avoid such costs.
        - There are infrastructure costs in alternative 6, but none in alternative 5.

Additional Observations and Questions

1. The study states that "It is not possible to accurately predict all of the complex environmental variables that influence changes in coastal morphology....Consequently, the model-projected

changes should not be interpreted as a precise estimate of future conditions in the Permit Area". Since this whole analysis depends on the results of a single model, this disclaimer seriously undermines the study's conclusions. In fact, the model used for the Ocean Isle DEIS, even when calibrated using historical data, was unable to predict the known direction of sand movement or erosion patterns. This same model incorrectly predicted shoreline movement at North Topsail. Its use is also prompting a re-analysis of the results predicted in the Figure Eight Study. Because of the heavy dependence on modeling results, this study needs to include the details of the model used, including its limitations and the probability of successfully projecting the future, especially in light of the poor results of prior modeling. To appreciate the difficulty of predicting natural phenomena, consider the variation in hurricane modeling that only attempts to project weather for the following week or two. This study, on the other hand, recommends a huge long term commitment based on the outcome a single model attempting to project natural occurrences 30 years into the future.

2. A review of the alternatives of the study would be a little easier to conduct if the tables summarizing the costs and benefits were located in the corresponding sub-sections of chapter 5.
3. Repeated references were made to the uncertainly of federal funding for beach renourishment projects. While this may be true, projects that support navigation of the waterway and inlet, which produce sand, do have a relatively higher probability of being funded.
4. It is the purpose of studies such as this one to determine the best alternative. The initial pages of the study refer to "The Town's Preferred Alternative (Alternative 6—Intermediate Terminal Groin with Beach Nourishment.)" Neither the Town nor any other entity should have had a preferred alternative four years before any analysis was done. The presence of this statement calls into question the objectivity of this study.
5. What is the source of funding for these alternatives (Federal, State, Town), and what is the revenue vehicle (grants, appropriations, additional taxes)?
6. What other major Town initiatives will be deferred or abandoned to implement this one?
7. What is the process, timeframe, and forum for the town commissioners to receive the final study, solicit input from their constituency, select an alternative, and determine sources and impact of funding?

Conclusion

This study appears to begin with a preordained outcome, omits analysis that are not supportive of that outcome, relies solely on modeling that does not appear credible, and erroneously concludes that an expense of $34MM to build a 1,120 foot long terminal groin is the most effective and efficient alternative.

Maria Waddell

From: Hughes, Emily B SAW <Emily.B.Hughes@usace.army.mil>
Sent: Tuesday, October 13, 2015 9:12 AM
To: Beter, Dale E SAW; Dahl, Kyle J SAW; McLendon, Scott C SAW; Pruitt, Carl E SAW
Subject: FW: [EXTERNAL] Holden Beach Terminal Groin Project Comments (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

Scott and I engaged with this woman the night of the PH. She was very passionate on the idea that we had failed to provide this document to the public in a convenient manner - meaning that we should be providing all of the local libraries with hard copies of the DEIS and Appendices. Is this our responsibility? We have members of the PRT representing Oak Island and the other municipalities - shouldn't they perhaps be the ones to make a hard copy available in their library/Town Hall/etc.? How do we address this?

Thanks,
Emily

-----Original Message-----
From: Eileen Governale [mailto:eileen@excavservices.com]
Sent: Monday, October 12, 2015 12:25 PM
To: Hughes, Emily B SAW
Subject: [EXTERNAL] Holden Beach Terminal Groin Project Comments

I am provided two comments on the DEIS for this project

The first is an administrative one, and an important one:

The DEIS is on-line only, and you have disenfranchised all those who are not able to manage the complexity of this on-line document (mostly those over 65 (at least 25% of this population). Further, there was one public meeting held in the evening at Holden Beach, at night, in the rain. Due to geographic constraints, Holden Beach is at least a 40 minute drive from Oak Island, and many people do not drive at night.

In addition, none of the figures, especially those in Sections 4 and 5 are legible in the on-line version. These figures are important visual aids to accompany the technical language presented in the document.

To summarize;

This is an important project, not only for Holden Beach, but for Oak Island. As a resident of oak island (in the study area), we have been largely excluded from the decision making process.The DEIS should have been made available to stakeholders in various forms, including print, poster sessions, etc. and at locations that are convenient to the relevant stakeholders. Most importantly, the DEIS should have been available in print for all residents in the study area at their local public libraries.

The second comment relates to the DEIS itself:

While alterrnative 6 will probably result in a stable wider beachfront for Holden (albeit at great cost), this is not a benign structure, and loss of tidal and intertidal acreage is expected to occur on the west end of oak island and our tidal flats. These habitats are 'critical', even as stated in the DEIS (section 4), yet the ecological and economic impacts to Oak Island are not addressed to the extent that they should be. After reading this DEIS, I am still in the dark as to what happens on OKI!

Our shorelines are precious to all of us. If potential impacts from this structure are poorly understood, the T.G. should not be selected as the best option.

Sincerely;

Eileen Governale
122 NE 18th St
Oak Island, NC 28465

Classification: UNCLASSIFIED
Caveats: NONE

Maria Waddell

From: Hughes, Emily B SAW <Emily.B.Hughes@usace.army.mil>
Sent: Friday, October 02, 2015 8:33 AM
To: avian@aol.com
Cc: Dahl, Kyle J SAW; Dawn York
Subject: RE: [EXTERNAL] Lockwood Folly/Holden Beach Terminal Groin (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

Thank you Mr. and Mrs. Meyer. Your comments have been received and added to the record. You're interest in this project is much appreciated.

Sincerely,

Emily Hughes

U.S. Army Corps of Engineers
Wilmington District
Environmental Resources Section
69 Darlington Avenue
Wilmington, North Carolina 28403

Office: (910) 251-4635

-----Original Message-----
From: avian@aol.com [mailto:avian@aol.com]
Sent: Friday, October 02, 2015 12:26 AM
To: Hughes, Emily B SAW
Cc: mikeg@nccoast.org; dmcnaught@environmentaldefense.org; drader@environmentaldefense.org
Subject: [EXTERNAL] Lockwood Folly/Holden Beach Terminal Groin

Emily Hughes, Project Manager
69 Darlington Avenue
Wilmington, NC 28403
Emily.b.hughes@usace.army.mil
October 2, 2015

Ms. Hughes and Corps of Engineers Managers:

We have reviewed the Lockwood Folly Inlet/Holden Beach Terminal Groin proposal. We would like to submit our comments for inclusion in the public record.
We speak on behalf of public beach users in North Carolina.

In 2010 to 2012, we walked every mile of shorefront on the North Carolina coast. One of our goals was to become familiar with the entire coast, to get a grasp on the entire NC shoreline. We accomplished that goal, and we learned much from our journey.

One firm conclusion we formed on our coastal trek was that any and every human-made structure on the public beach has a detrimental impact on public use of our beaches. Currently, at least fourteen such structures exist on the North Carolina coast. Construction of any other human-made structures should be considered only if clear evidence of significant public benefit exists. Clearly, such is not the case with the Holden Beach/Lockwood Folly Inlet proposal.

The Holden Beach/Lockwood Folly proposal states one of its main purposes is to ensure the continued use of the oceanfront beach. Construction of a terminal groin would not serve this stated purpose. In fact, a terminal groin would be detrimental to public use of the beach. If you doubt this fact, please walk the Bald Head Island Groin Field on the south end of Bald Head Island. Then walk the unimpeded east beach on Bald Head. No doubt will remain in your mind that terminal groins impede the use of public beach.

The proposal states that infrastructure, private property, and public beach are threatened by erosion. Public beach will exist wherever ocean meets the shore. The “threat” occurs whenever a structure is erected close to the shoreline; the threat is to the structure, not the beach. A terminal groin will not protect the public beach; it is designed to protect private property. Any action that is harmful to public beach and waters (including inlets, sound, and ocean water) and not clearly beneficial to significant public interests should not even be considered.

In summary, please do not approve this terminal groin project. Clearly, this project violates NC laws of public trust that protect public beaches for the benefit of all. If the project is approved, we would hope that this decision would be challenged in court as a breach of public trust laws.

Respectfully submitted,

Peter K. Meyer
Catherine E. Meyer
1616 Jetty’s Reach
Wilmington, NC 28409

cc: D. Rader
D. McNaught
NC Environmental Defense Fund

Mike Giles
North Carolina Coastal Federation

Classification: UNCLASSIFIED
Caveats: NONE

Maria Waddell

From:	Hughes, Emily B SAW <Emily.B.Hughes@usace.army.mil>
Sent:	Wednesday, October 14, 2015 8:17 AM
To:	Dawn York
Subject:	FW: [EXTERNAL] Holden Beach Draft Environmental Impact Statement (UNCLASSIFIED)
Attachments:	VMyers Comments DEIS.docx

Classification: UNCLASSIFIED
Caveats: NONE

G'mornin'!

-----Original Message-----
From: Vicki Myers [mailto:vymyers@gmail.com]
Sent: Tuesday, October 13, 2015 4:42 PM
To: Hughes, Emily B SAW
Subject: [EXTERNAL] Holden Beach Draft Environmental Impact Statement

Hello Emily,

Attached are my comments. Thanks!

Vicki Y. Myers
vymyers@gmail.com

Classification: UNCLASSIFIED
Caveats: NONE

Vicki Y. Myers
155 Scotch Bonnet Drive
Holden Beach, NC 28462
704-517-4280 cell
910-846-5872 hm
vymyers@gmail.com

October 13, 2015

Ms. Emily Hughes
Wilmington Regulatory Field Office
69 Darlington Avenue
Wilmington, NC 28403
Emily.B.Hughes@usace.army.mil

Ms. Hughes,

I have reviewed the Draft Environmental Impact Statement (DEIS) and attended the Public Hearing. This massive document and the appendices contain a lot of information, however, I am left with more questions than when I started.

My concerns center around several key areas: financial impact (economics of the alternatives), impacts outside of the project area, and general questions about the project. I emailed you some of my questions previously. Please see my email of September 29, 2015.

Terminal Groin Economics

It is difficult to even make assumptions about the costs related to the project because there are so many errors in the DEIS. This is disappointing because Holden Beach is a very small community with many residents living on a fixed income. Unlike our neighboring islands we do not have a commercial area on the mainland to generate tax revenue. As an island, we have many demands on our tax monies for multiple projects and constructing a groin with the additional required nourishment and monitoring will be a big commitment and cannot help but impact other projects.

There are errors in the DEIS. The information in the charts doesn't match the verbiage. For example, for Alternative 6, page 5-156: "In present value terms, construction costs range from $15.24 million (6% discount rate) to approximately $23.43 million (2.5% discount rate)," but table 5.17 on page 5-159 shows a present value of $21.97M – $36.32M.

In addition, the present value of Alternatives 3, 4, 5, and 6 all show the same amount according to the tables, even though the project costs vary. In fact, for Alternative 6 the present value at the 2.5% rate is *higher* than the total construction cost.

Furthermore, it is highly unlikely that Alternatives 3 and 4 would cost exactly the same ($55.5M) since one involves inlet management. The same is true for Alternatives 5 and 6 ($34.31M) since one is for a short groin and one is for the intermediate groin.

The cost information that feeds the DEIS appears to have been taken from Appendix F, ATM Engineering Analysis, specifically Section 9 and is shown in Table 9-7. The report states, "All three groin alternatives are more economical than the nourishment-only alternatives, primarily due to reduced mob/demob fees. " This assumes that the Town takes on the cost. If the AIWW continues to be dredged as needed and the sand is deposited on the beach, wouldn't this reduce the cost of the nourishment only option? While there is no guarantee, it is highly unlikely that the waterway will not continue to be dredged.

Section 5 of the DEIS compares everything to the Abandon and Retreat strategy. This is misleading; all alternatives should be compared to the status quo – Alternative 1.

Why is there not a table or section that compares the economics of the alternatives? The information is spread out by alternative in the Environmental Consequences section over 159 pages. Most people would never find the financials buried in with impacts on manatees and sediment levels and there is not a place that allows the reader to compare the Alternatives.

Impacts Outside of the Study Area

I was unable to find where there are assurances that areas to the west of the proposed groin would not be impacted. The State's Final Report Terminal Groin Study of March 1, 2010 stated "For Oregon Inlet, Fort Macon, and Amelia Island there is a moderate negative result over the second mile" indicating that property owners could see increased erosion rates further down the beach.

It is well documented that middle portion of our island is experiencing erosion and the Central Reach Project has been planned to help with that. If the groin proceeds, there is a real possibility that this project will not go forward because there won't be funding to cover it. So not only will over 500 properties not receive the protection and economic benefits of added sand but could actually be harmed by the groin.

If the study area is only 2500' how will property owners demonstrate that they are experiencing increased erosion rates other than use of the Annual Monitoring report? Why is "robust" monitoring as was promised at the Public Hearing not reaching further down the beach? Will the burden to show increased erosion rates fall on property owners? If the groin does cause increased erosion how will it be addressed? What if Oak Island experiences increased erosion, will the Town of Holden Beach be required to nourish their beach or remove/modify the groin?

Other Questions and Concerns

- This report is based on the old alignment of the inlet. The inlet is currently strongly oriented to the southwest. I expect the 2015 annual beach monitoring report will show accretion in the study area. What is the impact of the current inlet alignment on the project costs, modeling, and other factors?

- Why did the handout from the Public Hearing not match the information in the DEIS? Which one is correct? For example, the diagram in the handout shows a groin cross section 10' wide at the top, but the DEIS shows it to be 5" wide (page 5-142).

- Page 5-36 of the DEIS states the Central Reach Project will occur in 2014/2015. This is not correct.

- Figure 5.10 and Table 5.4 show Alt. #6 starts at 93' width, all other alternatives start at 85' (Page 5-20). Why is this? Shouldn't they start at the same point?

- Section 5.2.1 states, "It is not possible to accurately predict all of the complex environmental variables that influence changes in coastal morphology. In fact, some anthropogenic activities, such as AIWW navigation dredging, were purposely excluded from the modeling runs to minimize the potential for masking of project-induced changes." Is this realistic? The AIWW will continue to be dredged. It is also not comforting to have the report state that it can't predict changes, but all the recommendations are based on modeling.

- Why are you asking for public comment on an EIS when the appropriate environmental agencies have not yet weighed in? This process should be sequential, not parallel. This project is designated as one of four approved by the state to study the impact of terminal groins, it should not proceed without full input from all agencies and the public should have the opportunity to comment on it.

- Why has there not been a public question and answer session for this project. How can you expect to get public input when there are so many questions and the source document is a technical paper thousands of pages long?

- The report refers to the "Town's preferred option" – who is the Town? Who decided this?

In summary, I am disappointed. How can our Town leaders make good decisions with flawed information? It is clear that the report was written with the end in mind: that the best alternative was Alternative 6. The report is not unbiased; it takes a position and supports it. This report and the supporting documentation were prepared by firms that have a financial interest in the outcome.

While I am not opposed to a terminal groin on Holden Beach, I am concerned about the information that has been provided and feel that questions need to be addressed before it proceeds.

Best Regards,

Vicki Y. Myers

Maria Waddell

From: Hughes, Emily B SAW <Emily.B.Hughes@usace.army.mil>
Sent: Monday, September 21, 2015 11:42 AM
To: Dawn York
Subject: FW: [EXTERNAL] Holden Beach (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

-----Original Message-----
From: april o [mailto:aprilozamiz@gmail.com]
Sent: Saturday, September 19, 2015 6:16 PM
To: Hughes, Emily B SAW
Subject: [EXTERNAL] Holden Beach

Dear Emily,
One thing that makes NC unique from other states is its historical respect and hard work to preserve biodiversity; I hope I don't live to see this strength crumble with the increase in population and industry in the area.
Many man-made structures do not work in the long run from the perspective of ecosystems and natural forests that took millions of years to evolve and develop. I hope you can work as a team with the NC Coastal federation on alternative ideas. Happy endings to conflict are those in which two opposing sides are flexible to work together recognizing each have their own areas of expertise. It is very dangerous to make assumptions for biological systems. Piping plovers and sea turtles are endangered animals and should be protected as the USA has always tried to preserve our indigenous species. If it were up to me, I don't think any homes or structures should be built on the coast, it seems like walking up a mudslide, and a huge moneypit when considering potential hurricane damage, any sea level rise, and erosion. All may not support the idea of sea level rise, but one interesting fact is that insurance companies "do" for obvious strategic reasons that are unfair to the retiring population of adults. For this reason, it is also better not to perpetuate habitation and construction on sensitive lands/sands.

Thank You,

April

Classification: UNCLASSIFIED
Caveats: NONE

Maria Waddell

From: Hughes, Emily B SAW <Emily.B.Hughes@usace.army.mil>
Sent: Monday, September 21, 2015 11:41 AM
To: Dawn York
Subject: FW: [EXTERNAL] Terminal groin at Lockwood Folly Inlet at Holden Beach (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

-----Original Message-----
From: bob peek [mailto:bobpeek@frontier.com]
Sent: Saturday, September 19, 2015 4:05 PM
To: Hughes, Emily B SAW
Subject: [EXTERNAL] Terminal groin at Lockwood Folly Inlet at Holden Beach

I am very much opposed to building any hard structures on the coast of North Carolina. The Army Corps of Engineers should be about protecting our natural resources, not constructing structures that will eventually and inevitably degrade those resources.

Sincerely,

Robert Peek

Classification: UNCLASSIFIED
Caveats: NONE

Maria Waddell

From:	Hughes, Emily B SAW <Emily.B.Hughes@usace.army.mil>
Sent:	Thursday, September 24, 2015 12:56 PM
To:	Dawn York
Subject:	FW: [EXTERNAL] Holden Beach Terminal Groin DEIS (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

1st receipt of well thought out comments...

-----Original Message-----
From: Pam Sabalos [mailto:psabalos@atmc.net]
Sent: Thursday, September 24, 2015 12:48 PM
To: Hughes, Emily B SAW
Subject: [EXTERNAL] Holden Beach Terminal Groin DEIS

My name is Pam Sabalos. I am a Brunswick County resident. I have several concerns about the proposed terminal groin at Holden Beach.

1. We are an affluent community. We can make choices to build homes on shifting sands. The DEIS beautifully describes the history of migration, realignment, erosion and accretion of our barrier islands. We know how this ecosystem functions. And still some make bad investment decisions.

2. Terminal groins are ugly. Look at pictures of the New Jersey coast line. After being banned in North Carolina for 30 years because they don't work, legislators again ignored the wisdom of the Coastal Resources Commission and just raised the cap on terminal groins from 4 to 6.

3. The computer models which are used to predict the effects of a terminal groin can be wrong. They are based on assumptions about highly complex and ever changing currents, sands and storms. They are developed by contractors who are an economically interested third party. Given the 30 years of accumulated wisdom about terminal groins, I hope the models are verified, not just adopted by the Corp.

4. Terminal groins rob sand from Peter to pay Paul. Therefore, if you have one, you have to have many.

5. They do not eliminate the need for ongoing beach nourishment.

6. They are expensive to build and expensive to remove. A recent fiscal analysis of shifting inlets and terminal groins by the Western Carolina University Program for the Study of Developed Shorelines says that the benefits of groins in protecting beach homes from erosion are unlikely to outweigh the costs. To quote the author, Andrew Coburn, "The bottom line is that, while it may hold the tip of an island in place, a terminal groin will do so for the benefit of only a very small number of property owners at the expense of other private property owners and/or taxpayers…From a scientific perspective, it is not coastal erosion that has removed or narrowed the beach. The beach has narrowed because there is a building in the way of its natural, landward retreat. If there were no buildings, the beach would still be there."

7. And then there are the other expenses. Over the past 20 years I have watched the degradation of our unique environment. I have heard the assurances of local governments that projects would not affect our pristine waters, and then I have seen waters close. The permit area is rich in endangered and threatened species. The promises of protection involve many “maybes” and monitoring after the fact. That’s when it is too late. I’ve heard these generic promises before and learned they are impossible to keep, disingenuous, financially driven and often ultimately destructive.

Thank you for considering my concerns.

Sincerely,

Pam Sabalos

Classification: UNCLASSIFIED
Caveats: NONE

Maria Waddell

From: Hughes, Emily B SAW <Emily.B.Hughes@usace.army.mil>
Sent: Friday, October 09, 2015 8:15 AM
To: Dawn York
Subject: FW: [EXTERNAL] Holden beach terminal groin (UNCLASSIFIED)

Classification: UNCLASSIFIED
Caveats: NONE

-----Original Message-----
From: Lora Sharkey [mailto:ljsharkey200@outlook.com]
Sent: Thursday, October 08, 2015 4:43 PM
To: Hughes, Emily B SAW
Subject: [EXTERNAL] Holden beach terminal groin

I am registering my concerns that the disturbance caused by groin placement will harm nesting and foraging areas used by endangered birds such as Red Knots and Piping Plovers. I understand the mitigation plan contends that nourishment sand will provide suitable material, but once the beach is disturbed it will take time for the organisms in the sand to become reestablished. Food that would normally be located in the sand will not be available for the birds to feed on. Construction on the beach will undoubtedly relocate the birds accustomed to nesting and feeding in that area. Too many threatened or endangered species will be effected by Alternative 6.
I am against the installation of a permanent groin structure.

There is already in place a plan to dredge Lockwood Folly inlet to improve water quality. This action should be supported by the town of Holden Beach and the government should work together with Oak Island to accomplish inlet management. What is the potential disruption to the plans by Oak Island to manage the inlet if the groin is installed? I urge the Army Corps of Engineers to encourage the incorporated towns of Brunswick County to work together on a master plan for erosion control and beach nourishment so outcomes could be more predictable and environmental impact minimized.

Respectfully,

Lora Sharkey
432 Cades Trail
Southport, NC 28461

Sent from Surface

Classification: UNCLASSIFIED
Caveats: NONE

HOLDEN BEACH TERMINAL GROIN PUBLIC HEARING

DATE: SEPTEMBER 24, 2015

6:00 P.M.

LOCATION:

TOWN HALL, PUBLIC ASSEMBLY ROOM
110 ROTHSCHILD STREET
HOLDEN BEACH, NC 28462

ORIGINAL TRANSCRIPT

GEAN M. SEAY, INC.
NORTH CAROLINA STATE CERTIFIED COURT REPORTER
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ASCII - E-Transcript - Summation - Condensed - Indexing -
Video

APPEARANCES

FOR THE U.S. ARMY CORPS OF ENGINEERS:
Colonel Kevin P. Landers, Sr., Commander
Emily Hughes, Project Manager
Dale Beter, Regulatory
Scott McLendon, Regulatory

FOR NC DEPARTMENT OF ENVIRONMENT & NATURAL RESOURCES:
Doug Huggett
Debbie Wilson
Heather Coats

FOR THE TOWN OF HOLDEN BEACH:
Alan Holden, Mayor
David Hewett, Town Manager
Sandy Miller, Commissioner
Dennis Harrington, Commissioner

SPEAKERS

Colonel Kevin P. Landers, Sr., Commander, USACE
Scott McLendon, USACE
Dale Beter, NC Division of Coastal Management
Doug Huggett, NCDENR
Fran Way, Applied Technology & Management
Alan Holden, Mayor of Town of Holden Beach
David Hewett, Holden Beach Town Manager

Skip Klapheke, Taxpayer
Lewis Mitchell, Shore Protector
Petty Schiovone, Park & Recreation Chairman
Mike Giles, North Carolina Coastal Federation
Rich Weigand, Resident
Steve Mercer
Tony Marwitz, Holden Beach Turtle Patrol
Irvin Woods, Property Owner
Tom Tewey, Property Owner
Lyn Holden, Property Owner
Lloyd Young
Robert Dowd
Buel Barker
Rhonda Dixon

T A B L E O F C O N T E N T S

INTRODUCTION BY COLONEL LANDERS:

Good evening. I appreciate y'all coming out tonight in such lovely weather that I've brought with me. My name is Colonel Kevin Landers. I'm the District Engineer or the District Commander for the Wilmington Corps of Engineers District, and I'm gonna start out by officiating and kind of setting the stage, setting the ground rules for you.

Then I'm going to turn it over to a succession of speakers; and when I say speakers, they're gonna give you a brief kind of overview as to what their portion of this project or potential project is; and then also we're gonna have the Project Manager or the Project Engineer from the project itself give a quick little over brief. I'm gonna introduce a few people, establish those ground rules and then be ready to get on with it to allow for the public comment speakers.

So, let me start by giving you an agenda, kind of give you a road map as to where we're heading tonight. First, I'm gonna start with some introductions and they're gonna talk about what a public hearing is; and even more importantly from my standpoint what a public hearing is not; establish those ground rules and then Scott McLendon, who is my Chief of Regulatory at the District will give an overview of the regulatory program.

Dale Beter will offer an overview on his project specifically, will have some comments by the North Carolina Division of Coastal Management; a project overview by the Project Engineer himself; and then what we'll do is we'll open up the floor up here at the microphone for public comment.

So, we'll start with any elected officials that might want to have a comment before we turn it over to the – open the floor. We'll finish up with closing remarks and we'll finish and we'll stick around for a few minutes if anybody's got any conversation that can be had.

So, let me start with the purpose. What is the purpose of this? Well, the purpose is defined by the Code of Federal Regulations. I'm an Army guy, I'm been an Army guy for twenty-six years, we have regulations for everything. So, this is no different. This process is outlined in the Code of Federal Regulations, and it's fivefold. I'm gonna read all five of those real quick.

A public hearing may be held to acquire information which will be considered in evaluating a DA permit. So much like me as a civilian – as a citizen, if I wanted to go get a permit to put a garage up in my yard, I'd have to go through a permitting action. This is no different in that the Town has come to us and asked us for a permit

for a potential project; and we're evaluating the merits of that as we speak, and this is part of that process.

This affords the public the opportunity to present their views, opinions and information about such a permit. The public hearing is not a question and answer session. This is just one mechanism by which we're taking in information. So much like we seek advice or an opinion from the National Marine Fisheries, we're asking the opinion of the public to help inform us, for me to make ultimately the decision as whether I approve or deny a permit.

The information gathered will be used to develop the final Environmental Impact Statement, which the draft is currently on the internet; and the Corps is neither a proponent of nor an opponent to this project. So, right now I sit on the fence. I don't have an opinion on this project, I'm gathering all the facts in order to make that informed decision.

Now, let me start by introducing a few people. We'll start with the head table first. So, we'll start out with Scott McLendon, who is the Chief of Regulatory in the Wilmington District. Mr. Dale Beter next to him, which is the Wilmington Regulation Chief for our Wilmington Field Office. We have Ms. Emily Hughes, who is the Project Manager for this. Jonathan Howell from

the North Carolina Division of Coastal Management –

DOUG BETER: (INTERPOSING) Nope, no Jonathan. He's been promoted.

COLONEL LANDERS: We've got Doug Huggett from the North Carolina Coastal Management; and then lastly in the front row here, we have Fran Way, who's gonna give us a presentation – from ATM, is it?

MR. WAY: Yes.

COLONEL LANDERS: He is the Project Engineer for the project itself. Let me introduce a couple of officials; and if I miss somebody, I'll ask you at the end to stand up and recognize yourself. First, we have Alan Holden, the Mayor of Holden Beach. We have David Hewett, the Town Manager; Sandy Miller, one of the Commissioners; Dennis Harrington, another Commissioner; Ms. Debbie

Smith, the Mayor of Ocean Isle Beach; and Dean Walters, the Mayor Pro Tem of Ocean Isle Beach. I appreciate y'all coming. Is there any other elected officials that I missed?

MR. KYSER: Kin Kyser, May Pro Tem of Holden Beach.

MS. YOUNG: Sheila Young, Commissioner.

MS. MARTIN: Gina Martin, Commissioner.

COLONEL LANDERS: Alright, thank you all for coming. Okay, let's delve into the ground rules real quick.

I've already alluded to the fact that this is not a

question/answer session and the rationale behind that is this is a fact-finding for us. Then we'll make a determination. So, this is really a one-way conversation. If you're afforded the opportunity to have the microphone, we want to hear from you; but this is not a forum much like a town hall or a town meeting where we're looking to have dialog back and forth. We're essentially listening to you and trying to understand your position.

When you're called to the microphone, you'll move up forward here and each person will have three minutes. Right now we have ten people signed up. If that's gonna maintain itself, then we'll afford you a little more time to go over that three minutes but stereotypically we offer you three minutes. At the 30-second out point, we'll have somebody who's gonna signal the person who's speaking to try and read you in on the fact that your time is about to expire.

We ask you to speak loudly so that way the recorder can hear you, and the recorder up in the – your right-hand side, my left side. That will become public record at some point in time that you can obtain the minutes essentially from this meeting.

We invite your comments tonight, which will be used in forming this process.

Alright, what I'm going to do now is I'm going to

turn the floor over to Mr. Scott McLendon, who's gonna give you a few insights into the regulatory process from not only our District standpoint but the process itself.

MR. McCLENDON: Well, good evening everybody; and to reiterate what Colonel Landers just said, I certainly appreciate you all coming out on a less than ideal evening. Your being here is very important to us because our process that we're going through right now, while it's lengthy, invites public comments. So, your input into this process is very important to us; and this is an opportunity to do so beyond the permit process when we do public notice, and I'll get into that in just a minute.

But um, so thanks for being here. You may be wondering why the Corps of Engineers is involved with this process. This is gonna be a very high level view I'm gonna give you here in just a few minutes; but the Wilmington District, um the Chief Engineer is the delegated permit authority down here, Colonel Landers, relative to Section 404, the Clean Water Act, and Section 10 of the Rivers and Habors Act. Those are two authorities that we have that the Wilmington District administers; and I'm the Chief of that division, the Regulatory Division. Y'all have heard of Wetlands and Streams and the permitting process probably, a program

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everybody loves to hate but that Section 404 authority is one authority that we have and the Section 10 authority.

Okay, it's by virtue of the District issuing a permit for a license, okay, so a permit is kind of like a license, right. We're required to comply with a whole host of other federal statutes and mandates.

One of those is NEPA, the National Environmental Policy Act of 1969. That's the law that says that the District will have to prepare an Environmental Impact Statement for this project, and that's the process that we're in tonight. And by virtue of that requirement, the District is required to satisfy all the other federal statutes and laws that come in play.

So, for example, we're gonna have to look at endangered species for this project, we're gonna have to satisfy the – what's called essential fish habitat requirement, we're gonna have to look at historical properties, we have to look at impact on marine mammals. So, our program pulls in a whole bunch of other federal statutes; and before making a decision – and I'll stop right there for just a second just to make sure everybody understands me – we have not made a decision, we're still in the process and gathering comments leading to a decision.

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And as Colonel Landers said, I want to reaffirm that, too, the District has zero position on the project. We're not an opponent or a proponent. We are here to gather the facts and render a decision at the end of the process.

So, our process is fairly complicated. I'm not gonna sugar coat that to you. We do draw on a lot of things; in fact, Regulations tell us that we'll look at least twenty more of those things relative to what we call our public interest review. And so what we do is we're balancing what we call the reasonably foreseeable adverse impact associated with the project balanced against the benefits the project would bring.

Obviously, there's some erosion problems and the proposal is to build a terminal groin out there to fix that problem. The terminal groin may have some effects that we have to look at; and so, through this process, what we'll do through NEPA and through our requirements under 404, we're gonna look at alternatives to the proposed action.

So, it's not just an applicant comes up and says I want to build this. The District is required by law to say okay, this is what the applicant wants to do, are there alternatives to that action that may have less damage on the environment, and let's look at those, too.

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So, that's a very, very important component of our process.

The other thing I wanted to mention relative to our partners here – I'm standing right in front of them – I probably shouldn't do that. But the Division of Coastal Management is a really important partner in this process, too; because they have a separate regulatory or permitting responsibility in this process as well; and so, what we do is like to work very closely, hand-in-hand because you don't want the feds out there saying you gotta do A and the state saying well, you gotta do B. That doesn't help the town.

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So, it's very important that we coordinate our actions together and hopefully – I'm not saying we always agree but we usually do agree. And at the end of the day we'd like to come out with an answer that's consistent with the State's desire to protect the coastal resources and the Federal requirement to look at a very broad array of – of things.

So, we're in mid-process now. The comments that we get tonight and the comments that we'll receive in writing from you – and we'll talk about that a little more later – will be given to us and we'll address those comments in the preparation of the draft Environmental Impact Statement.

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So, that's my high level look. One more thing I did want to mention is that obviously the public is an important part of this process but we deal with a whole array of Federal and State agencies that are very important to us and in telling us what they think the potential effect, adverse and beneficial, might be relative to the proposed project. So, I'm trying to convey a sense that the District doesn't work in a vacuum on this. The District needs to hear from all sides so that we can come out and hopefully be in the middle on this.

We're gonna deal with the adverse effects and we'll deal with the beneficial effects; and hopefully, we'll come out with a decision that will satisfy the needs of the Town relative to the needs of protecting fish and mammals and birds and water quality and all those other things that we're responsible for.

So, I know I just threw a lot at you but that's an overview. Thank you, and I'm gonna turn it over to Dale.

MR. BETER: Again, good evening and thank you guys for coming out. As Scott mentioned, it's probably not the most, uh, well, it's a little rainy out there; so, we appreciate your participation. And with that said, as Scott alluded to and the Colonel also, this is a public

process.

Your being here tells us that you have an interest in this project and this process as well; so, what I'm gonna do is just take a couple of minutes and just go through some of the – where the project is, how we got where we are right now, and where we're gonna need to go with this project in the future.

The project started out pretty much with a need, what we call purpose and need, a need to address erosion, protection of property and infrastructure.

Back in 2012 we put out a Notice of Intent for, you know, noticing to the public, you guys, and the interested parties that this terminal groin project was gonna be proposed. We made a determination internally that we would review this under an EIS, which is an option under NEPA, because of the significance of it. We don't have a lot of terminal groins currently in the state, and we have three other terminal groins that we are reviewing in tandem with this project, one we permitted last year.

But we made this determination. Here we are right now at what we call coming out of the scoping phase into the evaluation phase of the project; and what that means is that while we're evaluating the project, we're relying on your input. So, again, emphasis on your

input into this process will help the Corps of Engineers to make a decision; and ultimately that will conclude with two documents, chiefly a final Environmental Impact Statement and a decision document we call a Record of Decision.

So, what we're gonna do tonight by hearing from you all and gathering these comments, is synthesize these comments and incorporate them in the final document or the final EIS. That process right now is a few months away. Right now we're still in the – in the process of receiving comments on the draft Environmental Impact Statement.

And with that said, there are six alternatives typically underneath – always underneath that actually. You always propose a No Action alternative and then other alternatives, including applicant's preferred alternative, which is what we're gonna see in the presentation and which is what you guys are interested in here.

Just a few other things and then we'll turn it over to the State and let them talk about their process in this, in this evaluation and under NEPA.

First of all, I wanted to let you guys know that as you guys come up and talk, we will let you know when your time is coming up. Henry Wicker will be timing the

actual comments; so, just be attentive to that. When you do come up, we want you to speak clearly into the mic, state your name, if you're an elected official, make that known as well.

The comments that we receive in the process that we're going through now is closely coordinated with the State so that we don't duplicate effort, which is a requirement of NEPA.

Some other things that – and Scott kind of touched on this, some of you guys will have comments about aquatic resources including fish and wildlife resources and things of that nature. While we're going through this review, this EIS process, we also deal with related Federal laws including the Endangered Species Act. So, we're in the process of right now looking at making our effective determinations and coordinating this project and the preferred alternative with the Federal resource agencies and State agencies as well. So, we're going to be doing that.

And I'd just like to cap it off with, um, with saying that this is an important event. This is the last public hearing of all the terminal groins that we've received application for, okay. So, we appreciate your attendance, we need your participation in this process to help us make the best decision possible and

with that said, I'll turn it over to the State Division of Coastal Management.

MR. HUGETT: Well, good evening from the State as well. First off, I'd like to apologize. My name is Doug Huggett and as a biologist, I only have a certain number of dress shirts and I chose one tonight that would show rain drops and I apologize for that. But we do appreciate you being here.

I'd like to introduce a couple of other folks. Coastal Management has a team of folks that are gonna be working on this project. In addition to Ms. Wilson, we have Heather Coats up here at the front table; and if I'm not mistaken, Mr. Greg Bodnar is in the back. So, we have a lot of – we've got a lot of expertise that we're trying to bring to bear to this project.

I'm not gonna go over the types of resource issues that we are going to be listing for and studying and looking into because those are most of the same types of issues that the Corps of Engineers have brought up, and we are very clearly joint partners with the Corps on this project. The Division of Coastal Management is the State lead for the terminal groin permitting under the Coastal Area Management Act.

And just a little bit of history to that, many may know that until recently a structure like a terminal

groin or something else that was considered a hardened structure was prohibited by law. Well, that state law has changed several years ago to allow originally for the construction – well, for the permitting and construction of four terminal groins. Under the budget bill that was passed, I believe last week, the four had been increased to six; but as of right now, there are four communities actively pursuing this. So, we are here today with that terminal groin legislation, the terminology we use, in mind.

Now, in addition to the NEPA requirements that the Corps of Engineers have talked to you about, of which we are an active participant, there are various things that the terminal groin legislation also requires from an applicant, and we will be looking into those issues as well.

First and foremost of that is the terminal groin legislation requires the applicant prepare what is known as an Inlet Management Plan; and its most basic, I kind of view the Inlet Management Plan as a process that steps up and requires a town to implement a – what we hope is a very robust monitoring plan that tries to ensure that the terminal groin, if it is ultimately permitted, and again we are taking no position on that ourselves either as a permit agency; but if a terminal groin is chosen, permitted and constructed, we want a monitoring plan in place that will assure that the groin is working as it's intended to and that it doesn't have unintended consequences or negative impacts on up or down drift beaches or properties, habitat, things of that nature.

So, this robust monitoring plan that will be developed will also have to include a set of triggers that if you hit a certain threshold or trigger with an erosion event or loss of beach or something of that nature, that some mitigation measures will be implemented, which may include modifications to the groin structure, putting additional sand on the beach, and things of that nature to try and minimize the potential adverse effects of these unintended consequences.

Kind of the worst case of the mitigation is modification of the groin structure itself up to and including potentially removal of the groin if it just is shown not to be working at all and we can't figure out how to fix it, working with the town, the applicant, and the engineers for the project.

The Inlet Management Plan also has to include a financial assurance package which the State has to certify that shows that over the life of the project, the Town has money available or has the ability or the

authority to pay for this mitigation and monitoring plan, any remedial actions that have to be taken, up to and including removal of the terminal groin. So, we'll be working - as the plan gets potentially refined, we'll be working with the applicant on that.

But in closing, though, I would like to say again we are very, very close partners with our friends at the Corps of Engineers. And this draft Environmental Impact Statement that they are working on also satisfies a requirement of the State terminal groin legislation; so, we're very active partners.

We want and need to hear concerns that the members of the public have, plus or minus, pro or con, because we as an agency are still reviewing the draft Environmental Impact Statement ourselves to provide comment and recommendation back to the Corps and we – while we have issues we look at, you folks know this area better than we do, we need your help in trying to figure out where those issues may be and make sure the document is accurately addressing those concerns.

So, again, we are actively involved. These are very important projects for us, we're working very closely with the Corps of Engineers and we do want to hear your concerns; so, I appreciate your time.

MR. WAY: Hi, my name is Fran Way; and I'm a coastal engineer with Applied Technology Management. We're an engineering firm, a coastal engineering firm that specializes in beach management and costal structures. We've been around in the southeast for over 30 years and we've been working with the Town of Holden Beach for, um, the last ten or twelve years on beach management projects.

I just have a few slides. I'm gonna talk about ten minutes and then we can get on with this. Right now, I'm just – the first slide is just a location map where there's Holden Beach. To the east, we have Oak Island; to the west, we have Ocean Isle. Long Bay is kind of the water body.

(comments from various members of the audience regarding position of the screens followed by re-positioning of the monitors)

Okay. Well, this is just a location map. Offshore of Long Bay is relatively sand starved. There are a few exceptions to that, but uh, this just kind of gives you a general indication of where the beach is or where the project location is.

Here's another general location map. Um, you see Holden Beach to the – Holden Beach, Lockwood Folly Inlet – LWFIX, that's Lockwood Folly Inlet Crossing and that's where Lockwood Folly Inlet meets up with the Atlantic Intracoastal Waterway, the AIWW. Behind Oak Island

there's Sheep Island, and Sheep Island was, um, the Army Corps of Engineers have used that as a disposal area for AIWW dredging for, you know, for decades and there's some upland back there. And you have the Lockwood Folly River back up to the north.

The Town and the Corps have been very active in beach management activities, putting sand on the beach. This has really helped out, keeping up with background erosion and mitigating that background erosion. However, on the east end the erosion rates have just been a little too large and has required excessive amounts of sand, a large area.

This is Hurricane Anna in 2008, and you can see that the dune was breached in this area and there had to be emergency measures coming; and this area just – just – it's the most vulnerable section of shoreline on Holden Beach.

This is another image. The top image is from 2008; the bottom image is from 1993; and you can see the X's on this indicate there are 27 homes that were lost between 1993 and about 2000 because of erosion. And all these homes out here are – are no more out there.

And so, that kind of gives you an idea of the extreme erosion that occurs on the east end. Now, this was in the 90's and the Army Corps of Engineers and the

Town of Holden Beach have really stepped up the nourishment program in the last fifteen years or so; but this still is a vulnerable area.

And this is another image of – of photos from the 90's on the east end, and you can see the homes out in the active beach are falling apart. And even today, under erosive conditions, you can go out on the beach and there's road debris and structure debris out there under – under more erosive conditions.

So, groins, we'll just talk about groins really quickly. On the top image, this is the Fort Macon terminal groin. It's been around since about the, uh, 1840's. It's been around. You can see how it's – the terminal groin terminal indicates at the end of an island. The terminal groin here, you can see how there's just a transition from the front beach to kind of the inlet beach. About half of that groin is buried right now and there's some other, there's a spur beach that you can't even see on the terminal groin at Fort Macon.

This is uh, right here is the Bald Head Island geotextile tube groin and you can kind of see that saw tooth pattern that is typical in some groin features where you have an up drift and a down drift signature.

And then here's another image of the Bald Head Island terminal groin and this is under construction now

and it's uh, Phase 1 is 1,300 feet and then phase 2 is 1,900 feet.

Here's another groin that's got a small t-head feature out in the front of the structure. This is a common feature, the small t-head, that kind of reduces rip currents and loss of sand offshore and the terminal groin that we are proposing for Holden Beach has one of those features.

Groin versus jetty, just real quick. Jetties really get out there. Jetties are much longer than groins typically and they're going out into much deeper water and they can adversely affect beach processes, literal sand drift, that sort of thing.

Terminal groins are trying to – being designed with these processes in mind. We're trying to enhance the beach and make that beach more resilient in storm damage and just make it wider and stronger and healthier.

And there's the Oregon Inlet terminal groin in the top photo and down on the lower right, that's the Masonboro Inlet jetties, which are much longer and may, you know, they do require sand management from up drift and down drift.

Here is the preferred alternative and this is just a schematic, uh, just to give you a general idea of what it is. The borrow area is back in the Lockwood Folly Inlet

Crossing and the nourishment – all – any groin project you have needs to have beach sand incorporated with it, and the nourishment is right along here and then there's the intermediate groin right there.

The landward end, under normal conditions the landward end should be – the anchor section will be buried but um, up to about half of that structure will be buried most of the time and it's about a thousand feet in length.

We did extensive modeling and analysis. We used the coastal modeling system that was designed by the Army Corps of Engineers, their Vicksburg, Mississippi research and design facility. It's a, you know, state of the art modeling system. We calibrated extensively the currents, water levels, sediment transport, and we did lots of analysis. I won't really get into this but we looked at Oak Island shorelines, we looked at the Holden Beach shorelines, and we looked at obviously the inlet and back inside the inlet.

The model is, um, is very, um – it's very complex but it's really picking up some of the important functions that we needed to do. In this particular instance, it's picking up – the time stamp on this because it has to get tide, it has to do everything – is ten seconds. Every ten seconds of model time. We run

the model for four years or six years; every ten seconds it's doing a calculation trying to figure out where the water is, where the waves are moving the sand, and over one year you can see that there's a shoal attachment that's kind of going – and I have some movies but I'm not gonna show them for now, but it's picking up this shoal attachment and anyone of you that's been around, you'll notice that every now and then there's gonna be a small shoal that attaches over here on the west – on the east end of Holden Beach.

And so, it really gives us a lot of confidence in the modeling that it's picking up this shoal movement and that we've seen it, you know, it occurs regularly, um, frequently on the east end.

We modeled pretty much all the alternatives – the nourishment only, groins, channel relocation, we modeled everything but this is just going to show you where the three primary groins we've modeled – the – the short groin, the intermediate groin, and the long groin.

The long groin is - was modeled after the Fort Macon terminal groin but it really wasn't our preferred alternative. And the short groin also didn't really – with those shoal attachments and everything, it was just a little too far west to really kind of take advantage of those shoal attachments and to really try to integrate

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with the beach processes in that area.

This is just a model run of the intermediate groin and the highlighted area here is the gain in beach width after two years. And you can see that the model, the groin is working as intended, keeping more sand here and actually there's even more sand here up on this side of the, uh, on the project.

In terms of hydrodynamics of the tide, the inlet system, the Lockwood Folly Inlet is a, you know, a large system that – relatively large, the estuarine push or flow going in and out of the Lockwood Folly Inlet. You can see that it's just a huge flood tide push of – of water getting in here.

In the surf zone, you do see some – these are current vectors. You do see some eddies and things in the surf zone, and you do see some eddies around the terminal groin itself; but in general, just the domination of the flow in and out of Lockwood Folly Inlet is pretty clear.

And this one is the ebb tide. These are current vectors again, and you see right here – you see some rip currents or possible rip currents or eddies along the shoreline here in the beach area around the terminal groin as well but you still see the eject here. If you were swimming, this would be by far the most dangerous

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place to swim, right near the inlet. And this is just kind of showing you generally what is going on there.

In the grand scheme of the inlet hydrodynamics, this terminal groin is not affecting the hydrodynamics and obviously we did that on purpose.

And so, this is the last image; you've already seen this. We're gonna put sand on both sides of the groin. Most of it's gonna be on this side but we are gonna still put some on that side of the groin; and that's almost like advance mitigation, and in terms of what Doug was talking about with the Inlet Management Plan. There is going to be a lot; there's gonna be rigorous monitoring. We're gonna monitor – there's gonna be a lot of monitoring, there's gonna be a lot of coordination with natural resource agencies to ensure that this is working as intended; and if it isn't, then we will revisit it.

And that's it. Thank you. And here's a copy of the EIS right here (indicating). You can see that a lot of research went into that.

COLONEL LANDERS: Alright, so what we're gonna do is we're gonna transition now into the comment period. So, I have deployed all over the world and the Army typically send me into places that are less than ideal for vacationing, and most of those places don't have a democratic type of environment to where you can be heard, where you can

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voice your opinions. So, I encourage you to step up to the microphone tonight if you have some comments and take advantage of our democratic system. It's a wonderful system and I fight for it. So, at the end of the day, we're gonna transition to that.

I would ask one thing of you, though. These meetings at times get emotionally laden. Although I know you're passionate about your beaches, you're passionate about your town, I would just ask you to be respectful as we kind of go through this. We want to hear you, we want to hear what your comments are, and we'll take all that to heart as we kind of work our way through this. But I would just ask you to be respectful to the people on the other side of the desk here. They're doing their jobs just like everybody else and I'd appreciate it.

Without further ado, Emily is gonna start calling names and then Henry is gonna start with the 3-minute clock.

MR. WICKER: You'll have 30 seconds left when I flash this up, just so you can wrap up your comments, to give you an opportunity to kind of close.

MS. HUGHES: Thank you all for being here. We're gonna start with the elected officials in the room. If there are any comments from them, we'd ask that you come up to the podium, state your name, speak clearly, and again, look

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to Henry for the 30 seconds signal. So, would any elected officials like to come up? Mr. Holden.

MAYOR HOLDEN: Thank you, ma'am. I'm Alan Holden, the Mayor of Holden Beach. I'm happy to see all these happy faces here, most of you are smiling; and um, thank you so much for being here and thank you for being here as well. I don't know which way you're supposed to face – it must be that way.

On behalf of the Town of Holden Beach, obviously we support this and obviously we support your being here to put forth your ideas pro or con, because we all want what's best for this community. What the Town of Holden Beach feels is this is the best for our community.

Me individually, personally, I've lived here over 66 years, nowhere else. I have a little bit of recollection of what's going on here and I have a little bit of insight, maybe more than some of the others, that haven't been here that long. It doesn't make me right but I'm pretty thoroughly convinced we're on the right track. And as I look around, there are maybe some others in the room that have lived here as well, but common knowledge and observation does carry some weight.

I don't have the credentials that some of you in the room have, but I've seen a lot and I've heard a lot from people like you that visit here and own property here,

and we are here tonight to take all that information from all of you and do what's best for this community. And I'm gonna make my words real short and simple, and I think Mr. Hewlett is gonna carry on in a few minutes, the Town Manager, with more insightful and more technical information. I thank you for being here.

MS. HUGHES: Thank you. Mr. Hewlett.

MR. HEWLETT: I'm David Hewett, the Town Manager and I will speak to the Board here. There is something to be said for the wisdom of multigenerational perspectives that Mayor Holden has so succinctly shared with us this evening. It only took a whole team of engineers and scientists almost three years and a foot-thick document to parrot that, what you've so succinctly said. And oh, by the way, about a truck load full of money, too.

The study, which of course is one of the requirements to evaluate the efficacy of constructing the terminal groin at Holden Beach, those requirements are established by law, include evaluations of alternatives ranging all the way from doing nothing to the groin construction and almost everything in between; but we have been limited to six.

Using significant numerical modeling and engineering analysis, the groin is selected as the preferred alternative because it best meets the project's purpose.

It will reduce the chronic erosion on the east end, protecting homes and infrastructure while simultaneously providing a viable recreational beach.

It will provide a long-term cost-effective and independent solution, independent solution to chronic erosion; and I stressed independent here because that is where the town is as a community. There is no federal 50-year project with its promised manna from the White House that's gonna take care of all the sand that we'll ever need in perpetuity, because it's not a viable project according to the national interest.

Along with that, federal funding that has up to the near recent past nourished the east end via the least cost method of disposal for the Intracoastal Waterway navigation maintenance sand is gone. We've had some drifts and dribbles of late, but that's really a residual funding resulting from recent storms and emergency

appropriations. But the federal money is gone, y'all. The Town is standing on its own two feet here.
The terminal groin is the linchpin in the Town's beach management plan; and stabilizing the east end by its construction will provide the anchor for all future beach management and renourishment efforts, making them more effective by lasting longer and ultimately costing less. Thank you.

MS. HUGHES: Thank you, David. Are there any other elected officials that would like to speak? (no response) Okay. I'm gonna begin calling the names of the people who signed up to speak and then if anyone wants to speak who's not on the list, you're welcome to. I'll open it up to anybody else who'd like to make comments. I apologize if I butcher your name – um, the first name is Skip –
(laughter)
MS. HUGHES: If we could have more order, please. And then we'll have Lewis Mitchell on deck.
MR. KLAPHEKE: My name is Skip Klapheke, and I live –
(from the audience) It's very hard to hear.
(from the audience) - Can I make a suggestion. Could the podium be moved to the side so the speaker could face everyone in the room?
(from the audience) Yes, please.
(the podium was moved)
MR. KLAPHEKE: Okay, let me see if I can get this down to three minutes. I'm gonna start with a summary. I think the study is not sufficient to allow a well-informed discussion of the alternatives. It omits analysis of well over 50% of the Holden Beach portion of the affected area. The financial presentation contained a lot of errors. I've read a lot of that. The model on which it

so much relies is similar to the model used in prior studies hasn't been particularly correct.
Let me give you some specifics. Alternatives 1, 2, 3, and 4 allow Holden Beach to undertake a project and adjust it as needed. 5 and 6 don't. We're committed for thirty years. If it's wrong, we have to pay to take it out.
It would seem to me that with other projects under way, it might make sense to try the 1, 2, 3, or 4 and see how their project worked before we sink our cost in something that we're forever stuck with.
All of the alternatives speak to the impact of the houses at the east end of McCray, but it's absolutely silent as to the impact on the eight oceanfront homes, four oceanfront lots and the infrastructure and the recreational amenities at Serenity Lane. These homes and

the neighborhood will experience significant aesthetic and tax impact no matter what alternative is selected but certainly alternatives 5 and 6.

Alternative 6, the one that is advocated strongly here, what's interesting is it is not remarkably different than Alternative 1. It addresses three more parcels for improvement, but it costs 3½ million dollars more; and if you pursue Alternative 6 versus 1, you're committed for the thirty years.

This project is gonna contend for resources that are equally important. There's the Central Reach Project, which covers four miles of the beach, we need water line replacements, road maintenance, and soon we'll need a sewer system upgrade.

The financial analysis has some errors. Um, I'll just give a couple of examples. Alternatives 5 and 6 are shown to have exactly the same cost and present value even though the groin in Alternative 6 is 7 percent longer.

The present value of Alternatives 3, 4, 5, and 6 are stated to be exactly the same even though Alternatives 3 and 4 cost 55 million dollars and Alternatives 5 and 6 cost 34 million dollars.

A lot of the tables in the summary don't equal the numbers that are in the text, and the present values are calculated incorrectly.

Just a couple additional comments, this whole thing hangs on the success of a single model; and when I think of how successful the hurricane predicting models are and they're only trying to do it for two weeks. This is the same model trying to predict natural phenomena for 4 to 30 years. I – I'd hesitate to sink all our money into that.

So, the question remains what is the process

timeframe for the Town Commissioners to receive the final studies, solicit input from the constituency, select an alternative and determine the sources of funding.

In conclusion, I'd sum it up by saying the study appears to be, to begin with a preordained outcome from an analysis that doesn't support that outcome. It relies solely on a single model that does not appear credible in some other areas and erroneously concludes an expense of 34 million dollars to build an 1100-foot groin as the most effective and efficient alternative. Thank you.

MS. HUGHES: Thank you. If you have additional written comments that you don't get to cover in your 3 minutes, please feel free to drop them off with me and they will be addressed. Thank you.

Okay, next we have Lewis Mitchell and then follow up with Peggy Schiavone.

MR. MITCHELL: I'm Lewis Mitchell. I own property down on Tarpon Drive about three quarters of the way down the beach, and I (3 inaudible words), and I'm gonna be really short so I won't need any of your water.

I think it's good to know that the EI's evaluated reasonable alternatives to the east end inlet management and beach nourishment. I realize we cannot continue to rely on the federal government to handle these necessary functions due to possible budget cutbacks.

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I want to know that the EIS evaluated potential impacts to our wildlife, fish, birds, turtles and such. I would like to know what the environment impact will be on the various wildlife in our area to include threatened and endangered species and habit modification.

Short enough?

MS. HUGHES: Very good, thank you, Lewis. Peggy and then Mike Giles with NC Coastal Federation.

MS. SCHIAVONE: I'm Peggy Schiavone and I live near the west end of Holden Beach and have for many years. Um, my concern was how the terminal groin was going to affect, um, our vacationers, our beach, our recreational beach, and um, from looking at the models and doing some of the research, it seems that it's going to result in a wider beach and provide shore protection benefits, and that is my concern. So, that's the way I feel. Thank you.

MS. HUGHES: Mike and then we have Rich Weigand.

MR. GILES: Well, I'm glad I'm facing y'all so y'all can't throw darts at my back. Good evening, my name is Mike Giles. I represent the North Carolina Coastal Federation, I'm a coastal advocate with the Federation. The Federation actively supports preservation and public use of our state's beautiful and productive beaches. We will submit detailed comments to the Corps after these brief comments.

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As a public trust resource, the beaches here at Holden Beach are spectacular. The US Army Corps of Engineers are responsible for the protection of the immense natural and cultural values of the Lockwood Folly Inlet for all citizens of North Carolina. This proposal to wall off the inlet with a terminal groin is not in the public interest and will benefit only a few property owners at the expense – let me repeat that, at the expense of many taxpayers.

The information presented in the draft study is insufficient to support the decision to build a terminal groin here. It's very difficult to determine based on the draft document exactly how much the project would cost the taxpayers and how many individual homes would be protected.

The estimated construction cost of the groin is extremely low compared to what other similar structures are estimated to cost elsewhere, including Ocean Isle Beach.

Looking at the modeling and based on the modeling, the proposed project will only benefit possibly eight homes. The modeling shows that after years four under Alternative 2, 28 properties and 19 homes would be affected by erosion; and under Alternative 6, 11 homes will still have water lapping at the doors.

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A comparison of benefits between the various alternatives shows very little added protection coming in from this extensive structure that will have a lifetime cost upwards somewhere exceeding 36, 40, 45 million dollars. We just don’t know. We still believe this is a gross underestimate of the total cost based on what other studies (inaudible word due to coughing in audience).

The taxpayers at Holden Beach who will be asked to pay for this structure should examine these costs carefully.

In crunching the numbers, I have extensive comments on the modeling, which I’m not gonna talk about tonight because I want to get to the cost. Looking at the economic cost, predicted cost for Alternative No. 2, it’s less than 2 million dollars. The laws tax revenues for those structures, estimated at 5.2 million dollars tax value, resulting in $6500 per year at a cost of 35 to 40 million dollars to build this terminal groin.

So, I think the taxpayers really need the correct information, the cost estimate for this project needs to be delved in more and more in depth.

The purpose of a groin is to manage a beach and even if a groin is built, the inlet channel will keep shifting. They’re required by state law the channel to be managed if the groin is constructed.

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For Bogue Inlet up in Carteret County, a terminal groin was found not to be the most cost effective by the local government there because the inlet channel still had to be managed with or without constructing a terminal groin. The same situation exists for Lockwood Folly Inlet.

The document does not comply, currently does not comply with the Endangered Species Act. No Section 7 consultation has been initiated even though 14 (inaudible word) and 6 critical habitats for threatened and endangered species occur in the permit area. This Section 7 consultation with the US Fish & Wildlife Service and the National Marine Fishery Services should have already been conducted.

So, now we don't have all the information we need to make an informed decision, to make informed comments; and the Federation has asked the Corps of Engineers and the other applicants, the other terminal groins in North Carolina why this consultation doesn't happen as prescribed by the National Environment Policy Act and the Corps' own regulatory controls. It states that Section 7 consultation should happen early in the draft Environmental Impact Statement.

At present, we believe the best alternative for management of the Lockwood Folly Inlet is no action or

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Alternative 4. This alternative will be less environmentally damaging, allow for unrestricted beach access for the public, and not anchor the end of a dynamic island and inlet system with a permanent structure.

This alternative should further be explored for the long-term costs and benefits compared with Alternative 2, Abandon and Retreat, which in the long run could be the least damaging and the most cost effective alternative to the citizens of Holden Beach. Thank you.

MS. HUGHES: Thank you, Mike. Next up we have Rich and on deck Steve Mercer.

MR. WEIGAND: Hi, my name is Richard Weigand; and I'm a resident and taxpayer in Holden Beach. First, there are two major disclaimers appearing in the document. The first is in Section 4.81 and just a couple of excerpts – these values should not be considered definitive and should not be used as the sole basis for the choice or ranking of alternatives. It goes on to say this section should not be considered on a formal cost-benefit analysis, it is not an attempt to monetize all aspects of the range of market and non-market costs and befits associated with the alternative actions. And then it talks about things left out – these services provided by the affected natural environment constitute real economic

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costs but are not monetized as part of this report.

The second disclaimer is in Section 5.21, the Numerical Modeling. And it says, Although the modeling results are presented in quantitative numerical projections, these estimates must be considered within the context of the model limitations. It is not possible to accurately predict all of the complex environmental variables that influence changes in coastal morphology.

So, how can you use the EIS if you can't use it for a cost benefit analysis. If you can't predict the environmental variables, then how can the town rely on this report to make such a critical and significant financial decision? It's kind of like you're left between well, I have a hunch or a gut feeling and sometimes the gut feeling is what you had to eat earlier in the day, so – it's not a point.

The second issue is with the inlet channel swinging as far southwest as anyone can remember, even those of your tenure, sir – um, and the eastern location of Alternative 6, you know, has it been considered that the wave and the current action between that T-head on the end of that terminal and that moving southwesterly direction of the channel itself, you know, what impact is that gonna have, because under the one slide where we looked at the flood plain push, that's not where the

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current channel is. The current channel wraps around coming west on the island.

Along with the same location, the land portion of the base is very much approaching –

MR. WICKER: 30 seconds.

MR. WEIGAND: But I talk slow. Alright, I'll cut it quick. It's approaching a very tall dune that formed in the past, you know, is that dune gonna be impacted because it's a huge barrier to the property behind it. It's gotta be 12 feet high. Um, my other concern is committing 30 to 55 million dollars, is this going to postpone other projects, which in my estimation have a higher priority, the Central Reach. I mean if the Central Reach of this island is ever breached, those of you who live in the center or west end of the island, you'd become inhabitable. You're not gonna get sewer, you're not gonna get any utilities, you're not gonna get access to your homes.

So, if we spend 30 to 50 million dollars on this project, what happens to the rest of the island? And lastly, I'm not sure I've heard anything as you talked about the process, how residents of Holden Beach can express to the Town itself their opinions and views and concerns for the project. Thank you.

MS. HUGHES: Thank you, Rich. And as I mentioned, if you have

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other written comments that you didn't express, you're free to hand them in. Now, we'll have Steve Mercer and then up next we have Tony Marwitz.

MR. MERCER: Well, based on everything I've heard so far, I think I'm more like the 7th ending stretch. I didn't come with any facts or figures; so, um, y'all can relax for a little bit while I'm doing my 3 minutes.

I'm Steve Mercer. I am a lifetime resident of Brunswick County. I want you all to know that sort of my history here is I think I've worked for the Holden family in the late 70s and 80s; and we were talking today, I think where I work is actually sort of the high tide line right now - so, down in the area where we've been affected here and where we're talking about.

I own a company called Coastal Transplants, and I've actually had the privilege of working with the Corps and the State, the Department of Defense – so, some of you may have seen me at some conferences. You may have heard my name and may have silently cursed me under your breath; but I hope some of you will recognize that my job is environmental restoration of coastal dunes.

In that capacity, I'm a member of the NC Byways, American Shore & Beach Preservation. I'm also a member of the North Carolina Coastal Federation and in conflict of interest on (few inaudible words).

Locally, I'm a member of the Holden Beach Nourishment Association. I've attended CRC meetings, seminars – technical seminars, conferences with all those folks and I've actually been on a couple of panels with the Coastal Federation.

In the past years the CRC have addressed the instability of the inlet areas and in doing so, (an unintelligible words due to coughing in audience) the Corps with the problems we were having here. I think this terminal groin is one of the tools sort of in the toolbox to solve some of those problems. The CRC and the State have had to handle it from a regulatory standpoint. The towns are trying to handle it from grass root methods and actually put something permanent in the ground to address that situation.

As Fran says, anybody who knows me has known that I've been diligent and have read every page in that report sitting on that desk over there and will be using that in the future, I'm sure.

I didn't come with a lot of technical information, because I assumed y'all had read that already. I know that some of the issues about mitigation and endangered species, they're already – they're covered in that report, and we already deal with a lot of those issues in the environmental statements and as we move forward with

our current dredging.

These structures aren't new. They're located all around the country. As far as modeling goes, I know each model is independent based on the site's specific situation; but those models come with history that's gathered from around the nation.

I'd like you to remember one thing if anything, a stable beach is a resource. It's a resource not just for homes and tourism and other things, it's a resource for habitat, both wildlife and plant. It's also a research opportunity.

And, Colonel, you mentioned in the beginning that this was all about gathering information. If you're really serious about that, next week you can join me. I'm gonna be fishing off one of those structures down in Texas and hopefully I'll catch some fish down there. Come join me and we'll catch some. Thank you very much.

MS. HUGHES: Thank you, Steve. Tony is up next and then Irvin Woods is on deck.

MR. MARWITZ: Thank you. My name is Tony Marwitz. I live on Holden Beach. Tonight I'm basically speaking as the President of the Holden Beach Turtle Patrol. I'm not gonna talk money, I'm gonna talk what I've seen. I've been involved with the Turtle Patrol for twenty years on this beach.

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During that time, we've had to deal with a very fragile and changing beach. We've had to move nests constantly. We've had nests destroyed because of over-wash or sand erosion. We've had to work around beach renourishment programs. The Town is excellent with us. We have an excellent relationship as far as doing that, but we have to do it.

I believe that the studies show we will have a wider more stable beach if we have this terminal groin. If we have a wider more stable beach, that means we don't have to move as many nests, we have much more attractive nesting places for turtles. I think any of the other wildlife that's endangered, the birds and all that lay on the beach, that's not my field of expertise but I think common sense says that a stable, more wider beach would be better for those.

We also will cut down on the need for the periodic renourishment. That's an expense and it's a hassle to work around that, so we'll get around that.

Basically, it appears to me that the terminal groin will give us a more stable beach, keep nests from eroding and yield more and better turtle nesting sites. Thank you.

MS. HUGHES: Thank you, Tony. Irvin, and then lastly we have Tom Tewey.

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MR. WOODS: Good evening. I'm Irvin Woods. I live in Hume, Virginia but I wanna live at Holden Beach. I've got – my wife and I have two houses on the east end as you're looking at the maps, the nourishment section. Both of our homes are – for those of you from Holden Beach, they're in the 2-block section of Ocean Boulevard where all the houses are behind the street, from Avenue A to uh, to Dunescape Avenue. There are only 13 houses in that two blocks between the ocean and the Intracoastal

Waterway, but this project is not for the benefit only of those of us who've invested a lot of money there.

A lot of - I would love the beach to be deserted except for me and my renters from Ohio or Pennsylvania or wherever during the summer. I can tell you on Saturdays and Sundays there are a lot of people that are residents of Holden Beach, taxpayers of Holden Beach, or renters or people who are dropping a lot of dollars while they're here. They come and enjoy Holden Beach. They enjoy that end of the beach.

In terms of the State involvement, uh, our two properties generate approximately three times - from the local level, approximately three times as much occupancy tax to the Town as they do real estate property tax. They generate over $10,000 sales tax, just from those two properties, and yet we welcome more than we like

sometimes. We welcome anybody to come and enjoy the beach. It is a public beach.

I grew up in South Carolina with a family home on Edisto Beach, which for those of you who might be familiar with it, it's got an interesting set of groins, not a thousand foot but about a hundred feet long that were installed in the 1950s. I was down there two weeks ago. They're still there and there's a good bit of sand out front.

I've reviewed part of the 500 pages of whatever this draft EIS, not all of it. I think Alternative 6 is the best long-term plan to the extent that we're not needing to come back and do dredging, pumping sand on the beach for a little longer duration in interval between um, between events. I think it will be a long-term benefit for those of you who are on other parts of the beach to the extent that we're able to get a long-term fix to the east end of the beach, we've got more resources available to the Central Reach or to other areas that might need it.

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Um, I'm a member of the American Shore & Beach Preservation Association. In a meeting last winter in Washington, the Corps of Engineers handout, “hard truth, project backlog, tough choices”. My take away long before that was that the priorities are not gonna be

dredge – federal priorities are not gonna be dredging inlets like Lockwood Folly, Shallotte or whatever the other inlets are in – in this country.

The projects are gonna be the Charleston Harbor, Wilmington, Jacksonville, those kinds of places. To the extent we can get a long-term fix that works, and I'm convinced – my mother, late mother, was an avid turtle program person in Edisto Beach, South Carolina, and was interviewed by Walter Cronkite. I've watched the east end of the beach and if we don't have beach out there, dry beach for habitat, we won't have any more turtles nesting on that end. It's in better shape now than it has been in some of the last ten years; but I think the overall benefit is gonna be both to everybody that's a resident and taxpayer at Holden Beach, the people who come and generate the revenue that helps subsidize the local residents of Holden Beach and people from across the bridge who come and enjoy the beach.

MS. HUGHES: Thank you, I think we have to wrap it up.

MR. WOODS: I happen to be a member of the Holden Beach Renourishment Association, but I'm not speaking on their behalf. I'm speaking on behalf of myself and my wife. Thank you.

MS. HUGHES: Thank you, Irvin. And now we have Tom Tewey with the Cape Fear River Watch and then I'll open it up to

anybody else that would like to make comments.

MR. TEWEY: I'm not here really speaking on behalf of Cape Fear River Watch, but um, I, um, am gonna take the liberty of speaking as an elder. I, um, visited today the house that I built on Holden Beach in 1970 and um, I lived on Holden Beach; and then moved over and lived on – and had a business in Brunswick County for, um, 30 years – 35 years and I moved to be near my business. I lived on Oak Island; and during that time I became intimate with this inlet between these two places. The fish, the birds, the animals, the children, the people who use these places, who experience the thrill that I experienced on coming to this place some – eight years ago.

I wanna – I'm gonna speak for the elders who are no longer here. And one of the people I wanted to speak on behalf of is, um, Bill Favor. Bill Favor was the first town administrator of Holden Beach, and he was also my best friend. You remember Bill. And um, Bill was the person who really educated all of us about this environment, about who – what (two unintelligible words) were and how - what the life cycle of the skimmers, the Black Skimmers; and what the fish fed off, and what was in the sand.

Bill wrote a column for five years, at least five

years, in the Brunswick Beacon about the environment. I urge you to include in the, um, documentation for this some work that Bill wrote about this, as he experienced it as a resident and town manager of Holden Beach during that time.

And um, he left a legacy in photographs. Actually, I have a photographic exhibit in my gallery called Seaway Gallery, Blue Dolphin Gallery; and it was, uh, part, the educational thing that Bill did about the things like photographing this habitat. Those photographs are all present – I went over to the Brunswick Beacon today and looked back at the old Brunswick Beacons. It was a really nostalgic tact for me because I saw all my old friends there and the letters they had written to – we've had other Environmental Impact Statements.

Bill Favor was responsible, was given the commission to handle bringing potable water to Holden Beach – isn't that right? Right. And um, and he did that and went to all these environmental impact things with the Corps of Engineers, the Fish & Wildlife Service, and all these other people.

These people have done an immense amount of things in Brunswick County to preserve – we did not have the number of – the kinds of wildlife here that are here today because of the preservationists of the past

throughout the Lockwood Folly River all the way up to Supply where the shrimpers in the past took their boats during hurricanes. Go through the Lockwood Folly – go up the Lockwood Folly River and see – it's not the same river that it was, um, fifty years ago. Thank you (to time keeper)

But anyhow I ask you to widen the time range that you're looking at as the people who are the scientists and biologists and so forth who are looking at this about the way the system works and what our role is in it.

I'm not advocating for or against this but I'm advocating to educate yourself more about the total environment system in which we live. We don't own this land, this land owns us.

MS. HUGHES: Thank you, Tom. Would anybody else like to take the mic at this time? Sir, in the back. Please state your name clearly.

MR. LYN HOLDEN: My name is Lyn Holden. I don't have any credentials like some of these other people, but I've lived here all my life. I'm a property owner down here, and I watched my father over the years try to get a jetty in this town; and um, he went to numerous meetings in Raleigh to see the politicians. He met with the Corps of Engineers numerous times. He never saw it materialize.

There are several reasons for that. Back then,

there was not as many people at Holden Beach as there is now. Um, when the politicians would come down here right before each election and they'd promise that we've got a jetty coming soon, it's on the way. And we all voted for them and we did every two years.

And New Hanover County the whole time were getting jetties, moving right along; and we sat right here and never got anything. And that was one of my father's aims, was to get a jetty. These groins are not jetties. I understand that; but I've heard enough from the research and what I know that Lockwood Folly would have been a lot better off if they had put a jetty down there 40 years ago. Holden Beach would not be having the problems they have right now.

Like I say, I don't have any degrees but I've watched a lot of things. I watched my father put groins down at Holden Beach until the town started, a different type of groins. These are things he paid for with his personal money, no grants, nothing. And we learned a lot. Before Hurricane Hazel, he made little old rafts of myrtle bushes out there, from before Hurricane Hazel, and they would gather sand. No money spent except your labor.

After Hurricane Hazel, they built a wall of sand going down the beach. They cut every myrtle bush on

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Holden Beach to put on that dune on Holden Beach. They was no myrtle bushes left but those myrtle bushes grow back every five years, they come right back. And watching him, what he did with those groins and listening to some of the older people on Lockwood Folly River, realized that we did not have the flow of water in and out that inlet.

As a kid, I saw banks of oyster shells on Galloway Flats up and down the Intracoastal Waterway. I don't mean a few oyster shells. They were this high when you'd stand by the bank, up and down the waterway. That's the type of oysters Brunswick County had.

And those old-timers said that we were losing the flow in the Lockwood Folly River; and if you use a little common sense and if you look at some of these maps, I think you will agree with that.

Another thing, I flew to Orlando, Florida from about '80 to 2000 once or twice a year. I learned to get a side seat in that airplane, and I would take off here and go to Orlando; and if you picked the right—hand seat, window, going South, more than 50% of the time you went right down that shoreline. You could see all those jetties, from South Carolina all the way to Florida. And there's no mystery about what those jetties do. We're talking about groins, which are not as long as the

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jetties, but when you look out that window and I'm going south, some of these jetties have one on each side of the inlet, some of them have one just on the south side.

But when you look out that window, at every one of them, if they had one groin on the south side, on the back side of that, there was a mound of sand for a mile or mile and a half past that. On the other side, not as great; but the sand would build up on the other side that did not even have a groin.

And I saw that for 15 or 20 years and like I said, I don't have any degrees; but I think the Town is on the right path. Something needs to be done. All this dredging down there is wasting a lot of federal money and the ones of y'all that fish in and out there, they can pump it and a good northeaster kind of little storm come by and it'll fill right back up.

But I think the Town is heading in the right direction, and I'm all for them trying it. Thank you.

MS. HUGHES: Thank you. The man in the green – that's you. Please state your name clearly.

MR. YOUNG: Good evening. My name is Lloyd Young. I'm a resident of Winding River Plantation, and we own property on Holden Beach. We have a beach house and a swimming pool, and I'm very interested in the public comments. I am relatively new here, moving from California a year

ago. So, I know none of the history and background of Holden Beach other than what I've heard tonight.

I am a civil engineer and so I've seen presentations like he made and the results of the modeling that you showed on those several slides are similar to what I've seen before, that terminal groins do work; and their effect though tends to be limited. And I'm interested in the beach areas further to the west and I would hope – I've not looked at the IES but I would hope that you've also evaluated the potential for beach erosion further to the west as a result of the terminal groin.

And also, you've evaluated the effect of renourishment of the beach from the currents and the flow in Lockwood Folly and moving from east to west.

So, that's my comments. Thank you very much.

MS. HUGHES: Anybody else?

MR. DOWD: Hello everyone. My name is Robert Dowd. I think we need to look at a few things here. We have a very dynamic situation in the Atlantic Intracoastal Waterway and a very unique situation here at Holden Beach.

I'll be honest, I live on Oak Island. I came here tonight because everybody's talking about Holden Beach and how it's gonna affect Holden Beach. We have members from Ocean Island. I wish they would have spoke about how it's going – how - their interest in how it's going

to affect Ocean Island.

Oak Island, we've got a terminal groin going in at

Bald Head Island; we don't know what that's gonna do. Now, we're looking at putting one here at Holden Beach; we don't know really what that's gonna do.

Let's be honest. I'm a realist, I'm from Maryland. We've got four of these things that we're allowed to be approved. This is the fourth one. Do we really think it's about turtles and birds? No. It's about money, it's about bringing money in and the effect that it's going to have on resources coming in and people spending their money. That's the honest bit of it, right? Let's not kid ourselves; it's not about birds, it's not about turtles. If it were about that, move off the island. The turtles will live, they'll come back. Move everything off and the beach will be theirs.

We don't want change. When we buy property on an island, we want the beach to stay exactly the way it is and we don't want anybody to come visit it. We want to be able to go to the beach and enjoy it and it be ours.

That's not the way it works, alright. Anybody who – we sailed down here from the Chesapeake Bay to live on Oak Island. Anybody who's ever sailed down that Intracoastal Waterway, an artificial waterway that made these islands, islands – knows that it changes. It

changes all the time. The oldtimers talk about Lockwood Folly used to be a whole different river fifty years ago. Well, it didn't change because we put in terminals. But now we want to put in terminals to make sure it doesn't change from what it is now.

How is this going to affect Oak Island? How is it going to affect Sunset Beach, how is it going to affect Ocean Isle, how is it going to affect everything? Right now, we don't know.

We have a unique beach. It faces south. Every other beach up and down this coast faces which way? East, alright. So, do the models work? Do we know? Do we know that the models work? Our beach faces south. It's a different ever changing dynamic situation.

Heck, just sailing up and down the Intracoastal Waterway here at Lockwood Folly, how many times do we have to move those buoys? You move those buoys all the time. I have a 4-foot shoal boat. I'd love to have an island packet with a 6-foot V-keel so I could get out there and really sail. Why do I have a 4-foot shoal boat? It shoals. It changes all the time. That river changes, the shoaling changes, all of it changes.

We don't want change, we're humans. We've gotta come in and make sure that it is the way that we want it to be, right? Realize, I'm from the Chesapeake. We brought

in Nutria, we brought in all kinds of different species

to make things better. We have a swan problem up there. You get to kill them down here, we can't. They're eating up our seagrass. Remember, every effect that we do as mankind to whatever nature is doing, has beneficial effects for some and detrimental effects for others.
Really make sure you know what you're doing before you start anything. Thank you.
MS. HUGHES: Thank you. Anybody else? There in the back. Just asking, will there be any other comments from the crowd? If we're gonna end here, anybody else, feel free to write on the notecards that were passed out if you have comments, you can leave them with us. Or there's information on the handout as far as where to send them to – written or email or by call. You can call me at any time.
MR. BARKER: My name is Buel Barker. I've looked down here for a place twenty years ago and we – we bought one over off of Lockwood Folly. We look out into the, uh, inlet; and I watch this sand move all the time. I'm for this terminal groin because we built a new place out on the east end five/six years ago; and we fought to get to build there. It wasn't a pretty thing. We spent a lot of money, over $200,000 to get to put a place there, just to build it before we started. We don't want it to wash

away.
Anybody that doesn't have a place on the east end, you know, I don't know what you're thinking. I know you don't have a dog in this fight and it's not all about preserving the property either; but yes, it is. Uh, the gentleman that spoke about the cost of – of putting this in versus the cost of losing our houses down there, I – I would say no, it's no, it's not worth 35 or 40 million dollars to some but it may be worth that to me to have my place there, you know. They're not losing theirs, we're losing ours.
And, you know, if it weren't for the dredging of Holden Beach, it just keeps getting smaller down there and if they haven't dredged and put it back on the beach, it would have been eroded on up onto all of those houses down there. And every time they dredge, the sand goes further on out and makes the bottom, which I'm an avid fisherman down there and I go out that inlet all the time, and uh, it makes the bottom fill up out further, so it's filling up the oyster beds or the clams or whatever's out there and they can't survive either.
So, I mean when you're pumping out there, you're just creating a more flatter bottom on down through the beach but it's not helping as far as preserving the land out there.

My existing home that I live in is directly straight out through there. Of course, this water flow is flowing this way now; but that is due to the Army Corps dredging it that way this last time. I've watched that thing get dredged 2 and 3 and 4 times a year it seems like.

You talk about money, of this 35 million dollars or whatever, how much does it cost to dredge that thing out 3 or 4 times a year and how much is it gonna be for all the years coming up? I'm just a common sense person. I think if the groin was put in, it would force the flow to be what it should be, it's gonna stay there, it's gonna keep the bottom washed out more, it's not gonna have to be dredged as much.

And I mean, you know, that may not be so but that's how I feel.

MR. HUGHES: Thank you. We have one more speaker.

MS. DIXON: I'll be brief. My name is – can you hear me? Everybody can hear me. My name is Rhonda Dixon and um, I think everybody here is trying to do the right thing, you know, I – you know, everybody here is trying to do the right thing; but the previous gentleman who just spoke about the inlet, I don't think it's the Corps of Engineers' charter to move that inlet. They are to dredge that inlet where the inlet naturally moves to and it's in a very strong southwest position right now, which

is actually favorable for the beach to build up. So, that's just one thing. I don't think they – that the people who – are dredging the inlet actually move it. But I would just urge the homeowners and the taxpayers of Holden Beach to really look at this study.

There are a lot of alternatives here. There are six of them. They're – it appears to me that it's a foregone conclusion that the right thing is a groin. I think there's many other alternatives here and with the cost associated with the groin, I would urge the homeowners and the taxpayers to really take a look at that and decide whether that's the way we want to spend our dollars here and all the other things that are available to us with the Central Reach and the other alternatives for beach renourishment other than a permanent structure on the east end of the island.

And I do not – I've read that study – and I do not think a lot of consideration was given to the homes and the impact on the downside of this terminal groin and I think it's an excellent point that we face south. It's a different scenario here. So, I urge you to decide who's gonna pay for this and how are we gonna pay for it. It's a very, very costly proposition. There are many, many different alternatives and I would just urge everyone to take a look at that and decide for yourself what you

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think is the right thing.

And I think we have an election coming up in November, and I think it's a really important point when we go to vote for the commissioners to be elected for the Town of Holden Beach this year because I think that it's a real election issue this time and I would urge everyone to educate yourself, especially now. Thank you.

MS. HUGHES: Thank you. Okay, so your handouts mention that the end of the comment period is October 13th; so, you have until then to submit comments, like I said, either by mail or email, phone call. And these will become public record. So, once all the comments are compiled, we'll put them out on our website so they'll be available to everybody.

COLONEL LANDERS: Okay, so what happens next is really the question. So, after we do all the comments and we absorb all those comments, we'll reach out to other federal agencies, that by the way I don't have control over their timelines, they tell me what their timelines are, to a frustration point. Uh, but they'll come back with their – their opinions as well.

At the end of the day, this document and then some is what the team back at the Wilmington District gets to consume to make a recommendation to me as to whether we approve a permit if a permit is asked for or deny that

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permit. As of today, there is no permit. This is a precursor to that process. So, in building in, the Town has charged an engineering firm to develop all this for them, and whatever is presented with a permit back to us, then we'll make a decision on.

So, that's kind of the next steps here, is that we have to continue to collect all the information, we kind of sort through all that information, and then ultimately the team will present to me what is the permit that's being asked for and here's the data that supports, denies, or whatever that recommendation looks like.

So, this process tonight was part of that information gathering in that you're gonna take the information that you've absorbed, you're gonna feed that to us. Some of you have already fed that to us, others will write us and comment in other ways; and then we'll take all that together and we'll make a determination if indeed a permit is brought to our table.

Okay. I appreciate all your participation. This is an important step in the process, but this is a precursor to a permitting action; and we'll just continue to follow the process as we move along. So, I appreciate your participation, and I hope y'all have a safe ride home.

(PUBLIC HEARING ENDED AT 7:41 P.M.)

STATE OF NORTH CAROLINA :
CERTIFICATE
COUNTY OF NEW HANOVER :

I, GEAN M. SEAY, a Notary Public and Court Reporter in and for the State of North Carolina, County of New Hanover, do hereby certify that the foregoing 66 pages constitute a true and accurate transcript of the Holden Beach Terminal Groin Public Hearing, held in the Town Hall of Holden Beach, 110 Rothschild Street, Holden Beach, North Carolina, at 6 P.M. on September 24, 2015, which was taken down and transcribed by me on the date set forth in the record and before the persons named therein. I further certify that I am not a relative, employee, attorney or counsel of any of the parties, or a relative or employee of such attorney or counsel, nor am I financially interested in this action.

WITNESS my hand and notarial seal this 4th day of October, 2015.

____

Gean M. Seay, CCR

Notary Public No. 19922450057

APPENDIX C

USFWS July 2016 Biological Opinion

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Raleigh Field Office
Post Office Box 33726
Raleigh, North Carolina 27636-3726

July 21, 2016

Mr. Scott C. McLendon
Chief, Regulatory Division
Wilmington District, Corps of Engineers
69 Darlington Avenue
Wilmington, NC 28403-1343

Subject: Town of Holden Beach: Holden Beach East End Shore Protection Project
Action ID No. SAW-2011-01914
FWS Log Number 04EN2000-2016-F-0283

Dear Mr. McLendon:

This document transmits the U.S. Fish and Wildlife Service's (Service) biological opinion based on our review of the proposed terminal groin located in the Town of Holden Beach, Brunswick County, NC, and its effects on piping plover (*Charadrius melodus melodus*), red knot (*Calidris canutus rufa*), seabeach amaranth (*Amaranthus pumilus*), West Indian manatee (*Trichechus manatus*), leatherback sea turtle (*Dermochelys coriacea*), Kemp's ridley sea turtle (*Lepidochelys kempi*), hawksbill sea turtle (*Eretmochelys imbricata*), the Northwest Atlantic loggerhead sea turtle population (*Caretta caretta*), and the North Atlantic Ocean green sea turtle population (*Chelonia mydas*), in accordance with section 7 of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*). Your January 22, 2016 request for formal consultation was received on January 26, 2016, and the final revised biological assessment (BA) was received on February 10, 2016.

This biological opinion is based on information provided in the February 2015 BA, the August 2015 Draft Environmental Impact Statement (DEIS) for the Town of Holden Beach, the August 28, 2015 public notice, the September 6, 2012 scoping meeting, field investigations, and other sources of information. A complete administrative record of this consultation is on file at the Service's Raleigh Field Office. The Service has assigned Log number 04EN2000-2016-F-0283 to this consultation.

The Service concurs with the U.S. Army Corps of Engineers (Corps) determination of not likely to adversely affect (NLAA) for the West Indian manatee. Concurrence is based upon the timing of the project and the proposed conservation measures.

The Service appreciates the cooperation of the Corps during this consultation. We would like to continue working with you and your staff regarding this project. Please note that issuance of the BO does not limit the Service's ability to provide comments on the Final EIS or any future public notices concerning this project. For further coordination please contact Kathy Matthews at (919) 856-4520, ext. 27. In future correspondence concerning the project, please reference FWS Log No. 04EN2000-2016-F-0283.

Sincerely,

Pete Benjamin
Field Supervisor

cc: USFWS, Jacksonville, FL (Ann Marie Lauritsen) (via email)
USFWS, Hadley, MA (Anne Hecht) (via email)
USFWS, Pleasantville, NJ (Wendy Walsh) (via email)
NMFS, Pivers Island (via email)
NMFS, St. Peterburg, FL
NCDCM, Morehead City, NC
NCWRC, Washington, NC
Town of Holden Beach

BIOLOGICAL OPINION

Town of Holden Beach

Holden Beach East End Shore Protection Project

July 21, 2016

Corps Action ID No. SAW-2011-01914

USFWS Log No. 04EN2000-2016-F-0283

Table of Contents

Acronyms

Act	Endangered Species Act
BA	Biological Assessment
BO	Biological Opinion
CAFF	Council Conservation of Arctic Flora and Fauna
CBRA	Coastal Barrier Resources Act
CFR	Code of Federal Regulations
CH	Critical Habitat
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
Corps	U.S. Army Corps of Engineers
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CSDR	Coastal Storm Damage Reduction
DOI	U.S. Department of the Interior
DTRU	Dry Tortugas Recovery Unit
F	Fahrenheit
FAC	Florida Administrative Code
FDEP	Florida Department of Environmental Protection
FEMA	Federal Emergency Management Agency
FR	Federal Register
GCRU	Greater Caribbean Recovery Unit
HCP	Habitat Conservation Plan
IPCC	Intergovernmental Panel on Climate Change
ITP	Incidental Take Permit
LF	Linear Feet
MHW	Mean High Water
MHWL	Mean High Water Line
MLLW	Mean Low Low Water
MLW	Mean Low Water
mtDNA	Mitochondrial Deoxyribonucleic Acid

NCDCM	North Carolina Division of Coastal Management
NCWRC	North Carolina Wildlife Resources Commission
NGMRU	Northern Gulf of Mexico Recovery Unit
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NRU	Northern Recovery Unit
NWR	National Wildlife Refuge
PBF	Physical and Biological Feature
PCE	Primary Constituent Element
PFRU	Peninsular Florida Recovery Unit
SAJ	South Atlantic Jacksonville
SAM	South Atlantic Mobile
Service	U.S. Fish and Wildlife Service
SF	Square Feet
SNBS	Statewide Nesting Beach Survey
TED	Turtle Excluder Device
TEWG	Turtle Expert Working Group
U.S.C.	United States Code
U.S.	United States
USEPA	United States Environmental Protection Agency

CONSULTATION HISTORY

February 24, 2012 – The Corps issued a Notice of Intent to prepare a Draft Environmental Impact Statement (DEIS) for the project, along with a Public Notice of their intent to hold a scoping meeting. The November 11, 2011 work plan was provided in this public notice.

July 17, 2012 – By email, the Service was invited to be a member of the Project Review Team (PRT) to assist in the development of the DEIS.

September 6, 2012– The Service attended a PRT meeting for the project.

August 28, 2015 – The Corps issued a public notice and the DEIS for the project. The public notice comment period for the DEIS ended on October 13, 2015.

October 2, 2015 – The Service provided written comments to the Corps on the DEIS.

January 22, 2016 – The Corps requested initiation of formal consultation for the project. The request for initiation of consultation included a biological assessment (BA).

February 1, 2016 – The Service discussed consultation with the applicant's consultant, by phone. The consultant expressed concern for potential shorebird monitoring requirements. The DEIS indicated that the Town of Holden Beach would be able to use bird monitoring data from Oak Island's monitoring efforts, but that will not be the case.

February 10, 2016 – By email, the Corps submitted a revised BA.

February 24, 2016 – The Service initiated formal consultation by letter to the Corps. The date for the biological opinion was set as June 24, 2016.

April 12, 2016 – By email, the Service provided a copy of the Draft Executive Summary and RPMs and Terms and Conditions to the Corps.

May 19, 2016 – By email, the Corps provided comments and recommended revisions from the Applicant to the Draft Executive Summary and RPMs and Terms and Conditions.

BIOLOGICAL OPINION

I. INTRODUCTION

A biological opinion (BO) is the document that states the opinion of the U.S. Fish and Wildlife Service (Service) as to whether a federal action is likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of designated critical habitat. This BO addresses piping plover (*Charadrius melodus melodus*), red knot (*Calidris canutus rufa*), seabeach amaranth (*Amaranthus pumilus*), and the loggerhead (*Caretta caretta*), leatherback (*Dermochelys coriacea*), green (*Chelonia mydas*), hawksbill (*Eretmochelys imbricata*), and Kemp's ridley sea turtles (*Lepidochelys kempii*). Designated terrestrial critical habitat for the Northern Recovery Unit of the Northwest Atlantic Ocean Loggerhead Turtle Distinct Population Segment (DPS), and designated critical habitat for wintering piping plovers is also addressed. The BO evaluates the effects of the proposed action, interrelated and interdependent actions, and cumulative effects relative to the status of the species and the status of the critical habitat to arrive at a Service opinion that the proposed action is or isn't likely to jeopardize species or adversely modify critical habitat. *Jeopardize the continued existence of* 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. On February 11, 2016, the Service and the National Marine Fisheries Service (NMFS) defined *destruction or adverse modification of designated critical habitat* as a direct or indirect alteration that appreciably diminishes the value of critical habitat for the conservation of a listed species (81 FR 7214). 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.

II. EXECUTIVE SUMMARY

The purpose of the proposed project is to mitigate chronic erosion on the eastern end of Holden Beach that threatens residential structures, infrastructure, and recreational assets. The proposed project is the preferred alternative in the August 28, 2015 DEIS (Alternative 6). The project includes the construction of a single, 1,000 linear-foot (lf) terminal groin with a 120 lf shore-parallel T-Head segment centered on the seaward terminus of the main stem. The project also involves placement of sand along a concurrent 0.75 mile (mi) (approximately 4,000 lf) segment of beach, and the periodic placement of sand every four years.

The proposed action has the potential to adversely affect nesting female sea turtles, sea turtle nests, hatchlings, and loggerhead terrestrial critical habitat, piping plover and piping plover critical habitat, red knot, and seabeach amaranth, within the proposed Action Area.

The Service anticipates that directly and indirectly an unspecified amount of nesting female sea turtles, sea turtle nests, and sea turtle hatchlings along 4,000 lf of sea turtle nesting beach habitat could be taken as a result of this proposed action. Take is expected to be in the form of: (1) Destruction of all nests that may be constructed and eggs that may be deposited and missed by a nest survey and nest mark and avoidance program within the boundaries of the proposed project; (2) destruction of all nests deposited during the period when a nest survey and nest mark and avoidance program is not required to be in place within the boundaries of the proposed project; (3) harassment in the form of disturbing or interfering with female turtles attempting to nest within the construction area or on adjacent beaches as a result of construction activities; (4) misdirection of nesting sea turtles or hatchling turtles on beaches within the boundaries of the proposed project or beaches adjacent to the construction area as they emerge from the nest and crawl to the water as a result of increased sand accretion due to the presence of the groin or jetty; (5) behavior modification of nesting females due to escarpment formation, resulting in false crawls or situations where they choose marginal or unsuitable nesting areas to deposit eggs; (6) destruction of nests from escarpment leveling within a nesting season when such leveling has been approved by the Service; (7) behavior modification of nesting females or hatchlings due to the presence of the groin which may act as a barrier to movement or cause disorientation of turtles while on the nesting beach; (8) physical entrapment of hatchling sea turtles on the nesting beach due to the presence of the groin; behavior modification of nesting females if they dig above a buried portion of the structure, resulting in false crawls or situations where they choose marginal or unsuitable nesting areas; and (9) obstructed or entrapped an unknown number of adult and hatchling sea turtles during ingress or egress at nesting sites.

The Service anticipates that directly and indirectly an unspecified amount of piping plovers and red knots along 4,000 lf of shoreline, all at some point, potentially usable by piping plovers and red knots, could be taken in the form of harm, harassment, and/or habitat loss as a result of this proposed action.

The construction of the groin and placement of sand in the Action Area could bury existing seabeach amaranth plants if work is conducted during the growing season. Sand placement at any time of year could also bury seeds to a depth that would prevent germination. Sand placement beaches could also have positive impacts on seabeach amaranth by creating additional habitat for the species.

After reviewing the current status of the nesting loggerhead sea turtle, green sea turtle, hawksbill sea turtle, leatherback sea turtle, Kemp's ridley sea turtle, piping plover, red knot, and seabeach amaranth, the environmental baseline for the Action Area, the effects of the proposed dredging and sand placement activities, the proposed Conservation Measures, and the cumulative effects, it is the Service's biological opinion that the groin construction and sand placement activities, as proposed, are not likely to jeopardize the continued existence of the leatherback sea turtle, hawksbill sea turtle, Kemp's ridley sea turtle, the North Atlantic Ocean Distinct Population Segment of the green sea turtle, the Northwest Atlantic Ocean Distinct Population Segment of the loggerhead sea turtle, piping plover, red knot, and seabeach amaranth. It is the Service's biological opinion that the groin construction and sand placement activities, as proposed, are not likely to result in the destruction or adverse modification of designated critical habitat for the piping plover or nesting loggerhead sea turtles. Incidental take of nesting and hatchling sea turtles is anticipated to occur during the life of the project. Take will occur on nesting habitat on 4,000 lf of shoreline.

Reasonable and Prudent Measures

The Service believes the following reasonable and prudent measures (RPMs) are necessary and appropriate to minimize take of loggerhead sea turtles, green sea turtles, leatherback sea turtles, hawksbill sea turtles, Kemp's ridley sea turtles, piping plovers, red knots, and seabeach amaranth. Unless specifically addressed below, these RPMs are applicable for the construction of the terminal groin and for any maintenance activities for the life of the permit. If the Applicant is unable to comply with the RPMs and Terms and Conditions, the Corps as the regulatory authority may inform the Service why the RPM or Term and Condition is not reasonable and prudent for the specific project or activity and request exception under the biological opinion.

RPMs – All Species

1. Prior to any construction, all derelict material or other debris must be removed from the beach.

2. Conservation Measures included in the permit application/project plans must be implemented in the proposed project. If a RPM and Term and Condition address the same requirement, the requirements of the RPM and Term and Condition take precedent over the Conservation Measure. This includes the timing of the proposed project to avoid the sea turtle nesting season, to reduce the possibility of sea turtle nest burial, crushing of eggs, or nest excavation.

3. Predator-proof trash receptacles must be installed and maintained at all beach access points used for the initial project construction and all maintenance events, to minimize the potential for attracting predators of sea turtles, piping plovers, and red knots.

4. A meeting between representatives of the Applicant's contractor, Corps, Service, NCWRC, the permitted sea turtle surveyor, bird and other species surveyors, as appropriate, must be held prior to the commencement of construction of the terminal groin.

5. In the event the terminal groin structure begins to disintegrate, all debris and structural material must be removed.

6. The Applicant or Corps must submit all reports produced pursuant to the Inlet Management Plan (referenced in the revisions to North Carolina General Statute 113A-115.1(e)(5)) to the Service's Raleigh Field Office, within 30 days of completion of each report.

7. The groin must be removed or modified if it is determined to not be effective as determined pursuant to the Inlet Management Plan listed above, or if it is determined to be causing a significant adverse impact to the beach and dune system.

8. During construction of the terminal groin, and for the life of the permit, all sand placement activities to maintain the sand fillet must be conducted within the winter work window (November 16 to April 30), unless necessitated by an emergency condition and allowed after consultation with the Service.

9. The pipeline placement must be coordinated with the Corps, the Raleigh Field Office, and the NCWRC.

<u>RPMs – Loggerhead, Green, Leatherback, Hawksbill, and Kemp's Ridley Sea Turtle</u>

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize take of loggerhead, green, leatherback, hawksbill, and Kemp's ridley sea turtles:

1. Beach compatible sand suitable for sea turtle nesting, successful incubation, and hatchling emergence shall be used on the project site for initial groin construction and all maintenance events.

2. No construction shall be conducted during the nesting season and hatching season from May 1 through November 15.

3. No permanent exterior lighting will be installed in association with this construction project, unless required by the U.S. Coast Guard. Temporary lighting will be allowed if safety lighting is required at any excavated trenches that must remain on the beach at night.

4. If the construction of the groin will be conducted during the period from April 15 to April 30, daily early morning surveys for early nesting sea turtles must be conducted. If the construction project will be conducted during the period from November 16 through November 30, surveys for late nesting sea turtles must be conducted. If nests are laid in the area of construction, the nests must be marked and avoided, or the eggs relocated. Nesting surveys and nest marking within and immediately adjacent to the project area must be initiated 65 days prior to construction activities or by April 15, whichever is later.

5. Visual surveys for escarpments along the Action Area must be made following completion of the terminal groin and any sand maintenance events, and also prior to May 1 for two subsequent years (after sand is placed on the beach). Escarpment formation must be monitored and leveling must be conducted if needed to reduce the likelihood of impacting nesting and hatchling sea turtles.

6. Staging areas for earth-moving equipment must be located off the beach during the early (April 15 through April 30) and late (November 16 through November 30) portions of the nesting season. Nighttime storage of earth-moving equipment not in use must be off the beach to minimize disturbance to sea turtle nesting and hatching activities. To the maximum extent practicable, all excavations and temporary alteration of beach topography will be filled or leveled to the natural beach profile prior to 9:00 p.m. each day.

7. Sand compaction must be monitored in the area of sand placement immediately after completion of the project, after any future sand maintenance events, and also prior to May 1 for two subsequent years after sand is placed on the beach.

8. Daily sea turtle nesting surveys must be conducted by the Applicant or Corps for three nesting seasons following construction of the groin or sand maintenance events, if the groin remains on the beach. All nests from a point 3,500 feet west (updrift) of the groin (at approximately Blockade Runner Drive) to a point 1,000 feet east (downdrift) of the

groin must be marked for three (3) years post-construction. These nests must be monitored daily until the end of incubation to determine whether those nests are eroded and whether the groin is a potential barrier to hatchlings moving off the beach and through the surf zone. If the groin is found to be an obstruction, the Corps will notify NCWRC and the Service immediately for remedial action.

9. A report describing the fate of the nests and hatchlings and any actions taken, must be submitted to the Service following completion of the proposed work for each year when an activity has occurred (such as sand placement).

10. A post-construction survey of all artificial lighting visible from the adjacent beach (2,000 lf west of the groin in the sand fillet) must be completed by the Applicant or Corps to determine if sand accretion caused by the groin created an increased impact due to artificial lighting within the vicinity of the groin structures.

<u>RPMs – Piping Plover and Red Knot</u>

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize take of piping plovers and red knots:

1. 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.

2. A bird monitoring plan must be developed to monitor piping plovers, red knots, waterbirds, colonial waterbirds and other shorebirds in the Lockwoods Folly Inlet area during and after construction. Monitoring must be conducted for a minimum of three (3) full years past the completion of groin construction, or until the end of the shorebird nesting season (August 31) of the third year, whichever is later.

<u>RPM – Seabeach Amaranth</u>

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize take of seabeach amaranth:

1. Seabeach amaranth surveys must be conducted in the Action Area for a minimum of three years after completion of construction.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, the Corps must comply with the following terms and conditions, which implement the RPMs described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary. Unless addressed specifically below, the terms and conditions are applicable for the construction of the terminal groin and for any maintenance activities for the life of the permit.

Terms and Conditions – All Species

1. Prior to any sand placement or construction, all derelict coastal armoring geotextile material and other debris must be removed from the beach to the maximum extent possible.

2. Conservation Measures included in the permit application/project plans must be implemented in the proposed project. If a RPM and Term and Condition address the same requirement, the requirements of the RPM and Term and Condition take precedent over the Conservation Measure. This includes the timing of the proposed project to avoid the sea turtle nesting season, to reduce the possibility of sea turtle nest burial, crushing of eggs, or nest excavation.

3. Predator-proof trash receptacles must be installed and maintained during construction at all beach access points used for the project construction and sand maintenance events, to minimize the potential for attracting predators of sea turtles, piping plovers, and red knots. All contractors conducting the work must provide predator-proof trash receptacles for the construction workers. All contractors and their employees must be briefed on the importance of not littering and keeping the Action Area free of trash and debris. See **Appendix A** for examples of suitable receptacles.

4. A meeting between representatives of the contractor, the Service, NCWRC, the permitted sea turtle surveyor, bird and other species surveyors, as appropriate, must be held prior to the commencement of construction of the terminal groin. At least 10 business days advance notice must be provided prior to conducting this meeting. The meeting will provide an opportunity for explanation and/or clarification of the required measures in the BO, as well as follow-up meetings during construction.

5. In the event the structure begins to disintegrate, all debris and structural material must be removed from the nesting beach area and deposited off-site immediately upon coordination with the Service. If removal of the structure is required during the period

from May 1 to November 15, no work will be initiated without prior coordination with the Corps and the Service.

6. The Applicant or Corps must submit all reports produced pursuant to the Inlet Management Plan (referenced in the revisions to North Carolina General Statute 113A-115.1(e)(5)) to the Service's Raleigh Field Office, within 30 days of completion of each report.

7. The groin must be removed or modified if it is determined to not be effective as determined by the Inlet Management Plan referred to above, or if it is determined to be causing a significant adverse impact to the beach and dune system.

8. During construction of the terminal groin, and for the life of the permit, all sand placement activities to maintain the sand fillet must be conducted within the winter work window (November 16 to April 30), unless necessitated by an emergency condition and allowed after consultation with the Service.

9. The pipeline placement must be coordinated with the Corps, the Raleigh Field Office, and the NCWRC.

<u>Terms and Conditions – Loggerhead, Green, Leatherback, Hawksbill, and Kemp's ridley Sea Turtle</u>

1. 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. In general, fill material that meets the requirements of the North Carolina Technical Standards for Beach Fill (15A NCAC 07H .0312) is considered compatible.

2. During the nesting season (May 1 through November 15), no construction will be allowed on the beach, and no equipment may be placed and/or stored on the beach.

3. No permanent exterior lighting will be installed in association with this construction project, unless required by the U.S. Coast Guard. Temporary lighting will be allowed if safety lighting is required at any excavated trenches that must remain on the beach at night.

4. If the construction of the groin will be conducted during the period from April 15 to April 30, daily early morning surveys for early nesting sea turtles must be conducted. If the construction project will be conducted during the period from November 16 through November 30, surveys for late nesting sea turtles must be conducted. If nests are laid in the area of construction, the nests must be marked and avoided, or relocated. Nesting surveys and nest marking within and immediately adjacent to the project area must be initiated 65 days prior to construction activities or by April 15, whichever is later.

5. Visual surveys for escarpments along the Action Area must be made immediately after completion of construction, after sand maintenance events, 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's Raleigh Field Office.

6. Staging areas for earth-moving equipment must be located off the beach during the early (April 15 through April 30) and late (November 16 through November 30) portions of the nesting season. Nighttime storage of earth-moving equipment not in use must be off the beach to minimize disturbance to sea turtle nesting and hatching activities. To the maximum extent practicable, all excavations and temporary alteration of beach topography will be filled or leveled to the natural beach profile prior to 9:00 p.m. each day. During any periods when excavated trenches must remain on the beach at night, nighttime sea turtle monitoring by the sea turtle permit holder will be required in the project area in order to further reduce possible impacts to nesting and hatchling sea turtles. Nighttime monitors will record data on false crawls, successful nesting, and any additional activities of nesting or hatchling sea turtles in the project area.

7. Sand compaction must be monitored in the area of sand placement immediately after completion of the construction, after any sand maintenance event, and also prior to May 1 for two subsequent years after any construction or sand placement event. Out-year compaction monitoring and remediation are not required if the placed material no longer remains on the dry beach.
    a. Within 7 days of completion of sand placement and prior to any tilling, a field meeting shall be held with the Service, NCWRC, and the Corps to inspect the Action Area for compaction, and determine whether tilling is needed.
    b. If tilling is needed for nesting suitability, the area must be tilled to a depth of 36 inches.
    c. All tilling activity shall be completed prior to May 1.
    d. Tilling must occur landward of the wrack line and avoid all vegetated areas that are 3 square feet (sf) or greater, with a 3 sf buffer around the vegetated areas.
    e. If tilling occurs during shorebird nesting season (after April 1), shorebird surveys are required prior to tilling per the Migratory Bird Treaty Act.
    f. A report on the results of compaction monitoring will be submitted to the Raleigh Field Office and NCWRC prior to any tilling actions being taken. An annual summary of compaction assessments and the actions taken will be submitted to the Service, as required in REPORTING REQUIREMENTS, below.
    g. This condition will be evaluated annually and may be modified if necessary to address sand compaction problems identified during the previous year.

8. Daily sea turtle nesting surveys must be conducted by the Applicant or Corps for three (3) full nesting seasons following construction if the groin structure remains in place. All nests from a point 3,500 feet west (updrift) of the groin (at approximately Blockade Runner Drive) to a point 1,000 feet east (downdrift) of the groin must be marked for three (3) years post-construction. The survey area must be divided into three segments: Updrift Zone, Project Zone, and Downdrift Zone. The parameters listed in the table below shall be recorded for each crawl encountered on a daily survey. In addition, any obstructions (natural or man-made) encountered by the turtle and the turtle's response to that obstruction must be reported. These nests must be monitored daily till the end of hatching to determine whether those nests are eroded and whether the groin is a potential barrier to hatchlings moving off the beach and through the surf zone. This information will be provided to the Raleigh Field Office pursuant to the REPORTING REQUIREMENTS section, below, and will be used to periodically assess the cumulative effects of these projects on sea turtle nesting and hatchling production and monitor suitability for nesting. If the groin is found to be an obstruction, the Corps will notify NCWRC and the Service immediately for remedial action.

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 the groin, sand bags, or scarps, should be noted.
False Crawl Type	Categorization of the stage at which nesting was abandoned	Number in each of the following categories: a) Emergence - no digging; b) Preliminary body pit; c) Abandoned egg chamber.
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 the groin, scarps, or sandbags measured in meters. Any abnormal cavity morphologies should be reported as well as whether turtle touched the groin, 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.

9. A report describing the fate of sea turtle nests and hatchlings and any actions taken, must be submitted to the Raleigh Field Office following completion of the proposed work for each year when an activity has occurred (e.g. sand placement or groin construction). Please see REPORTING REQUIREMENTS below, for more information.

10. A post construction survey(s) of all artificial lighting visible from the adjacent beach, from the groin to a point 2,000 feet west of the groin, must be completed by the Applicant or Corps. Two surveys of all lighting visible from the construction area must be conducted by the Applicant or the Corps, using standard techniques for such a survey (**Appendix B**), in the year following construction. The first survey must be conducted between May 1 and May 15 and a brief summary provided to the Raleigh Field Office.

The second survey must be conducted between July 15 and August 1. A summary report of the surveys, (include the following information: methodology of the survey, a map showing the position of the lights visible from the beach, a description of each light source visible from the beach, recommendations for remediation, and any actions taken), must be submitted to the Raleigh Field Office within 3 months after the last survey is conducted. After the annual report is completed, a meeting must be set up with the Applicant, county or municipality, NCWRC, Corps, and the Service to discuss the survey report, as well as any documented sea turtle disorientations in or adjacent to the project area.

<u>Terms and Conditions – Piping Plover and Red Knot</u>

1. 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 antagonizing shorebirds while allowing them to exit the area.

2. A bird monitoring plan must be developed to monitor piping plovers, red knots, waterbirds, colonial waterbirds and other shorebirds during and after construction. Monitoring must be conducted for a minimum of three (3) full years past the completion of groin construction, or until the end of the shorebird nesting season (August 31) of the third year after construction, whichever is later. Post-construction monitoring may only be ceased after the review of at least three years' worth of data and approval by the Corps, Service, NCDCM, and NCWRC.
    a. The bird monitoring plan, including methods and a figure showing the proposed locations and extent of monitoring, must be submitted for review and approval to the Corps, Service, NCDCM, and NCWRC, at least 60 days prior to the anticipated start of construction.
    b. During construction, bird monitoring must be conducted weekly. For at least three years after construction is completed, bimonthly (twice-monthly) bird surveys shall be conducted in all intertidal and shoreline areas from a point 3,500 lf west (updrift) of the groin (at approximately Blockade Runner Drive) to a point at approximately the west end of West Beach Drive on Oak Island. All intertidal and supratidal unvegetated areas of the oceanfront, inlet shoulders, and sandy shoreline along the AIWW (in the vicinity of Lockwoods Folly Inlet and piping

plover critical habitat unit NC-16) must be included. Field observations must be conducted during daylight hours, and primarily during high tide.

c. Shorebird identification, especially when in non-breeding plumage, can be difficult. The person(s) conducting the survey must demonstrate the qualifications and ability to identify shorebird species and be able to provide the information listed below. The bird monitoring plan should include the collection and reporting of the following:
    i. Date, location, time of day, weather, and tide cycle when survey was conducted;
    ii. Latitude and longitude of observed piping plover and red knot locations (decimal degrees preferred);
    iii. Any color bands observed on piping plovers or red knots or other birds;
    iv. Behavior (e.g., foraging, roosting, preening, bathing, flying, aggression, walking, courtship, copulation);
    v. Landscape features(s) where birds are located (e.g., inlet spit, tidal creeks, shoals, lagoon shoreline);
    vi. Habitat features(s) used by birds when observed (e.g., intertidal, fresh wrack, old wrack, dune, mid-beach, vegetation);
    vii. Substrata used by birds (e.g., sand, mud/sand, mud, algal mat); and
    viii. The amount and type of recreational use (e.g., people, dogs on or off leash, vehicles, kite-boarders).

d. All monitoring information shall be provided in standardized form on an Excel spreadsheet. Monitoring results shall be submitted (datasheets, maps, database) on standard electronic media (e.g., CD, DVD) to the Raleigh Field Office. Please see REPORTING REQUIREMENTS below, for more information.

<u>Terms and Conditions – Seabeach Amaranth</u>

1. Seabeach amaranth surveys must be conducted updrift and downdrift of the terminal groin in the Action Area, from a point 3,500 lf west of the groin (at approximately Blockade Runner Drive) along Holden Beach to a point 1,000 lf east of the groin, for a minimum of three years after completion of groin construction. Surveys should be conducted in August 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. Please see REPORTING REQUIREMENTS, below, for more information.

Reporting Requirements

An annual report detailing the monitoring and survey data collected during the preceding year (required in the above Terms and Conditions) and summarizing all sea turtle, piping plover, red knot, shorebird, and seabeach amaranth data must be provided to the Raleigh Field Office by January 31 of each year for review and comment. In addition, any information or data related to a conservation measure or recommendation that is implemented should be included in the annual report. The contact for these reporting requirements is:

Pete Benjamin, Supervisor
Raleigh Field Office
U.S. Fish and Wildlife Service
Post Office Box 33726
Raleigh, North Carolina 27636-3726
(919) 856-4520

Upon locating a dead, injured, or sick individual of an endangered or threatened species, initial notification must be made to the Service Law Enforcement Office below. Additional notification must be made to the Service 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.

Jason Keith
U.S. Fish and Wildlife Service
551-F Pylon Drive
Raleigh, NC 27606
(919) 856-4786, extension 34

Reinitiation Notice

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

In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

For this biological opinion, the incidental take will be exceeded when the groin construction and nourishment of 4,000 lf of beach extends beyond the project's authorized boundaries. Incidental take of an undetermined number of young or eggs of sea turtles, piping plovers, red knots, and seabeach amaranth plants has been exempted from the prohibitions of section 9 by this opinion.

III. DESCRIPTION OF THE PROPOSED ACTION

A. Project Description

The purpose of the proposed project is to mitigate chronic erosion on the eastern end of Holden Beach that threatens residential structures, infrastructure, and recreational assets. The proposed project is the preferred alternative in the August 28, 2015 DEIS (Alternative 6). The project includes the construction of a single, 1,000 linear-foot (lf) terminal groin with a 120 lf shore-parallel T-Head segment centered on the seaward terminus of the main stem. The project also involves placement of sand along a concurrent 0.75 mi (approximately 4,000 lf) segment of beach, and the periodic placement of sand every four years.

The DEIS describes the Action Area to include the shorelines of Holden Beach and the adjacent Atlantic Ocean and Lockwoods Folly Inlet, Brunswick County, North Carolina (**Figure 1**). The Action Area includes approximately 5,000 lf of beach and inlet shoreline on Holden Beach, from Blockade Runner Drive (approximately station 45+00) to Lockwoods Folly Inlet (station 0+00 and areas beyond that station above Mean High Water (MHW)). The Action Area for direct impacts includes those sections of Holden Beach where terminal groin construction, sediment disposal, and earthen manipulation will occur – approximately 5,000 lf within the construction footprint and east and west of the groin (downdrift and updrift). The Action Area for indirect impacts, however, is much larger. Because sea turtles and piping plovers 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; for the purposes of this opinion it will be approximately 10,000 lf of beach and inlet shoreline on either side of Lockwoods Folly Inlet (on Holden Beach and Oak Island) for piping plovers, red knots, and sea turtles (for a total of 20,000 lf).

The Action Area for seabeach amaranth is the area within the 4,000 lf proposed project footprint and the shoreline from the proposed groin to Lockwoods Folly Inlet (approximately 1,000 additional lf to the northeast or downdrift of the groin).

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.

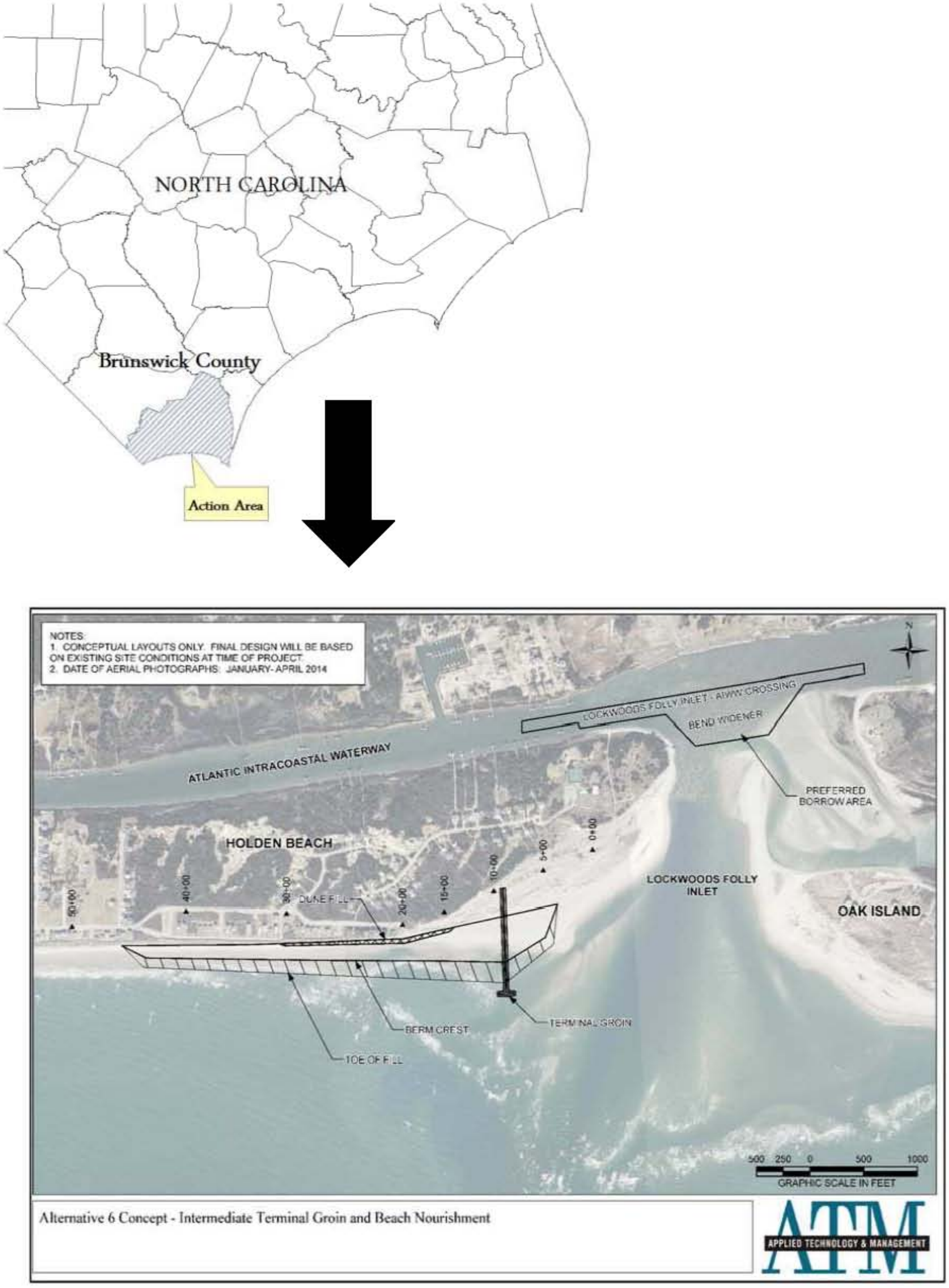

Figure 1. Action Area for direct impacts (Applied Technology and Management, 2015).

Holden Beach was incorporated in 1969. Land ownership within the Action Area is both public and private, and land use encompasses recreational, commercial, and residential activities. The majority of the development is residential. The Action Area was relatively sparsely developed until the 1970s and 1980's. Since then, it has become more heavily developed with homes and recreational facilities. From the BA, the permanent population of Holden Beach is approximately 575, with a seasonal population of over 10,000.

B. Project Design

The applicant proposes to construct a 1,000 lf terminal groin with a 700 lf segment extending seaward from the toe of the primary dune, and a 300 lf shore anchorage system extending landward from the toe of the primary dune. The groin is proposed to be constructed of stone approximately 4 to 5 feet in diameter. The groin will have a crest width of 5 feet and a base width of 40 feet, while the underlying geo-textile base layer would have a width of 45 feet. The base of the groin will cover approximately 1.37 acres. The groin is proposed at a crest height of +6 feet NAVD at the landward end and +3 feet NAVD at the waterward end. Excavation will be needed for portions of the structure in order to place the foundation stone or mattress. Construction materials will be stored at the public access parking lot and transported to the beach using heavy equipment. The groin would be constructed from land.

The groin will serve as a template for fill material placed westward and eastward thereof. The project includes proposed maintenance of the sand fillet and adjacent beach at 4-year intervals after the initial placement of sand and initiation of groin construction. 100,000 to 150,000 cubic yards (cy) of beach fill is anticipated to be placed along 4,000 lf of shoreline east and west of the terminal groin on a four-year nourishment interval. The proposed source of the sand for the initial construction and for maintenance of the sand fillet is the existing federal borrow area (LFIX and Bend Widener, and inland LFI navigation channels) within Lockwoods Folly Inlet. Dredging is proposed with a cutterhead pipeline dredge.

According to the BA, the groin is designed as a leaky structure. The rubblemound portion of the groin would be constructed with loosely placed armor stone on top of a foundation mat or mattress. The loose nature of the armor stone was designed to facilitate the movement of littoral material through the structure while the relative low crest elevation would allow some sediment to pass over the structure during periods of high tide.

This BO addresses impacts to the piping plover (*Charadrius melodus*), red knot (*Calidris canutus rufa*), seabeach amaranth (*Amaranthus pumilus*), the leatherback (*Dermochelys coriacea*), hawksbill, and Kemp's ridley (*Lepidochelys kempii*) sea turtles, the North Atlantic Ocean Distinct Population Segment of the green sea turtle (*Chelonia mydas*), and the Northwest

Atlantic Ocean Distinct Population Segment of the loggerhead sea turtle (*Caretta caretta*), all Federally-listed species under the purview of the Service occurring in the Action Area. This BO also addresses critical habitat for piping plover and terrestrial critical habitat for loggerhead sea turtles. Whales, sturgeon, and sea turtles in the water are the jurisdiction of NMFS. The Service and NMFS share Federal jurisdiction for sea turtles under the Endangered Species Act (ESA). The Service has responsibility for sea turtles on the nesting beach. NMFS has jurisdiction for sea turtles in the marine environment. Activities proposed in this formal consultation would involve only impacts to sea turtles in the terrestrial environment, which includes the following life stages: nesting sea turtles, nests and eggs, and hatchlings as they emerge from the nest and crawl to the sea.

C. Project Timing and Duration

The initial dredging of Lockwoods Folly Inlet, construction of the groin, and the beach nourishment on Holden Beach is proposed to be conducted between November 15 and April 30. The initial groin construction and placement of sand is expected to take between four and six months to complete. On approximately 4-year intervals, maintenance of the 4,000 lf sand fillet and adjacent beach nourishment is anticipated to take up to12 weeks.

D. Conservation Measures

To reduce the potential impacts of the proposed project on Federally-listed species, the Applicant has proposed the following Conservation Measures (taken directly from the BA):

<u>For piping plover and red knot</u>:

Environmental Windows

The proposed project window for the initial groin-construction/nourishment event (16 Nov - 30 April would avoid: 1) the majority of the piping plover breeding season, 2) the peak red knot migration period in NC (May), and 3) peak benthic invertebrate recruitment periods. The proposed project window for all subsequent maintenance nourishment events (16 Nov - 31 March) would avoid: 1) the piping plover breeding season, 2) the peak red knot migration period in NC, and 3) peak benthic invertebrate recruitment periods.

Sediment Compatibility

All beach fill material would comply with the State of North Carolina Technical Standards for Beach Fill Projects (15A NCAC 07H .0312), thereby minimizing the extent and duration of potential beach fill placement impacts on roosting/foraging habitats and benthic infaunal prey communities. The Technical Standards require comparative analyses of recipient beach and proposed borrow site sediments; including quantitative analyses of percent weight of fine-grained sediment, percent weight of granular sediment, percent weight of gravel, and percent weight of calcium carbonate. As previously described, analyses have shown that sediments associated with the preferred and potential supplemental borrow sites are compatible according to the state standards. Continuous visual monitoring of fill material would be conducted at the pipeline outfall before it is redistributed along the beach. If noticeable quantities of incompatible fill material are detected, the contractor will cease operations and immediately contact the Wilmington District Regulatory Branch and NCDCM to determine the appropriate course of corrective action.

Staging Areas and Beach Access

The staging area and refueling location for construction equipment (bulldozers, front-end loaders, pickups, etc.) would be located off the beach at the existing East End public access parking lot. Construction equipment would access the beach via the existing public access corridor. During nighttime hours, idle construction equipment would be stored off the beach to the extent practicable. Heavy equipment would be removed from refurbished shorelines as soon as practicable, restoring unrestricted public access.

Shielded Lighting

Directional, shielded, and low intensity lighting would be employed to minimize the potential effects of artificial nighttime lighting on shorebirds.

Inlet Management Plan

Pursuant to the NC Coastal Policy Reform Act of 2013, the Town would implement a plan for management of the LFI, as well as the immediately adjacent estuarine and ocean shorelines that are under the influence of the inlet. The inlet management plan would include: 1) post-construction monitoring for groin-related impacts, 2) establishment of a baseline for assessing impacts and the thresholds that will trigger mitigation, 3) provisions for the implementation of mitigation measures in the event that thresholds are reached, and 4) provisions for modification or removal of the groin in the event that impacts cannot be otherwise mitigated

For sea turtles:

Sand Placement and Groin Construction

Environmental Windows

The proposed project construction windows (16 Nov - 30 April for initial construction and 16 Nov - 31 March for subsequent maintenance nourishment events) would avoid the sea turtle nesting and hatching season. Adherence to these project windows would avoid impacts on nesting females, nests, eggs, and hatchlings.

Sediment Compatibility

All beach fill material would comply with the State of North Carolina Technical Standards for Beach Fill Projects (15A NCAC 07H .0312). The Technical Standards require the characterization of sediments from the recipient beach and the proposed borrow sites. Sediment characteristics that are considered include percent weight of fine-grained sediment, percent weight of granular sediment, percent weight of gravel, and percent weight of calcium carbonate. Results of the characterization studies are submitted to the NCDCM, which ultimately determines the suitability of sediments from the proposed, borrow site. Daily monitoring of beach nourishment activities would be conducted to further ensure the compatibility of the beach fill material. Visual monitoring of the fill material would be conducted at the dredge pipe outfall before it is redistributed along the beach. If any incompatible fill material is detected, the contractor will cease operations and immediately contact the Wilmington District Regulatory Branch and NCDCM to determine the appropriate course of corrective action.

Escarpment Monitoring

Immediately after the beach construction operation is complete and prior to 1 May, surveys for escarpments will be conducted within the limits of the construction area. Escarpments that are identified prior to or during the nesting season that interfere with sea turtle nesting (exceeding 18 inches in height for a distance of 100 lf) would be leveled to the natural beach profile. If it is determined that escarpment leveling is required during the nesting or hatching season, leveling actions would be coordinated with the Service.

Compaction Monitoring

Immediately after completion of this project and prior to May 1 for one subsequent year, sand compaction will be monitored in the area of restoration in accordance with the Service. If required, the area will be tilled to a depth of 36 inches. All tilling activity shall be completed prior to May 1. A report on the results of compaction monitoring will be submitted to the Service prior to any tilling actions being taken.

Dredging

Environmental Windows

The proposed hopper dredging window (16 November - 31 March) would coincide with periods of low sea turtle abundance. As previously described, multiple studies have shown that sea turtles avoid waters where sea surface temperatures are below 11^{o}C. The presence of sea turtles in nearshore and inshore waters is generally restricted to the months of April through December. Adherence to the proposed window would reduce the likelihood of sea turtle entrainment during dredging operations.

Rigid Draghead Deflector

Use of the rigid draghead deflector would be required during all hopper dredging operations. All dredging contracts would require the proper installation and operation of the rigid draghead deflector. Sea turtle entrainment rates are dramatically reduced when rigid deflectors are used and deployed correctly.

Silent Inspector

The Silent Inspector automated dredge monitoring system would be required on all hopper dredges. Data generated by the Silent Inspector would be used to monitor contractor compliance with hopper dredge operating requirements, including proper operation of the draghead.

Inflow Screening

Dredging contracts would require 100% inflow screening. NMFS-approved endangered species observers would provide 100% (24 hour/day) monitoring of inflow screens, dragheads, and hoppers. During active dredging when dragheads are submerged, NMFS-approved endangered species observers would continuously monitor (24 hours) the inflow screening for turtles and/or turtle parts. At the completion of each load cycle, dragheads would be physically inspected as they are lifted from the sea surface and placed on the saddle to account for sea turtles that may be impinged within the draghead. The dredge contractor would install lighting sufficient to illuminate the screens and draghead during nighttime hours. Endangered species observers would work in 12 or 24-hour shifts, such that one observer would be onboard the dredge at all times.

Endangered Species Observers

In addition to monitoring inflow screening, dragheads, and hoppers; during daylight hours the endangered species observer would survey for the presence of endangered species during transit to and from the work zones.

For seabeach amaranth:

Measures to reduce effects on seabeach amaranth will include the use of compatible sediments and timing nourishment events to avoid the peak growing season. All beach fill material would comply with the State of North Carolina Technical Standards for Beach Fill Projects (15A NCAC 07H .0312). The Technical Standards require the characterization of sediments from the recipient beach and the proposed borrow sites. Sediment characteristics that are considered include percent weight of fine-grained sediment, percent weight of granular sediment, percent weight of gravel, and percent weight of calcium carbonate. Results of the characterization studies are submitted to the NCDCM, which ultimately determines the suitability sediments from the proposed borrow sites. Daily monitoring of beach nourishment activities would be conducted to further ensure the compatibility of the beach fill material. Visual monitoring of the fill material would be conducted at the dredge pipe outfall before it is redistributed along the beach. If any incompatible fill material is detected, the contractor will cease operations and immediately contact the Wilmington District Regulatory Branch and NCDCM to determine the appropriate course of corrective action. The proposed project construction windows (16 Nov - 30 April for initial construction and 16 Nov - 31 March for subsequent maintenance nourishment events) would avoid the seabeach amaranth peak growing season, thus reducing the potential for direct impacts on plant growth and reproduction.

IV. LOGGERHEAD, GREEN, LEATHERBACK, HAWKSBILL, AND KEMP'S RIDLEY SEA TURTLES

A. Status of the Species/Critical Habitat

1) Species/critical habitat description

The Service and the NMFS share Federal jurisdiction for sea turtles under the Act. The Service has responsibility for sea turtles on the nesting beach. NMFS has jurisdiction for sea turtles in the marine environment. This BO addresses nesting sea turtles, their nests and eggs, and hatchlings as they emerge from the nest and crawl to the sea. Five species of sea turtles are analyzed in this BO: the loggerhead, green, leatherback, hawksbill, and Kemp's ridley.

Species/critical habitat 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). The nine DPSs and their statuses are:

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

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

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

Designated critical habitat

On July 10, 2014, the Service designated portions North Carolina beaches as critical habitat for the Northwest Atlantic (NWA) population of loggerhead sea turtles. Holden Beach is located within Critical Habitat Unit LOGG-T-NC-08 (Holden Beach, Brunswick County). From the Federal Register (FR) Notice (see http://www.regulations.gov/#!documentDetail;D=FWS-R4-ES-2012-0103-0001), this unit consists of 13.4 km (8.3 mi) of island shoreline along the Atlantic Ocean and extends from Lockwoods Folly Inlet to Shallotte Inlet. The island is separated from the mainland by the Atlantic Intracoastal Waterway, Elizabeth River, Montgomery Slough, Boone Channel, and salt marsh. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in private or local government ownership. This unit was occupied at the time of listing and is currently occupied. This unit supports expansion of nesting from the adjacent unit on Oak Island (LOGG-T-NC-07) that has high-density nesting by loggerhead sea turtles in North Carolina. Oak Island is located within the adjacent unit LOGG-T-NC-07. This unit consists of 20.9 km (13.0 mi) of island from the mouth of the Cape Fear River to Lockwoods Folly Inlet. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures, and contains high-density loggerhead sea turtle nesting.

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. Recovery units are management subunits of a listed entity that are geographically or otherwise identifiable and essential to the recovery of the listed entity. Within the U.S., four terrestrial recovery units have been designated for the Northwest Atlantic population 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). 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 nesting (numbers of nests) within the recovery unit.

Under the ESA and its implementing regulations, the Service is required to identify the physical or biological features (PBFs) essential to the conservation of the loggerhead sea turtle in areas occupied at the time of listing, focusing on the features' primary constituent elements (PCEs). The Service determined that the following PBFs are essential for the loggerhead sea turtle:

(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** - Natural Coastal Processes or Activities That Mimic These Natural Processes.
It is important that loggerhead nesting beaches are allowed to respond naturally to coastal dynamic processes of erosion and accretion or mimic these processes.

The Service considers PCEs to be those specific elements of the PBFs that provide for a species' life-history processes and are essential to the conservation of the species. Based on our current knowledge of the PBFs and habitat characteristics required to sustain the species' life-history processes, the terrestrial primary constituent elements specific to the Northwest Atlantic Ocean DPS of the loggerhead sea turtle are the extra-tidal or dry sandy beaches from the mean high-water line to the toe of the secondary dune, which are capable of supporting a high density of nests or serving as an expansion area for beaches with a high density of nests and that are well distributed within each State, or region within a State, and representative of total nesting, consisting of four components:

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

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

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

(4) **PCE 4—**Natural coastal processes or artificially created or maintained habitat mimicking natural conditions. This includes artificial habitat types that mimic the natural conditions described in PCEs 1 to 3 above for beach access, nest site selection, nest construction, egg deposition and incubation, and hatchling emergence and movement to the sea.

This unit contains all of the PBFs and PCEs. 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. The critical habitat in the project area has been relatively undisturbed since designation in 2014.

Species/critical habitat 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 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 2009b). Hatchling green turtles eat a variety of plants and animals, but adults feed almost exclusively on seagrasses and marine algae.

Major green turtle nesting colonies in the Atlantic occur on Ascension Island, Aves Island, Costa Rica, and Surinam. 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, from

Volusia through Nassau Counties in Florida, as well as in Georgia, South Carolina, North Carolina, and as far north as Delaware in 2011. Nests have been documented in smaller numbers south of Broward County in Miami-Dade. Nesting also has been documented along the Gulf coast of Florida from Escambia County through Franklin County in northwest Florida and from Pinellas County through Monroe County in southwest Florida (FWC/FWRI 2010b).
Green sea turtles are generally found in fairly shallow waters (except when migrating) inside reefs, bays, and inlets. The green turtle is attracted to lagoons and shoals with an abundance of marine grass and algae. Open beaches with a sloping platform and minimal disturbance are required for nesting. 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.

Species/critical habitat description - Leatherback Sea Turtle

The leatherback sea turtle was federally listed as an endangered species on June 2, 1970 (35 FR 8491). Leatherbacks have the widest distribution of the sea turtles with nonbreeding animals recorded as far north as the British Isles and the Maritime Provinces of Canada and as far south as Argentina and the Cape of Good Hope (Pritchard 1992). Foraging leatherback excursions have been documented into higher-latitude subpolar waters. They have evolved physiological and anatomical adaptations (Frair et al. 1972; Greer et al. 1973) that allow them to exploit waters far colder than any other sea turtle species would be capable of surviving.

The adult leatherback can reach 4 to 8 feet in length and weigh 500 to 2,000 pounds. The carapace is distinguished by a rubber-like texture, about 1.6 inches thick, made primarily of tough, oil-saturated connective tissue. Hatchlings are dorsally mostly black and are covered with tiny scales; the flippers are edged in white, and rows of white scales appear as stripes along the length of the back (NMFS 2009c). Jellyfish are the main staple of its diet, but it is also known to feed on sea urchins, squid, crustaceans, tunicates, fish, blue-green algae, and floating seaweed. This is the largest, deepest diving of all sea turtle species.

Leatherback turtle nesting grounds are distributed worldwide in the Atlantic, Pacific, and Indian Oceans on beaches in the tropics and subtropics. The Pacific Coast of Mexico historically supported the world’s largest known concentration of nesting leatherbacks. The leatherback turtle regularly nests in the U.S. Caribbean in Puerto Rico and the U.S. Virgin Islands. Along the U.S. Atlantic coast, most nesting occurs in Florida (NMFS and Service 1992). Nesting has also been reported in Georgia, South Carolina, and North Carolina (Rabon et al. 2003) and in Texas (Shaver 2008). Adult females require sandy nesting beaches backed with vegetation and sloped sufficiently so the distance to dry sand is limited. Their preferred beaches have proximity to deep water and generally rough seas.

Marine and terrestrial critical habitat for the leatherback sea turtle has been designated at Sandy Point on the western end of the island of St. Croix, U.S. Virgin Islands (44 FR 17710). There is no designated critical habitat in North Carolina.

Species/critical habitat description – Hawksbill Sea Turtle

The hawksbill sea turtle was Federally listed as endangered on June 2, 1970 (35 FR 8491). The hawksbill is found in tropical and subtropical seas of the Atlantic, Pacific, and Indian Oceans. The species is widely distributed in the Caribbean Sea and western Atlantic Ocean. Data collected in the Wider Caribbean reported that hawksbills typically weigh around 176 pounds or less; hatchlings average about 1.6 inches straight length and range in weight from 0.5 to 0.7 ounces. The carapace is heart shaped in young turtles, and becomes more elongated or egg-shaped with maturity. The top scutes are often richly patterned with irregularly radiating streaks of brown or black on an amber background. The head is elongated and tapers sharply to a point. The lower jaw is V-shaped (NMFS 2009d).

Within the continental U.S., hawksbill sea turtle nesting is rare, and nests are only known from Florida and North Carolina. Nesting in Florida is restricted to the southeastern coast of Florida (Volusia through Miami-Dade Counties) and the Florida Keys (Monroe County) (Meylan 1992; Meylan et al. 1995). Two nests have been recorded in North Carolina, both in 2015. Both nests, located on the Seashore, were originally thought to be loggerhead nests, but discovered to be hawksbill nests after DNA testing of eggshells. Hawksbill tracks are difficult to differentiate from those of loggerheads and may not be recognized by surveyors. Therefore, surveys in Florida and elsewhere in the southeastern U.S. likely underestimate actual hawksbill nesting numbers (Meylan et al. 1995). In the U.S. Caribbean, hawksbill nesting occurs on beaches throughout Puerto Rico and the U.S. Virgin Islands (NMFS and USFWS 1993).

Critical habitat for the hawksbill sea turtle was designated on June 24, 1982 (47 FR 27295) and September 2, 1998 (63 FR 46693). Critical habitat for the hawksbill sea turtle has been designated for selected beaches and/or waters of Mona, Monito, Culebrita, and Culebra Islands, Puerto Rico. There is no designated critical habitat in North Carolina.

Species/critical habitat 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, along with the flatback sea turtle (*Natator depressus*), has the most geographically restricted distribution 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 inches 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 swimming crabs, but may also include fish, jellyfish, and an array of mollusks.

The Kemp's ridley has a restricted distribution. Nesting is essentially limited to the beaches of the western Gulf of Mexico, primarily in Tamaulipas, Mexico (NMFS et al. 2011). Nesting also occurs in Veracruz and a few historical records exist for Campeche, Mexico (Marquez-Millan 1994). Nesting also occurs regularly in Texas and infrequently in a few other U.S. states. However, historic nesting records in the U.S. are limited to south Texas (Carr 1961; Hildebrand 1963).

Most Kemp's ridley nests located in the U.S. have been found in south Texas, especially Padre Island (Shaver and Caillouet 1998; Shaver 2002, 2005). Nests have been recorded elsewhere in Texas (Shaver 2005; 2006a; 2006b; 2007; 2008), and in Florida (Johnson et al. 1999; Foote and Mueller 2002; Hegna et al. 2006; FWC/FWRI 2010b), Alabama (J. Phillips, Service, personal communication, 2007 cited in NMFS et al. 2011; J. Isaacs, Service, personal communication, 2008 cited in NMFS et al. 2011), Georgia (Williams et al. 2006), South Carolina (Anonymous 1992), and North Carolina (Marquez et al. 1996), but these events are less frequent. Kemp's ridleys inhabit the Gulf of Mexico and the Northwest Atlantic Ocean, as far north as the Grand Banks (Watson et al. 2004) and Nova Scotia (Bleakney 1955). They occur near the Azores and eastern north Atlantic (Deraniyagala 1938; Brongersma 1972; Fontaine et al. 1989; Bolten and Martins 1990) and Mediterranean (Pritchard and Marquez 1973, Brongersma and Carr 1983; Tomas and Raga 2007; Insacco and Spadola 2010).

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 inches 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).

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

2) Life history

Life history – Loggerhead Sea Turtle

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

1. Terrestrial zone (supralittoral) - the nesting beach where 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 feet. The neritic zone generally includes the continental shelf, but in areas where the continental shelf is very narrow or nonexistent, the neritic zone conventionally extends to areas where water depths are less than 656 feet.

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

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

Numbers of nests and nesting females are often highly variable from year to year due to a number of factors including environmental stochasticity, periodicity in ocean conditions, anthropogenic effects, and density-dependent and density-independent factors affecting survival, somatic growth, and reproduction (Meylan 1982; Hays 2000; Chaloupka 2001; Solow et al. 2002). Despite these sources of variation, and because female turtles exhibit strong nest site fidelity, a nesting beach survey can provide a valuable assessment of changes in the adult female population, provided that the study is sufficiently long and effort and methods are standardized (Meylan 1982; Gerrodette and Brandon 2000; Reina et al. 2002). **Table 1** summarizes key life history characteristics for loggerheads nesting in the U.S.

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

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

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

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

Table 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 inches Curved Carapace Length) sex ratio	65-70 percent female[4]
Remigration interval (number of years between successive nesting migrations)	2.5-3.7 years[9]
Nesting season	late April-early September
Hatching season	late June-early November
Age at sexual maturity	32-35 years[10]
Life span	>57 years[11]

[1] Dodd (1988).
[2] Dodd and Mackinnon (1999, 2000, 2001, 2002, 2003, 2004).
[3] Witherington (2006) (information based on nests monitored throughout Florida beaches in 2005, n = 865).
[4] NMFS (2001); Foley (2005).
[5] Mrosovsky (1988).
[6] Witherington (2006) (information based on nests monitored throughout Florida beaches in 2005, n = 1,680).
[7] Murphy and Hopkins (1984); Frazer and Richardson (1985); Hawkes et al. 2005; Scott 2006.
[8] Caldwell (1962), Dodd (1988).
[9] Richardson et al. (1978); Bjorndal et al. (1983).
[10] Snover (2005).
[11] Dahlen et al. (2000).

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).

Life history – Leatherback Sea Turtle

Leatherbacks nest an average of five to seven times within a nesting season, with an observed maximum of 11 nests (NMFS and Service 1992). The interval between nesting events within a season is about 9 to 10 days. Clutch size averages 80 to 85 yolked eggs, with the addition of usually a few dozen smaller, yolkless eggs, mostly laid toward the end of the clutch (Pritchard 1992). Nesting migration intervals of 2 to 3 years were observed in leatherbacks nesting on the Sandy Point National Wildlife Refuge, St. Croix, U.S. Virgin Islands (McDonald and Dutton 1996). Leatherbacks are believed to reach sexual maturity in 13 to 16 years (Dutton et al. 2005; Jones et al. 2011).

Life history – Hawksbill Sea Turtle

Hawksbills nest on average about 4.5 times per season at intervals of approximately 14 days (Corliss et al. 1989). In Florida and the U.S. Caribbean, clutch size is approximately 140 eggs, although several records exist of over 200 eggs per nest (NMFS and USFWS 1993). On the basis of limited information, nesting migration intervals of two to three years appear to predominate.

Hawksbills are recruited into the reef environment at about 14 inches in length and are believed to begin breeding about 30 years later. However, the time required to reach 14 inches in length is unknown and growth rates vary geographically. As a result, actual age at sexual maturity is unknown.

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, personal communication, 2007 as cited in NMFS et al. 2011). 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).

3) Population dynamics

Population dynamics – 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 (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 1,296 in 2015 (Godfrey, unpublished data; www.seaturtle.org (accessed April 4, 2016)). Total estimated nesting in Florida, where 90 percent of nesting occurs, has fluctuated between 52,374 and 98,602 nests per year from 2009-2013 (FWC 2014; http://myfwc.com/media/2786250/loggerheadnestingdata09-13.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. From a global perspective, the U.S. nesting aggregation is of paramount importance to the survival of the species, as is the population that nests on islands in the Arabian Sea off Oman (Ross 1982; Ehrhart 1989; Baldwin et al. 2003).

Population dynamics - Green Sea Turtle

There are an estimated 150,000 females that nest each year in 46 sites throughout the world (NMFS and Service 2007a). In the U.S. Atlantic, the majority of nesting occurs along the coast of eastern central Florida, with an average of 10,377 each year from 2008 to 2012 (B. Witherington, Florida Fish and Wildlife Conservation Commission, pers. comm., 2013). 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 1998a). 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).

Population dynamics – Leatherback Sea Turtle

A dramatic drop in nesting numbers has been recorded on major nesting beaches in the Pacific. Spotila et al. (2000) have highlighted the dramatic decline and possible extirpation of leatherbacks in the Pacific.

The East Pacific and Malaysia leatherback populations have collapsed. Spotila et al. (1996) estimated that only 34,500 females nested annually worldwide in 1995, which is a dramatic decline from the 115,000 estimated in 1980 (Pritchard 1982). In the eastern Pacific, the major nesting beaches occur in Costa Rica and Mexico. At Playa Grande, Costa Rica, considered the most important nesting beach in the eastern Pacific, numbers have dropped from 1,367 leatherbacks in 1988-1989 to an average of 188 females nesting between 2000-2001 and 2003-2004. In Pacific Mexico, 1982 aerial surveys of adult female leatherbacks indicated this area had become the most important leatherback nesting beach in the world. Tens of thousands of nests were laid on the beaches in 1980s, but during the 2003-2004 seasons a total of 120 nests were recorded. In the western Pacific, the major nesting beaches lie in Papua New Guinea, Papua, Indonesia, and the Solomon Islands. These are some of the last remaining significant nesting assemblages in the Pacific. Compiled nesting data estimated approximately 5,000 to 9,200 nests annually with 75 percent of the nests being laid in Papua, Indonesia. However, the most recent population size estimate for the North Atlantic alone is a range of 34,000 to 94,000 adult leatherbacks (TEWG 2007). In Florida, the number of nests has been increasing since 1979 (Stewart et al. 2011). The average annual number of nests in the 1980s was 63 nests, which rose to 263 nests in the 1990s and to 754 nests in the 2000s (Stewart et al. 2011). In 2012, 1,712 nests were recorded statewide (http://myfwc.com/research/wildlife/sea-turtles/nesting/).

Nesting in the Southern Caribbean occurs in the Guianas (Guyana, Suriname, and French Guiana), Trinidad, Dominica, and Venezuela. The largest nesting populations at present occur in the western Atlantic in French Guiana with nesting varying between a low of 5,029 nests in 1967 to a high of 63,294 nests in 2005, which represents a 92 percent increase since 1967 (TEWG 2007). Trinidad supports an estimated 6,000 leatherbacks nesting annually, which represents more than 80 percent of the nesting in the insular Caribbean Sea. Leatherback nesting along the Caribbean Central American coast takes place between Honduras and Colombia. In Atlantic Costa Rica, at Tortuguero, the number of nests laid annually between 1995 and 2006 was estimated to range from 199 to 1,623.

In Puerto Rico, the main nesting areas are at Fajardo (Northeast Ecological Corridor) and Maunabo on the main island of Puerto Rico and on the islands of Culebra and Vieques. Between 1993 and 2010, the number of nests in the Fajardo area ranged from 51 to 456. In the Maunabo area, the number of nests recorded between 2001 and 2010 ranged from a low of 53 in 2002 to a high of 260 in 2009 (Diez 2011). On the island of Culebra, the number of nests ranged from a low 41 in 1996 to a high of 395 in 1997 (Diez 2011). On beaches managed by the Commonwealth of Puerto Rico on the island of Vieques, the Puerto Rico Department of Natural and Environmental Resources recorded annually 14-61 leatherback nests between 1991 and 2000; 145 nests in 2002; 24 in 2003; and 37 in 2005 (Diez 2011). The number of leatherback sea turtle nests recorded on Vieques Island beaches managed by the Service ranged between 13 and 163 during 2001-2010. Using the numbers of nests recorded in Puerto Rico between 1984 and 2005, the Turtle Expert Working Group (2007) estimated a population growth of approximately 10 percent per year. Recorded leatherback nesting on the Sandy Point National Wildlife Refuge on the island of St. Croix, U.S. Virgin Islands, between 1982 and 2010, ranged from a low of 82 in 1986 to a high of 1,008 in 2001 (Garner and Garner 2010). Using the number of observed females at Sandy Point from 1986 to 2004, the Turtle Expert Working Group (2007) estimated a population growth of approximately 10 percent per year. In the British Virgin Islands, annual nest numbers have increased in Tortola from zero to six nests per year in the late 1980s to 35 to 65 nests per year in the 2000s (TEWG 2007).

The most important nesting beach for leatherbacks in the eastern Atlantic lies in Gabon, Africa. It was estimated there were 30,000 nests along 60 mi of Mayumba Beach in southern Gabon during the 1999-2000 nesting season (Billes et al. 2000). Some nesting has been reported in Mauritania, Senegal, the Bijagos Archipelago of Guinea-Bissau, Turtle Islands and Sherbro Island of Sierra Leone, Liberia, Togo, Benin, Nigeria, Cameroon, Sao Tome and Principe, continental Equatorial Guinea, Islands of Corisco in the Gulf of Guinea and the Democratic Republic of the Congo, and Angola. In addition, a large nesting population is found on the island of Bioko (Equatorial Guinea) (Fretey et al. 2007). In North Carolina between the year 2000 and 2015, as many as 9 nests were laid per year (Godfrey, unpublished data).

Population dynamics – Hawksbill Sea Turtle

About 15,000 females are estimated to nest each year throughout the world with the Caribbean accounting for 20 to 30 percent of the world's hawksbill population. Only five regional populations remain with more than 1,000 females nesting annually (Seychelles, Mexico, Indonesia, and two in Australia) (Meylan and Donnelly 1999). Mexico is now the most important region for hawksbills in the Caribbean with about 3,000 nests per year (Meylan 1999). In the U.S. Pacific, hawksbills nest only on main island beaches in Hawaii, primarily along the east coast of the island of Hawaii. Hawksbill nesting has also been documented in American Samoa and Guam (NMFS and USFWS 1998b).

Population dynamics – Kemp's Ridley Sea Turtle

Most Kemp's ridleys nest on the coastal beaches of the Mexican states of Tamaulipas and Veracruz, although a small number of Kemp's ridleys nest consistently along the Texas coast (TEWG 1998; 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 2010b). 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.

4) Status and distribution

Status and distribution – All Sea Turtles

Reason for Listing: 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.

Status and distribution – Loggerhead Sea Turtle

Range-wide Trend: 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. The five recovery units identified in the Northwest Atlantic are:

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

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

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

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

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

The mtDNA analyses show that there is limited exchange of females among these recovery units (Ehrhart 1989; Foote et al. 2000; NMFS 2001; Hawkes et al. 2005). Male-mediated gene flow appears to be keeping the subpopulations genetically similar on a nuclear DNA level (Francisco-Pearce 2001).

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

The NRU is the second largest loggerhead recovery unit within the Northwest Atlantic Ocean DPS. Annual nest totals from northern beaches averaged 5446 nests from 2006 to 2011, a period of near-complete surveys of NRU nesting beaches, representing approximately 1,328 nesting females per year (4.1 nests per female, Murphy and Hopkins 1984) (NMFS and Service 2008). In 2008, nesting in Georgia reached what was a new record at that time (1,646 nests), with a downturn in 2009, followed by yet another record in 2011 (1,987 nests). South Carolina had the two highest years of nesting in the 2000s in 2009 (2,183 nests) and 2010 (3,141 nests). The previous high for that 11-year span was 1,433 nests in 2003. North Carolina had 947 nests in 2011, which is above the average of 765. The Georgia, South Carolina, and North Carolina nesting data come from the seaturtle.org Sea Turtle Nest Monitoring System, which is populated with data input by the State agencies. The loggerhead nesting trend from daily beach surveys was declining significantly at 1.3 percent annually from 1983 to 2007 (NMFS and USFWS, 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).

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

1. Number of Nests and Number of Nesting Females
   a. Northern Recovery Unit
      i. There is statistical confidence (95 percent) that the annual rate of increase over a generation time of 50 years is 2 percent or greater resulting in a total annual number of nests of 14,000 or greater for this recovery unit (approximate distribution of nests is North Carolina =14 percent [2,000 nests], South Carolina =66 percent [9,200 nests], and Georgia =20 percent [2,800 nests]); and
      ii. This increase in number of nests must be a result of corresponding increases in number of nesting females (estimated from nests, clutch frequency, and remigration interval).

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

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

   d. Northern Gulf of Mexico Recovery Unit
      i. There is statistical confidence (95 percent) that the annual rate of increase over a generation time of 50 years is three percent or greater resulting in a

total annual number of nests of 4,000 or greater for this recovery unit (approximate distribution of nests (2002-2007) is Florida= 92 percent [3,700 nests] and Alabama =8 percent [300 nests]); and

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

e. Greater Caribbean Recovery Unit

i. The total annual number of nests at a minimum of three nesting assemblages, averaging greater than 100 nests annually (e.g., Yucatán, Mexico; Cay Sal Bank, Bahamas) has increased over a generation time of 50 years; and

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

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

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

Status and distribution - Green Sea Turtle

Range-wide Trend: 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. It extends due east across the Atlantic Ocean at 48° N. and follows the coast south to include the northern portion of the Islamic Republic of Mauritania (Mauritania) on the African continent to 19° N. It extends west at 19° N. to the Caribbean basin to 65.1° W., then due south to 14° N., 65.1° W., then due west to 14° N., 77° W., and due south to 7.5° N., 77° W., 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. Although the SNBS program provides information on distribution and total abundance statewide, it cannot be used to assess trends because of variable survey effort. Therefore, green turtle nesting trends are best assessed using standardized nest counts made at INBS sites surveyed with constant effort over time (1989-2010). 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), the Recovery Plan for U.S. Pacific Populations of the Green Turtle was signed in 1998 (NMFS and Service 1998b), and the Recovery Plan for U.S. Pacific Populations of the East Pacific Green Turtle was signed in 1998 (NMFS and Service 1998a).

Status and distribution - Leatherback Sea Turtle

Range-wide Trend: Declines in leatherback nesting have occurred over the last two decades along the Pacific coasts of Mexico and Costa Rica. The Mexican leatherback nesting population, once considered to be the world's largest leatherback nesting population (historically estimated to be 65 percent of the worldwide population), is now less than 1 percent of its estimated size in 1980. Spotila et al. (1996) estimated the number of leatherback sea turtles nesting on 28 beaches throughout the world from the literature and from communications with investigators studying those beaches. The estimated worldwide population of leatherbacks in 1995 was about 34,500 females on these beaches with a lower limit of about 26,200, and an upper limit of about 42,900. This is less than one-third the 1980 estimate of 115,000. Leatherbacks are rare in the Indian Ocean and in very low numbers in the western Pacific Ocean. The most recent population size estimate for the North Atlantic is a range of 34,000 to 94,000 adult leatherbacks (TEWG 2007). The largest population is in the western Atlantic. Using an age-based demographic model, Spotila et al. (1996) determined that leatherback populations in the Indian Ocean and western Pacific Ocean cannot withstand even moderate levels of adult mortality and that the Atlantic populations are being exploited at a rate that cannot be sustained. They concluded that leatherbacks are on the road to extinction and further population declines can be expected unless action is taken to reduce adult mortality and increase survival of eggs and hatchlings.

In the U.S., nesting populations occur in Florida, Puerto Rico, and the U.S. Virgin Islands. In Florida, the SNBS program documented an increase in leatherback nesting numbers from 98 nests in 1989 to between 453 and 1,747 nests per season in the early 2000s (FWC 2009a; Stewart and Johnson 2006). Although the SNBS program provides information on distribution and total abundance statewide, it cannot be used to assess trends because of variable survey effort. Therefore, leatherback nesting trends are best assessed using standardized nest counts made at INBS sites surveyed with constant effort over time (1989-2010). Under the INBS program, approximately 30 percent of Florida's SNBS beach length is surveyed. The INBS nest counts represent approximately 34 percent of known leatherback nesting in Florida. An analysis of the INBS data has shown an exponential increase in leatherback sea turtle nesting in Florida since 1989. From 1989 through 2010, the annual number of leatherback sea turtle nests at the core set of index beaches ranged from 27 to 615 (FWC 2010b). Using the numbers of nests recorded from 1979 through 2009, Stewart et al. (2011) estimated a population growth of approximately 10.2 percent per year. In Puerto Rico, the main nesting areas are at Fajardo (Northeast Ecological Corridor) and Maunabo on the main island and on the islands of Culebra and Vieques. Nesting ranged from 51 to 456 nests between 2001 and 2010 (Diez 2011). In the U.S. Virgin Islands, leatherback nesting on Sandy Point National Wildlife Refuge on the island of St. Croix ranged from 143 to 1,008 nests between 1990 and 2005 (TEWG 2007; NMFS and Service 2007b).

Recovery Criteria

The U.S. Atlantic population of leatherbacks can be considered for delisting if the following conditions are met:

1. The adult female population increases over the next 25 years, as evidenced by a statistically significant trend in the number of nests at Culebra, Puerto Rico, St. Croix, U.S. Virgin Islands, and along the east coast of Florida;
2. Nesting habitat encompassing at least 75 percent of nesting activity in U.S. Virgin Islands, Puerto Rico, and Florida is in public ownership; and
3. All priority one tasks identified in the recovery plan have been successfully implemented.

Status and distribution – Hawksbill Sea Turtle

The hawksbill sea turtle has experienced global population declines of 80 percent or more during the past century and continued declines are projected (Meylan and Donnelly 1999). Most populations are declining, depleted, or remnants of larger aggregations. Hawksbills were previously abundant, as evidenced by high-density nesting at a few remaining sites and by trade statistics.

Recovery Criteria

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

1. The adult female population is increasing, as evidenced by a statistically significant trend in the annual number of nests on at least five index beaches, including Mona Island and Buck Island Reef National Monument;

2. Habitat for at least 50 percent of the nesting activity that occurs in the U.S. Virgin Islands and Puerto Rico is protected in perpetuity;

3. Numbers of adults, subadults, and juveniles are increasing, as evidenced by a statistically significant trend on at least five key foraging areas within Puerto Rico, U.S. Virgin Islands, and Florida; and

4. All priority one tasks identified in the recovery plan have been successfully implemented.

The Recovery Plan for the Hawksbill Turtle in the U.S. Caribbean, Atlantic, and Gulf of Mexico was signed in 1993 (NMFS and USFWS 1993), and the Recovery Plan for U.S. Pacific Populations of the Hawksbill Turtle was signed in 1998 (NMFS and USFWS 1998b).

Status and distribution – Kemp's Ridley Sea Turtle

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 goal of the recovery plan 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 (Service 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 Recover 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.

5) Analysis of the species/critical habitat likely to be affected

The loggerhead sea turtle, the green sea turtle, the leatherback sea turtle, the hawksbill sea turtle, and the Kemp's ridley sea turtle are currently listed because of their reduced population sizes caused by overharvest and habitat loss with continuing anthropogenic threats from commercial fishing, disease, and degradation of remaining habitat.

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.
The Service and the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS) share Federal jurisdiction for sea turtles under the Act. The Service has responsibility for sea turtles on the nesting beach. NMFS has jurisdiction for sea turtles in the marine environment.

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

The proposed action has the potential to adversely affect nesting females, nests, and hatchlings on the beach within the proposed Action Area. Potential effects include destruction of nests deposited within the boundaries of the proposed project, harassment in the form of disturbing or interfering with female turtles attempting to nest within the construction area or on adjacent beaches as a result of construction activities, disorientation of hatchling turtles on beaches adjacent to the construction area as they emerge from the nest and crawl to the water as a result of project lighting or presence of the groin, and behavior modification of nesting females during the nesting season resulting in false crawls or situations where they choose marginal or unsuitable nesting areas to deposit eggs due to escarpment formation or presence of the groin within the Action Area. The quality of the placed sand could affect the ability of female turtles to nest, the suitability of the nest incubation environment, and the ability of hatchlings to emerge from the nest. The presence of the groin could affect the movement of sand by altering the natural coastal processes and could affect the ability of female turtles to nest, the suitability of the nest incubation environment, and the ability of hatchlings to emerge from the nest and crawl to the ocean.

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 Service 2008). However, the construction of a groin and sand placement action includes avoidance and minimization measures that reduce the possibility of mortality of a nesting female on the beach as a result of the project. Therefore, we do not anticipate the loss of any nesting females on the beach as a result of the project.

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 Service 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.

During project construction, direct mortality of the developing embryos in nests within the Action Area may occur for nests that are missed and not relocated or marked for avoidance. The exact number of these missed nests is not known. However, in two separate monitoring programs on the east coast of Florida where hand digging was performed to confirm the presence of nests and thus reduce the chance of missing nests through misinterpretation, trained observers still missed about 6 to 8 percent of the nests because of natural elements (Martin 1992; Ernest and Martin 1993). This must be considered a conservative number, because missed nests are not always accounted for. In another study, Schroeder (1994) found that even under the best of conditions, about 7 percent of nests can be misidentified as false crawls by highly experienced sea turtle nest surveyors. Missed nests are usually identified by signs of hatchling emergences or egg or hatchling predation in areas where no nest was previously documented. Signs of hatchling emergence are very easily obliterated by the same elements that interfere with detection of nests. 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 Service 2008). Thus, even if, for example, the number of missed nests approaches twice the rate mentioned above, 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) not all eggs in all unmarked nests will produce hatchlings, and 2) destruction and/or failure of a missed nest will not always result from a construction project. A variety of natural and unknown factors negatively affect incubating egg clutches, including tidal inundation, storm events, 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. During project construction, predators of eggs and nestlings may be attracted to the Action Area due to food waste from the construction crew.

The presence of the groin may create a physical obstacle to nesting sea turtles. The impact of nesting females interacting with the groin in the marine environment will be analyzed by NMFS in their consultation. As a result, the groin is anticipated to result in decreased nesting and loss of nests that do get laid within the Action Area for all subsequent nesting seasons following the completion of the proposed project. However, it is unknown whether nests that would have been laid in the Action Area had the project not occurred are actually lost from the population, or if nesting is simply displaced to adjacent beaches. Regardless, eggs and hatchlings have a low reproductive value; each egg or hatchling has been estimated to have only 0.004 percent of the value of a nesting female (NMFS and Service 2008). The Service would not expect this loss to have a significant effect on the recovery and survival of the species, for the following reasons: 1) some nesting is likely just displaced to adjacent non-project beaches, 2) not all eggs will produce hatchlings, and 3) destruction and/or failure of nests will not always result from the construction project. A variety of natural and unknown factors negatively affect incubating egg clutches, including tidal inundation, storm events, and predation.

The DEIS states that the terminal groin was designed to include large voids between the stones to facilitate sediment movement though the structures. The interaction between the groin and the hydrodynamics of tide and current often results in the alteration of the beach profile seaward and in the immediate vicinity of the structure (Pilkey and Wright 1988; Terchunian 1988; Tait and Griggs 1990; Plant and Griggs 1992); including increased erosion seaward of structures, increased longshore currents that move sand away from the area, loss of interaction between the dune and ocean, and concentration of wave energy at the ends of an armoring structure (Schroeder and Mosier 1996). These changes or combination of changes can have various detrimental effects on sea turtles and their nesting habitat.

In the U.S., consultations with the Service have included military missions and operations, beach nourishment and other shoreline protection projects, and actions related to protection of coastal development on sandy beaches along the coast. Much of the Service's section 7 consultation involves beach nourishment projects. A list of the Service's consultations completed over the last two years in North Carolina is included in **Table 2**. The Act does not require entities conducting projects with no Federal nexus to apply for a section 10(a)(1)(B) permit. This is a voluntary process and is applicant driven. Section 10(a)(1)(A) permits are scientific permits that include activities that would enhance the survival and conservation of a listed species. Those permits are not listed as they are expected to benefit the species and are not expected to contribute to the cumulative take assessment.

Table 2. Biological opinions within the Raleigh Field Office geographic area that have been issued since 2014 for adverse impacts to sea turtle species.

OPINIONS	SPECIES	HABITAT	
		Critical Habitat (loggerhead)	**Habitat**
Fiscal Year 2014: 1 BO	Loggerhead, leatherback, green, and Kemp's ridley sea turtles	12,600 lf (2.4 mi)	12,600 lf (2.4 mi)
Fiscal Year 2015: 5 BOs	Loggerhead, leatherback, green, hawksbill, and Kemp's ridley sea turtles	50,268 lf (9.5 mi)	70,268 lf (13.3 mi)
Fiscal Year 2016 (to date): 4 BOs	Loggerhead, leatherback, green, hawksbill, and Kemp's ridley sea turtles	98,400 lf (18.63 mi)	178,519 lf (33.8 mi)
Total: 10 BOs		161,268 lf (30.5 mi)	261,387 lf (49.5 mi)

B. Environmental Baseline

1) Status of sea turtle species within the Action Area

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 3** for data on observed loggerhead sea turtle nests on Holden Beach and Oak Island. Data was provided from www.seaturtle.org (accessed on March 7, 2016).

Table 3. Number of loggerhead nests observed between 2009 and 2015 on Holden Beach and Oak Island.

Year	**Number of Loggerhead Nests**	
	Holden Beach	Oak Island
2009	23	56
2010	27	56
2011	30	63
2012	48	79
2013	73	93
2014	19	31
2015	53	101

Critical Habitat Unit LOGG-T-NC-07 and -08

For the Northern Recovery Unit, the Service 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 nesting (numbers of nests) within the recovery unit.

These critical habitat units are two of 38 designated critical habitat units for the Northern Recovery Unit of the Northwest Atlantic DPS. In North Carolina, 96.1 shoreline mi (154.6 km) of critical habitat for nesting loggerhead sea turtles was designated. Up to a quarter of this acreage has been affected recently by activities such as beach nourishment, sandbag revetment construction, and groin construction, or is proposed for such activities. However, with the exception of beach nourishment activities and recreational activities, most of the critical habitat units in North Carolina remain relatively unaffected by development.

The green sea turtle nesting and hatching season North Carolina beaches extends from May 15 through November 15. Incubation ranges from about 45 to 75 days. One green sea turtle nest was reported on Oak Island in 2010 and on Holden Beach in both 2010 and 2013 (data from www.seaturtle.org).

The leatherback sea turtle nesting and hatching season on North Carolina beaches extends from April 15 through November 15. Incubation ranges from about 55 to 75 days. There was one leatherback nest reported on Holden Beach in 2010.

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. No Kemp's ridley nests have been reported on Holden Beach or Oak Island. However, Kemp's ridley sea turtles are known to occasionally nest throughout the state, and nests have been documented north and south of the Action Area.

The hawksbill sea turtle nesting and hatching season has not been determined on North Carolina beaches, but is assumed to be similar to other species. Two hawksbill nests were reported in 2015 at Cape Hatteras National Seashore south of Hatteras; the first records of hawksbill sea turtle nests in the state of North Carolina. One nest successfully hatched (hatching success of 64.5%), the other was destroyed by high surf from storms. The nest that successfully hatched had an incubation period of 59 days. It is currently unclear whether or not the hawksbill sea turtle may nest in the Action Area.

2) Factors affecting the species environment within the Action Area

A number 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** lists the most recent projects, within the past 5 years.

Nourishment activities widen beaches, change their sedimentology and stratigraphy, alter coastal processes and often plug dune gaps and remove overwash areas. The Brunswick County Beaches project was authorized by Public Law 89-789 (November 6, 1966), for the purposes of hurricane wave protection and beach erosion control. However, no work has been conducted under the authorized project. The town of Holden Beach received authorization in 2013 to dredge approximately 1,300,000 cy from an offshore borrow area and place the material onto approximately 22,000 lf of shoreline in Holden Beach. However, this activity has not yet been conducted.

Inlet dredging activities alter the sediment dynamics on adjacent shorelines and stabilize these dynamic environments; beach disposal of dredge material further alters the natural habitat adjacent to inlets. Estuarine dredging of navigational channels can alter water circulation patterns and sediment transport pathways, as well as increase the frequency and magnitude of boat wakes; sound-side sand or mud flats may be impacted by increased erosion rates as a result. Historically, there has been a Federal navigation project in the Lockwoods Folly Inlet and AIWW for decades, and the Corps dredges the inlet at least annually. In some cases, the inlet is dredged using a sidecast dredge, such as the Dredge Merritt. In an unknown number of dredging events, the sediment has been placed on Holden Beach or Oak Island using pipelines.

Table 4. Actions that have occurred on Holden Beach and/or in Lockwoods Folly Inlet in the last 5 years.

Year	Species Impacted	Project Type	Anticipated Take
2015	Loggerhead, green, leatherback, hawksbill, and Kemp's ridley sea turtle, piping plover, red knot, seabeach amaranth	Dredging of Eastern Channel and Placement of sand on Oak Island Beaches	4,400 lf of shoreline and 3.49 acres of piping plover critical habitat
Regularly, most recently in 2014, 2011, 2010, and 2009	Loggerhead, green, leatherback, hawksbill, and Kemp's ridley sea turtle, piping plover, red knot, seabeach amaranth	AIWW dredging, Lockwoods Folly Inlet dredging with beach disposal	Up to 4,000 lf of beach shoreline and inlet habitats
2009	Loggerhead, green, leatherback, hawksbill, and Kemp's ridley sea turtle, piping plover, red knot, seabeach amaranth	Beach nourishment with sand from an upland source	Up to 23,400 lf of beach shoreline

Beach scraping or bulldozing 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 been frequent on North Carolina beaches in recent 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.

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 sea turtle nesting habitat. Geotubes (long cylindrical bags made of high-strength permeable fabric and filled with sand) 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 North Topsail Beach, and more sandbags were recently added to protect a parking lot downdrift of the revetment. Sandbags have been placed in some portions of the Action Area on Holden Beach and Oak Island.

<u>Threats to Sea Turtles</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 (National Research Council (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 2007).

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 its designated critical habitat, the Service will have a better basis to address the nature and magnitude of this potential threat and will more effectively evaluate these effects to the range-wide status of sea turtles.

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

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). 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.

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 that are designed to trap sand that would otherwise be transported by longshore currents and can cause downdrift erosion (Kaufman and Pilkey 1979).

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

Threats to loggerhead sea turtle terrestrial habitat

Recreational beach use: beach cleaning, human presence (e.g., dog beach, special events, piers, and recreational beach equipment);

Beach driving: essential and nonessential off-road vehicles, all-terrain vehicles, and recreational access and use;

Predation: depredation of eggs and hatchlings by native and nonnative predators;

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;
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;

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;

Artificial lighting: direct and indirect lighting, skyglow, and bonfires;

Beach erosion: erosion due to aperiodic, short-term weather-related erosion events, such as atmospheric fronts, northeasters, tropical storms, and hurricanes;

Climate change: includes sea level rise;

Habitat obstructions: tree stumps, fallen trees, and other debris on the beach; nearshore sand bars; and ponding along beachfront seaward of dry beach;

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;

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.

C. Effects of the Action

1) Factors to be considered

Proximity of action: Construction of the groin and 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, leatherback, hawksbill, and Kemp's ridley nesting females, their nests, and hatchling sea turtles.

Distribution: Construction and presence of the groin and sand placement activities may impact nesting and hatchling sea turtles and sea turtle nests occurring along Holden Beach and Oak Island adjacent to the Atlantic Ocean and Lockwoods Folly Inlet. The Service expects the proposed construction activities could directly and indirectly affect the availability of habitat for nesting and hatchling sea turtles.

Timing: The timing of the sand placement activities and construction of the groin could directly and indirectly impact nesting females, their nests, and hatchling sea turtles if conducted between May 1 and November 15. The presence of the groin and future sand placement activities could directly and indirectly impact nesting females, their nests, and hatchling sea turtles for each subsequent nesting season within the Action Area.

Nature of the effect: The effects of the construction and presence of the groin and 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.

The Service expects the action will result in direct and indirect, long-term effects to sea turtles, including the Northwest Atlantic DPS of the loggerhead sea turtle. Due to downdrift erosion, there may be loss or degradation of loggerhead terrestrial Critical Habitat Unit LOGG-T-NC-08.

The Service expects there may be morphological changes to adjacent nesting 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 loggerhead and other sea turtles.

Duration: The construction of the groin is to be a one-time activity and may take up to six months to complete. The sand placement activity is likely to be a multiple-year activity, and each sand placement project may take 12 weeks to complete. Thus, the direct effects would be expected to be short-term in duration. Indirect effects from the activity may continue to impact nesting and hatchling sea turtles and sea turtle nests in subsequent nesting seasons. In addition, the placement of the groin represents a long-term impact since the groin could be in place for many years.

Disturbance frequency: Sea turtle populations in the southeastern U.S. may experience decreased nesting success, hatching success, and hatchling emerging success that could result from the construction and sand placement activities being conducted during one nesting season, or during the earlier or later parts of one or two nesting seasons.

The frequency of maintenance dredging activities varies greatly, and can be as often as annually or semiannually, depending on the rate of shoaling and funding availability. Sand placement activities as a result of shore protection activities typically occur once every 3 to 5 years. For this project, sand placement is anticipated every 5 years. Dredging and sand placement typically occurs during the winter work window, but can occur at any time during the year based on availability of funding and of dredges to conduct the work. The disturbance frequency related to groin and jetty repair and replacement varies greatly based on the original construction methodology, the construction materials, and the conditions under which the structure is placed.

Disturbance intensity and severity: Depending on the timing of the construction and sand placement activities during the sea turtle nesting season, effects to the sea turtle populations in the southeastern U.S. could be important. The placement of the groin represents a long-term impact within the Action Area since the groin could be in place for many years.

2) Analyses for effects of the action

The Action Area encompasses 4,000 lf of shoreline on the Atlantic coast of North Carolina.

Beneficial Effects: Groins constructed in appropriate high erosion areas, or to offset the effects of shoreline armoring, may reestablish a beach where none currently exists, stabilize the beach in rapidly eroding areas and reduce the potential for escarpment formation, reduce destruction of nests from erosion, and reduce the need for future sand placement events by extending the interval between sand placement events. However, caution should be exercised to avoid automatically assuming the reestablishment of a beach will wholly benefit sea turtle populations without determining the extent of the groin effect on nesting and hatchling sea turtle behavior.

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.

Direct Effects: There should be no potential adverse effects during the project construction because the groin is intended to be constructed outside of the sea turtle nesting season.

Following construction, the presence of the groin has the potential to adversely affect sea turtles. For instance, the groin may interfere with the egress and ingress of adult females at nesting sites; alter downdrift beach profiles through erosion, escarpment formation, and loss of berms; trap or obstruct hatchlings during a critical life-history stage; increase hatchling and adult female energy expenditure in attempts to overcome the structures; and attract additional predatory fish or concentrate existing predatory fish, thereby increasing the potential of hatchling predation.

a. *Equipment during construction*

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). In addition, a significant reduction in sea turtle nesting activity has been documented on beaches illuminated with artificial lights (Witherington 1992). Lights on a project beach may deter females from coming ashore to nest, misdirect females trying to return to the surf after a nesting event, and misdirect emergent hatchlings.

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 Brevard and Palm Beach Counties, Florida. A sand placement project in Brevard County, completed in 2002, showed 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. A shoreline protection project was constructed at Ocean Ridge in Palm Beach County, Florida, between August 1997 and April 1998. Lighting disorientation events increased after nourishment. In spite of continued aggressive efforts to identify and correct lighting violations in 1998 and 1999, 86 percent of the disorientation reports were in the nourished area in 1998 and 66 percent of the reports were in the nourished area in 1999 (Howard and Davis 1999).

c. *Entrapment/physical obstruction*

Groins have the potential to interfere with the egress or ingress of adult females at nesting sites where they may proceed around them successfully, abort nesting for that night, or move to another section of beach to nest. This may cause an increase in energy expenditure, and, if the body of the groin is exposed, may act as a barrier between beach segments and also prevent nesting on the adjacent beach. In general, the groin is exposed to dissipate wave energy and facilitate sand bypass, functioning in many cases to stabilize the beach and adjacent areas.

Typically, sea turtles emerge from the nest at night when lower sand temperatures elicit an increase in hatchling activity (Witherington et al. 1990). After emergence, approximately 20 to 120 hatchlings crawl en *masse* immediately to the surf, using predominately visual cues to orient them (Witherington and Salmon 1992; Lohmann et al. 1997). Upon reaching the water, sea turtle hatchlings orient themselves into the waves and begin a period of hyperactive swimming activity, or swim frenzy, which lasts for approximately 24 hours (Salmon and Wyneken 1987; Wyneken et al. 1990; Witherington 1991). The swim frenzy effectively moves the hatchling quickly away from shallow, predator rich, nearshore waters to the relative safety of deeper water (Gyuris 1994; Wyneken et al. 2000). The first hour of a hatchling's life is precarious and predation is high, but threats decrease as hatchlings distance themselves from their natal beaches (Stancyk 1995; Pilcher et al. 2000). Delays in hatchling migration (both on the beach and in the water) can cause added expenditures of energy and an increase of time spent in predator rich nearshore waters. On rare occasions hatchlings will encounter natural nearshore features that are similar to the emergent structures proposed for this project. However, observations of hatchling behavior during an encounter with a sand bar at low tide, a natural shore-parallel barrier, showed the hatchlings maintained their shore-perpendicular path seaward, by crawling over the sand bar versus deviating from this path to swim around the sand bar through the trough, an easier alternative. In spite of the groin design features, the groin may adversely affect sea turtle hatchlings by serving as a barrier or obstruction to sea turtle hatchlings and delaying offshore migration; depleting or increasing expenditure of the "swim frenzy" energy critical for allowing hatchlings to reach the relative safety of offshore development areas; and possibly entrapping hatchlings within the groin or within eddies or other associated currents.

Indirect Effects: Many of the direct effects of a groin or 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*

The presence of the groin may alter the natural coastal processes and result in an unnatural beach profiles resulting from the presence of groin, which could negatively impact sea turtles regardless of the timing of projects. The use of heavy machinery can cause sand compaction (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 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.

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

Beach nourishment projects create an elevated, wider, and unnatural flat slope berm. Sea turtles nest closer to the water the first few years after nourishment because of the altered profile (and perhaps unnatural sediment grain size distribution) (Ernest and Martin 1999; Trindell 2005).

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

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

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

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 may also develop on beaches between groins as the beaches equilibrate to their final profiles. 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 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 Council 1990a), and can also result in greater adverse effects due to artificial lighting, as discussed above.

d. *Future sand migration and erosion*

Groins and jetties are shore-perpendicular structures that are designed to trap sand that would otherwise be transported by longshore currents. Jetties are defined as structures placed to keep sand from flowing into channels (Kaufman and Pilkey 1979; Komar 1983). In preventing normal sand transport, these structures accrete updrift beaches while causing accelerated beach erosion downdrift of the structures (Komar 1983; Pilkey et al. 1984; NRC 1987), a process that results in degradation of sea turtle nesting habitat. As sand fills the area updrift from the groin or jetty, some littoral drift and sand deposition on adjacent downdrift beaches may occur due to spillover. However, these groins and jetties often force the stream of sand into deeper offshore water where it is lost from the system (Kaufman and Pilkey 1979). The greatest changes in beach profile near groins and jetties are observed close to the structures, but effects eventually may extend many mi along the coast (Komar 1983).

Jetties are placed at ocean inlets to keep transported sand from closing the inlet channel. Together, jetties and inlets are known to have profound effects on adjacent beaches (Kaufman and Pilkey 1979). Witherington et al. (2005) found a significant negative relationship between loggerhead nesting density and distance from the nearest of 17 ocean inlets on the Atlantic coast of Florida. The effect of inlets in lowering nesting density was observed both updrift and downdrift of the inlets, leading researchers to propose that beach instability from both erosion and accretion may discourage sea turtle nesting.

Erosion control structures (e.g., terminal groins, T-groins, and breakwaters), in conjunction with beach nourishment, can help stabilize U.S. Gulf and Atlantic coast barrier island beaches (Leonard et al. 1990). However, groins often result in accelerated beach erosion downdrift of the structures (Komar 1983; NRC 1987) and corresponding degradation of suitable sea turtle nesting habitat (NMFS and Service 1991; 1992). Initially, the greatest changes are observed close to the structures, but effects may eventually extend significant distances along the coast (Komar 1983). Groins operate by blocking the natural longshore transport of littoral drift (Kaufman and Pilkey 1979; Komar 1983). Conventional rubble mound groins control erosion by trapping sand and dissipating some wave energy. In general, except for terminal groins at the downdrift limit of a littoral cell, groins are not considered favorable erosion control alternatives because they usually impart stability to the updrift beach and transfer erosion to the downdrift side of the structure. In addition, groins deflect longshore currents offshore, and excess sand builds up on the updrift side of the structure which may be carried offshore by those currents. This aggravates downdrift erosion and erosion escarpments are common on the downdrift side of groins (Humiston and Moore 2001).

Future sand displacement on nesting beaches is a potential effect of the nourishment project. Dredging of sand offshore from an Action Area has the potential to cause erosion of the newly created beach or other areas on the same or adjacent beaches by creating a sand sink. The remainder of the system responds to this sand sink by providing sand from the beach to attempt to reestablish equilibrium (NRC 1990b).

e. *Erosion control structure breakdown*

If erosion control structures fail and break apart, the resulting debris may be spread upon the beach, which may further impede nesting females from accessing suitable nesting sites (resulting in a higher incidence of false crawls) and trap hatchlings and nesting turtles (NMFS and Service 1991; 1992; 1993).

3) Species' response to a proposed action

The Service determined there is a potential for long-term adverse effects on sea turtles, particularly hatchlings, as a result of the presence of the groin. However, the Service acknowledges the potential benefits of the erosion control structure since it may extend the sand placement interval. Nonetheless, an increase in sandy beach may not necessarily equate to an increase in suitable sea turtle nesting habitat.

The following summary illustrates sea turtle responses to and recovery from a nourishment project comprehensively studied by Ernest and Martin (1999). A significantly larger proportion of turtles emerging on nourished beaches abandoned their nesting attempts than turtles emerging on natural or pre-nourished beaches. 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 associated with the nourishment project (e.g., beach profile, sediment grain size, beach compaction, frequency and extent of escarpments). 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 conditions. However, tilling (minimum depth of 36 inches) is effective in reducing sediment compaction to levels that did not significantly prolong digging times. As natural processes reduced compaction levels on nourished beaches during the second post-construction year, digging times returned to natural levels (Ernest and Martin 1999).

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.

D. Cumulative Effects

This project occurs on non-federal lands. Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the Action Area considered in this biological opinion.

It is reasonable to expect continued shoreline stabilization, inlet dredging, and beach renourishment projects in this area in the future since erosion and sea-level rise increases would impact the existing beachfront development.

V. PIPING PLOVER

A. Status of the Species/Critical Habitat

1) Species/critical habitat description

Listing: 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). Piping plovers were listed principally because of habitat destruction and degradation, predation, and human disturbance. Protection of the species under the ESA reflects the species' precarious status range-wide.

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 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) (**Figure 2**).

Figure 2. Distribution and range of piping plovers (base map from Haig and Elliott-Smith 2004). Conceptual presentation of subspecies and DPS ranges are not intended to convey precise boundaries.

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.

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 nest above the high tide line on coastal beaches; on sand flats at the ends of sand spits and barrier islands; on gently sloping foredunes; in blowout areas behind primary dunes (overwashes); in sparsely vegetated dunes; and in overwash 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.

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 arrive on their breeding grounds in late March or early April. Following establishment of nesting territories and courtship rituals, the pair forms a depression in the sand, where the female lays her eggs. By early September both adults and young depart for their wintering areas.

Piping Plover Critical Habitat

The Service has designated critical habitat for the piping plover on three occasions. Two of these designations protected different piping plover breeding populations. Critical habitat for the Great Lakes breeding population was designated May 7, 2001 (66 Federal Register [FR] 22938; USFWS 2001a), and critical habitat for the northern Great Plains breeding population was designated September 11, 2002 (67 FR 57637; USFWS 2002). The Service designated critical habitat for wintering piping plovers on July 10, 2001 (66 FR 36038; USFWS 2001b). Wintering piping plovers may include individuals from the Great Lakes and northern Great Plains breeding populations as well as birds that nest along the Atlantic Coast. Piping plover critical habitat unit NC-16 (Lockwoods Folly Inlet – Brunswick County) is located within the Action Area. This 36 ha (90 ac) unit is on Oak Island (formerly known as the Town of Long Beach) and is privately owned. This unit extends from the end of West Beach Drive, west to MLLW at Lockwoods Folly Inlet, including emergent sandbars south and adjacent to the island. This unit includes land from MLLW on Atlantic Ocean across to MLLW adjacent to the Eastern Channel and the Intracoastal Waterway.

The PCEs essential for the conservation of wintering piping plovers are those habitat components that support foraging, roosting, and sheltering and the physical features necessary for maintaining the natural processes that support these habitat components. The PCEs include intertidal beaches and flats (between annual low tide and annual high tide) and associated dune systems and flats above annual high tide. Important components of intertidal flats include sand and/or mud flats with no or very sparse emergent vegetation. In some cases, these flats may be covered or partially covered by a mat of blue-green algae. Adjacent non-or sparsely-vegetated sand, mud, or algal flats above high tide are also important, especially for roosting piping plovers, and are PCEs of piping plover wintering habitat. Such sites may have debris, detritus (decaying organic matter), or micro-topographic relief (less than 50 cm above substrate surface) offering refuge from high winds and cold weather. Important components of the beach/dune ecosystem include surf-cast algae, sparsely vegetated backbeach and salterns (beach area above mean high tide seaward of the permanent dune line, or in cases where no dunes exist, seaward of a delineating feature such as a vegetation line, structure, or road), spits, and washover areas. Washover areas are broad, unvegetated zones, with little or no topographic relief, that are formed and maintained by the action of hurricanes, storm surge, or other extreme wave action.

Critical habitat does not include existing developed sites consisting of buildings, marinas, paved areas, boat ramps, exposed oil and gas pipelines and similar structures. Only those areas containing these PCEs within the designated boundaries are considered critical habitat.

2) Life history

The piping plover is a small, pale sand-colored shorebird, about seven inches long with a wingspan of about 15 inches (Palmer 1967). 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. Plovers are known to begin breeding as early as one year of age (MacIvor 1990; Haig 1992); however, the percentage of birds that breed in their first adult year is unknown. 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 2009).

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 2009);
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).

North Carolina is one of the only states in which piping plovers may be found year-round. 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 five 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.

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). 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. 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). Studies have shown that the relative importance of various feeding habitat types may vary by site (Gibbs 1986; Coutu et al. 1990; McConnaughey et al. 1990; Loegering 1992; Goldin 1993; Hoopes 1993). 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).

Piping plovers exhibit a high degree of intra- and interannual wintering site fidelity (Nicholls and Baldassarre 1990; Drake et al. 2001; Noel and Chandler 2008; Stucker and Cuthbert 2006). 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.

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. 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). 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. Both sexes incubate the eggs which hatch within 30 days, and both sexes feed the young until they can fly. The fledgling period, the time between the hatching of the chicks and the point at which they can fly, generally lasts 25 to 35 days.

Atlantic Coast and Florida studies highlighted the importance of inlets for nonbreeding and breeding piping plovers. Almost 90 percent of roosting piping plovers at ten coastal sites in southwest Florida were on inlet shorelines (Lott et al. 2009b). Piping plovers were among seven shorebird species found more often than expected ($p = 0.0004$; Wilcoxon Test Scores) at inlet locations versus non-inlet locations in an evaluation of 361 International Shorebird Survey sites from North Carolina to Florida (Harrington 2008).

3) Population dynamics

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). The census is the largest known, complete avian species census. It is designed to determine species abundance and distribution throughout its annual cycle. 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 2011 International Piping Plover Census (IPPC) surveys documented 43 wintering piping plovers at 36 sites along approximately 405 km of North Carolina shoreline, and 59 breeding plovers (Elliott-Smith et al. 2015). Midwinter surveys may 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 (National Park Service 2007), where none were seen during the January 2006 International Piping Plover Winter Census (Elliott-Smith et al. 2009). Local movements of non-breeding piping plovers and number of surveyor visits to the site may also affect abundance estimates (Maddock et al. 2009; Cohen 2009).

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) 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, other studies suggest that survivability is good at wintering sites (Drake et al. 2001). Please see the Piping Plover 5-Year Review: Summary and Evaluation for additional information on survival rates at wintering habitats (USFWS 2009).

The 3,973 piping plover individuals tallied during the 2011 winter census account for 69 percent of the known breeding birds recorded during that year's breeding census (Ferland and Haig 2002). About 89 percent of birds that are known to winter in the U.S. do so along the Gulf Coast (Texas to Florida), while 8 percent winter along the Atlantic Coast (North Carolina to Florida). The status of piping plovers on winter and migration grounds is difficult to assess, but threats to piping plover habitat used during winter and migration identified by the Service during its designation of critical habitat continue to affect the species. Unregulated motorized and pedestrian recreational use, inlet and shoreline stabilization projects, beach maintenance and nourishment, and pollution affect most winter and migration areas. Conservation efforts at some locations have likely resulted in the enhancement of wintering habitat.

Northern Great Plains Population

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 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. Plovers do nest on shorelines of reservoirs created by the dams, but reproductive success is often low and reservoir habitat is not available in many years due to high water levels or vegetation. Dams operated with steady constant flows allow vegetation to grow on potential nesting islands, making these sites unsuitable for nesting. Population declines in alkali wetlands are attributed to wetland drainage, contaminants, and predation.

The Northern Great Plains population is geographically widespread, with many birds in very remote places, especially in the U.S. and Canadian alkali lakes. Thus, determining the number of birds or even identifying a clear trend in the population is a difficult task. The IPPC was designed, in part, to help deal with this problem by instigating a large effort every five years in which an attempt is made to survey every area with known or potential piping plover breeding habitat during a two-week window (i.e., the first two weeks of June). The relatively short window is designed to minimize double counting if birds move from one area to another. As a major criterion for delisting, the 1988 recovery plan (and the 2006 Canadian Recovery Plan (Environment Canada 2006)) uses the numbers from the IPPC.

Participation in the IPPC has been excellent on the Northern Great Plains, with a tremendous effort put forth to attempt to survey areas during the census window (Elliot-Smith et al. 2009). The large area to be surveyed and sparse human population in the Northern Great Plains make annual surveys of the entire area impractical, so the IPPC provides an appropriate tool for helping to determine the population trend. Many areas are only surveyed during the IPPC years. **Figure 3** shows the number of adult plovers in the Northern Great Plains (U.S. and Canada) for all five IPPCs. The IPPC shows that the U.S. population decreased between 1991 and 1996, then increased in 2001 and 2006. Combined with the numbers from Canada, the IPPC numbers suggest that the population declined from 1991 through 2001, then increased almost 58% between 2001 and 2006 (Elliott-Smith et al. 2009). 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). It is unknown if the decrease in counts is an accurate accounting of the piping plover population numbers, or if birds were not counted due to displacement from flooding in the region that made traditional habitat unsuitable.

The increase in 2006 is likely due in large part to a multi-year drought across much of the region starting in 2001 that exposed thousands of acres of nesting habitat. The Corps ran low flows on the riverine stretches of the Missouri River for most of the years between censuses; allowing more habitat to be exposed and resulting in relatively high fledge ratios (USACE 2008). The Corps also began to construct habitat using mechanical means (dredging sand from the riverbed) on the Missouri River in 2004, providing some new nesting and foraging habitat. The drought also caused reservoir levels to drop on many reservoirs throughout the Northern Great Plains (e.g. Missouri River Reservoirs (ND, SD), Lake McConnaughey (NE)), providing shoreline habitat. The population increase may also be partially due to more intensive management activities on the alkali lakes, with increased management actions to improve habitat and reduce predation pressures. In 2011, the count was much lower, perhaps due to extreme flooding of nesting habitat.

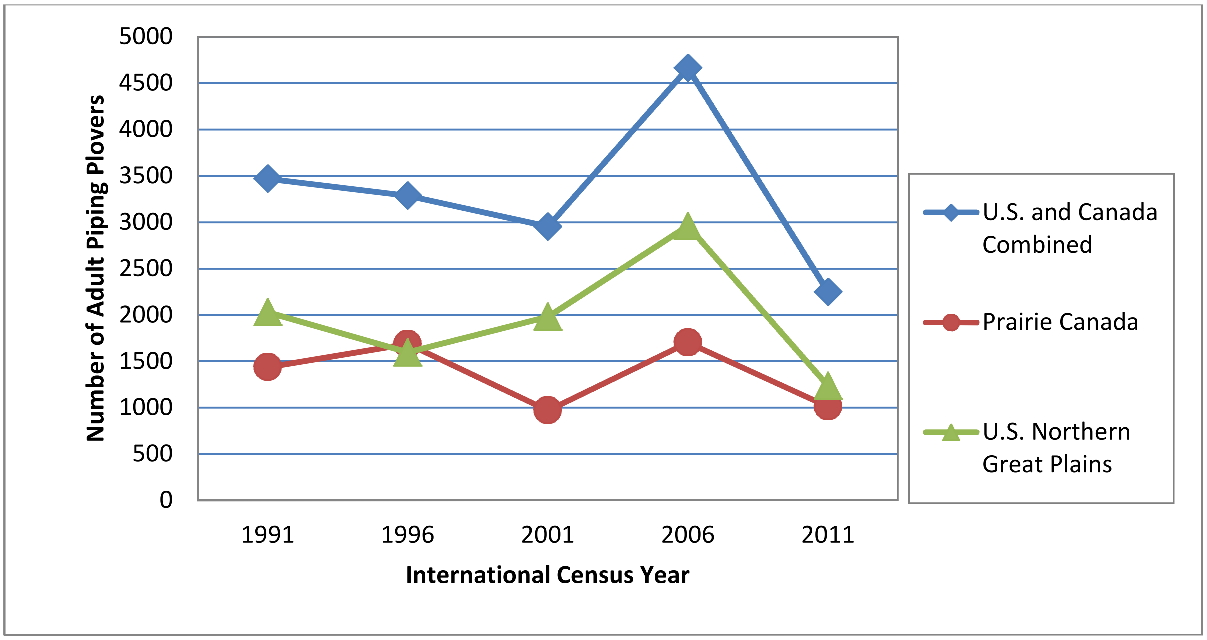

Figure 3. The number of adults reported for the U.S. and Canada Northern Great Plains during the International Censuses from 1991 to 2011. Data from Elliott-Smith et al. 2009, Elliott-Smith et al. 2015, Ferland and Haig 2002, Haig and Plissner 1993, Plissner and Haig 2000.

While the IPPC provides an index to the piping plover population, the design does not always provide sufficient information to understand the population's dynamics. The five-year time interval between IPPC efforts may be too long to allow managers to get a clear picture of what the short-term population trends are and to respond accordingly if needed. As noted above, the first three IPPCs (1991, 1996, and 2001) showed a declining population, while the fourth (2006) indicated a dramatic population rebound of almost 58% for the combined U.S. and Canada Northern Great Plains population between 2001 and 2006. The results for 2011 indicate a similar grand population total as 2006, but a declining population in the U.S. The larger overall population total in 2011 can be attributed to the larger numbers of plovers observed in the Bahamas. With only five data points over 20 years, it is impossible to determine if and to what extent the data reflects a real population trend versus error(s) in the 2011 census counts and/or a previous IPPC. The 2006 IPPC included a detectability component, in which a number of pre-selected sites were visited twice by the same observer(s) during the two-week window to get an estimate of error rate. This study found an approximately 76% detectability rate through the entire breeding area, with a range of between 39% to 78% detectability among habitat types in the Northern Great Plains.

Great Lakes 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 piping plover 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 2013 (**Figure 4**) (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). Monitoring efforts in years since have documented mostly increases with a few years of decreases. The Great Lakes annual monitoring program is an intensive survey effort with nearly daily monitoring of active breeding locations. The differences in the counts of breeding pairs between 2009 and 2013 may be due to weather conditions or movement patterns of the birds, but the reason for declines in the number of breeding pairs during those years is not known (Elliott-Smith et al. 2015).

A single breeding pair discovered in 2007 in the Great Lakes region of Canada represented the first confirmed piping plover nest there in over 30 years. The number of nesting pairs in Canada increased to four in 2008, and to six in 2011.

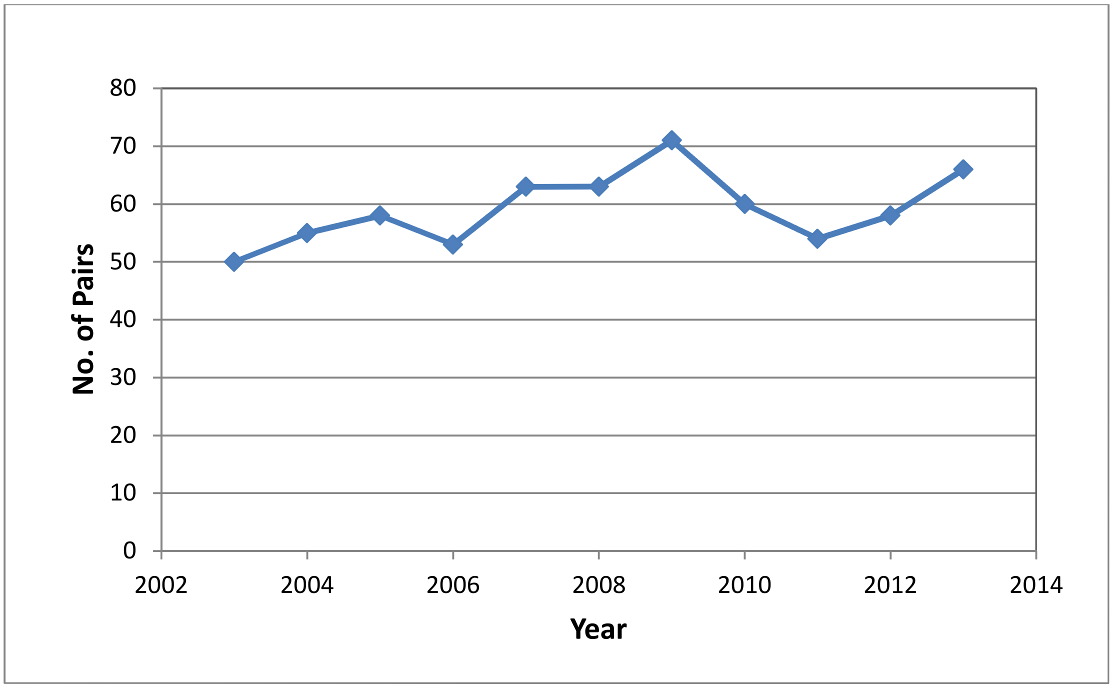

Figure 4. Annual Breeding Pair Estimates for Great Lakes Piping Plovers (2003-2013). Data from Cuthbert and Saunders 2013.

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). Available data suggest that the most recent population decline began in the late 1940s or early 1950s (Haig and Oring 1985). Reports of local or statewide declines between 1950 and 1985 are numerous, and many are summarized by Cairns and McLaren (1980) and Haig and Oring (1985). While Wilcox (1939) estimated more than 500 pairs of piping plovers on Long Island, New York, the 1989 population estimate was 191 pairs (see Table 4, USFWS 1996a). There was little focus on gathering quantitative data on piping plovers in Massachusetts through the late 1960s because the species was commonly observed and presumed to be secure. However, numbers of piping plover breeding pairs declined 50 to 100 percent at seven Massachusetts sites between the early 1970s and 1984 (Griffin and Melvin 1984). Piping plover surveys in the early years of the recovery effort found that counts of these cryptically-colored birds sometimes went up with increased census effort, suggesting that some historic counts of piping plovers by one or a few observers may have underestimated the piping plover population. Thus, the magnitude of the species decline may have been more severe than available numbers imply.

Annual estimates of breeding pairs of Atlantic Coast piping plovers are based on multiple surveys at most occupied sites. Sites that cannot be monitored repeatedly in May and June (primarily sites with few pairs or inconsistent occupancy) are surveyed at least once during a standard nine-day count period (Hecht and Melvin 2009). See **Table 5** for data from the International Piping Plover Breeding Surveys.

Table 5. Number of Breeding Pairs from the 1991, 1996, 2001, 2006, and 2011 International Piping Plover Breeding 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**
Maine	18	57	48	34	33
New Hampshire	not surveyed	ns	7	3	4
Massachusetts	148	437	481	465	630
Rhode Island	22	45	46	63	86
Connecticut	30	20	23	36	26
New York	181	256	309	422	318
New Jersey	122	103	109	84	97
Delaware	5	4	5	9	8
Maryland	16	50	28	64	36
Virginia	131	72	106	157	179
North Carolina	***30***	***34***	***21***	***41***	***59***
U.S. Total	**702**	**1,078**	**2,111**	**2,640**	**1,931**
Canada	236	189	632	872	459
France	2	3	4	4	1
GRAND TOTAL	**938**	**1,270**	**2,747**	**3,516**	**2,391**

Since its 1986 listing under the ESA, the Atlantic Coast population estimate increased from approximately 790 pairs to an estimated 2,391 pairs in 2011, and the U.S. portion of the population more than tripled, from approximately 550 pairs to an estimated 1,931 pairs (Hecht and Melvin 2009, Elliott-Smith et al. 2015). Even discounting apparent increases in New York, New Jersey, and North Carolina between 1986 and 1989, which likely were due in part to increased census effort (USFWS 1996a), the population nearly doubled between 1989 and 2008. The overall population growth pattern was tempered by periodic rapid declines in the Southern and Eastern Canada Recovery Units. The eastern Canada population decreased 21% in just three years (2002-2005), and the population in the southern half of the Southern Recovery Unit declined 68% in seven years (1995-2001). The 64% decline in the Maine population, from 66 pairs in 2002 to 24 pairs in 2008, following only a few years of decreased productivity, provides another example of the continuing risk of rapid and precipitous reversals in population growth (Hecht and Melvin 2009).

4) Status and distribution

Reason for Listing: 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. These factors include development and shoreline stabilization. The 1985 final rule stated the number of piping plovers on the Gulf of Mexico coastal wintering grounds might be declining as indicated by preliminary analysis of the Christmas Bird Count data. Independent counts of piping plovers on the Alabama coast indicated a decline in numbers between the 1950s and early 1980s. At the time of listing, the Texas Parks and Wildlife Department stated 30 percent of wintering habitat in Texas had been lost over the previous 20 years. 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.

Range-wide Trend: Five range-wide population surveys have been conducted for the piping plover; the 1991 (Haig and Plissner 1992), 1996 (Plissner and Haig 1997), 2001, 2006 (Elliott-Smith et al. 2009), and 2011 IPPCs. These surveys were completed to help determine the species distribution and to monitor progress toward recovery. Data from these surveys were provided in the previous pages.

Recovery Criteria

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

Northern Great Plains 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).

Great Lakes Population (USFWS 2003)

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 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.

Breeding Range

Northern Great Plains Population

The IPPC numbers indicate that the Northern Great Plains 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 numeric, distributional, or temporal elements of the population recovery criteria achieved.

As the Missouri River basin emerged from drought and breeding habitat was inundated in subsequent years after 2006, the population declined (See **Figure 3**). The management activities carried out in many areas during drought conditions undoubtedly helped to maintain and increase the piping plover population, especially to mitigate for otherwise poor reproductive success during wet years when habitat is limited.

While the population increase seen between 2001 and 2006 demonstrates the possibility that the population can rebound from low population numbers, ongoing efforts are needed to maintain and increase the population. In the U.S., piping plover crews attempt to locate most piping plover nests and take steps to improve their success. This work has suffered from insufficient and unstable funding in most areas.

Emerging threats, such as energy development (particularly wind, oil and gas and associated infrastructure) and climate change are likely to impact piping plovers both on the breeding and wintering grounds. The potential impact of both of these threats is not well understood, and measures to mitigate for them are also uncertain at this time.

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

Great Lakes Population

The population has shown significant growth, from approximately 17 pairs at the time of listing in 1986, to 66 pairs in 2013. The total of 66 breeding pairs represents approximately 44% of the current recovery goal of 150 breeding pairs for the Great Lakes 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 been 1.76, well above the 1.5 fledglings per breeding pair recovery goal. A 2010 analysis of banded piping plovers in the Great Lakes, however, suggests that after-hatch year (adult) survival rates may be declining (Roche et al. 2010). Continued population growth will require the long-term maintenance of productivity goals concurrent with measures to sustain or improve important vital rates.

Several years of population growth is evidence of the effectiveness of the ongoing Great Lakes piping plover recovery program. Most major threats, however, including habitat degradation, predation, and human disturbance remain persistent and pervasive. Severe threats from human disturbance and predation remain ubiquitous within the Great Lakes. 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 partners. Because threats to Great Lakes piping plovers persist, reversal of gains in abundance and productivity are expected to quickly follow if current protection efforts are reduced.

Emerging potential threats to piping plovers in the Great Lakes basin include disease, wind turbine generators and, potentially, climate change. Type-E botulism in the Northern Lake Michigan basin has resulted in several piping plover mortalities since 2000 (USFWS 2013c). Future outbreaks in areas that support a concentration of breeding piping plovers could impact survival rates and population abundance. Wind turbine projects, many of which are currently in the planning stages, need further study to determine potential risks to piping plovers and/or their habitat, as well as the need for specific protections to prevent or mitigate impacts. Climate change projections for the Great Lakes include the potential for significant water-level decreases. The degree to which this factor will impact piping plover habitat is unknown, but prolonged water-level decreases are likely to alter habitat condition and distribution.

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

Atlantic Coast Population

Substantial population growth, from approximately 790 pairs in 1986 to an estimated 2,391 pairs in 2011, has decreased the Atlantic Coast piping plover's vulnerability to extinction since ESA listing (**Table 5**). Thus, considerable progress has been made towards the overall goal of 2,000 breeding pairs articulated in recovery criterion 1. As discussed in the 1996 revised recovery plan, 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. Although the New England Recovery Unit has sustained its subpopulation target for the requisite five years, and the New York-New Jersey Recovery Unit reached its target in 2007 (but dipped below again in 2008), considerable additional growth is needed in the Southern and Eastern Canada Recovery Units (recovery criterion 1).
Productivity goals (criterion 3) specified in the 1996 recovery plan must be revised to accommodate new information about latitudinal variation in productivity needed to maintain a stationary population. Population growth, particularly in the three U.S. recovery units, provides indirect evidence that adequate productivity has occurred in at least some years. However, overall security of a 2,000 pair population will require long-term maintenance of these revised recovery-unit-specific productivity goals concurrent with population numbers at or above abundance goals.

Twenty years of relatively steady population growth, driven by productivity gains, also evidences the efficacy of the ongoing Atlantic Coast piping plover recovery program. However, all of the major threats (habitat loss and degradation, predation, human disturbance, and inadequacy of other (non-ESA) regulatory mechanisms) identified in the 1986 ESA listing and 1996 revised recovery plan remain persistent and pervasive. Severe threats from human disturbance and predation remain ubiquitous 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 persist (and in many cases have increased since listing), reversal of gains in abundance and productivity would quickly follow diminishment of current protection efforts.

Finally, two emerging potential threats, wind turbine generators and climate change (especially sea-level rise) are likely to affect Atlantic Coast piping plovers throughout their life cycle. These two threats must be evaluated to ascertain their effects on piping plovers and/or their habitat, as well as the need for specific protections to prevent or mitigate impacts that could otherwise increase overall risks to the species.

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 (and, to a lesser extent, the New York-New Jersey) Recovery Units (USFWS 2009). Furthermore, the factors that led to the piping plover's 1986 listing remain operative rangewide (including in New England), and many of these threats have increased. Interruption of costly, labor-intensive efforts to manage these threats would quickly lead to steep population declines.

Nonbreeding 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. Migration stopovers by banded piping plovers from the Great Lakes have been documented in New Jersey, Maryland, Virginia, and North Carolina (Stucker and Cuthbert 2006). Migrating breeders from eastern Canada have been observed in Massachusetts, New Jersey, New York, and North Carolina (Amirault et al. 2005). As many as 85 staging piping plovers have been tallied at various sites in the Atlantic breeding range (Perkins 2008 pers. communication), but the composition (e.g., adults that nested nearby and their fledged young of the year versus migrants moving to or from sites farther north), stopover duration, and local movements are unknown. In general, distance between stopover locations and duration of stopovers throughout the coastal migration range remains poorly understood.

Review of published records of piping plover sightings throughout North America by Pompei and Cuthbert (2004) found more than 3,400 fall and spring stopover records at 1,196 sites. Published reports indicated that piping plovers do not concentrate in large numbers at inland sites and that they seem to stop opportunistically. In most cases, reports of birds at inland sites were single individuals.

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 (Nicholls and Baldassarre 1990; Drake et al. 2001; Noel et al. 2005; Stucker and Cuthbert 2006). 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). 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).

Gratto-Trevor et al. (2009) found strong patterns (but no exclusive partitioning) in winter distribution of uniquely banded piping plovers from four breeding populations (**Figure 5**). All eastern Canada and 94% of Great Lakes birds wintered from North Carolina to southwest Florida. However, eastern Canada birds were more heavily concentrated in North Carolina, and a larger proportion of Great Lakes piping plovers were found in South Carolina and Georgia. Northern Great Plains populations were primarily seen farther west and south, especially on the Texas Gulf Coast. Although the great majority of Prairie Canada individuals were observed in

Texas, particularly southern Texas, individuals from the U.S. Great Plains were more widely distributed on the Gulf Coast from Florida to Texas.

The findings of Gratto-Trevor et al. (2009) provide evidence of differences in the wintering distribution of piping plovers from these four breeding areas. However, the distribution of birds by breeding origin during migration remains largely unknown. Until recently, the wintering locations of the U.S. Atlantic Coast breeding population was relatively unknown, as was the breeding origin of piping plovers wintering on Caribbean islands. A 2010 banding effort in the Bahamas, led by Dr. Cheri Trevor-Gratto, indicated that the majority of piping plovers wintering in the Bahamas are from the Atlantic breeding population (AFWA 2015). A 2014/2015 winter census effort on five Bahamian islands located 657 piping plovers, 31 of which had bands identifying them as members of the U.S. or Canadian breeding population. Research efforts indicate that around half of the Atlantic population of the endangered piping plovers winter across the Bahamas for up to ten months each year. The majority (25%) of the plovers are in just three locations – Andros Island, Joulter Cays and the Berry Islands (AFWA 2015). In September 2015, the Bahamian government established the 113,920-acre Joulter Cays National Park. This large group of uninhabited islands and intertidal sand flats will continue to provide important wintering habitat for piping plovers, red knots, and other shorebirds (Audubon 2015; BNT 2015).

Five rangewide mid-winter (late January to early February) IPPCs, conducted at five-year intervals starting in 1991, are summarized in **Table 6**. 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.

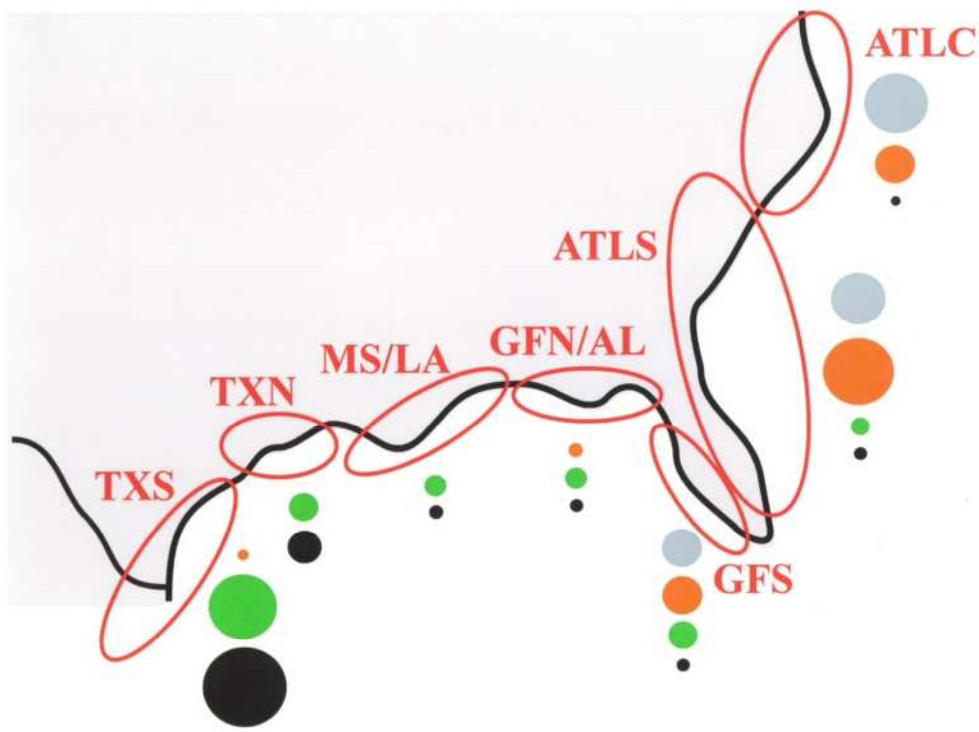

Figure 5. (from Gratto-Trevor et al. 2009, reproduced by permission). Breeding population distribution in the wintering/migration range. Regions: ATLC=Atlantic (eastern) Canada; ATLS=Atlantic South; GFS=Gulf Coast of southern Florida; GFN=Gulf Coast of north Florida; AL=Alabama; MS/LA=Mississippi and Louisiana; TXN=northern Texas; and TXS=southern Texas. For each breeding population, circles represent the percentage of individuals reported wintering along the eastern coast of the U.S. from the central Atlantic to southern Texas/Mexico up to December 2008. Each individual was counted only once. Grey circles represent Eastern Canada birds, Orange U.S. Great Lakes, Green U.S. Great Plains, and Black Prairie Canada. The relative size of the circle represents the percentage from a specific breeding area seen in that winter region. Total number of individuals observed on the wintering grounds was 46 for Eastern Canada, 150 for the U.S. Great Lakes, 169 for the U.S. Great Plains, and 356 for Prairie Canada.

Table 6. 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%

Mid-winter 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). Even as far south as the Florida Panhandle, monthly counts at Phipps Preserve in Franklin County ranged from a mid-winter low of four piping plovers in December 2006 to peak counts of 47 in October 2006 and March 2007 (Smith 2007). Pinkston (2004) observed much heavier use of Texas Gulf Coast (ocean-facing) beaches between early September and mid-October (approximately 16 birds per mi) than during December to March (approximately two birds per mi).

Local movements of nonbreeding piping plovers may also affect abundance estimates. At Deveaux Bank, one of South Carolina's most important piping plover sites, five counts at approximately 10-day intervals between August 27 and October 7, 2006, oscillated from 28 to 14 to 29 to 18 to 26 (Maddock et al. 2009). Noel and Chandler (2008) detected banded Great Lakes piping plovers known to be wintering on their Georgia study site in 73.8 $\pm$ 8.1 % of surveys over three years.

Abundance estimates for nonbreeding piping plovers may also be affected by the number of surveyor visits to the site. Preliminary analysis of detection rates by Maddock et al. (2009) found 87% detection during the mid-winter period on core sites surveyed three times a month during fall and spring and one time per month during winter, compared with 42% detection on sites surveyed three times per year (Cohen 2009 pers. communication).

The 2004 and 2005 hurricane seasons affected a substantial amount of habitat along the Gulf Coast. Habitats such as those along Gulf Islands National Seashore have benefited from increased washover events, which created optimal habitat conditions for piping plovers. Conversely, hard shoreline structures put into place following storms throughout the species range to prevent such shoreline migration prevent habitat creation (see *Factors Affecting Species Environment within the Action Area*).

The Service is aware of the following site-specific conditions that benefit several habitats piping plover use while wintering and migrating, including critical habitat units. In Texas, one critical habitat unit was afforded greater protection due to the acquisition of adjacent upland properties by the local Audubon chapter. In another unit in Texas, vehicles were removed from a portion of the beach decreasing the likelihood of automobile disturbance to plovers. Removal of an exotic plant that threatens to invade suitable piping plover habitat is occurring in a critical habitat unit in South Florida. The Service and other government agencies remain in a contractual agreement with the USDA for predator control within limited coastal areas in the Florida panhandle, including portions of some critical habitat units. Continued removal of potential terrestrial

predators is likely to enhance survivorship of wintering and migrating piping plovers.
The status of piping plovers on winter and migration grounds is difficult to assess, but threats to piping plover habitat used during winter and migration identified by the Service during its designation of critical habitat continue to affect the species. Unregulated motorized and pedestrian recreational use, inlet and shoreline stabilization projects, beach maintenance and nourishment, and pollution affect most winter and migration areas. Conservation efforts at some locations have likely resulted in the enhancement of wintering habitat.

Threats to Piping Plovers

The three recovery plans stated that shoreline development throughout the wintering range poses a threat to all populations of piping plovers. The plans further stated 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.

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. Dredging of inlets can affect spit formation adjacent to inlets and directly remove or affect ebb and flood tidal shoal formation. Jetties, which stabilize an island, cause island widening and subsequent growth of vegetation on inlet shores. Seawalls restrict natural island movement and exacerbate erosion. As discussed in more detail below, all these efforts result in loss of piping plover habitat. Construction of these projects 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. In Florida, for example, approximately 825 mi of coastline and parallel bayside flats (unspecified amount) were present prior to the advent of high human densities and beach stabilization projects. We estimate that only about 35% of the Florida coastline continues to support natural coastal formation processes, thereby concentrating foraging and roosting opportunities for all shorebird species and forcing some individuals into suboptimal habitats. Thus, intra- and inter-specific competition most likely exacerbates threats from habitat loss and degradation.

Sand placement projects

In the wake of episodic storm events, managers of lands under public, private, and county ownership often protect coastal structures using emergency storm berms; this is frequently followed by beach nourishment or renourishment activities (nourishment projects are considered "soft" stabilization versus "hard" stabilization such as seawalls). Berm placement and beach nourishment deposit substantial amounts of sand along Gulf of Mexico and Atlantic beaches to protect local property in anticipation of preventing erosion and what otherwise will be considered natural processes of overwash and island migration (Schmitt and Haines 2003).

Past and ongoing stabilization projects fundamentally alter the naturally dynamic coastal processes that create and maintain beach strand and bayside habitats, including those habitat components that piping plovers rely upon. Although impacts may vary depending on a range of factors, stabilization projects may directly degrade or destroy piping plover roosting and foraging habitat in several ways. Front beach habitat may be used to construct an artificial berm that is densely planted in grass, which can directly 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 roosting habitats by converting vegetated areas to open sand areas. The vegetation growth caused by impeding natural overwash can also reduce the maintenance and creation of bayside intertidal feeding habitats. In addition, stabilization projects may indirectly encourage further development of coastal areas and increase the threat of disturbance.

Although benthic invertebrates are adapted to the coastal dynamics and erosion, transport, and deposition of sediments, some natural sedimentation events can cause high mortality of benthic invertebrates (Peterson 1985, Peterson and Black 1988). It is reasonable to expect that certain beach filling activities could also cause high mortality of benthic invertebrates.

At least 668 of 2,340 coastal shoreline mi (29% of beaches throughout the piping plover winter and migration range in the U.S.) are bermed, nourished, or renourished, generally for recreational purposes and to protect commercial and private infrastructure (**Table 7**). However, only approximately 54 mi or 2.31% of these impacts have occurred within critical habitat. In Louisiana, sediment placement projects are deemed environmental restoration projects by the Service, because without the sediment, many areas would erode below sea level.

Table 7. Summary of the extent of nourished beaches in piping plover wintering and migrating habitat within the conterminous U.S. From USFWS unpublished data (project files, gray literature, and field observations).

State	**Sandy beach shoreline miles available**	**Sandy beach shoreline miles nourished to date (within critical habitat units)**	**Percent of sandy beach shoreline affected (within critical habitat units)**
North Carolina	301[7]	117[5] (approximately 4.0)	39 (unknown)
South Carolina	187[1]	56 (0.6)	30 (0.32))
Georgia	100[1]	8 (0.4)	8 (0.40)
Florida	825[2]	404 (6)[6]	49 (0.72)
Alabama	53[1]	12 (2)	23 (3.77)
Mississippi	110[3]	≥6 (0)	5 (0)
Louisiana	397[1]	Unquantified (usually restoration-oriented)	Unknown
Texas	367[4]	65 (45)	18 (12.26)
Overall Total	2,340 (does not include Louisiana)	≥668 does not include Louisiana (58 in CH)	29% (≥2.47% in CH)

Data from [1]www.50states.com; [2] Clark 1993; [3]N.Winstead, Mississippi Museum of Natural Science 2008; [4] www.Surfrider.org; [5] H. Hall, USFWS, pers. comm. 2009, K. Matthews, USFWS, pers. comm. 2015; [6] partial data from Lott et al. (2009a); [7]NOAA 1975.

Inlet stabilization/relocation

Many navigable mainland or barrier island tidal inlets along the Atlantic and Gulf of Mexico coasts are stabilized with jetties, groins, or by seawalls and/or adjacent industrial or residential development. Using Google Earth© (accessed April 2009 and October 2014), Service's biologists visually estimated the number of navigable mainland or barrier island tidal inlets throughout the wintering range of the piping plover in the conterminous U.S. that have some form of hardened structure. This includes seawalls or adjacent development, which lock the inlets in place (**Table 8**).

Table 8. Number of hardened inlets by state. Asterisk (*) represents an inlet at the state line, in which case half an inlet is counted in each state.

State	Visually estimated number of navigable mainland and barrier island inlets per state	Number of hardened inlets	% of inlets affected
North Carolina	20	3.5* (+3 proposed)	17.5% (32.5%)
South Carolina	34	3.5*	10.3%
Georgia	26	2	7.7%
Florida	82	41	50%
Alabama	14	6	42.9%
Mississippi	16	7	43.8%
Louisiana	40	9	22.5%
Texas	17	10	58.8%
Overall Total	249	82 (85 with proposed)	32.9% (34.1%)

Tidal inlet relocation can cause loss and/or degradation of piping plover habitat; although less permanent than construction of hard structures, effects can persist for years. Service biologists are aware of at least seven inlet relocation projects (two in North Carolina, three in South Carolina, two in Florida), but this number likely under-represents the extent of this activity.

Sand mining/dredging

Sand mining, the practice of extracting (dredging) sand from sand bars, shoals, and inlets in the nearshore zone, is a less expensive source of sand than obtaining sand from offshore shoals for beach nourishment. Sand bars and shoals are sand sources that move onshore over time and act as natural breakwaters. Inlet dredging reduces the formation of exposed ebb and flood tidal shoals considered to be primary or optimal piping plover roosting and foraging habitat. Removing these sand sources can alter depth contours and change wave refraction as well as cause localized erosion (Hayes and Michel 2008). Exposed shoals and sandbars are also valuable to piping plovers, as they tend to receive less human recreational use (because they are only accessible by boat) and therefore provide relatively less disturbed habitats for birds. We do not have a good estimate of the amount of sand mining that occurs across the piping plover wintering range, nor do we have a good estimate of the number of inlet dredging projects that occur. Most jettied inlets need maintenance dredging, but non-hardened inlets are often dredged as well.

Groins

Groins (structures made of concrete, rip rap, wood, or metal built perpendicular to the beach in order to trap sand) are typically found on developed beaches with severe erosion. Although groins can be individual structures, they are often clustered along the shoreline. Groins can act as barriers to longshore sand transport and cause downdrift erosion (Hayes and Michel 2008), which prevents piping plover habitat creation by limiting sediment deposition and accretion. These structures are found throughout the southeastern Atlantic Coast, and although most were in place prior to the piping plover's 1986 ESA listing, installation of new groins continues to occur. In North Carolina, there are two currently existing groins, at Fort Macon in Carteret County and on Bald Head Island in New Hanover County. There are also two degraded groin/jetty structures in Dare County, adjacent to the old location of the Cape Hatteras lighthouse. Three other local governments in North Carolina are seeking authorization for terminal groins (Ocean Isle Beach, Holden Beach, and Figure 8 Island).

Seawalls and revetments

Seawalls and revetments are vertical hard 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 intertidal foraging habitat and adjacent roosting habitat. Seawalls confine the wave energy and intensify the erosion by concentrating the sediment transport processes in an increasingly narrow zone. Eventually, the beach disappears, leaving the seawall directly exposed to the full force of the waves (Williams et al 1995). 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. At four California study sites, each comprised of an unarmored segment and a segment seaward of a seawall, Dugan and Hubbard (2006) found that armored segments had narrower intertidal zones, smaller standing crops of macrophyte wrack, and lower shorebird abundance and species richness. Geotubes (long cylindrical bags made of high-strength permeable fabric and filled with sand) and sandbag revetments are softer alternatives, but act as barriers by preventing overwash. We did not find any sources that summarize the linear extent of seawall, revetment, and geotube installation projects that have occurred across the piping plover's wintering and migration habitat. 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). In 2014/2015, a sandbag revetment was constructed on over 1,800 lf of shoreline at the north end of Topsail Island. The intertidal areas and sand flats along the inlet were used as a sand source.

The inlet shoreline downdrift of the sandbag revetment has eroded significantly since installation. In 2016, the Town of North Topsail also placed a sandbag revetment above the MHWL along the downdrift beach.

Exotic/invasive vegetation

One identified threat to piping plover habitat, not described in the listing rule or recovery plans, is the spread of coastal invasive plants into suitable piping plover habitat. Like most invasive species, coastal exotic plants reproduce and spread quickly and exhibit dense growth habits, often outcompeting native plant species. If left uncontrolled, invasive plants cause a habitat shift 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.

Beach vitex (*Vitex rotundifolia*) is a woody vine introduced into the southeastern U.S. as a dune stabilization and ornamental plant (Westbrooks and Madsen 2006). It currently occupies a very small percentage of its potential range in the U.S. The species has been found on beaches in all eight coastal counties in North Carolina and three counties in South Carolina. Small populations have been found in Maryland, Virginia, Georgia, Florida and Alabama. Based on this species' tolerance for cold temperatures, it is expected to grow well in coastal environments from New Jersey to Florida, and west to Texas. Task forces formed in North and South Carolina in 2004-2005 have made great strides to remove this plant from their coasts. To date, over 800 sites in North Carolina have been treated, with an additional 100 sites in need of treatment. Similar efforts are underway in South Carolina and several hundred sites have been treated there (Suiter 2015 pers. comm.).

Unquantified amounts of crowfootgrass (*Dactyloctenium aegyptium*) grow invasively along portions of the Florida coastline. It forms thick bunches or mats that may change the vegetative structure of coastal plant communities and alter shorebird habitat. The Australian pine (*Casuarina equisetifolia*) changes the vegetative structure of the coastal community in south Florida and islands within the Bahamas. Shorebirds prefer foraging in open areas where they are able to see potential predators, and tall trees provide good perches for avian predators. Australian pines potentially impact shorebirds, including the piping plover, by reducing attractiveness of foraging habitat and/or increasing avian predation. The propensity of these exotic species to spread, and their tenacity once established, make them a persistent threat, partially countered by increasing landowner awareness and willingness to undertake eradication activities.

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Wrack removal and beach cleaning or rock-picking

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 many other shorebirds on their winter, breeding, and migration grounds. Because shorebird numbers are positively correlated with wrack cover and biomass of their invertebrate prey that feed on wrack (Tarr and Tarr 1987; Hubbard and Dugan 2003; Dugan et al. 2003), grooming will lower bird numbers (Defreo et al. 2009). There is increasing popularity in the Southeast, especially in Florida, for beach communities to carry out "beach cleaning" and "beach raking" actions. Beach cleaning occurs on private beaches, where piping plover use is not well documented, and on some municipal or county beaches that are used by piping plovers. Most wrack removal on state and federal lands is limited to post-storm cleanup and does not occur regularly.

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 and Sons 2012). However, these efforts also 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).

Predation

The 1996 Atlantic Coast Recovery Plan summarized evidence that human activities affect types, numbers, and activity patterns of some predators, thereby exacerbating natural predation on breeding piping plovers. The impact of predation on migrating or wintering piping plovers remains largely undocumented.

Recreational disturbance

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), which can lead to roost abandonment and local population declines (Burton et al. 1996). Pfister et al. (1992) implicate anthropogenic disturbance as a factor in the long-term decline of migrating shorebirds at staging areas. Disturbance, i.e., beach driving, human and pet presence that alters bird behavior, disrupts piping plovers as well as other shorebird species. Disturbance can cause shorebirds to spend less time roosting or foraging and more time in alert postures or fleeing from the disturbances (Johnson and Baldassarre 1988; Burger 1991; Burger 1994; Elliott and Teas 1996; Lafferty 2001a, 2001b; Thomas et al. 2002), which limits the local abundance of piping plovers (Zonick and Ryan 1995; Zonick 2000). 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 birds react to dogs from farther distances than people (Lafferty 2001a; 2001b; Thomas et al. 2002). Dogs off leash are more likely to flush piping plovers from farther distances than are dogs on leash; nonetheless, dogs both on and off leashes disturb piping plovers (Hoopes 1993). Pedestrians walking with dogs often go through flocks of foraging and roosting shorebirds; some even encourage their dogs to chase birds.

Beach driving and off-road vehicles can significantly degrade piping plover habitat (Wheeler 1979) or disrupt the birds' normal behavior patterns (Zonick 2000). The 1996 Atlantic Coast recovery plan cites tire ruts crushing wrack into the sand, making it unavailable as cover or as foraging substrate (Hoopes 1993; Goldin 1993). The plan also notes that the magnitude of the threat from off-road vehicles is particularly significant, because vehicles extend impacts to remote stretches of beach where human disturbance will otherwise be very slight. Godfrey et al. (1980 as cited *in* Lamont et al. 1997) postulated that vehicular traffic along the beach may compact the substrate and kill marine invertebrates that are food for the piping plover. Zonick (2000) found that the density of off-road vehicles negatively correlated with abundance of roosting piping plovers on the ocean beach. Cohen et al. (2008) found that radio-tagged 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 is allowed, and recommended controlled management experiments to determine if recreational disturbance drives roost site selection. Ninety-six percent of piping plover detections were on the south side of the inlet even though it was farther away from foraging sites (1.8 km from the sound side foraging site to the north side of the inlet versus 0.4 km from the sound side foraging site to the north side of the inlet; Cohen et al. 2008).

Based on surveys with land managers and biologists, knowledge of local site conditions, and other information, we have estimated the levels of eight types of disturbance at sites in the U.S. with wintering piping plovers. There are few areas used by wintering piping plovers that are devoid of human presence, and just under half have leashed and unleashed dog presence (Smith 2007; Lott et al. 2009b; Service unpubl. data 2009; Maddock and Bimbi unpubl. data). **Table 9** summarizes the disturbance analysis results. Data are not available on human disturbance at wintering sites in the Bahamas, other Caribbean countries, or Mexico.

Although the timing, frequency, and duration of human and dog presence throughout the wintering range are unknown, studies in Alabama and South Carolina suggest that most disturbances to piping plovers occurs during periods of warmer weather, which coincides with piping plover migration (Johnson and Baldassarre 1988; Lott et al. 2009b; Maddock et al. 2009). Smith (2007) documents varying disturbance levels throughout the nonbreeding season at northwest Florida sites.

Table 9. Percent of known piping plover winter and migration habitat locations, by state, where various types of anthropogenic disturbance have been reported.

	Percent by State							
Disturbance Type	**AL**	**FL**	**GA**	**LA**	**MS**	**NC**	**SC**	**TX**
Pedestrians	67	92	94	25	100	100	88	54
Dogs on leash	67	69	31	25	73	94	25	25
Dogs off leash	67	81	19	25	73	94	66	46
Bikes	0	19	63	25	0	0	28	19
ATVs	0	35	0	25	0	17	25	30
ORVs	0	21	0	25	0	50	31	38
Boats	33	65	100	100	0	78	63	44
Kite surfing	0	10	0	0	0	33	0	0

LeDee (2008) collected survey responses in 2007 from 35 managers (located in seven states) at sites that were designated as critical habitat for wintering piping plovers. Ownership included federal, state, and local governmental agencies and non-governmental organizations managing national wildlife refuges; national, state, county, and municipal parks; state and estuarine research reserves; state preserves; state wildlife management areas; and other types of managed lands. Of 44 reporting sites, 40 allowed public beach access year-round and four sites were closed to the public. Of the 40 sites that allow public access, 62% of site managers reported

>10,000 visitors during September-March, and 31% reported >100,000 visitors. Restrictions on visitor activities on the beach included automobiles (at 81% of sites), all-terrain vehicles (89%), and dogs during the winter season (50%). Half of the survey respondents reported funding as a primary limitation in managing piping plovers and other threatened and endangered species at their sites. Other limitations included "human resource capacity" (24%), conflicting management priorities (12%), and lack of research (3%).

Disturbance can be addressed by implementing recreational management techniques such as vehicle and pet restrictions and symbolic fencing (usually sign posts and string) of roosting and feeding habitats. In implementing conservation measures, managers need to consider a range of site-specific factors, including the extent and quality of roosting and feeding habitats and the types and intensity of recreational use patterns. In addition, educational materials such as informational signs or brochures can provide valuable information so that the public understands the need for conservation measures.

In sum, although there is some variability among states, disturbance from human beach recreation and pets poses a moderate to high and escalating threat to migrating and wintering piping plovers. Systematic review of recreation policy and beach management across the nonbreeding range will assist in better understanding cumulative impacts. Site-specific analysis and implementation of conservation measures should be a high priority at piping plover sites that have moderate or high levels of disturbance and the Service and state wildlife agencies should increase technical assistance to land managers to implement management strategies and monitor their effectiveness.

Climate Change (sea-level rise)

Over the past 100 years, the globally-averaged sea level has risen approximately 10-25 centimeters (Rahmstorf et al. 2007), a rate that is an order of magnitude greater than that seen in the past several thousand years (Douglas et al. 2001 as cited in Hopkinson et al. 2008). The IPCC suggests that by 2080 sea-level rise could convert as much as 33% of the world's coastal wetlands to open water (IPCC 2007). Although rapid changes in sea level are predicted, estimated time frames and resulting water levels vary due to the uncertainty about global temperature projections and the rate of ice sheets melting and slipping into the ocean (IPCC 2007; CCSP 2008).

Potential effects of sea-level rise on coastal beaches may vary regionally due to subsidence or uplift as well as the geological character of the coast and nearshore (CCSP 2009; Galbraith et al. 2002). In the last century, for example, sea-level rise along the U.S. Gulf Coast exceeded the global average, with averages as high as 0.32 inches per year, because those areas are subsiding

(USEPA 2014). Sediment compaction and oil and gas extraction compound tectonic subsidence (Penland and Ramsey 1990; Morton et al. 2003; Hopkinson et al. 2008). Low elevations and proximity to the coast make all nonbreeding coastal piping plover foraging and roosting habitats vulnerable to the effects of rising sea level. Sea-level rise was cited as a contributing factor in the 68% decline in tidal flats and algal mats in the Corpus Christi area (i.e., Lamar Peninsula to Encinal Peninsula) in Texas between the 1950s and 2004 (Tremblay et al. 2008). Mapping by Titus and Richman (2001) showed that more than 80% of the lowest land along the Atlantic and Gulf coasts was in Louisiana, Florida, Texas, and North Carolina, where 73.5% of all wintering piping plovers were tallied during the 2006 IPPC (Elliott-Smith et al. 2009).

Inundation of piping plover habitat by rising seas could lead to permanent loss of habitat if natural coastal dynamics are impeded by numerous structures or roads, especially if those shorelines are also armored. Without development or armoring, low undeveloped islands can migrate toward the mainland, pushed by the overwashing of sand eroding from the seaward side and being re-deposited in the bay (Scavia et al. 2002). Overwash and sand migration are impeded on developed portions of islands. Instead, as sea-level increases, the ocean-facing beach erodes and the resulting sand is deposited offshore. The buildings and the sand dunes then prevent sand from washing back toward the lagoons, and the lagoon side becomes increasingly submerged during extreme high tides (Scavia et al. 2002), diminishing both barrier beach shorebird habitat and protection for mainland developments.

Modeling for three sea-level rise scenarios (reflecting variable projections of global temperature rise) at five important U.S. shorebird staging and wintering sites predicted loss of 20-70% of current intertidal foraging habitat (Galbraith et al. 2002). These authors estimated probabilistic sea-level changes for specific sites partially based on historical rates of sea-level change (from tide gauges at or near each site); they then superimposed this on projected 50% and 5% probability of global sea-level changes by 2100 of 34 cm and 77 cm, respectively. The 50% and 5% probability sea level change projections were based on assumed global temperature increases of 2° C (50% probability) and 4.7° C (5% probability). The most severe losses were projected at sites where the coastline is unable to move inland due to steep topography or seawalls. The Galbraith et al. (2002) Gulf Coast study site, Bolivar Flats, Texas, is a designated critical habitat unit known to host high numbers of piping plovers during migration and throughout the winter; e.g., 275 individuals were tallied during the 2006 IPPC (Elliott-Smith et al. 2009). Under the 50% likelihood scenario for sea-level rise, Galbraith et al. (2002) projected approximately 38% loss of intertidal flats at Bolivar Flats by 2050; however, after initially losing habitat, the area of tidal flat habitat was predicted to slightly increase by the year 2100, because Bolivar Flats lacks armoring, and the coastline at this site can thus migrate inland. Although habitat losses in some areas are likely to be offset by gains in other locations, Galbraith et al. (2002) noted that time lags may exert 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 reproductive fitness.

Table 10 displays the potential for adjacent development and/or hardened shorelines to impede response of habitat to sea-level rise in the eight states supporting wintering piping plovers. Although complete linear shoreline estimates are not readily obtainable, almost all known piping plover wintering sites in the U.S. were surveyed during the 2006 IPPC. To estimate effects at the census sites, as well as additional areas where piping plovers have been found outside of the census period, Service biologists reviewed satellite imagery and spoke with other biologists familiar with the sites. Of 406 sites, 204 (50%) have adjacent structures that may prevent the creation of new habitat if existing habitat were to become inundated. These threats will be perpetuated in places where damaged structures are repaired and replaced, and exacerbated where the height and strength of structures are increased. Data do not exist on the amount or types of hardened structures at wintering sites in the Bahamas, other Caribbean countries, or Mexico.

Table 10. Number of sites surveyed during the 2006 winter IPPC with hardened or developed structures adjacent to the shoreline.

State	Number of sites surveyed during the 2006 winter Census	Number of sites with some armoring or development	Percent of sites affected
North Carolina	37 (+2)*	20	51
South Carolina	39	18	46
Georgia	13	2	15
Florida	188	114	61
Alabama	4 (+2)*	3	50
Mississippi	16	7	44
Louisiana	25 (+2)*	9	33
Texas	78	31	40
Overall Total	406	204	50

An asterisk (*) indicates additional piping plovers sites not surveyed in the 2006 Census.

Sea-level rise poses a significant threat to all piping plover populations during the migration and wintering portion of their life cycle. Ongoing coastal stabilization activities may strongly influence the effects of sea-level rise on piping plover habitat. Improved understanding of how sea-level rise will affect the quality and quantity of habitat for migrating and wintering piping plovers is an urgent need.

Storm events

Although coastal piping plover habitats are storm-created and maintained, the 1996 Atlantic Coast Recovery Plan also noted that storms and severe cold weather may take a toll on piping plovers, and the 2003 Great Lakes Recovery Plan postulated that loss of habitats such as overwash passes or wrack, where birds shelter during harsh weather, poses a threat.

Storms are a component 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, Gulf Islands National Seashore habitats in Florida benefited from increased washover events that created optimal habitat conditions during the 2004 and 2005 hurricane seasons, with biologists reporting piping plover use of these habitats within six months of the storms (Nicholas 2005 pers. communication). Hurricane Katrina (2005) overwashed the mainland beaches of Mississippi, creating many tidal flats where piping plovers were subsequently observed (Winstead 2008). Hurricane Katrina also created a new inlet and improved habitat conditions on some areas of Dauphin Island, Alabama (LeBlanc 2009 pers. communication). Conversely, localized storms, since Katrina, have induced habitat losses on Dauphin Island (LeBlanc 2009 pers. communication).

Noel and Chandler (2005) suspect that changes in habitat caused by multiple hurricanes along the Georgia coastline altered the spatial distribution of piping plovers and may have contributed to winter mortality of three Great Lakes piping plovers. Following Hurricane Ike in 2008, Arvin (2009) reported decreased numbers of piping plovers at some heavily eroded Texas beaches in the center of the storm impact area and increases in plover numbers at sites about 100 mi to the southwest. However, piping plovers were observed later in the season using tidal lagoons and pools that Ike created behind the eroded beaches (Arvin 2009).

The adverse effects on piping plovers attributed to storms are sometimes due to a combination of storms and other environmental changes or human use patterns. For example, four hurricanes between 2002 and 2005 are often cited in reference to rapid erosion of the Chandeleur Islands, a chain of low-lying islands in Louisiana where the 1991 IPPC tallied more than 350 piping plovers. Comparison of imagery taken three years before and several days after Hurricane Katrina found that the Chandeleur Islands lost 82% of their surface area (Sallenger et al. 2009 unpublished), and a review of aerial photography prior to the 2006 Census suggested little piping plover habitat remained (Elliott-Smith et al. 2009). However, Sallenger et al. (2009 unpublished) noted that habitat changes in the Chandeleurs stem not only from the effects of these storms but rather from the combined effects of the storms, long-term (>1,000 years) diminishing sand supply, and sea-level rise relative to the land.

Other storm-induced adverse effects include post-storm acceleration of human activities such as beach nourishment, sand scraping, and berm and seawall construction. Such stabilization activities can result in the loss and degradation of feeding and resting habitats. Storms also can cause widespread deposition of debris along beaches. Removal of debris often requires large machinery, which can cause extensive disturbance and adversely affect habitat elements such as wrack. Another example of indirect adverse effects linked to a storm event is the increased access to Pelican Island (LeBlanc 2009 pers. communication) due to merging with Dauphin Island following a 2007 storm (Gibson et al. 2009).

In sum, storms can create or enhance piping plover habitat while causing localized losses elsewhere in the wintering and migration range. Available information suggests that some birds may have resiliency to storms and move to unaffected areas without harm, while other reports suggest birds may perish from storm events. Significant concerns include disturbance to piping plovers and habitats during cleanup of debris, and post-storm acceleration of shoreline stabilization activities, which can cause persistent habitat degradation and loss.

Summary of Threats

Habitat loss and degradation on winter and migration grounds from shoreline and inlet stabilization efforts, both within and outside of designated critical habitat, remain a serious threat to all piping plover populations. Modeling strongly suggests that the population viability is very sensitive to adult and juvenile survival. Therefore, while there is a great deal of effort extended to improve breeding success, to improve and maintain a higher population over time, it is also necessary to ensure that the wintering habitat, where birds spend most of their time, is secure. On the wintering grounds, the shoreline areas used by wintering piping plovers are being developed, stabilized, or otherwise altered, making it unsuitable. Even in areas where habitat conditions are appropriate, human disturbance on beaches may negatively impact piping plovers' energy budget, as they may spend more time being vigilant and less time in foraging and roosting behavior. In many cases, the disturbance is severe enough, that piping plovers appear to avoid some areas altogether. 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.

Table 11 lists biological opinions since 2014 within the Raleigh Field Office geographic area that have been issued for adverse impacts to piping plovers.

OPINIONS	HABITAT	
	Critical Habitat	**Habitat**
Fiscal Year 2014: 1 BO	n/a	12,600 lf (2.4 mi)
Fiscal Year 2015: 5 BOs	Approx. 33.49 acre, or 2,200 lf	70,268 lf (13.3 mi)
Fiscal Year 2016 (to date): 4 BOs	Approx. 6,000 lf	178,519 lf (33.8 mi)
Total: 10 BOs	Approx. 33.49 ac or approx. 8,200 lf	261,387 lf (49.5 mi)

5) Analysis of the species likely to be affected

The proposed action has the potential to adversely affect wintering and migrating piping plovers and their habitat from all breeding populations, and breeding piping plovers from the Atlantic Coast breeding population using the Action Area. The Atlantic Coast and northern Great Plains breeding populations of piping plover are listed as threatened, while the Great Lakes breeding population is listed as endangered. All wintering populations of piping plover are listed as threatened. 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. Proposed impacts to the shoreline may also result in loss or degradation of suitable nesting habitat for all shorebirds, including the piping plover.

B. Environmental Baseline

North Carolina barrier beaches are part of a complex and dynamic coastal system that continually respond to inlets, tides, waves, erosion and deposition, longshore sediment transport, and depletion, fluctuations in sea level, and weather events. The location and shape of the coastline perpetually adjusts to these physical forces. Winds move sediment across the dry beach forming dunes and the island interior landscape. The natural communities contain plants and animals that are subject to shoreline erosion and deposition, salt spray, wind, drought conditions, and sandy soils. Vegetative communities include foredunes, primary and secondary dunes, interdunal swales, sand pine scrub, and maritime forests.

During storm events, overwash across the barrier islands is common, depositing sediments on the bayside, clearing vegetation and increasing the amount of open, sandflat habitat ideal for shoreline dependent shorebirds. However, the protection or persistence of these important natural land forms, processes, and wildlife resources is often in conflict with long-term beach stabilization projects and their indirect effects, i.e., increases in residential development, infrastructure, and public recreational uses, and preclusion of overwash which limits the creation of open sand flats preferred by piping plovers.

1) Status of the species within the Action Area

In North Carolina, piping plovers may be observed during every month of the year. Nesting pairs are most likely to be seen on Cape Hatteras and Cape Lookout National Seashores, where up to 97% of the breeding individuals and breeding pairs have been recorded each year.

On Holden Beach and Oak Island, the 2006 and 2011 IPPC surveys documented no wintering piping plovers and no breeding piping plovers (Elliott-Smith et al. 2009). However, NCWRC unpublished data indicate that piping plovers have been documented on either side of the inlet during spring and summer months, including two individuals during the 2015 breeding season (Sara Schweitzer, personal communication). Entries at the ebird.org website (accessed March 11, 2016) indicate that piping plovers have been documented during spring and summer months on both Holden Beach and Oak Island sides of Lockwoods Folly Inlet. In addition, shorebird monitoring along Oak Island identified one piping plover along Lockwoods Folly Inlet in 2015 (Dawn York, personal communication).

2) Factors affecting the species environment within the Action Area

A number 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** (page 62) lists the most recent projects within the past 5 years.

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

Sand nourishment: The beaches of Holden Beach and Oak Island are regularly nourished with sand from the Lockwoods Folly Inlet. Nourishment activities widen beaches, change their sedimentology and stratigraphy, alter coastal processes and often plug dune gaps and remove overwash areas.

Inlet dredging activities alter the sediment dynamics on adjacent shorelines and stabilize these dynamic environments; beach disposal of dredge material further alters the natural habitat adjacent to inlets. Estuarine dredging of navigational channels can alter water circulation patterns and sediment transport pathways, as well as increase the frequency and magnitude of boat wakes; sound-side sand or mud flats may be impacted by increased erosion rates as a result. Historically, there has been a Federal navigation project in the Lockwoods Folly Inlet and AIWW for decades, and the Corps dredges the inlet at least annually. In some cases, the inlet is dredged using a sidecast dredge, such as the Dredge Merritt. In an unknown number of dredging events, the sediment has been placed on Holden Beach or Oak Island using pipelines.

Beach scraping or bulldozing 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 been frequent on North Carolina beaches in recent 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.

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. Geotubes (long cylindrical bags made of high-strength permeable fabric and filled with sand) 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 North Topsail Beach, and more sandbags were recently added to protect a parking lot downdrift of the revetment. Sandbags have been placed along some portions of the Action Area on Holden Beach and Oak Island.

C. Effects of the Action

This section is an analysis of the beneficial, direct and indirect effects of the proposed action on migrating, wintering, and breeding piping plovers within the Action Area. The analysis includes effects interrelated and interdependent of the project activities. An interrelated activity is an activity that is part of a proposed action and depends on the proposed activity. An interdependent activity is an activity that has no independent utility apart from the action.

1) Factors to be considered

The proposed project will occur within habitat used by migrating, wintering, and breeding piping plovers and construction will occur during a portion of the migration and winter seasons. 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 foraging areas.

Proximity of the action: Construction of the groin and sand placement activities would occur within and adjacent to foraging and roosting breeding habitats for migrating or wintering piping plovers, and potential breeding habitat.

Distribution: Project construction activities that may impact migrants and the wintering population of piping plovers, and potential breeding piping plovers would occur along the eastern end of Holden Beach and western end of Oak Island.

Timing: The timing of project construction could directly and indirectly impact migrating and wintering piping plovers. Piping plovers and red knots may be present year-round in the Action Area, however, the timing of sand placement and groin construction activities will likely occur during the migration and wintering period (July to May).

Nature of the effect: The effects of the project construction include a temporary reduction in foraging and resting habitat and nesting habitat, a long-term decreased rate of change that may preclude habitat creation, and increased recreational disturbance. 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.
Although the Service expects direct short-term effects from disturbance during project construction, it is anticipated the action will also result in direct and indirect, long term effects to piping plovers. Direct effects to piping plovers and their habitat as a result of groin and jetty repair or replacement will primarily be due to construction ingress and egress when construction is required to be conducted from land. In addition, construction materials and equipment may need to be stockpiled on the beach. Piping plover habitats would remain disturbed until the project is completed and the habitats are restored. The direct effects would be expected to be short-term in duration, until the benthic community reestablishes within the new beach profile. Indirect effects from the activity, including those related to altered sand transport systems, may continue to occur as long as the groin remains on the beach. Due to downdrift erosion, there may be loss or degradation of piping plover Critical Habitat Unit NC-16. The Service expects there may be morphological changes to piping plover habitat and critical habitat, including roosting, foraging, and nesting habitat.

Duration: Groin installation will be a one-time activity, which will take as long as six months to complete. Sand fillet maintenance will be a recurring activity and will take up to 12 weeks to complete each time. Thus, the direct effects would be expected to be short-term in duration. After each dredging event, the loss of any Critical Habitat in the intertidal shoals will not be recovered unless and until sand movement again creates shoals in the project area. Indirect effects from the activity may continue to impact migrating, wintering, and breeding plovers in subsequent seasons after sand placement. The habitat will be temporarily unavailable to wintering plovers during the construction period, and the quality of the habitat will be reduced for several months or perhaps years following project activities. The mean linear distance moved by wintering plovers from their core area is estimated to be approximately 2.1 mi (Drake et al. 2001), suggesting they could be negatively impacted by temporary disturbances anywhere in their core habitat area. Erosion and loss of habitat down-drift of the groin may increase after project completion and have long term-impacts.

Disturbance frequency: Disturbance from groin construction activities will be short-term lasting up to two years. Recreational disturbance may increase after project completion and have long term-impacts. Disturbance from maintenance of the sand fillet can be anticipated every 5 years for the life of the project.

Disturbance intensity and severity: Project construction is anticipated to be conducted during portions of the piping plover migration, winter, and nesting seasons. Conservation measures have been incorporated into the project to minimize impacts. The Action Area encompasses an area in the nesting and wintering range of the piping plover; however, the overall intensity of the disturbance is expected to be minimal. The intensity of the effect on piping plover habitat may vary depending on the frequency of the sand placement activities, the existence of staging areas, and the location of the beach access points. The severity of direct impacts is also likely to be slight, as plovers located within the Action Area are expected to move outside of the construction zone due to disturbance; therefore, no plovers are expected to be directly taken as a result of this action.

2) Analyses for effects of the action

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.

Direct effects: Direct effects are those direct or immediate effects of a project on the species or its habitat. The construction window (i.e., beach renourishment and groin installation) will extend through one or more piping plover migration and winter seasons. Since piping plovers can be present on these beaches year-round, construction is likely to occur while this species is utilizing these beaches and associated habitats. 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 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.

Burial and suffocation of invertebrate species will occur during each nourishment and renourishment cycle. Impacts from maintenance of the sand fillet will affect at least 4,000 lf of shoreline. Timeframes projected for benthic recruitment and re-establishment following beach nourishment are between 6 months to 2 years.

Maintenance dredging of shallow-draft inlets can occasionally require the removal of emergent shoals that may have formed at the location of the Federally-authorized channel from the migration of the channel over time. In these cases, the dredging activities would result in a complete take of that habitat. However, this take could be either temporary or more permanent in nature depending upon the location of future shoaling within the inlet.

Indirect effects: The proposed project includes beach renourishment and groin installation along approximately 4,000 lf of shoreline as protective elements against shoreline erosion to protect man-made infrastructure. Indirect effects include reducing the potential for the formation of optimal foraging, roosting, and nesting habitat, erosion and loss of habitat downdrift of the groin, and increasing 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 pedestrian use.

3) Species' response to a proposed action

The Service anticipates potential adverse effects throughout the Action Area by limiting proximity to roosting, foraging, and nesting habitat, degrading occupied foraging habitat, and increasing disturbance from increased recreational use.

Elliott and Teas (1996) found a significant difference in actions between piping plovers encountering pedestrians and those not encountering pedestrians. Piping plover 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.

D. Cumulative Effects

This project occurs on non-federal lands. Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the Action Area considered in this biological opinion.

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.

VI. RED KNOT

A. Status of the Species/Critical Habitat

1) Species/critical habitat description

On December 11, 2014, the Service listed the rufa red knot (*Calidris canutus rufa*) (or red knot) as threatened throughout its range (79 FR 73706). The red knot is a medium-sized shorebird about 9 to 11 inches (in) (23 to 28 centimeters (cm)) in length. 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 season (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. There is no designation of critical habitat for red knot.

2) Life history

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.

Major spring stopover areas along the Mid- and South Atlantic coast include Río Gallegos, Península Valdés, and San Antonio Oeste (Patagonia, Argentina); Lagoa do Peixe (eastern Brazil, State of Rio Grande do Sul); Maranhão (northern Brazil); the Virginia barrier islands (U.S.); and Delaware Bay (Delaware and New Jersey, U.S.) (Cohen et al. 2009; Niles et al. 2008; González 2005). Important fall stopover sites include southwest Hudson Bay (including the Nelson River delta), James Bay, the north shore of the St. Lawrence River, the Mingan Archipelago, and the Bay of Fundy in Canada; the coasts of Massachusetts and New Jersey and the mouth of the Altamaha River in Georgia, U.S.; the Caribbean (especially Puerto Rico and the Lesser Antilles); and the northern coast of South America from Brazil to Guyana (Newstead et al. 2013; Niles 2012; Niles et al. 2010; Schneider and Winn 2010; Niles et al. 2008; Antas and Nascimento 1996; Morrison and Harrington 1992; Spaans 1978). However, large and small groups of red knots, sometimes numbering in the thousands, may occur in suitable habitats all along the Atlantic and Gulf coasts from Argentina to Canada during migration (Niles et al. 2008).

Some red knots wintering in the Southeastern U.S. and the Caribbean migrate north along the U.S. Atlantic coast before flying overland to central Canada from the mid-Atlantic, while others migrate overland directly to the Arctic from the Southeastern U.S. coast (Niles et al. 2012). These eastern red knots typically make a short stop at James Bay in Canada, but may also stop briefly along the Great Lakes, perhaps in response to weather conditions (Niles et al. 2008; Morrison and Harrington 1992). Red knots are restricted to the ocean coasts during winter, and occur primarily along the coasts during migration. However, small numbers of rufa red knots are reported annually across the interior U.S. (i.e., greater than 25 mi from the Gulf or Atlantic Coasts) during spring and fall migration—these reported sightings are concentrated along the Great Lakes, but multiple reports have been made from nearly every interior State (eBird.org 2012).

Long-distance migrant shorebirds are highly dependent on the continued existence of quality habitat at a few key staging areas. These areas serve as stepping stones between wintering and breeding areas. Conditions or factors influencing shorebird populations on staging areas control much of the remainder of the annual cycle and survival of the birds (Skagen 2006; International Wader Study Group 2003). At some stages of migration, very high proportions of entire populations may use a single migration staging site to prepare for long flights. Red knots show some fidelity to particular migration staging areas between years (Duerr et al. 2011; Harrington 2001).

Habitats used by red knots in migration and wintering areas are similar in character, generally coastal marine and estuarine (partially enclosed tidal area where fresh and salt water mixes) habitats with large areas of exposed intertidal sediments. In North America, red knots are commonly found along sandy, gravel, or cobble beaches, tidal mudflats, salt marshes, shallow coastal impoundments and lagoons, and peat banks (Cohen et al. 2010; Cohen et al. 2009; Niles et al. 2008; Harrington 2001; Truitt et al. 2001). The supra-tidal (above the high tide) 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 (*Limulus polyphemus*) 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 (juveniles); *Donax* and *Darina* clams; snails (*Littorina spp*.), and other mollusks, with polychaete worms, insect larvae, and crustaceans also eaten in some locations. A prominent departure from typical prey items occurs each spring when red knots feed on the eggs of horseshoe crabs, particularly during the key migration stopover within the Delaware Bay of New Jersey and Delaware. Delaware Bay serves as the principal spring migration staging area for the red knot because of the availability of horseshoe crab eggs (Clark et al. 2009; Harrington 2001; Harrington 1996; Morrison and Harrington 1992), which provide a superabundant source of easily digestible food.

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.

3) Population dynamics

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 to 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).

For many portions of the knot's range, available survey data are patchy. Prior to the 1980s, numerous natural history accounts are available, but provide mainly qualitative or localized population estimates. No population information exists for the breeding range because, in breeding habitats, red knots are thinly distributed across a huge and remote area of the Arctic. Despite some localized survey efforts, (e.g., Niles et al. 2008), there are no regional or comprehensive estimates of breeding abundance, density, or productivity (Niles et al. 2008).

Counts in wintering areas are useful in estimating red knot populations and trends because the birds generally remain within a given wintering area for a longer period of time compared to the areas used during migration. This eliminates errors associated with turnover or double-counting that can occur during migration counts. Harrington et al. (1988) reported that the mean count of birds wintering in Florida was 6,300 birds (± 3,400, one standard deviation) based on 4 aerial surveys conducted from October to January in 1980 to 1982. Based on these surveys and other work, the Southeast wintering group was estimated at roughly 10,000 birds in the 1970s and 1980s (Harrington 2005a).

Based on resightings of birds banded in South Carolina and Georgia from 1999 to 2002, the Southeast wintering population was estimated at 11,700 ± 1,000 (standard error) red knots. Although there appears to have been a gradual shift by some of the southeastern knots from the Florida Gulf coast to the Atlantic coasts of Georgia and South Carolina, population estimates for the Southeast region in the 2000s were at about the same level as during the 1980s (Harrington 2005a). Based on recent modeling using resightings of marked birds staging in Georgia in fall, as well as other evidence, the Southeast wintering group may number as high as 20,000 (B. Harrington pers. comm. November 12, 2012), but field survey data are not available to corroborate this estimate.

Beginning in 2006, coordinated red knot surveys have been conducted from Florida to Delaware Bay during 2 consecutive days from May 20 to 24 (**Table 12**). This period is thought to represent the peak of the red knot migration. There has been variability in methods, observers, and areas covered. From 2006 to 2010, there was no change in counts that could not be attributed to varying geographic survey coverage (Dey et al. 2011); thus, we do not consider any apparent trends in these data before 2010.

Table 12. Red knot counts along the Atlantic coast of the U.S., May 20 to 24, 2006 to 2012 (A. Dey pers. comm. October 12, 2012; Dey et al. 2011).

<table>
<tr><th>State</th><th>2006</th><th>2007</th><th>2008</th><th>2009</th><th>2010</th><th>2011</th><th>2012</th></tr>
<tr><td>New Jersey</td><td>7,860</td><td>4,445</td><td>10,045</td><td rowspan="2">16,229</td><td>8,945</td><td>7,737</td><td>23,525</td></tr>
<tr><td>Delaware</td><td>820</td><td>2,950</td><td>5,350</td><td>5,530</td><td>5,067</td><td>3,433</td></tr>
<tr><td>Maryland</td><td>nr</td><td>nr</td><td>663</td><td>78</td><td>5</td><td>83</td><td>139</td></tr>
<tr><td>Virginia</td><td>5,783</td><td>5,939</td><td>7,802</td><td>3,261</td><td>8,214</td><td>6,236</td><td>8,482</td></tr>
<tr><td>North Carolina</td><td>235</td><td>304</td><td>1,137</td><td>1,466</td><td>1,113</td><td>1,868</td><td>2,832</td></tr>
<tr><td>South Carolina</td><td>nr</td><td>125</td><td>180</td><td>10</td><td>1,220</td><td>315</td><td>542</td></tr>
<tr><td>Georgia</td><td>796</td><td>2,155</td><td>1,487</td><td>nr</td><td>260</td><td>3,071</td><td>1,466</td></tr>
<tr><td>Florida</td><td>nr</td><td>nr</td><td>868</td><td>800</td><td>41</td><td>nr</td><td>10</td></tr>
<tr><td>Total</td><td>15,494</td><td>15,918</td><td>27,532</td><td>21,844</td><td>25,328</td><td>24,377</td><td>40,429</td></tr>
</table>

nr = not reported

Because red knot numbers peak earlier in the Southeast than in the mid-Atlantic (M. Bimbi pers. comm. June 27, 2013), the late-May coast-wide survey data likely reflect the movement of some birds north along the coast, and may miss other birds that depart for Canada from the Southeast along an interior (overland) route prior to the survey window. Thus, greater numbers of red knots may utilize Southeastern stopovers than suggested by the data in **Table 12**. For example, a peak count of over 8,000 red knots was documented in South Carolina during spring 2012 (South Carolina Department of Natural Resources 2012). Dinsmore et al. (1998) found a mean of 1,363 (±725) red knots in North Carolina during spring 1992 and 1993, with a peak count of 2,764 birds.

4) Status and distribution

Reason for listing: 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 (“mismatches”) in the timing of the birds’ annual migratory cycle relative to favorable food and weather conditions.

Range-Wide Trends:

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; L. Patrick pers. comm. August 31, 2012; Niles et al. 2008). Smaller numbers of knots winter in the Caribbean, and along the central Gulf coast (Alabama, Mississippi), the mid-Atlantic, and the Northeast U.S. *Calidris canutus* is also known to winter in Central America and northwest South America, but it is not yet clear if all these birds are the *rufa* subspecies.

In some years, more red knots have been counted during a coordinated spring migration survey than can be accounted for at known wintering sites, suggesting there are unknown wintering areas. Indeed, geolocators have started revealing previously little-known wintering areas, particularly in the Caribbean (Niles et al. 2012; L. Niles pers. comm. January 8, 2013).

The core of the Southeast wintering area (i.e., that portion of this large region supporting the majority of birds) is thought to shift from year to year among Florida, Georgia, and South Carolina (Niles et al. 2008). However, the geographic limits of this wintering region are poorly defined. Although only small numbers are known, wintering knots extend along the Atlantic coast as far north as Virginia (L. Patrick pers. comm. August 31, 2012; Niles et al. 2006), Maryland (Burger et al. 2012), and New Jersey (BandedBirds.org 2012; H. Hanlon pers. comm. November 22, 2012; A. Dey pers. comm. November 19, 2012). Still smaller numbers of red knots have been reported between December and February from Long Island, New York, through Massachusetts and as far north as Nova Scotia, Canada (eBird.org 2012).

Recovery Criteria

A Recovery Plan for the red knot has not yet been completed. It will be developed, pursuant to Subsection 4(f) of the ESA, in the near future.

Threats to the Red Knot

Within the nonbreeding portion of the range, red knot habitat is primarily threatened by the highly interrelated effects of sea level rise, shoreline stabilization, and coastal development. Lesser threats to nonbreeding habitat include agriculture and aquaculture, invasive vegetation, and beach maintenance activities. Within the breeding portion of the range, the primary threat to red knot habitat is from climate change. With arctic warming, vegetation conditions in the breeding grounds are expected to change, causing the zone of nesting habitat to shift and perhaps contract. Arctic freshwater systems—foraging areas for red knots during the nesting season—are particularly sensitive to climate change. For more information, please see the proposed and final rules and supplemental documents on the Internet at *http://www.regulations.gov* (Docket Number FWS–R5–ES–2013–0097).

Climate Change & Sea Level Rise

The natural history of Arctic-breeding shorebirds makes this group of species particularly vulnerable to global climate change (Meltofte et al. 2007; Piersma and Lindström 2004; Rehfisch and Crick 2003; Piersma and Baker 2000; Zöckler and Lysenko 2000; Lindström and Agrell 1999). Relatively low genetic diversity, which is thought to be a consequence of survival through past climate-driven population bottlenecks, may put shorebirds at more risk from human-induced climate variation than other avian taxa (Meltofte et al. 2007); low genetic diversity may result in reduced adaptive capacity as well as increased risks when population sizes drop to low levels.

In the short term, red knots may benefit if warmer temperatures result in fewer years of delayed horseshoe crab spawning in Delaware Bay (Smith and Michaels 2006) or fewer occurrences of late snow melt in the breeding grounds (Meltofte et al. 2007). However, there are indications that changes in the abundance and quality of red knot prey are already underway (Escudero et al. 2012; Jones et al. 2010), and prey species face ongoing climate-related threats from warmer temperatures (Jones et al. 2010; Philippart et al. 2003; Rehfisch and Crick 2003), ocean acidification (NRC 2010; Fabry et al. 2008), and possibly increased prevalence of disease and parasites (Ward and Lafferty 2004). In addition, red knots face imminent threats from loss of habitat caused by sea level rise (NRC 2010; Galbraith et al. 2002; Titus 1990), and increasing asynchronies ("mismatches") between the timing of their annual breeding, migration, and wintering cycles and the windows of peak food availability on which the birds depend (Smith et al. 2011; McGowan et al. 2011; Meltofte et al. 2007; van Gils et al. 2005a; Baker et al. 2004).

With arctic warming, vegetation conditions in the red knot's breeding grounds are expected to change, causing the zone of nesting habitat to shift and perhaps contract, but this process may take decades to unfold (Feng et al. 2012; Meltofte et al. 2007; Kaplan et al. 2003). Ecological shifts in the Arctic may appear sooner. High uncertainty exists about when and how changing interactions among vegetation, predators, competitors, prey, parasites, and pathogens may affect the red knot, but the impacts are potentially profound (Fraser et al. 2013; Schmidt et al. 2012; Meltofte et al. 2007; Ims and Fuglei 2005).

For most of the year, red knots live in or immediately adjacent to intertidal areas. These habitats are naturally dynamic, as shorelines are continually reshaped by tides, currents, wind, and storms. Coastal habitats are susceptible to both abrupt (storm-related) and long-term (sea level rise) changes. Outside of the breeding grounds, red knots rely entirely on these coastal areas to fulfill their roosting and foraging needs, making the birds vulnerable to the effects of habitat loss from rising sea levels. Because conditions in coastal habitats are also critical for building up nutrient and energy stores for the long migration to the breeding grounds, sea level rise affecting conditions on staging areas also has the potential to impact the red knot's ability to breed successfully in the Arctic (Meltofte et al. 2007).

According to the NRC (2010), the rate of global sea level rise has increased from about 0.02 in (0.6 mm) per year in the late 19th century to approximately 0.07 in (1.8 mm) per year in the last half of the 20th century. The rate of increase has accelerated, and over the past 15 years has been in excess of 0.12 in (3 mm) per year. In 2007, the IPCC estimated that sea level would "likely" rise by an additional 0.6 to 1.9 feet (ft) (0.18 to 0.59 meters (m)) by 2100 (NRC 2010). This projection was based largely on the observed rates of change in ice sheets and projected future thermal expansion of the oceans but did not include the possibility of changes in ice sheet dynamics (e.g., rates and patterns of ice sheet growth versus loss). Scientists are working to improve how ice dynamics can be resolved in climate models. Recent research suggests that sea levels could potentially rise another 2.5 to 6.5 ft (0.8 to 2 m) by 2100, which is several times larger than the 2007 IPCC estimates (NRC 2010; Pfeffer et al. 2008). However, projected rates of sea level rise estimates remain rather uncertain, due mainly to limits in scientific understanding of glacier and ice sheet dynamics (NRC 2010; Pfeffer et al. 2008). The amount of sea level change varies regionally because of different rates of settling (subsidence) or uplift of the land, and because of differences in ocean circulation (NRC 2010). In the last century, for example, sea level rise along the U.S. mid- Atlantic and Gulf coasts exceeded the global average by 5 to 6 in (13 to 15 cm) because coastal lands in these areas are subsiding (USEPA 2013). Land subsidence also occurs in some areas of the Northeast, at current rates of 0.02 to 0.04 in (0.5 to 1 mm) per year across this region (Ashton et al. 2007), primarily the result of slow, natural geologic processes (NOAA 2013). Due to regional differences, a 2-ft (0.6-m) rise in global sea level by the end of this century would result in a relative sea level rise of 2.3 ft (0.7 m) at New York City, 2.9 ft (0.9 m) at Hampton Roads, Virginia, and 3.5 ft (1.1 m) at Galveston, Texas (U.S. Global Change Research Program (USGCRP) 2009). **Table 13** shows that local rates of sea level rise in the range of the red knot over the second half of the 20th century were generally higher than the global rate of 0.07 in (1.8 mm) per year.

Table 13. Local sea level trends from within the range of the red knot (NOAA 2012)

Station	Mean Local Sea Level Trend (mm per year)	Data Period
Pointe-Au-Père, Canada	-0.36 ± 0.40	1900–1983
Woods Hole, Massachusetts	2.61 ± 0.20	1932–2006
Cape May, New Jersey	4.06 ± 0.74	1965–2006
Lewes, Delaware	3.20 ± 0.28	1919–2006
Chesapeake Bay Bridge Tunnel, Virginia	6.05 ± 1.14	1975–2006
Beaufort, North Carolina	2.57 ± 0.44	1953–2006
Clearwater Beach, Florida	2.43 ± 0.80	1973–2006
Padre Island, Texas	3.48 ± 0.75	1958–2006
Punto Deseado, Argentina	-0.06 ± 1.93	1970–2002

Data from along the U.S. Atlantic coast suggest a relationship between rates of sea level rise and long-term erosion rates; thus, long-term coastal erosion rates may increase as sea level rises (Florida Oceans and Coastal Council 2010). However, even if such a correlation is borne out, predicting the effect of sea level rise on beaches is more complex. Even if wetland or upland coastal lands are lost, sandy or muddy intertidal habitats can often migrate or reform. However, forecasting how such changes may unfold is complex and uncertain. Potential effects of sea level rise on beaches vary regionally due to subsidence or uplift of the land, as well as the geological character of the coast and nearshore (U.S. Climate Change Science Program (CCSP) 2009b; Galbraith et al. 2002). Precisely forecasting the effects of sea level rise on particular coastal habitats will require integration of diverse information on local rates of sea level rise, tidal ranges, subsurface and coastal topography, sediment accretion rates, coastal processes, and other factors that is beyond the capability of current models (CCSP 2009b; Frumhoff et al. 2007; Thieler and Hammar-Klose 2000; Thieler and Hammar-Klose 1999).

Because the majority of the Atlantic and Gulf coasts consist of sandy shores, inundation alone is unlikely to reflect the potential consequences of sea level rise. Instead, long-term shoreline changes will involve contributions from inundation and erosion, as well as changes to other coastal environments such as wetland losses. Most portions of the open coast of the U.S. will be subject to significant physical changes and erosion over the next century because the majority of coastlines consist of sandy beaches, which are highly mobile and in a state of continual change (CCSP 2009b).

By altering coastal geomorphology, sea level rise will cause significant and often dramatic changes to coastal landforms including barrier islands, beaches, and intertidal flats (CCSP 2009b; Rehfisch and Crick 2003), primary red knot habitats. Due to increasing sea levels, storm-surge-driven floods now qualifying as 100-year events are projected to occur as often as every 10 to 20 years along most of the U.S. Atlantic coast by 2050, with even higher frequencies of such large floods in certain localized areas (Tebaldi et al. 2012). Rising sea level not only increases the likelihood of coastal flooding, but also changes the template for waves and tides to sculpt the coast, which can lead to loss of land orders of magnitude greater than that from direct inundation alone (Ashton et al. 2007).

Red knot migration and wintering habitats in the U.S. generally consist of sandy beaches that are dynamic and subject to seasonal erosion and accretion. Sea level rise and shoreline erosion have reduced availability of intertidal habitat used for red knot foraging, and in some areas, roosting sites have also been affected (Niles et al. 2008). With moderately rising sea levels, red knot habitats in many portions of the U.S. would be expected to migrate or reform rather than be lost, except where they are constrained by coastal development or shoreline stabilization (Titus et al. 2009). However, if the sea rises more rapidly than the rate with which a particular coastal system can keep pace, it could fundamentally change the state of the coast (CCSP 2009b).

Climate change is also resulting in asynchronies during the annual cycle of the red knot. The successful annual migration and breeding of red knots is highly dependent on the timing of departures and arrivals to coincide with favorable food and weather conditions. The frequency and severity of asynchronies is likely to increase with climate change. In addition, stochastic encounters with unfavorable conditions are more likely to result in population-level effects for red knots now than when population sizes were larger, as reduced numbers may have reduced the resiliency of this subspecies to rebound from impacts.

For unknown reasons, more red knots arrived late in Delaware Bay in the early 2000s, which is generally accepted as a key causative factor (along with reduced supplies of horseshoe crab eggs) behind red knot population declines that were observed over this same timeframe. Thus, the red knot's sensitivity to timing asynchronies has been demonstrated through a population-level response. Both adequate supplies of horseshoe crab eggs and high-quality foraging habitat in Delaware Bay can serve to partially mitigate minor asynchronies at this key stopover site. However, the factors that caused delays in the spring migrations of red knots from Argentina and Chile are still unknown, and we have no information to indicate if this delay will reverse, persist, or intensify. Superimposed on this existing threat of late arrivals in Delaware Bay are new threats of asynchronies emerging due to climate change. Climate change is likely to affect the reproductive timing of horseshoe crabs in Delaware Bay, mollusk prey species at other stopover sites, or both, possibly pushing the peak seasonal availability of food outside of the windows when red knots rely on them. In addition, both field studies and modeling have shown strong links between the red knot's reproductive output and conditions in the Arctic including insect abundance and snow cover. Climate change may also cause shifts in the period of optimal arctic conditions relative to the time period when red knots currently breed.

Shoreline stabilization

Structural development along the shoreline and manipulation of natural inlets upset the naturally dynamic coastal processes and result in loss or degradation of beach habitat (Melvin et al. 1991). As beaches narrow, the reduced habitat can directly lower the diversity and abundance of biota (life forms), especially in the upper intertidal zone. Shorebirds may be impacted both by reduced habitat area for roosting and foraging, and by declining intertidal prey resources, as has been documented in California (Defeo et al. 2009; Dugan and Hubbard 2006). In Delaware Bay, hard structures also cause or accelerate loss of horseshoe crab spawning habitat (CCSP 2009b; Botton et al. in Shuster et al. 2003; Botton et al. 1988), and shorebird habitat has been, and may continue to be, lost where bulkheads have been built (Clark in Farrell and Martin 1997). In addition to directly eliminating red knot habitat, hard structures interfere with the creation of new shorebird habitats by interrupting the natural processes of overwash and inlet formation. Where hard stabilization is installed, the eventual loss of the beach and its associated habitats is virtually assured (Rice 2009), absent beach nourishment, which may also impact red knots. Where they are maintained, hard structures are likely to significantly increase the amount of red knot habitat lost as sea levels continue to rise.

In a few isolated locations, however, hard structures may enhance red knot habitat, or may provide artificial habitat. In Delaware Bay, for example, Botton et al. (1994) found that, in the same manner as natural shoreline discontinuities like creek mouths, jetties and other artificial obstructions can act to concentrate drifting horseshoe crab eggs and thereby attract shorebirds. Another example comes from the Delaware side of the bay, where a seawall and jetty at Mispillion Harbor protect the confluence of the Mispillion River and Cedar Creek. These structures create a low energy environment in the harbor, which seems to provide highly suitable conditions for horseshoe crab spawning over a wider variation of weather and sea conditions than anywhere else in the bay (G. Breese pers. comm. March 25, 2013). Horseshoe crab egg densities at Mispillion Harbor are consistently an order of magnitude higher than at other bay beaches (Dey et al. 2011), and this site consistently supports upwards of 15 to 20 percent of all the knots recorded in Delaware Bay (Lathrop 2005). Notwithstanding localized red knot use of artificial structures, and the isolated case of hard structures improving foraging habitat at Mispillion Harbor, the nearly universal effect of such structures is the degradation or loss of red knot habitat.

Sand Placement

Where shorebird habitat has been severely reduced or eliminated by hard stabilization structures, beach nourishment may be the only means available to replace any habitat for as long as the hard structures are maintained (Nordstrom and Mauriello 2001), although such habitat will persist only with regular nourishment episodes (typically on the order of every 2 to 6 years). In Delaware Bay, beach nourishment has been recommended to prevent loss of spawning habitat for horseshoe crabs (Kalasz 2008; Carter et al. in Guilfoyle et al. 2007; Atlantic States Marine Fisheries Commission (ASMFC) 1998), and is being pursued as a means of restoring shorebird habitat in Delaware Bay following Hurricane Sandy (Niles et al. 2013; USACE 2012). Beach nourishment was part of a 2009 project to maintain important shorebird foraging habitat at Mispillion Harbor, Delaware (Kalasz pers. comm. March 29, 2013; Siok and Wilson 2011). However, red knots may be directly disturbed if beach nourishment takes place while the birds are present. On New Jersey's Atlantic coast, beach nourishment has typically been scheduled for the fall, when red knots are present, because of various constraints at other times of year. 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 directly 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 (sparsely vegetated flats in or adjacent to intertidal areas). 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 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.

Dredging/sand mining

Many inlets in the U.S. range of the red knot are routinely dredged and sometimes relocated. In addition, nearshore areas are routinely dredged ("mined") to obtain sand for beach nourishment. Regardless of the purpose, inlet and nearshore dredging can affect red knot habitats. Dredging often involves removal of sediment from sand bars, shoals, and inlets in the nearshore zone, directly impacting optimal red knot roosting and foraging habitats (Harrington in Guilfoyle et al. 2007; Winn and Harrington in Guilfoyle et al. 2006). These ephemeral habitats are even more valuable to red knots because they tend to receive less recreational use than the main beach strand. In addition to causing this direct habitat loss, the dredging of sand bars and shoals can preclude the creation and maintenance of red knot habitats by removing sand sources that would otherwise act as natural breakwaters and weld onto the shore over time (Hayes and Michel 2008; Morton 2003). Further, removing these sand features can cause or worsen localized erosion by altering depth contours and changing wave refraction (Hayes and Michel 2008), potentially degrading other nearby red knot habitats indirectly because inlet dynamics exert a strong influence on the adjacent shorelines. Studying barrier islands in Virginia and North Carolina, Fenster and Dolan (1996) found that inlet influences extend 3.4 to 8.1 mi (5.4 to 13.0 km), and that inlets dominate shoreline changes for up to 2.7 mi (4.3 km). Changing the location of dominant channels at inlets can create profound alterations to the adjacent shoreline (Nordstrom 2000).

Reduced food availability

Commercial harvest of horseshoe crabs has been implicated as a causal factor in the decline of the rufa red knot, by decreasing the availability of horseshoe crab eggs in the Delaware Bay stopover (Niles et al. 2008). Notwithstanding the importance of the horseshoe crab and Delaware Bay, other lines of evidence suggest that the rufa red knot also faces threats to its food resources throughout its range.

During most of the year, bivalves and other mollusks are the primary prey for the red knot. Mollusks in general are at risk from climate change-induced ocean acidification (Fabry et al. 2008). Oceans become more acidic as carbon dioxide emitted into the atmosphere dissolves in the ocean. The pH (percent hydrogen, a measure of acidity or alkalinity) level of the oceans has decreased by approximately 0.1 pH units since preindustrial times, which is equivalent to a 25 percent increase in acidity. By 2100, the pH level of the oceans is projected to decrease by an additional 0.3 to 0.4 units under the highest emissions scenarios (NRC 2010). As ocean acidification increases, the availability of calcium carbonate declines. Calcium carbonate is a key building block for the shells of many marine organisms, including bivalves and other mollusks (USEPA 2012; NRC 2010). Vulnerability to ocean acidification has been shown in bivalve species similar to those favored by red knots, including mussels (Gaylord et al. 2011; Bibby et al. 2008) and clams (Green et al. 2009). Reduced calcification rates and calcium metabolism are also expected to affect several mollusks and crustaceans that inhabit sandy beaches (Defeo et al. 2009), the primary nonbreeding habitat for red knots. Relevant to Tierra del Fuego-wintering knots, bivalves have also shown vulnerability to ocean acidification in Antarctic waters, which are predicted to be affected due to naturally low carbonate saturation levels in cold waters (Cummings et al. 2011).

Blue mussel spat is an important prey item for red knots in Virginia (Karpanty et al. 2012). The southern limit of adult blue mussels has contracted from North Carolina to Delaware since 1960 due to increasing air and water temperatures (Jones et al. 2010). Larvae have continued to recruit to southern locales (including Virginia) via currents, but those recruits die early in the summer due to water and air temperatures in excess of lethal physiological limits. Failure to recolonize southern regions will occur when reproducing populations at higher latitudes are beyond dispersal distance (Jones et al. 2010). Thus, this key prey resource may soon disappear from the red knot's Virginia spring stopover habitats (Karpanty et al. 2012).

Reduced food availability at the Delaware Bay stopover site due to commercial harvest and subsequent population decline of the horseshoe crab is considered a primary causal factor in the decline of the rufa subspecies in the 2000s (Escudero et al. 2012; McGowan et al. 2011; CAFF 2010; Niles et al. 2008; COSEWIC 2007; González et al. 2006; Baker et al. 2004; Morrison et al. 2004), although other possible causes or contributing factors have been postulated (Fraser et al. 2013; Schwarzer et al. 2012; Escudero et al. 2012; Espoz et al. 2008; Niles et al. 2008). Due to harvest restrictions and other conservation actions, horseshoe crab populations showed some signs of recovery in the early 2000s, with apparent signs of red knot stabilization (survey counts, rates of weight gain) occurring a few years later. Since about 2005, however, horseshoe crab population growth has stagnated for unknown reasons. Under the current management framework (known as Adaptive Resource Management, or ARM), the present horseshoe crab harvest is not considered a threat to the red knot because harvest levels are tied to red knot populations via scientific modeling. Most data suggest that the volume of horseshoe crab eggs is currently sufficient to support the Delaware Bay's stopover population of red knots at its present size. However, because of the uncertain trajectory of horseshoe crab population growth, it is not yet known if the egg resource will continue to adequately support red knot populations over the next 5 to 10 years. In addition, implementation of the ARM could be impeded by insufficient funding for the shorebird and horseshoe crab monitoring programs that are necessary for the functioning of the ARM models. Many studies have established that red knots stopping over in Delaware Bay during spring migration achieve remarkable and important weight gains to complete their migrations to the breeding grounds by feeding almost exclusively on a superabundance of horseshoe crab eggs. A temporal correlation occurred between increased horseshoe crab harvests in the 1990s and declining red knot counts in both Delaware Bay and Tierra del Fuego by the 2000s. Other shorebird species that rely on Delaware Bay also declined over this period (Mizrahi and Peters in Tanacredi et al. 2009), although some shorebird declines began before the peak expansion of the horseshoe crab fishery (Botton et al. in Shuster et al. 2003).

Hunting

Legal and illegal sport and market hunting in the mid-Atlantic and Northeast U.S. substantially reduced red knot populations in the 1800s, and we do not know if the subspecies ever fully recovered to its former abundance or distribution. Neither legal nor illegal hunting are currently a threat to red knots in the U.S., but both occur in the Caribbean and parts of South America. Hunting pressure on red knots and other shorebirds in the northern Caribbean and on Trinidad is unknown. Hunting pressure on shorebirds in the Lesser Antilles (e.g., Barbados, Guadeloupe) is very high, but only small numbers of red knots have been documented on these islands, so past mortality may not have exceeded tens of birds per year. Red knots are no longer being targeted in Barbados or Guadeloupe, and other measures to regulate shorebird hunting on these islands are being negotiated. Much larger numbers (thousands) of red knots occur in the Guianas, where legal and illegal subsistence shorebird hunting is common. About 20 red knot mortalities have been documented in the Guianas, but total red knot hunting mortality in this region cannot be surmised. Subsistence shorebird hunting was also common in northern Brazil, but has decreased in recent decades. We have no evidence that hunting was a driving factor in red knot population declines in the 2000s, or that hunting pressure is increasing. In addition, catch limits, handling protocols, and studies on the effects of research activities on survival all indicate that overutilization for scientific purposes is not a threat to the red knot.

Threats to the red knot from overutilization for commercial, recreational, scientific, or educational purposes exist in parts of the Caribbean and South America. Specifically, legal and illegal hunting does occur. We expect mortality of individual knots from hunting to continue into the future, but at stable or decreasing levels due to the recent international attention to shorebird hunting.

Predation

In wintering and migration areas, the most common predators of red knots are peregrine falcons (*Falco peregrinus*), harriers (*Circus spp*.), accipiters (Family Accipitridae), merlins (*F. columbarius*), shorteared owls (*Asio flammeus*), and greater black-backed gulls (*Larus marinus*) (Niles et al. 2008). Other large are anecdotally known to prey on shorebirds (Breese 2010). In migration areas like Delaware Bay, terrestrial predators such as red foxes (*Vulpes vulpes*) and feral cats (*Felis catus*) may be a threat to red knots by causing disturbance, but direct mortality from these predators may be low (Niles et al. 2008).

Although little information is available from the breeding grounds, the long-tailed jaeger (*Stercorarius longicaudus*) is prominently mentioned as a predator of red knot chicks in most accounts. Other avian predators include parasitic jaeger (*S. parasiticus*), pomarine jaeger (*S. pomarinus*), herring gull and glaucous gulls, gyrfalcon (*Falcon rusticolus*), peregrine falcon, and snowy owl (*Bubo scandiacus*). Mammalian predators include arctic fox (*Alopex lagopus*) and sometimes arctic wolves (*Canis lupus arctos*) (Niles et al. 2008; COSEWIC 2007). Predation pressure on Arctic-nesting shorebird clutches varies widely regionally, interannually, and even within each nesting season, with nest losses to predators ranging from close to 0 percent to near 100 percent (Meltofte et al. 2007), depending on ecological factors. Abundance of arctic rodents, such as lemmings, is often cyclical, although less so in North America than in Eurasia. In the Arctic, 3- to 4-year lemming cycles give rise to similar cycles in the predation of shorebird nests. When lemmings are abundant, predators concentrate on the lemmings, and shorebirds breed successfully. When lemmings are in short supply, predators switch to shorebird eggs and chicks (Niles et al. 2008; COSEWIC 2007; Meltofte et al. 2007; USFWS 2003b; Blomqvist et al. 2002; Summers and Underhill 1987).

Recreational disturbance

In some wintering and stopover areas, red knots and recreational users (e.g., pedestrians, ORVs, dog walkers, boaters) are concentrated on the same beaches (Niles et al. 2008; Tarr 2008). Recreational activities affect red knots both directly and indirectly. These activities can cause habitat damage (Schlacher and Thompson 2008; Anders and Leatherman 1987), cause shorebirds to abandon otherwise preferred habitats, and negatively affect the birds' energy balances. Effects to red knots from vehicle and pedestrian disturbance can also occur during construction of shoreline stabilization projects including beach nourishment. Red knots can also be disturbed by motorized and nonmotorized boats, fishing, kite surfing, aircraft, and research activities (Niles et al. 2008; Peters and Otis, 2007; Harrington 2005b; Meyer et al. 1999; Burger 1986) and by beach raking or cleaning.

Table 14 lists biological opinions since 2014 within the Raleigh Field Office geographic area that have been issued for adverse impacts to red knots.

OPINIONS	**HABITAT**
Fiscal Year 2014: 1 BO	12,600 lf (2.4 mi)
Fiscal Year 2015: 5 BOs	70,268 lf (13.3 mi)
Fiscal Year 2016 (to date): 4 BOs	178,519 lf (33.8 mi)
Total: 10 BOs	261,387 lf (49.5 mi)

5) Analysis of the species likely to be affected

The proposed action has the potential to adversely affect wintering and migrating red knots and their habitat. Potential effects to red knots include direct loss of foraging and roosting habitat in the Action Area and in the updrift and downdrift portions of Holden Beach and Oak Island, 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.

B. Environmental Baseline

1) Status of the species within the Action Area

Data provided by the NCWRC and in the BA indicate that red knots have been observed on Holden Beach for at least a decade. See **Table 15**.

Table 15. Number of red knot observations between 2006 and 2014 on Holden Beach.

Year	**Red Knot observations**
2006	5
2011	15
2012	56
2014	Multiple groups of 10-25 or more

Data from the BA also indicate that aerial surveys observed 18 red knots on Western Long Beach on Oak Island in May 2009, while other efforts have documented additional observations in May of 2011 on Oak Island (eBird.org 2014).

2) Factors affecting the species environment within the Action Area

A number of recent and on-going beach disturbance activities have altered the proposed Action Area. **Table 4** (page 62) lists the most recent projects, within the past 5 years.

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

Sand nourishment: The beaches of Holden Beach and Oak Island are regularly nourished with sand from the Corps' Navigation project in the AIWW. Nourishment activities widen beaches, change their sedimentology and stratigraphy, alter coastal processes and often plug dune gaps and remove overwash areas.

Inlet dredging activities alter the sediment dynamics on adjacent shorelines and stabilize these dynamic environments; beach disposal of dredge material further alters the natural habitat adjacent to inlets. Estuarine dredging of navigational channels can alter water circulation patterns and sediment transport pathways, as well as increase the frequency and magnitude of boat wakes; sound-side sand or mud flats may be impacted by increased erosion rates as a result. Historically, there has been a Federal navigation project in the Lockwoods Folly Inlet and AIWW for decades, and the Corps dredges the inlet at least annually. In some cases, the inlet is dredged using a sidecast dredge, such as the Dredge Merritt. In an unknown number of dredging events, the sediment has been placed on Holden Beach or Oak Island using pipelines.

Beach scraping or bulldozing 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 been frequent on North Carolina beaches in recent 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.

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 red knot habitat. Geotubes (long cylindrical bags made of high-strength permeable fabric and filled with sand) 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 North Topsail Beach, and more sandbags were recently added to protect a parking lot downdrift of the revetment. Sandbags have been placed along some portions of the Action Area.

C. Effects of the Action

This section is an analysis of the beneficial, direct and indirect effects of the proposed action on migrating and wintering red knots within the Action Area. The analysis includes effects interrelated and interdependent of the project activities. An interrelated activity is an activity that is part of a proposed action and depends on the proposed activity. An interdependent activity is an activity that has no independent utility apart from the action.

1) Factors to be considered

The proposed project will occur within habitat used by migrating and wintering red knots and construction will occur during a portion of the migration and winter seasons. Long-term and permanent impacts could preclude the creation of new habitat and increase recreational disturbance. Short-term and temporary impacts to red knots could result from project work disturbing roosting red knots and degrading currently occupied foraging areas.

Proximity of action: Beach renourishment and groin installation will occur within and adjacent to red knot roosting and foraging habitat.

Distribution: Project construction activities that may impact migrants and the wintering population of red knots on Holden Beach and Oak Island would occur along the shoreline on the east end of Holden Beach and the west end of Oak Island.

Timing: The timing of project construction could directly and indirectly impact migrating and wintering red knots.

Nature of the effect: The effects of the project construction include a temporary or permanent reduction in foraging habitat, a long term decreased rate of change 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.

Duration: Groin installation will be a one-time activity, which will take up to six months to complete. Sand fillet maintenance will be a recurring activity and will take up to 12 weeks to complete each time. 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 frequency: Disturbance from construction activities will be short term, lasting up to six months. Disturbance from maintenance of the sand fillet can be anticipated every 5 years for the life of the project. Recreational disturbance may increase after project completion and have long-term impacts.

Disturbance intensity and severity: Project construction is anticipated to be conducted during portions of the red knot migration and winter seasons. Conservation measures have been incorporated into the project to minimize impacts.

2) Analyses for effects of the action

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 (i.e., sand placement and groin installation) 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 fillet maintenance activity. Impacts will affect the 4,000 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 and groin installation along 4,000 lf of shoreline as protective elements against shoreline erosion to protect man-made infrastructure. Indirect effects include reducing the potential for the formation of optimal habitats (coastal marine and estuarine habitats with large areas of exposed intertidal sediments) and erosion of foraging and resting habitat downdrift of the groin.

The proposed project may limit 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, including disturbance by unleashed pets and increased pedestrian use.

3) Species' response to a proposed action

The proposed project 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. 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 groin and the sand.

D. Cumulative Effects

This project occurs on non-federal lands. Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the Action Area considered in this biological opinion.

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.

VII. SEABEACH AMARANTH

A. Status of the Species/Critical Habitat

1) Species/critical habitat description

Seabeach amaranth (*Amaranthus pumilus*) 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 on April 7, 1993 (58 FR 18035) 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 inches 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.

2) Life history

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).

3) Population dynamics

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 (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 I88 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 extent stochastic events have on long-term population trends of seabeach amaranth has not been assessed.

4) Status and distribution

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).

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 grooming, 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

Delisting of seabeach amaranth will be considered when a minimum of 75 percent of the sites with suitable habitat within at least six of the nine historically occupied States are occupied by seabeach amaranth populations for 10 consecutive years.

Table 16 lists biological opinions since 2014 within the Raleigh Field Office geographic area that have been issued for adverse impacts to seabeach amaranth.

OPINIONS	**HABITAT**
Fiscal Year 2014: 1 BO	12,600 lf (2.4 mi)
Fiscal Year 2015: 5 BOs	67,968 lf (12.9 mi)
Fiscal Year 2016 (to date): 4 BOs	118,300 lf (22.4 mi)
Total: 10 BOs	198,868 lf (37.7 mi)

5) Analysis of the species likely to be affected

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 proposed action has the potential to adversely affect seabeach amaranth within the proposed Action Area. 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 Applicant proposes to construct the groin and place sand between November 16 and April 30. However, given favorable weather, seabeach amaranth plants may persist until January. Therefore, there is still the potential for sand placement to adversely impact plants in the Action Area.

B. Environmental Baseline

1) Status of the species within the Action Area

Since 1992, seabeach amaranth surveys have been conducted on Holden Beach and Oak Island. The numbers of seabeach amaranth vary widely from year to year. On Holden Beach, the numbers vary from 1 individual in 1997 to 1,954 individuals in 2006. On Oak Island, the numbers vary from 1 individual in 2013 to 6,103 individuals in 1993. See **Table 17** for data from the Corps.

Table 17. Annual seabeach amaranth results on Holden Beach and Oak Island, NC between 1992 and 2013.

Year	Number of Seabeach Amaranth	
	Holden Beach	Oak Island
1992	21	3148
1993	52	6103
1994	239	4409
1995	59	4628
1996	99	1983
1997	1	599
1998	32	5367
1999	268	15
2000	10	9
2001	223	66
2002	702	542
2003	843	1267
2004	79	11
2005	800	174
2006	1954	462
2007	281	116
2008	574	65
2009	123	64
2010	434	1576
2011	116	16
2012	46	5
2013	108	1

2) Factors affecting the species environment within the Action Area

A number of recent and on-going beach disturbance activities have altered the proposed Action Area. **Table 4** (page 62) lists the most recent projects, within the past 5 years.

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

Sand nourishment: The beaches of Holden Beach and Oak Island are regularly nourished with sand from the Corps' Lockwoods Folly Navigation Project, along with other privately-funded beach nourishment activities.

Shoreline stabilization: Some portion of the Action Area has been stabilized with sandbags.

C. Effects of the Action

1) Factors to be considered

Proximity of action: Beach renourishment and groin installation will occur within and adjacent to seabeach amaranth habitat.

Distribution: Project construction activities that may affect seabeach amaranth plants on Holden Beach would occur along the eastern shoreline of the island.

Timing: The timing of project construction could directly and indirectly impact seabeach amaranth.

Nature of the effect: The effects of the project construction 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.

Duration: Groin installation will be a one-time activity, which will take up to six months to complete. Sand fillet maintenance will be a recurring activity and will take up to 12 weeks to complete each time. Thus, the direct effects would be expected to be short-term in duration. Indirect effects from the activity may continue to impact seabeach amaranth in subsequent seasons after sand placement.

Disturbance frequency: Disturbance from the initial construction activities will be short term, lasting up to six months. Disturbance from maintenance of the sand fillet can be anticipated every 5 years for the life of the project. Recreational disturbance may increase after project completion and have long-term impacts.

Disturbance intensity and severity: 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.

2) Analyses for effects of the action

Beneficial Effects: The placement 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 dredged sand may be compatible with seabeach amaranth provided the timing of beach disposal is appropriate, the material placed on the beach is compatible with the natural sand, and special precautions are adopted to protect existing seabeach amaranth plants. Further studies are needed to determine the best methods of beach disposal in seabeach amaranth habitat (Weakley and Bucher 1992).

Direct Effects: Groin construction and sand placement activities may bury or destroy existing plants, resulting in mortality, or bury seeds to a depth that would prevent future germination, resulting in reduced plant populations. Increased traffic from recreationists and their pets can also destroy existing plants by trampling or breaking the plants.

Indirect Effects: Future tilling of the beach may be necessary if beach compaction hinders sea turtle nesting activities. Thus, the placement of heavy machinery or associated tilling equipment on the beach may destroy or bury existing plants.

3) Species' response to a proposed action

The construction of the groin and placement of sand in the Action Area could bury existing plants if work is conducted during the growing season. Sand placement at any time of year could also bury seeds to a depth that would prevent germination.

Sand placement beaches could also have positive impacts on seabeach amaranth by creating additional habitat for the species. Although more study is needed before the long-term impacts can be accurately assessed, several populations are shown to have established themselves on beaches receiving dredged sediments, and have thrived through subsequent applications of dredged material (Weakley and Bucher 1992).

D. Cumulative Effects

This project occurs on non-federal lands. Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the Action Area considered in this biological opinion.

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.

VIII. CONCLUSION

Sea Turtles

After reviewing the current status of the nesting loggerhead sea turtle, green sea turtle, leatherback sea turtle, hawksbill sea turtle, and Kemp's ridley sea turtle, the environmental baseline for the Action Area, the effects of the proposed sand placement and groin construction, the proposed Conservation Measures, and the cumulative effects, it is the Service's biological opinion that the placement of sand and construction and presence of the groin as proposed, is not likely to jeopardize the continued existence of the loggerhead sea turtle, green sea turtle, leatherback sea turtle, hawksbill sea turtle, and Kemp's ridley sea turtle. The Service has determined that the project is not likely to destroy or adversely modify designated critical habitat for nesting loggerhead sea turtles.

The conservation of the five loggerhead recovery units in the Northwest Atlantic is essential to the recovery of the loggerhead sea turtle. Each individual recovery unit is necessary to conserve genetic and demographic robustness, or other features necessary for long-term sustainability of the entire population. Thus, maintenance of viable nesting in each recovery unit contributes to the overall population. The NRU, one of the five loggerhead recovery units in the Northwest Atlantic occurs within the Action Area. The NRU averages 5,215 nests per year (based on 1989-2008 nesting data). Of the available nesting habitat within the NRU, construction will occur and/or will likely have an effect on 4,000 lf of nesting shoreline.

Generally, green, leatherback, hawksbill, and Kemp's ridley sea turtle nesting overlaps with or occurs within the beaches where loggerhead sea turtles nest on both the Atlantic and Gulf of Mexico beaches. Thus, for green, leatherback, hawksbill, and Kemp's ridley sea turtles, dredging and sand placement activities will affect 4,000 lf of shoreline.

Long-term adverse effects to adult and hatchling sea turtles are anticipated as a result of the presence of the groin. The permanent placement of the groin is expected to affect nesting, hatching, and hatchling emerging success within that area for the life of the structure. Although a variety of factors, including some that cannot be controlled, can influence how an erosion control structure construction project will perform from an engineering perspective, measures can be implemented to minimize adverse impacts to sea turtles. Take of sea turtles will be minimized by implementation of the Reasonable and Prudent Measures, and Terms and

Conditions outlined below. These measures have been shown to help minimize adverse impacts to sea turtles.

Research has shown that the principal effect of sand placement on sea turtle reproduction is a reduction in nesting success, and this reduction is most often limited to the first year or two following project construction. Research has also shown that the impacts of a nourishment project on sea turtle nesting habitat are typically short-term because a nourished beach will be reworked by natural processes in subsequent years, and beach compaction and the frequency of escarpment formation will decline. Although a variety of factors, including some that cannot be controlled, can influence how a nourishment project will perform from an engineering perspective, measures can be implemented to minimize impacts to sea turtles.

Piping Plovers

Construction will occur and/or will likely have an effect on 4,000 lf of shoreline. After reviewing the current status of the northern Great Plains, Great Lakes, and Atlantic Coast wintering piping plover populations, 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 implementation of these actions, as proposed, is not likely to jeopardize the continued existence of the piping plover. The Service has determined that the project is not likely to destroy or adversely modify designated critical habitat for wintering piping plovers.

Red Knot

Construction will occur and/or will likely have an effect on 4,000 lf of shoreline. After reviewing the current status of the migrating and wintering red knot populations, 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 implementation of these actions, as proposed, is not likely to jeopardize the continued existence of the red knot.

Seabeach Amaranth

Construction will occur and/or will likely have an effect on 4,000 lf of shoreline. After reviewing the current status of the seabeach amaranth population, 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 implementation of these actions, as proposed, is not likely to jeopardize the continued existence of the seabeach amaranth.

INCIDENTAL TAKE STATEMENT

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

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

Sections 7(b)(4) and 7(o)(2) of the ESA generally do not apply to listed plant species. However, limited protection of listed plants from take is provided to the extent that the ESA prohibits the removal and reduction to possession of Federally listed endangered plants or the malicious damage of such plants on areas under Federal jurisdiction, or the destruction of endangered plants on non-Federal areas in violation of state law or regulation, or in the course of any violation of a State criminal trespass law.

AMOUNT OR EXTENT OF TAKE

Amount of Extent of Take – Loggerhead, Green, Leatherback, Hawksbill, and Kemp's Ridley Sea Turtles

The Service anticipates 4,000 lf of nesting beach habitat could be taken as a result of this proposed action. Take is expected to be in the form of: (1) Destruction of all nests that may be constructed and eggs that may be deposited and missed by a nest survey and nest mark and avoidance program within the boundaries of the proposed project; (2) destruction of all nests deposited during the period when a nest survey and nest mark and avoidance program is not required to be in place within the boundaries of the proposed project; (3) harassment in the form of disturbing or interfering with female turtles attempting to nest within the construction area or on adjacent beaches as a result of construction activities; (4) misdirection of nesting sea turtles or hatchling turtles on beaches within the boundaries of the proposed project or beaches adjacent to the construction area as they emerge from the nest and crawl to the water as a result of increased sand accretion due to the presence of the groin or jetty; (5) behavior modification of nesting females due to escarpment formation, resulting in false crawls or situations where they choose marginal or unsuitable nesting areas to deposit eggs; (6) destruction of nests from escarpment leveling within a nesting season when such leveling has been approved by the Service; (7) behavior modification of nesting females or hatchlings due to the presence of the groin which may act as a barrier to movement or cause disorientation of turtles while on the nesting beach; (8) physical entrapment of hatchling sea turtles on the nesting beach due to the presence of the groin; behavior modification of nesting females if they dig above a buried portion of the structure, resulting in false crawls or situations where they choose marginal or unsuitable nesting areas; and (9) obstructed or entrapped an unknown number of adult and hatchling sea turtles during ingress or egress at nesting sites.

Incidental take is anticipated for only the 4,000 lf of beach that has been identified. The Service anticipates incidental take of sea turtles will be difficult to detect for the following reasons: (1) the turtles nest primarily at night and all nests are not found because [a] natural factors, such as rainfall, wind, and tides may obscure crawls and [b] human-caused factors, such as pedestrian and vehicular traffic, may obscure crawls, and result in nests being destroyed because they were missed during a nesting survey and nest mark and avoidance program (2) the total number of hatchlings per undiscovered nest is unknown; (3) 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; (6) an unknown number of adult and hatchling sea turtles may be obstructed or entrapped during ingress or egress at nesting sites; and (7) 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 construction and presence of the groin and sand placement on suitable turtle nesting beach habitat because: (1) turtles nest within the project site; (2) the groin construction project will modify beach profile and width and increase the presence of escarpments; (3) the renourishment project will modify the incubation substrate, beach slope, and sand compaction; and (4) artificial lighting will deter and/or misdirect nesting hatchling turtles.

Amount or Extent of Take – Piping Plover and Red Knot

It is difficult for the Service to estimate the exact number of piping plovers and 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 piping plovers and red knots to find suitable foraging and roosting habitat during any given year.

The Service anticipates that directly and indirectly an unspecified amount of piping plovers and red knots along 4,000 lf of shoreline, all at some point, potentially usable by piping plovers and red knots, could be taken in the form of harm and harassment as a result of this proposed action; however, incidental take of piping plovers and 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 plovers and red knots may be carried away by waves or predators.

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

(1) piping plovers and 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 disturbance may be expected; and
(4) a temporary reduction of food base will occur.

The Service has reviewed the biological information and other information relevant to this action. The take is expected in the form of harm and harassment because of: (1) decreased fitness and survivorship of plovers and red knots due to loss and degradation of foraging and roosting habitat; (2) decreased fitness and survivorship of plovers and red knots attempting to migrate to breeding grounds due to loss and degradation of foraging and roosting habitat; and (3) decreased fitness and survivorship of piping plovers attempting to nest in the Action Area.

EFFECT OF THE TAKE

Sea Turtles

In the accompanying biological opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to the loggerhead sea turtle, green sea turtle, leatherback sea turtle, hawksbill sea turtle, and Kemp's ridley sea turtle species. The Service has determined that the proposed project will not result in destruction or adverse modification of designated critical habitat for the loggerhead sea turtle. Incidental take of nesting and hatchling sea turtles is anticipated to occur during the life of the project. Take will occur on nesting habitat on 4,000 lf of shoreline.

Piping Plovers

In the accompanying biological opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to the piping plover species. The Service has determined that the proposed project will not result in destruction or adverse modification of critical habitat for the piping plover. Incidental take of piping plovers is anticipated to occur during construction of the terminal groin and for the life of the project. Take will occur on migrating, overwintering, and nesting habitat along 4,000 lf of shoreline.

Red Knot

In the accompanying biological opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to the red knot species. Incidental take of red knots is anticipated to occur during construction of the terminal groin and for the life of the project. Take will occur on migrating and overwintering habitat along 4,000 lf of shoreline.

Seabeach Amaranth

In the accompanying biological opinion, the Service determined that the potential of the project to damage or destroy seabeach amaranth is not likely to result in jeopardy to the seabeach amaranth species. Damage or destruction of seabeach amaranth plants is anticipated to occur along approximately 4,000 feet of shoreline.

IX. REASONABLE AND PRUDENT MEASURES

The Service believes the following reasonable and prudent measures (RPMs) are necessary and appropriate to minimize take of loggerhead sea turtles, green sea turtles, leatherback sea turtles, hawksbill sea turtles, Kemp's ridley sea turtles, piping plovers, red knots, and seabeach amaranth. Unless specifically addressed below, these RPMs are applicable for the construction of the terminal groin and for any maintenance activities for the life of the permit. If the Applicant is unable to comply with the RPMs and Terms and Conditions, the Corps as the regulatory authority may inform the Service why the RPM or Term and Condition is not reasonable and prudent for the specific project or activity and request exception under the biological opinion.

RPMs – All Species

1. Prior to any construction, all derelict material or other debris must be removed from the beach.

2. Conservation Measures included in the permit application/project plans must be implemented in the proposed project. If a RPM and Term and Condition address the same requirement, the requirements of the RPM and Term and Condition take precedent over the Conservation Measure. This includes the timing of the proposed project to avoid the sea turtle nesting season, to reduce the possibility of sea turtle nest burial, crushing of eggs, or nest excavation.

3. Predator-proof trash receptacles must be installed and maintained at all beach access points used for the initial project construction and all maintenance events, to minimize the potential for attracting predators of sea turtles, piping plovers, and red knots.

4. A meeting between representatives of the Applicant's contractor, Corps, Service, NCWRC, the permitted sea turtle surveyor, bird and other species surveyors, as appropriate, must be held prior to the commencement of construction of the terminal groin.

5. In the event the terminal groin structure begins to disintegrate, all debris and structural material must be removed.

6. The Applicant or Corps must submit all reports produced pursuant to the Inlet Management Plan (referenced in the revisions to North Carolina General Statute 113A-115.1(e)(5)) to the Service's Raleigh Field Office, within 30 days of completion of each report.

7. The groin must be removed or modified if it is determined to not be effective as determined pursuant to the Inlet Management Plan listed above, or if it is determined to be causing a significant adverse impact to the beach and dune system.

8. During construction of the terminal groin, and for the life of the permit, all sand placement activities to maintain the sand fillet must be conducted within the winter work window (November 16 to April 30), unless necessitated by an emergency condition and allowed after consultation with the Service.

9. The pipeline placement must be coordinated with the Corps, the Raleigh Field Office, and the NCWRC.

RPMs – Loggerhead, Green, Leatherback, Hawksbill, and Kemp's Ridley Sea Turtle

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize take of loggerhead, green, leatherback, hawksbill, and Kemp's ridley sea turtles:

1. Beach compatible sand suitable for sea turtle nesting, successful incubation, and hatchling emergence shall be used on the project site for initial groin construction and all maintenance events.

2. No construction shall be conducted during the nesting season and hatching season from May 1 through November 15.

3. No permanent exterior lighting will be installed in association with this construction project, unless required by the U.S. Coast Guard. Temporary lighting will be allowed if safety lighting is required at any excavated trenches that must remain on the beach at night.

4. If the construction of the groin will be conducted during the period from April 15 to April 30, daily early morning surveys for early nesting sea turtles must be conducted. If the construction project will be conducted during the period from November 16 through November 30, surveys for late nesting sea turtles must be conducted. If nests are laid in

the area of construction, the nests must be marked and avoided, or the eggs relocated. Nesting surveys and nest marking within and immediately adjacent to the project area must be initiated 65 days prior to construction activities or by April 15, whichever is later.

5. Visual surveys for escarpments along the Action Area must be made following completion of the terminal groin and any sand maintenance events, and also prior to May 1 for two subsequent years (after sand is placed on the beach). Escarpment formation must be monitored and leveling must be conducted if needed to reduce the likelihood of impacting nesting and hatchling sea turtles.

6. Staging areas for earth-moving equipment must be located off the beach during the early (April 15 through April 30) and late (November 16 through November 30) portions of the nesting season. Nighttime storage of earth-moving equipment not in use must be off the beach to minimize disturbance to sea turtle nesting and hatching activities. To the maximum extent practicable, all excavations and temporary alteration of beach topography will be filled or leveled to the natural beach profile prior to 9:00 p.m. each day.

7. Sand compaction must be monitored in the area of sand placement immediately after completion of the project, after any future sand maintenance events, and also prior to May 1 for two subsequent years after sand is placed on the beach.

8. Daily sea turtle nesting surveys must be conducted by the Applicant or Corps for three nesting seasons following construction of the groin or sand maintenance events, if the groin remains on the beach. All nests from a point 3,500 feet west (updrift) of the groin (at approximately Blockade Runner Drive) to a point 1,000 feet east (downdrift) of the groin must be marked for three (3) years post-construction. These nests must be monitored daily until the end of incubation to determine whether those nests are eroded and whether the groin is a potential barrier to hatchlings moving off the beach and through the surf zone. If the groin is found to be an obstruction, the Corps will notify NCWRC and the Service immediately for remedial action.

9. A report describing the fate of the nests and hatchlings and any actions taken, must be submitted to the Service following completion of the proposed work for each year when an activity has occurred (such as sand placement).

10. A post-construction survey of all artificial lighting visible from the adjacent beach (2,000 lf west of the groin in the sand fillet) must be completed by the Applicant or Corps to

determine if sand accretion caused by the groin created an increased impact due to artificial lighting within the vicinity of the groin structures.

RPMs – Piping Plover and Red Knot

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize take of piping plovers and red knots:

1. 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.

2. A bird monitoring plan must be developed to monitor piping plovers, red knots, waterbirds, colonial waterbirds and other shorebirds in the Lockwoods Folly Inlet area during and after construction. Monitoring must be conducted for a minimum of three (3) full years past the completion of groin construction, or until the end of the shorebird nesting season (August 31) of the third year, whichever is later.

RPM – Seabeach Amaranth

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize take of seabeach amaranth:

1. Seabeach amaranth surveys must be conducted in the Action Area for a minimum of three years after completion of construction.

X. TERMS AND CONDITIONS

In order to be exempt from the prohibitions of section 9 of the ESA, the Corps must comply with the following terms and conditions, which implement the RPMs described above and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary. Unless addressed specifically below, the terms and conditions are applicable for the construction of the terminal groin and for any maintenance activities for the life of the permit.

Terms and Conditions – All Species

1. Prior to any sand placement or construction, all derelict coastal armoring geotextile material and other debris must be removed from the beach to the maximum extent possible.

2. Conservation Measures included in the permit application/project plans must be implemented in the proposed project. If a RPM and Term and Condition address the same requirement, the requirements of the RPM and Term and Condition take precedent over the Conservation Measure. This includes the timing of the proposed project to avoid the sea turtle nesting season, to reduce the possibility of sea turtle nest burial, crushing of eggs, or nest excavation.

3. Predator-proof trash receptacles must be installed and maintained during construction at all beach access points used for the project construction and sand maintenance events, to minimize the potential for attracting predators of sea turtles, piping plovers, and red knots. All contractors conducting the work must provide predator-proof trash receptacles for the construction workers. All contractors and their employees must be briefed on the importance of not littering and keeping the Action Area free of trash and debris. See **Appendix A** for examples of suitable receptacles.

4. A meeting between representatives of the contractor, the Service, NCWRC, the permitted sea turtle surveyor, bird and other species surveyors, as appropriate, must be held prior to the commencement of construction of the terminal groin. At least 10 business days advance notice must be provided prior to conducting this meeting. The meeting will provide an opportunity for explanation and/or clarification of the required measures in the BO, as well as follow-up meetings during construction.

5. In the event the structure begins to disintegrate, all debris and structural material must be removed from the nesting beach area and deposited off-site immediately upon coordination with the Service. If removal of the structure is required during the period from May 1 to November 15, no work will be initiated without prior coordination with the Corps and the Service.

6. The Applicant or Corps must submit all reports produced pursuant to the Inlet Management Plan (referenced in the revisions to North Carolina General Statute 113A-115.1(e)(5)) to the Service's Raleigh Field Office, within 30 days of completion of each report.

7. The groin must be removed or modified if it is determined to not be effective as determined by the Inlet Management Plan referred to above, or if it is determined to be causing a significant adverse impact to the beach and dune system.

8. During construction of the terminal groin, and for the life of the permit, all sand placement activities to maintain the sand fillet must be conducted within the winter work window (November 16 to April 30), unless necessitated by an emergency condition and allowed after consultation with the Service.

9. The pipeline placement must be coordinated with the Corps, the Raleigh Field Office, and the NCWRC.

Terms and Conditions – Loggerhead, Green, Leatherback, Hawksbill, and Kemp's ridley Sea Turtle

1. 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. In general, fill material that meets the requirements of the North Carolina Technical Standards for Beach Fill (15A NCAC 07H .0312) is considered compatible.

2. During the nesting season (May 1 through November 15), no construction will be allowed on the beach, and no equipment may be placed and/or stored on the beach.

3. No permanent exterior lighting will be installed in association with this construction project, unless required by the U.S. Coast Guard. Temporary lighting will be allowed if safety lighting is required at any excavated trenches that must remain on the beach at night.

4. If the construction of the groin will be conducted during the period from April 15 to April 30, daily early morning surveys for early nesting sea turtles must be conducted. If the construction project will be conducted during the period from November 16 through

November 30, surveys for late nesting sea turtles must be conducted. If nests are laid in the area of construction, the nests must be marked and avoided, or relocated. Nesting surveys and nest marking within and immediately adjacent to the project area must be initiated 65 days prior to construction activities or by April 15, whichever is later.

5. Visual surveys for escarpments along the Action Area must be made immediately after completion of construction, after sand maintenance events, 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's Raleigh Field Office.

6. Staging areas for earth-moving equipment must be located off the beach during the early (April 15 through April 30) and late (November 16 through November 30) portions of the nesting season. Nighttime storage of earth-moving equipment not in use must be off the beach to minimize disturbance to sea turtle nesting and hatching activities. To the maximum extent practicable, all excavations and temporary alteration of beach topography will be filled or leveled to the natural beach profile prior to 9:00 p.m. each day. During any periods when excavated trenches must remain on the beach at night, nighttime sea turtle monitoring by the sea turtle permit holder will be required in the project area in order to further reduce possible impacts to nesting and hatchling sea turtles. Nighttime monitors will record data on false crawls, successful nesting, and any additional activities of nesting or hatchling sea turtles in the project area.

7. Sand compaction must be monitored in the area of sand placement immediately after completion of the construction, after any sand maintenance event, and also prior to May 1 for two subsequent years after any construction or sand placement event. Out-year compaction monitoring and remediation are not required if the placed material no longer remains on the dry beach.
   a. Within 7 days of completion of sand placement and prior to any tilling, a field meeting shall be held with the Service, NCWRC, and the Corps to inspect the Action

Area for compaction, and determine whether tilling is needed.

b. If tilling is needed for nesting suitability, the area must be tilled to a depth of 36 inches.
c. All tilling activity shall be completed prior to May 1.
d. Tilling must occur landward of the wrack line and avoid all vegetated areas that are 3 square feet (sf) or greater, with a 3 sf buffer around the vegetated areas.
e. If tilling occurs during shorebird nesting season (after April 1), shorebird surveys are required prior to tilling per the Migratory Bird Treaty Act.
f. A report on the results of compaction monitoring will be submitted to the Raleigh Field Office and NCWRC prior to any tilling actions being taken. An annual summary of compaction assessments and the actions taken will be submitted to the Service, as required in REPORTING REQUIREMENTS, below.
g. This condition will be evaluated annually and may be modified if necessary to address sand compaction problems identified during the previous year.

8. Daily sea turtle nesting surveys must be conducted by the Applicant or Corps for three (3) full nesting seasons following construction if the groin structure remains in place. All nests from a point 3,500 feet west (updrift) of the groin (at approximately Blockade Runner Drive) to a point 1,000 feet east (downdrift) of the groin must be marked for three (3) years post-construction. The survey area must be divided into three segments: Updrift Zone, Project Zone, and Downdrift Zone. The parameters listed in the table below shall be recorded for each crawl encountered on a daily survey. In addition, any obstructions (natural or man-made) encountered by the turtle and the turtle's response to that obstruction must be reported. These nests must be monitored daily till the end of hatching to determine whether those nests are eroded and whether the groin is a potential barrier to hatchlings moving off the beach and through the surf zone. This information will be provided to the Raleigh Field Office pursuant to the REPORTING REQUIREMENTS section, below, and will be used to periodically assess the cumulative effects of these projects on sea turtle nesting and hatchling production and monitor suitability for nesting. If the groin is found to be an obstruction, the Corps will notify NCWRC and the Service immediately for remedial action.

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 the groin, sand bags, or scarps, should be noted.
False Crawl Type	Categorization of the stage at which nesting was abandoned	Number in each of the following categories: a) Emergence - no digging; b) Preliminary body pit; c) Abandoned egg chamber.
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 the groin, scarps, or sandbags measured in meters. Any abnormal cavity morphologies should be reported as well as whether turtle touched the groin, 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.

9. A report describing the fate of sea turtle nests and hatchlings and any actions taken, must be submitted to the Raleigh Field Office following completion of the proposed work for each year when an activity has occurred (e.g. sand placement or groin construction). Please see REPORTING REQUIREMENTS below, for more information.

10. A post construction survey(s) of all artificial lighting visible from the adjacent beach, from the groin to a point 2,000 feet west of the groin, must be completed by the Applicant or Corps. Two surveys of all lighting visible from the construction area must be conducted by the Applicant or the Corps, using standard techniques for such a survey (**Appendix B**), in the year following construction. The first survey must be conducted between May 1 and May 15 and a brief summary provided to the Raleigh Field Office.

The second survey must be conducted between July 15 and August 1. A summary report of the surveys, (include the following information: methodology of the survey, a map showing the position of the lights visible from the beach, a description of each light source visible from the beach, recommendations for remediation, and any actions taken), must be submitted to the Raleigh Field Office within 3 months after the last survey is conducted. After the annual report is completed, a meeting must be set up with the Applicant, county or municipality, NCWRC, Corps, and the Service to discuss the survey report, as well as any documented sea turtle disorientations in or adjacent to the project area.

Terms and Conditions – Piping Plover and Red Knot

1. 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 antagonizing shorebirds while allowing them to exit the area.

2. A bird monitoring plan must be developed to monitor piping plovers, red knots, waterbirds, colonial waterbirds and other shorebirds during and after construction. Monitoring must be conducted for a minimum of three (3) full years past the completion of groin construction, or until the end of the shorebird nesting season (August 31) of the third year after construction, whichever is later. Post-construction monitoring may only be ceased after the review of at least three years' worth of data and approval by the Corps, Service, NCDCM, and NCWRC.
    a. The bird monitoring plan, including methods and a figure showing the proposed locations and extent of monitoring, must be submitted for review and approval to the Corps, Service, NCDCM, and NCWRC, at least 60 days prior to the anticipated start of construction.
    b. During construction, bird monitoring must be conducted weekly. For at least three years after construction is completed, bimonthly (twice-monthly) bird surveys shall be conducted in all intertidal and shoreline areas from a point 3,500 lf west (updrift) of the groin (at approximately Blockade Runner Drive) to a point at approximately the west end of West Beach Drive on Oak Island. All intertidal and supratidal unvegetated areas of the oceanfront, inlet

shoulders, and sandy shoreline along the AIWW (in the vicinity of Lockwoods Folly Inlet and piping plover critical habitat unit NC-16) must be included. Field observations must be conducted during daylight hours, and primarily during high tide.

c. Shorebird identification, especially when in non-breeding plumage, can be difficult. The person(s) conducting the survey must demonstrate the qualifications and ability to identify shorebird species and be able to provide the information listed below. The bird monitoring plan should include the collection and reporting of the following:
    i. Date, location, time of day, weather, and tide cycle when survey was conducted;
    ii. Latitude and longitude of observed piping plover and red knot locations (decimal degrees preferred);
    iii. Any color bands observed on piping plovers or red knots or other birds;
    iv. Behavior (e.g., foraging, roosting, preening, bathing, flying, aggression, walking, courtship, copulation);
    v. Landscape features(s) where birds are located (e.g., inlet spit, tidal creeks, shoals, lagoon shoreline);
    vi. Habitat features(s) used by birds when observed (e.g., intertidal, fresh wrack, old wrack, dune, mid-beach, vegetation);
    vii. Substrata used by birds (e.g., sand, mud/sand, mud, algal mat); and
    viii. The amount and type of recreational use (e.g., people, dogs on or off leash, vehicles, kite-boarders).

d. All monitoring information shall be provided in standardized form on an Excel spreadsheet. Monitoring results shall be submitted (datasheets, maps, database) on standard electronic media (e.g., CD, DVD) to the Raleigh Field Office. Please see REPORTING REQUIREMENTS below, for more information.

Terms and Conditions – Seabeach Amaranth

1. Seabeach amaranth surveys must be conducted updrift and downdrift of the terminal groin in the Action Area, from a point 3,500 lf west of the groin (at approximately Blockade Runner Drive) along Holden Beach to a point 1,000 lf east of the groin, for a minimum of three years after completion of groin construction. Surveys should be conducted in August 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. Please see REPORTING REQUIREMENTS, below, for more information.

XI. REPORTING REQUIREMENTS

An annual report detailing the monitoring and survey data collected during the preceding year (required in the above Terms and Conditions) and summarizing all sea turtle, piping plover, red knot, shorebird, and seabeach amaranth data must be provided to the Raleigh Field Office by January 31 of each year for review and comment. In addition, any information or data related to a conservation measure or recommendation that is implemented should be included in the annual report. The contact for these reporting requirements is:

Pete Benjamin, Supervisor
Raleigh Field Office
U.S. Fish and Wildlife Service
Post Office Box 33726
Raleigh, North Carolina 27636-3726
(919) 856-4520

Upon locating a dead, injured, or sick individual of an endangered or threatened species, initial notification must be made to the Service 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.

Jason Keith
U.S. Fish and Wildlife Service
551-F Pylon Drive
Raleigh, NC 27606
(919) 856-4786, extension 34

XII. COORDINATION OF INCIDENTAL TAKE STATEMENT WITH OTHER LAWS, REGULATIONS, AND POLICIES

The Service will not refer the incidental take of any migratory bird for prosecution under the Migratory Bird Treaty Act of 1918, as amended (16 USC S 703-712), if such take is in compliance with the terms and conditions specified herein. Take resulting from activities that are not in conformance with the Corps permit or this biological opinion (e.g. deliberate harassment of wildlife, etc.) are not considered part of the proposed action and are not covered by this incidental take statement and may be subject to enforcement action against the individual responsible for the act.

XIII. CONSERVATION RECOMMENDATIONS

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

For the benefit of Loggerhead, Green, Leatherback, Hawksbill, and Kemp's ridley sea turtles, the Service recommends the following conservation recommendations:

1. Construction activities for this project and similar future projects should be planned to take place outside the main part of the sea turtle nesting and hatching season, as much as possible.

2. Appropriate native salt-resistant dune vegetation should be established on the restored dunes.

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

For the benefit of the piping plover and red knot, the Service recommends the following conservation recommendations:

1. The Corps' and/or Applicant should maintain suitable piping plover and red knot 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 and red knots.

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 life histories and basic biology of piping plovers and red knots, and ways recreationists can assist in species protection efforts (e.g., keeping pets on a leash, removing trash to sealed refuse containers, etc.). The Service would be willing to assist the Applicant 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.).

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.

XIV. REINITIATION NOTICE – CLOSING STATEMENT

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

In instances where the amount or extent of incidental take is exceeded, any operations causing such take must cease pending reinitiation.

For this biological opinion, the incidental take will be exceeded when the groin construction and nourishment of 4,000 lf of beach extends beyond the project's authorized boundaries. Incidental take of an undetermined number of young or eggs of sea turtles, piping plovers, red knots, and seabeach amaranth plants has been exempted from the prohibitions of section 9 by this opinion.

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Appendix A

EXAMPLES OF PREDATOR PROOF TRASH RECEPTACLES

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

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

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

Example of trash receptacle must be secured or heavy enough so it is not easily turned over.

Appendix B

Assessments: Discerning Problems Caused by Artificial Lighting

Excerpt from:

Understanding, Assessing, and resolving light-pollution problems on sea turtle nesting beaches
Florida Wildlife Research institute technical report tr-2
revised 2003

LIGHTING INSPECTIONS

WHAT ARE LIGHTING INSPECTIONS?

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

WHICH LIGHTS CAUSE PROBLEMS?

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

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

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

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

HOW SHOULD LIGHTING INSPECTIONS BE CONDUCTED?

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

GATHER BACKGROUND INFORMATION

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

PRELIMINARY DAYTIME INSPECTIONS

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

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

NIGHTTIME INSPECTIONS

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

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

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

WHEN SHOULD LIGHTING INSPECTIONS BE CONDUCTED?

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

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

WHO SHOULD CONDUCT LIGHTING INSPECTIONS?

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

WHAT SHOULD BE DONE WITH INFORMATION FROM LIGHTING INSPECTIONS?

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

Lighting Survey Form for NC

Lighting survey must be conducted to include a landward view from the seaward most extent of the beach profile. Survey must occur after 9pm. The survey shall follow standard techniques for such a survey and include the number and type of visible lights, location of lights and photo documentation.

Date: ____

Location (name of beach): ________________________________

Contact information of person conducting the lighting survey: __________________________

____

Time survey started: _______

Time survey ended: _______

Location survey began (include address or GPS location):________________________________

____

Location survey ended (include address or GPS location): ________________________________

____

Date summarizing report sent to the following:
seaturtle@fws.gov:_________________________________

Contact information for follow up meeting with the FWS and State Wildlife Agency:
____

For each light visible from the nesting beach provide the following information:

Location of Light (include cross street and nearest beach access)	GPS location of Light	Description of light (type and location)	Photo take (YES/ NO)

APPENDIX D

SB151 LEGISLATION

GENERAL ASSEMBLY OF NORTH CAROLINA
SESSION 2013

SESSION LAW 2013-384
SENATE BILL 151

AN ACT TO AMEND MARINE FISHERIES LAWS; AMEND THE LAWS GOVERNING THE CONSTRUCTION OF TERMINAL GROINS; AND CLARIFY THAT CITIES MAY ENFORCE ORDINANCES WITHIN THE STATE'S PUBLIC TRUST AREAS.

The General Assembly of North Carolina enacts:

PART I. AMEND MARINE FISHERIES LAW

SECTION 1. G.S. 113-172 reads as rewritten:

"**§ 113-172. License agents.**

(a) The Secretary shall designate license agents for the Department. ~~At least one license agent shall be designated for each county that contains or borders on coastal fishing waters. The Secretary may designate additional license agents in any county if the Secretary determines that additional agents are needed to provide efficient service to the public.~~ The Division and license agents designated by the Secretary under this section shall issue licenses authorized under this Article in accordance with this Article and the rules of the Commission. The Secretary may require license agents to enter into a contract that provides for their duties and compensation, post a bond, and submit to reasonable inspections and audits. If a license agent violates any provision of this Article, the rules of the Commission, or the terms of the contract, the Secretary may initiate proceedings for the forfeiture of the license agent's bond and may summarily suspend, revoke, or refuse to renew a designation as a license agent and may impound or require the return of all licenses, moneys, record books, reports, license forms and other documents, ledgers, and materials pertinent or apparently pertinent to the license agency. The Secretary shall report evidence or misuse of State property, including license fees, by a license agent to the State Bureau of Investigation as provided by G.S. 114-15.1.

(b) License agents shall be compensated by adding a surcharge of one dollar ($1.00) to each license sold and retaining the surcharge. If more than one license is listed on a consolidated license form, the license agent shall be compensated as if a single license were sold. It is unlawful for a license agent to add more than the surcharge authorized by this section to the fee for each license sold."

SECTION 2.(a) G.S. 113-168.5 reads as rewritten:

"**§ 113-168.5. License endorsements for Standard Commercial Fishing License.**

(a), (b) Repealed by Session Laws 1998-225, s. 4.14.

~~(c) Menhaden Endorsements. – Except as provided in G.S. 113-169, it is unlawful to use a vessel to take menhaden by purse seine in coastal fishing waters, to land menhaden taken by purse seine, or to sell menhaden taken by purse seine without obtaining a menhaden endorsement of a SCFL. The fee for a menhaden endorsement shall be two dollars ($2.00) per ton, based on gross tonnage as determined by the custom house measurement for the mother ship. The menhaden endorsement shall be required for the mother ship but no separate endorsement shall be required for a purse boat carrying a purse seine. The application for a menhaden endorsement must state the name of the person in command of the vessel. Upon a change in command of a menhaden vessel, the owner must notify the Division in writing within 30 days.~~

(d) Shellfish Endorsement for North Carolina Residents. – The Division shall issue a shellfish endorsement of a SCFL to a North Carolina resident at no charge. The holder of a SCFL with a shellfish endorsement is authorized to take and sell shellfish."

SECTION 2.(b) G.S. 113-169 is repealed.

SECTION 2.(c) G.S. 113-168.2(a1) reads as rewritten:

"(a1) Use of Vessels. – The holder of a SCFL is authorized to use only one vessel in a commercial fishing operation at any given time. The Commission may adopt a rule to exempt from this requirement a person in command of a vessel that is auxiliary to a vessel engaged in a pound net operation, long-haul operation, <u>or </u>beach seine ~~operation, or menhaden~~ operation."

PART II. AMEND TERMINAL GROIN CONSTRUCTION LAW

SECTION 3.(a) G.S. 113A-115.1 reads as rewritten:

"**§ 113A-115.1. Limitations on erosion control structures.**

(a) As used in this section:

(1) "Erosion control structure" means a breakwater, bulkhead, groin, jetty, revetment, seawall, or any similar structure.

(1a) "Estuarine shoreline" means all shorelines that are not ocean shorelines that border estuarine waters as defined in G.S. 113A-113(b)(2).

(2) "Ocean shoreline" means the Atlantic Ocean, the oceanfront beaches, and frontal dunes. The term "ocean shoreline" includes an ocean inlet and lands adjacent to an ocean inlet but does not include that portion of any inlet and lands adjacent to the inlet that exhibits characteristics of estuarine shorelines.

~~(3) "Terminal groin" means a structure that is constructed on the side of an inlet at the terminus of an island generally perpendicular to the shoreline to limit or control sediment passage into the inlet channel.~~

<u>(3) "Terminal groin" means one or more structures constructed at the terminus of an island or on the side of an inlet, with a main stem generally perpendicular to the beach shoreline, that is primarily intended to protect the terminus of the island from shoreline erosion and inlet migration. A "terminal groin" shall be pre-filled with beach quality sand and allow sand moving in the littoral zone to flow past the structure. A "terminal groin" may include other design features, such as a number of smaller supporting structures, that are consistent with sound engineering practices and as recommended by a professional engineer licensed to practice pursuant to Chapter 89C of the General Statutes. A "terminal groin" is not a jetty.</u>

(b) No person shall construct a permanent erosion control structure in an ocean shoreline. The Commission shall not permit the construction of a temporary erosion control structure that consists of anything other than sandbags in an ocean shoreline. This ~~section~~ <u>subsection </u>shall not apply to any of the following:

(1) Any permanent erosion control structure that is approved pursuant to an exception set out in a rule adopted by the Commission prior to July 1, 2003.

(2) Any permanent erosion control structure that was originally constructed prior to July 1, 1974, and that has since been in continuous use to protect an inlet that is maintained for navigation.

(3) Any terminal groin permitted pursuant to this section.

(b1) This section shall not be construed to limit the authority of the Commission to adopt rules to designate or protect areas of environmental concern, to govern the use of sandbags, or to govern the use of erosion control structures in estuarine shorelines.

(c) The Commission may renew a permit for an erosion control structure issued pursuant to a variance granted by the Commission prior to July 1, 1995. The Commission may authorize the replacement of a permanent erosion control structure that was permitted by the Commission pursuant to a variance granted by the Commission prior to July 1, 1995, if the Commission finds that: (i) the structure will not be enlarged beyond the dimensions set out in the original permit; (ii) there is no practical alternative to replacing the structure that will provide the same or similar benefits; and (iii) the replacement structure will comply with all applicable laws and with all rules, other than the rule or rules with respect to which the Commission granted the variance, that are in effect at the time the structure is replaced.

(d) Any rule that prohibits permanent erosion control structures shall not apply to terminal groins permitted pursuant to this section.

(e) In addition to the requirements of Part 4 of Article 7 of Chapter 113A of the General Statutes, an applicant for a permit for the construction of a terminal groin shall submit all of the following to the Commission:

(1) Information to demonstrate that structures or infrastructure are ~~imminently threatened by erosion, and nonstructural approaches to erosion control,~~

~~including relocation of threatened structures, are impractical.~~threatened by erosion.

(2) An environmental impact statement that satisfies the requirements of G.S. 113A-4. An environmental impact statement prepared pursuant to the National Environmental Policy Act (NEPA), 42 U.S.C. § 4321, et seq., for the construction of the terminal groin shall satisfy the requirements of this subdivision.

(3) A list of property owners and local governments that may be affected by the construction of the proposed terminal groin and its accompanying beach fill project and proof that the property owners and local governments have been notified of the application for construction of the terminal groin and its accompanying beach fill project.

(4) A plan for the construction and maintenance of the terminal groin and its accompanying beach fill project prepared by a professional engineer licensed to practice pursuant to Chapter 89C of the General Statutes.

(5) A plan for the management of the inlet and the estuarine and ocean shorelines immediately adjacent to and under the influence of the inlet. The inlet management plan monitoring and mitigation requirements must be reasonable and not impose requirements whose costs outweigh the benefits. The inlet management plan is not required to address sea level rise. The inlet management plan shall do all of the following relative to the terminal groin and its accompanying beach fill project:

a. Describe the post-construction activities that the applicant will undertake to monitor the impacts on coastal resources.

b. Define the baseline for assessing any adverse impacts and the thresholds for when the adverse impacts must be mitigated.

c. Provide for mitigation measures to be implemented if adverse impacts reach the thresholds defined in the plan.

d. Provide for modification or removal of the terminal groin if the adverse impacts cannot be mitigated.

(6) Proof of financial assurance verified by the Commission or the Secretary of Environment and Natural Resources in the form of a bond, insurance policy, escrow account, guaranty, local government taxing or assessment authority, a property owner association's approved assessment, or other financial instrument or combination of financial instruments that is adequate to cover the cost ~~of:~~of implementing all of the following components of the inlet management plan:

a. Long-term maintenance and monitoring of the terminal groin.

b. Implementation of mitigation ~~measures as provided in the inlet management plan.~~measures.

c. Modification or removal of the terminal ~~groin as provided in the inlet management plan.~~groin.

~~d. Restoration of public, private, or public trust property if the groin has an adverse impact on the environment or property.~~

(f) The Commission shall issue a permit for the construction of a terminal groin if the Commission finds no grounds for denying the permit under G.S. 113A-120 and the Commission finds all of the following:

(1) The applicant has complied with all of the requirements of subsection (e) of this section.

~~(2) The applicant has demonstrated that structures or infrastructure are imminently threatened by erosion and that nonstructural approaches to erosion control, including relocation of threatened structures, are impractical.~~

(3) The terminal groin will be accompanied by a concurrent beach fill project to prefill the groin.

(4) Construction and maintenance of the terminal groin will not result in significant adverse impacts to private property or to the public recreational beach. In making this finding, the Commission shall take into account the potential benefits of the project, including protection of the terminus of the

island from shoreline erosion and inlet migration, beaches, protective dunes, wildlife habitats, roads, homes, and infrastructure, and mitigation measures, including the accompanying beach fill project, that will be incorporated into the project design and construction and the inlet management plan.

(5) The inlet management plan is adequate for purposes of monitoring the impacts of the proposed terminal groin and mitigating any adverse impacts identified as a result of the monitoring.

(6) Except to the extent expressly modified by this section, the project complies with State guidelines for coastal development adopted by the Commission pursuant to G.S. 113A-107.

(g) The Commission may issue no more than four permits for the construction of a terminal groin pursuant to this section.

(h) ~~No permit may be issued where funds are~~A local government may not use funds generated from any of the following financing mechanisms ~~and would be used~~ for any activity related to the terminal groin or its accompanying beach fill project:

(1) Special obligation bonds issued pursuant to Chapter 159I of the General Statutes.

(2) Nonvoted general obligation bonds issued pursuant to G.S. 159-48(b)(4).

(3) Financing contracts entered into under G.S. 160A-20 or G.S. 159-148.

(i) No later than September 1 of each year, the Coastal Resources Commission shall report to the Environmental Review Commission on the implementation of this section. The report shall provide a detailed description of each proposed and permitted terminal groin and its accompanying beach fill project, including the information required to be submitted pursuant to subsection (e) of this section. For each permitted terminal groin and its accompanying beach fill project, the report shall also provide all of the following:

(1) The findings of the Commission required pursuant to subsection (f) of this section.

(2) The status of construction and maintenance of the terminal groin and its accompanying beach fill project, including the status of the implementation of the plan for construction and maintenance and the inlet management plan.

(3) A description and assessment of the benefits of the terminal groin and its accompanying beach fill project, if any.

(4) A description and assessment of the adverse impacts of the terminal groin and its accompanying beach fill project, if any, including a description and assessment of any mitigation measures implemented to address adverse impacts."

SECTION 3.(b) Section 3 of S.L. 2011-387 is repealed.

PART III. CITIES ENFORCE ORDINANCES WITHIN PUBLIC TRUST AREAS

SECTION 4.(a) Article 8 of Chapter 160A of the General Statutes is amended by adding a new section to read as follows:

"**§ 160A-203. Cities enforce ordinances within public trust areas.**

(a) Notwithstanding the provisions of G.S. 113-131 or any other provision of law, a city may, by ordinance, define, prohibit, regulate, or abate acts, omissions, or conditions upon the State's ocean beaches and prevent or abate any unreasonable restriction of the public's rights to use the State's ocean beaches. In addition, a city may, in the interest of promoting the health, safety, and welfare of the public, regulate, restrict, or prohibit the placement, maintenance, location, or use of equipment, personal property, or debris upon the State's ocean beaches. A city may enforce any ordinance adopted pursuant to this section or any other provision of law upon the State's ocean beaches located within or adjacent to the city's jurisdictional boundaries to the same extent that a city may enforce ordinances within the city's jurisdictional boundaries. A city may enforce an ordinance adopted pursuant to this section by any remedy provided for in G.S. 160A-175. For purposes of this section, the term "ocean beaches" has the same meaning as in G.S. 77-20(e).

(b) Nothing in this section shall be construed to (i) limit the authority of the State or any State agency to regulate the State's ocean beaches as authorized by G.S. 113-131, or common law as interpreted and applied by the courts of this State; (ii) limit any other authority granted to cities by the State to regulate the State's ocean beaches; (iii) deny the existence of the authority recognized in this section prior to the date this section becomes effective; (iv) impair the right of the people of this State to the customary free use and enjoyment of the State's ocean beaches, which rights remain reserved to the people of this State as provided in G.S. 77-20(d); (v) change or modify the riparian, littoral, or other ownership rights of owners of property bounded by the Atlantic Ocean; or (vi) apply to the removal of permanent residential or commercial structures and appurtenances thereto from the State's ocean beaches."

SECTION 4.(b) G.S. 113-131 reads as rewritten:

"**§ 113-131. Resources belong to public; stewardship of conservation agencies; grant and delegation of powers; injunctive relief.**

(a) The marine and estuarine and wildlife resources of the State belong to the people of the State as a whole. The Department and the Wildlife Resources Commission are charged with stewardship of these resources.

(b) The following powers are hereby granted to the Department and the Wildlife Resources Commission and may be delegated to the Fisheries Director and the Executive Director:

(1) Comment on and object to permit applications submitted to State agencies which may affect the public trust resources in the land and water areas subject to their respective management duties so as to conserve and protect the public trust rights in such land and water areas;

(2) Investigate alleged encroachments upon, usurpations of, or other actions in violation of the public trust rights of the people of the State; and

(3) Initiate contested case proceedings under Chapter 150B for review of permit decisions by State agencies which will adversely affect the public trust rights of the people of the State or initiate civil actions to remove or restrain any unlawful or unauthorized encroachment upon, usurpation of, or any other violation of the public trust rights of the people of the State or legal rights of access to such public trust areas.

(c) Whenever there exists reasonable cause to believe that any person or other legal entity has unlawfully encroached upon, usurped, or otherwise violated the public trust rights of the people of the State or legal rights of access to such public trust areas, a civil action may be instituted by the responsible agency for injunctive relief to restrain the violation and for a mandatory preliminary injunction to restore the resources to an undisturbed condition. The action shall be brought in the superior court of the county in which the violation occurred. The institution of an action for injunctive relief under this section shall not relieve any party to such proceeding from any civil or criminal penalty otherwise prescribed for the violation.

(d) The Attorney General shall act as the attorney for the agencies and shall initiate actions in the name of and at the request of the Department or the Wildlife Resources Commission.

(e) In this section, the term "public trust resources" means land and water areas, both public and private, subject to public trust rights as that term is defined in G.S. 1-45.1.

(f) Notwithstanding the provisions of this section, a city may adopt and enforce ordinances as provided in G.S. 160A-203."

PART IV. EFFECTIVE DATE

SECTION 5. Section 3 of this act is effective when the act becomes law and applies to permit applications submitted on or after that date. The remainder of this act is effective when it becomes law.

In the General Assembly read three times and ratified this the 22nd day of July, 2013.

s/ Tom Apodaca
Presiding Officer of the Senate

s/ Thom Tillis
Speaker of the House of Representatives

s/ Pat McCrory
Governor

Approved 10:45 a.m. this 23rd day of August, 2013

APPENDIX E

INLET MANAGEMENT PLAN

INLET MANAGEMENT PLAN
HOLDEN BEACH EAST END SHORE PROTECTION PROJECT
LOCKWOODS FOLLY INLET, NC

1.0 INTRODUCTION

The Town of Holden Beach (herein referred to as the “Town”) has proposed the construction of a terminal groin and a concurrent 150,000 cubic yard (cy) beach nourishment at the east end of Holden Beach, adjacent to Lockwoods Folly (LWF) Inlet, as part of its ongoing beach management activities. Projects involving terminal groins are required to include an inlet management plan to monitor impacts on coastal resources, among other things. Specifically, Senate Bill 151 § 113A-115.1(f)(5) calls for:

> “A plan for the management of the inlet and the estuarine and ocean shorelines immediately adjacent to and under the influence of the inlet. The inlet management plan shall do all of the following relative to the terminal groin and its accompanying beach fill project:
>
> a. Describe the post-construction activities that the applicant will undertake to monitor the impacts on coastal resources.
> b. Define the baseline for assessing any adverse impacts and the thresholds for when the adverse impacts must be mitigated.
> c. Provide for mitigation measures to be implemented if adverse impacts reach the thresholds defined in the plan.
> d. Provide for modification or removal of the terminal groin if the adverse impacts cannot be mitigated.”

Section 2 of this document discusses the monitoring effort; Section 3 discusses the project threshold/triggers; Section 4 discusses the Technical Advisory Committee (TAC); and Section 5 discusses potential mitigation measures.

2.0 PHYSICAL MONITORING

2.1 EXISTING MONITORING

As part of its ongoing beach management plan, the Town of Holden Beach routinely monitors the shoreline from Shallotte Inlet to LWF Inlet with annual beach and bathymetric surveys dating back to 2000. Island-wide survey transects are generally spaced at ~1,000 foot intervals; however, inlet survey transect spacing is tighter and encompasses inlet and ebb shoal areas (see Figure C-1). Beginning with the April 2012 survey (annual surveys are conducted in the spring) an additional seven transects were included on western Oak Island in order to more closely monitor inlet-related effects and establish more consistent baseline data. Figure C-1 shows an overview of the latest Town survey from April 2015. The U.S. Army Corps of Engineers (USACE) also performs routine bathymetric surveys of LWF Inlet, the Atlantic Intracoastal Waterway (AIWW) inlet crossing (LWFIX), and the bend widener section of the AIWW inlet crossing (see Figures C-2 and C-3).

Additional physical monitoring beyond the ongoing efforts by the Town of Holden Beach and USACE will be performed to help fully observe any potential project-related effects to surrounding areas as part of the inlet management plan. These efforts are detailed in the following sections.

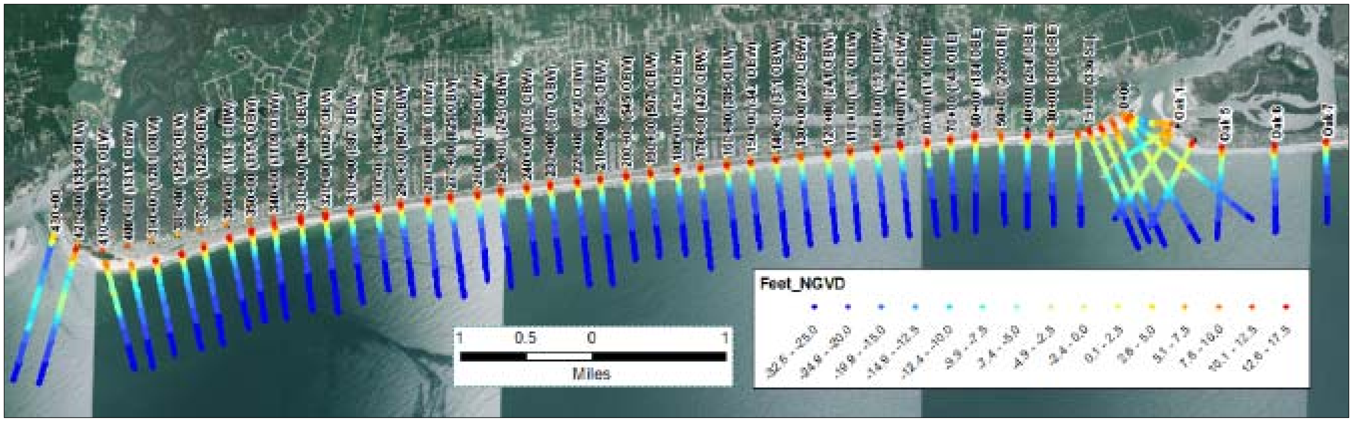

Figure C-1. Town of Holden Beach Annual Bathymetric Survey, April 2015.

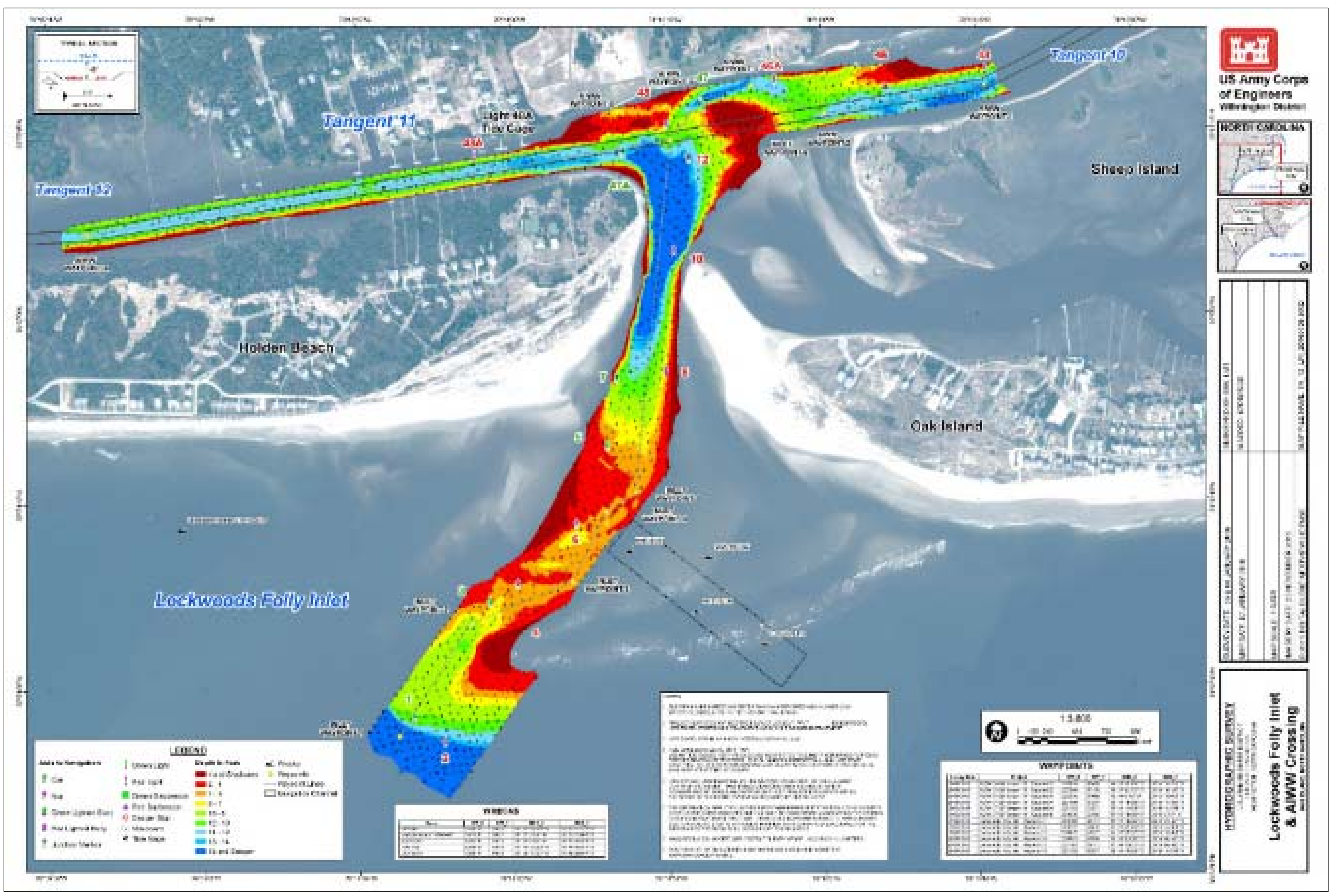

Figure C-2. USACE LWF Inlet, AIWW Inlet Crossing, and Bend Widener January 2016 Survey (source: Wilmington USACE Navigation Branch).

2.2 PROPOSED BEACH FILL AND INLET AREA MONITORING

Project monitoring will include physical surveying and aerial photography every spring and fall. This monitoring program is scheduled to continue for the life of the project; however, the Town of Holden Beach will coordinate with regulatory agencies to determine whether the monitoring program may be shortened, modified, or terminated following several years of successful project monitoring results.

2.2.1 SURVEYING

Pre-project, immediate post-project and subsequent monitoring beach profile surveys will be performed at 16 control reference transects; including 10 transects on Holden Beach and 6 transects on Oak Island (see Figure C-3). These transects coincide with ongoing annual springtime survey transects performed by the Town of Holden Beach. For the purposes of monitoring, “annual” surveys will occur in the spring while “semi-annual” surveys will occur in the fall.

It should be noted that the easternmost transect on Holden Beach (transect 0+00) and the westernmost transect on Oak Island (Oak 1) each have three radial transects emanating from the same point of origin. In both cases, there are two shorter radial transects with more east-west orientations across Lockwoods Folly Inlet (transects 109+00 and 119+00 on Holden Beach and Oak 2 and 3 on Oak Island). Note that these transects were not surveyed as regularly as the main transects during previous years but are proposed to be included for both annual and semi-annual monitoring. The 16 transects used for the annual and semi-annual monitoring will be utilized for baseline and threshold determination (discussed in following sections) and are representative of the entire project oceanfront study area (e.g., updrift and downdrift).

The proposed transects in Figure C-3 cover the oceanic shoreline and nearshore areas. In addition, surveying of the estuarine bathymetry, including the AIWW inlet crossing and bend widener, will also occur (see following sections for more information).

Immediate pre-project and immediate post-project and annual surveys thereafter will be performed from the primary dune (or equivalent) to a minimum elevation of -20 feet referenced to the North American Vertical Datum of 1988 (NAVD88). This elevation typically occurs within 2,500 feet from the shoreline. All survey lines will be terminated if a distance of 2,500 feet is reached prior to the target depth. Landside spot elevations will be measured at a maximum of 25 foot intervals, with higher density in areas of significant features such as escarpments or any notable change in elevation. Hydrographic soundings (vessel survey portion) will be reported at a minimum of approximately 10 foot intervals.

All profiles will be surveyed approximately along and parallel to the monitoring transects as shown on Figure C-3. These transects can extend landward or seaward as needed to meet established minimum depths. Due to the naturally dynamic nature of LWF Inlet, survey transect extents may vary from survey to survey.

2.2.1.1 Semi-Annual (Fall) Surveys

Unless otherwise approved, semi-annual profile surveys conducted in the fall will be identical to the spring surveys discussed above. The Town of Holden Beach may ask for a reduction to the fall surveying effort following several years of successful monitoring. A request to reduce the semi-annual surveying requirements may include: 1) extending the survey transects to low-tide wading depth only (i.e., no vessel survey component), and/or 2) removing some or all of the fall survey transects entirely. Note that proposed threshold values are related to MHW shoreline position; therefore, wading depth surveys, which will extend to at least -6 feet NAVD88, will capture this metric. Unless otherwise approved, fall surveys will extend out to -20 foot NAVD88 depths (identical to the spring survey).

2.2.1.2 LWF Inlet Surveying

The USACE routinely surveys the AIWW inlet crossing and bend widener typically two (2) to four (4) times per year. The USACE surveying generally depends on shoaling (e.g., more surveying is needed under more hazardous navigation conditions) and funding. Immediate pre- and post-project surveys of the borrow area will always be conducted by the Town within approximately four (4) weeks of active dredging in order to accurately quantify volumes and areas dredged.

Similar to the Bald Head Island (BHI) Terminal Groin Inlet Management Plan, it is proposed that the latest USACE LWF Inlet surveys available will be used for annual and semi-annual monitoring if the USACE surveys are within 3 months of the beach profile surveys. If USACE surveys are not available for this time period, the Town will collect this LWF Inlet data coincident with the beach profile transect data collection.

2.2.2 AERIAL PHOTOGRAPHY

Aerial photographs of the study area, including the ocean survey transects, AIWW and LWF Inlet area, and emergent flood shoal area (Figure C-3), will be obtained twice a year in the spring and fall, similar to the survey data collection. The primary purpose of this monitoring will be to assess estuarine shoreline and flood shoal change within the LWF Inlet. Aerial photography will be taken near low tide conditions. Note that shoreline armoring and erosion already occurs on the mainland portion of the LWF Inlet (see Photos C-1 and C-2).

Unless otherwise approved, annual and semi-annual aerial photographs will continue for the entirety of the 30-year project design life. The applicant will coordinate with regulatory agencies to determine whether the aerial photography schedule may be shortened, modified, or terminated based on several years of successful monitoring results. The extremely variable nature and recent dredging of the emergent flood shoal by Oak Island merits the use of aerial photography for monitoring of the shoal area.

Photo C-1: Erosional scarping of LWF Inlet estuarine shoreline on Holden Beach (February 2014 photo)

Photo C-2: Shoreline armoring to prevent erosion along mainland LWF Inlet shoreline (vehicle in photo is parked at the end of Stone Chimney Road).

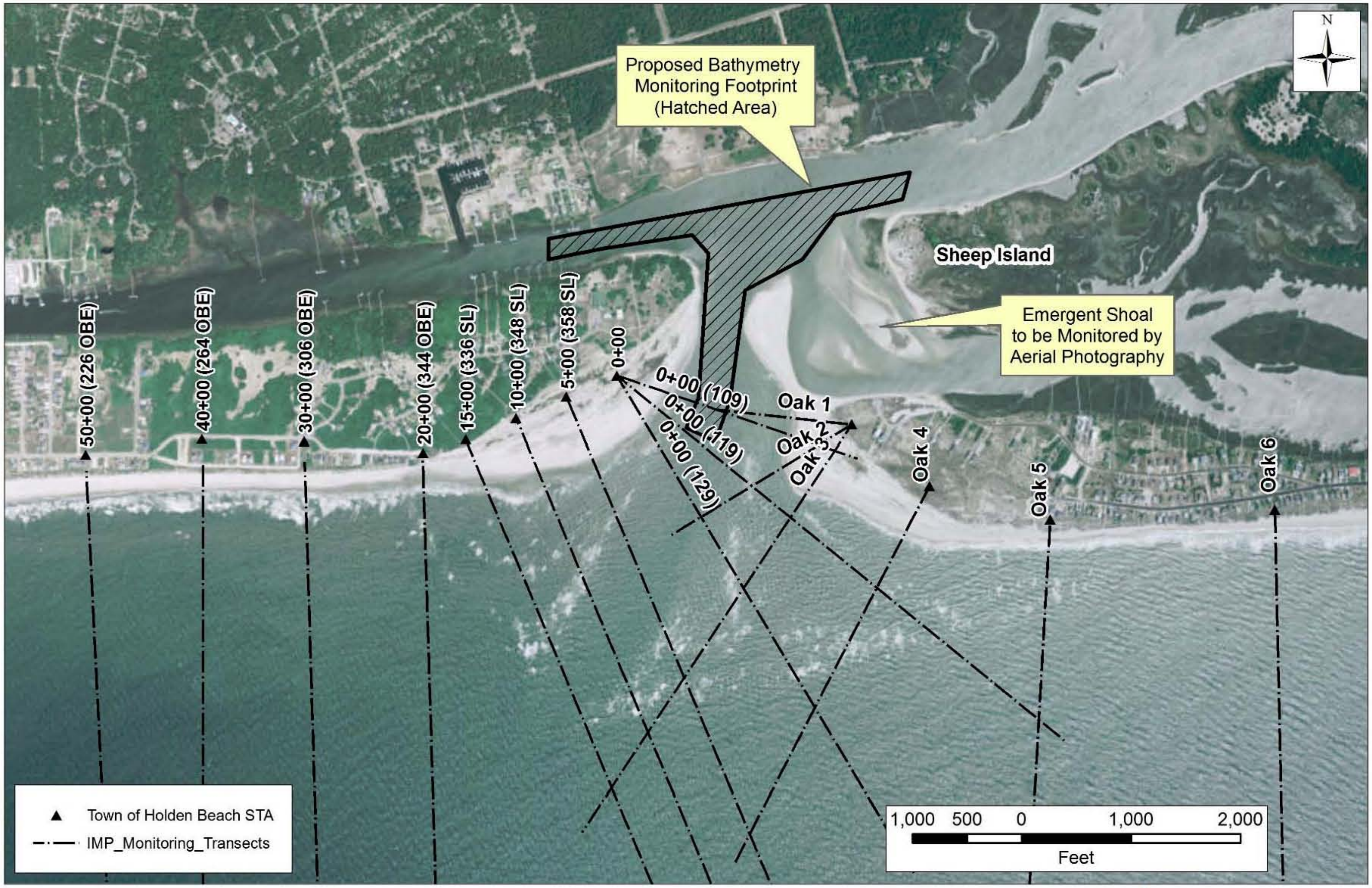

Figure C-3. Pre- and Post-Project Physical Monitoring Transects. Transects shown are to be surveyed during normal, annual survey events as well as semi-annual monitoring events. These transects will also be utilized for baseline and threshold determination.

ATM APPLIED TECHNOLOGY & MANAGEMENT

2.3 BEACH PROFILE AND INLET AREA MONITORING SCHEDULE

A pre-construction survey will be performed within approximately four (4) weeks prior to the commencement of beach fill placement. This survey will document the baseline conditions immediately prior to construction. Similarly, an immediate post-construction survey will be performed within approximately four (4) weeks following completion of beach fill and groin construction. It is assumed that beach nourishment will occur either before or concurrent with groin construction. This will more easily allow the groin to be constructed from land. Table C-1 presents the proposed surveying timeline for the inlet management plan.

As previously discussed, "annual" surveys will occur in the spring while "semi-annual" surveys will occur in the fall. As previously mentioned, Holden Beach has proactively conducted beach profile surveys on an annual basis and in the spring in order to monitor ongoing beach erosion/accretion processes and plan for future projects. Annual surveys will continue to include transects along all of Holden Beach and the western portion of Oak Island shown in Figure C-1 as part of the Town's ongoing monitoring. Semi-annual surveys will only include the 16 transects on Holden Beach and Oak Island as identified in Section 2.2.1.

Table C-1. Physical Monitoring Survey and Aerial Photography Schedule

Survey*	Timeline
Pre-Project Survey	within ~4 weeks of project initiation
Post-Project Survey	within ~4 weeks of project completion
Semi-annual	6 months post-project
Annual	1-year post-project
Semi-annual	1.5-year post-project
Annual	2-year post-project
Semi-annual	2.5-year post-project
Annual	3-year post-project
Semi-annual	3.5-year post-project
Annual (ongoing)	Ongoing surveys resume annually
Semi-annual (ongoing)	Ongoing, although the Town may ask to remove this subject to successful project monitoring

For annual and semi-annual monitoring, the most recent available USACE AIWW inlet crossing, bend widener, and LWF inlet surveys will be used in conjunction with annual surveys.

As previously mentioned, the most recent available USACE AIWW inlet crossing, bend widener, and LWF Inlet surveys will be used in conjunction with the annual and semi-annual monitoring schedule. However, if USACE surveys have not occurred within approximately three (3) months of the annual survey, these areas will be surveyed during the Town's survey collection effort. An example of the typical USACE data collection is presented in Figure C-4, and the Town's proposed surveying area is also presented. The USACE survey area is generally much larger than needed for the purposes of the groin project monitoring. Holden Beach will coordinate with the USACE Navigation Branch to ensure that the monitoring area is sufficiently captured for each event.

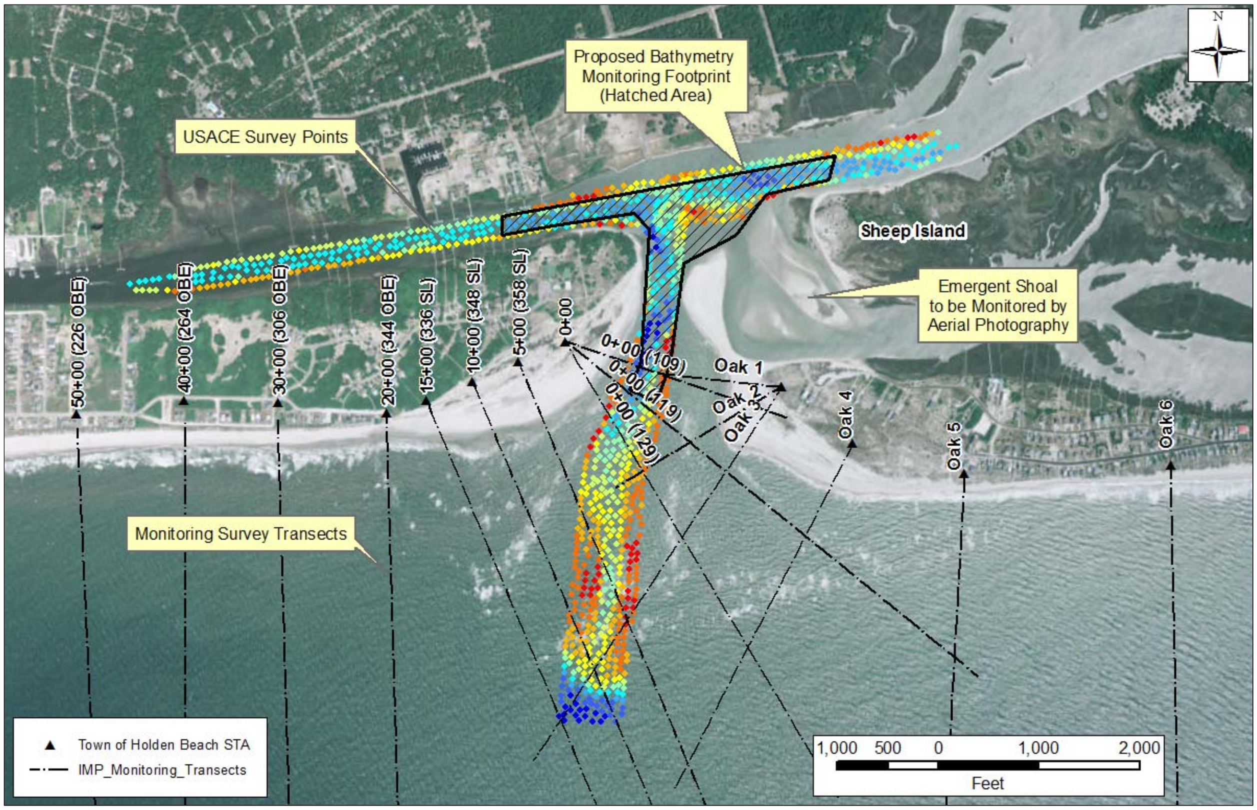

Figure C-4. Typical USACE bathymetric survey data. If no USACE survey is available for monitoring data, proposed bathymetry monitoring footprint shown. Bathymetry footprint may vary based on shoaling/navigable depths.

2.4 PHYSICAL MONITORING DATA ANALYSIS

The monitoring data collected will be analyzed to determine shoreline and volumetric changes in the project area and the adjacent beaches, and to assess project performance. The following analyses will be performed, at a minimum, and included in each required report following monitoring events:

- Beach profile comparison plots: The current survey for each profile will be graphically compared to the previous survey(s).
- Shoreline change analysis: The MHW (1.8 feet NAVD88) shoreline positions along each surveyed transect will be compared, plotted, and analyzed for mean and extreme changes between consecutive surveys. Values will be reported in feet of MHW position retreat (negative-erosion) or advancement (positive-accretion) along the monitoring transect. Results will be compared to previous yearly, short-term and historical values as discussed in Section 3.3.
- Volume change analysis: Project placement volumes will be compared with volume remaining in the active profile at the time of each survey. Estimates of cross-shore

and longshore sediment volume changes will be calculated and compared with each subsequent survey, to the extent possible.

- Storm events: Any significant storm events that affect the project beach will be described based on available local meteorological data.
- Other relevant events: Any dredging (e.g., LWF Inlet sidecasting, LWFIX maintenance) and/or nourishment projects in the study area (eastern Holden Beach, western Oak Island) will be discussed. Estuarine shoreline armoring and any potential changes to channel migration or buoy relocation may also prove relevant to LWF processes.
- Aerial assessment: Aerial photography will be compared with previous monitoring aerials for the study area. This assessment will include estuarine shorelines as well as any significant ebb and flood shoals within the project area.
- Performance assessment: An overall project performance assessment will be based on the design goals and current state of the project determined through the data collection and analysis efforts described above.

3.0 POST-PROJECT ANALYSIS, BASELINE AND THRESHOLD DETERMINATION

The subsequent sections describe a brief review of LWF Inlet dynamics, the methodology for determining adverse impacts, and establishing thresholds required for mitigation.

3.1 DYNAMICS OF LOCKWOODS FOLLY INLET

According to the North Carolina Beach and Inlet Management Plan (NC BIMP), between 1858 and 1938, LWF Inlet migrated westward approximately 2,300 feet to its present location (NC BIMP, 2011). Cleary and Marden (2001) estimate that the midpoint of LWF Inlet has migrated approximately 500 feet west since 1938. Several other studies have analyzed the movement of LWF Inlet over the last century, including Cleary (1996, 2008) and CSE (2009). The North Carolina Department of Environmental Quality (NCDEQ, previously known as NCDENR) also developed a shoreline analysis using historical aerials shown in Figure C-5. As Cleary (1996) states, “Although the inlet has been locationally stable, there has been considerable morphologic change within the inlet, its shoals and along adjacent shorelines.” A chronic erosion trend exists along the east end of Holden Beach, up to 2 kilometers (km) from LWF Inlet.

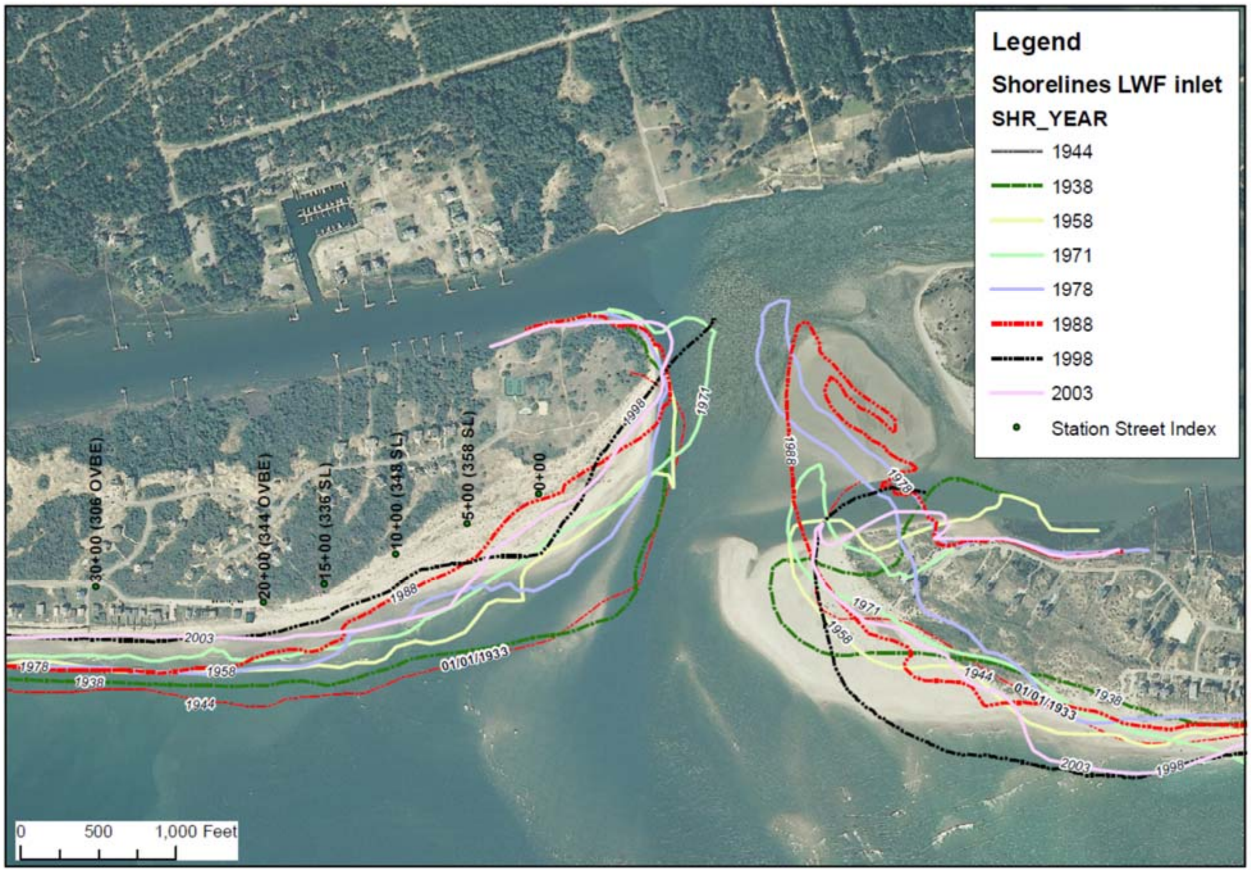

Figure C-5. Historical Shoreline Change of Lockwoods Folly Inlet Area.

Concerning inlet area shoreline morphology, Cleary (1996) has documented several severe, extended periods of erosion on both sides of LWF Inlet, stating:

> Within 100 m of LWF Inlet, the Holden Beach shoreline has eroded 260 meters during the past 58 years, at an average of 4.5 meters per year.
>
> The most dramatic changes to Long Beach [Oak Island] have occurred within 400 meters of the inlet. Since 1938, this area has experienced an average net accretion of 1 meter per year, though it was plagued by serious erosion in the 1970s and 1980s. Almost 100 meters of shoreline eroded between 1974 and 1986, at an average of 8 meters per year.

NCDEQ Division of Coastal Management (DCM) also calculate long-term (~50yr) erosion rates and construction setbacks along the NC shorelines. Warren and Richardson (2010) performed a statistical shoreline analysis (standard deviation of shoreline position and average rate of shoreline change) that identified DCM Transect 530 as the point along the oceanfront where LWF Inlet processes were no longer dominant [see Figure C-6 on the following page for DCM and Town stationing]. Figure C-6 shows the same analysis for Oak Island's west end. The 2011 setback factors (SBF) as determined by DCM are also presented in Figure C-6. Note that the western Oak Island SBF is 2 feet, which is the state minimum and generally denotes stable/accretional shoreline conditions for the period of analysis (1944 to 2009).

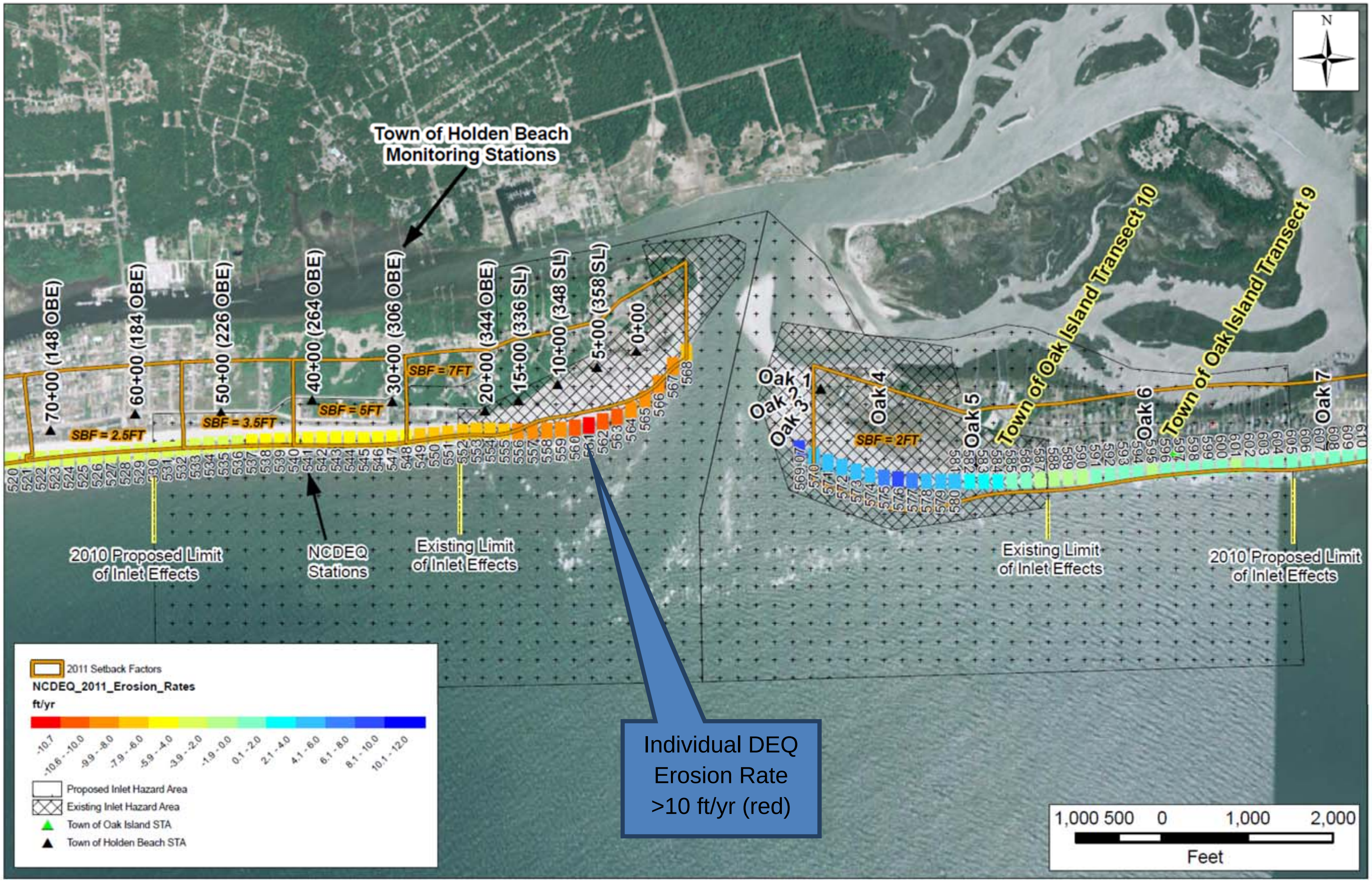

Figure C-6. NCDEQ 2011 Holden Beach and Oak Island Long-Term Erosion Rates, Inlet Hazard Areas (IHA)and Setback Factors (SBF). Proposed IHA also shown (Warren and Richardson, 2010). IHA indicate area of inlet influence. Holden Beach and Oak Island Transect Stationing also shown for reference.

Terminal groins, as with all groins, typically hold sand on the updrift side (forming a “fillet”) and have the potential to detrimentally affect to downdrift beaches, generally under extremely erosional conditions when nourishment is not a required component of the program. In a regional net transport sense, Holden Beach is downdrift of the proposed eastern end terminal groin. However, at the project site where the net transport is to the east, the inlet throat itself is downdrift of any groin placed along the inlet margin (see Figure C-7).

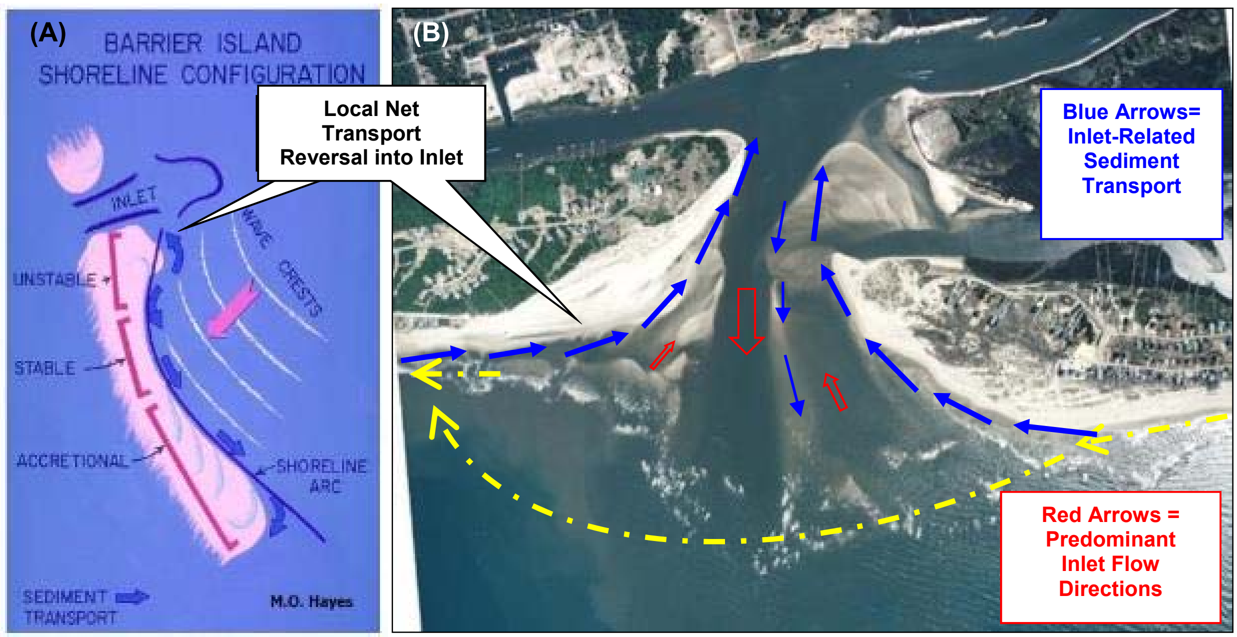

Figure C-7. (A) Generalized Net Sand Transport near an Inlet (Source: Hayes). Note that net transport reverses to the south of the inlet. (A) very closely resembles (B), typical net transport trends at LWF Inlet and on Holden Beach. Yellow arrows represent regional net sediment transport.

3.2 HURRICANE AND STORM EFFECTS

Hurricanes are typically the most extreme episodic events to affect shorelines in the region. For example, in 2008, Hurricane Hanna significantly affected the Holden Beach shoreline. Hanna made landfall approximately 20 miles west of Holden Beach on September 6, 2008, subjecting the Holden Beach shoreline to the most intense northeast quadrant conditions due to the counter-clockwise storm rotation. As a result, the entire area suffered damage; however, the east end exhibited more erosion than the rest of the island. Table C-2 presents losses per linear foot along the east end from Hurricane Hanna. Up to 21.2 cubic yards per foot (cy/ft) was lost at Station 20+00 (just west of the terminal groin), while the Central Reach shoreline lost an average of 8 cy/ft. Figure C-8 presents a post-Hanna photo on the east end, showing significant dune and upper beach erosion. Dune unit volumes [above 7 feet referenced to the National Geodetic Vertical Datum (ft NGVD)] on the east end have averaged approximately 6 cy/ft, according to surveys ranging from 2000 through 2015.

Table C-2. Unit Volume Change due to Hurricane Hanna

Station	Unit Volume Change (cy/ft) due to Hurricane Hanna
15+00	-1.6
20+00	-21.2
30+00	-5.3
40+00	-12.3

Figure C-8. Post Hurricane Hanna Image Showing Dune Losses on the East End of Holden Beach (~Station 25+00).

3.3 PROJECT BASELINE AND THRESHOLD DETERMINATION

In order to characterize baseline shoreline variations adjacent to Lockwoods Folly Inlet and in potential impact areas of the proposed terminal groin (Figure C-9), historical survey data was analyzed for MHW shoreline changes dating back to 2000 for the Holden Beach shoreline transects. In 2012, Holden Beach also added seven (7) transects along the west end of Oak Island to establish baseline conditions for the proposed project. The Town of Oak Island has also been independently monitoring the Oak Island shoreline since as early as 1997, but at fewer transects and only out to approximate mean low water (MLW). The sixteen (16) monitoring transects identified in Section 2 (Holden Beach transects 50+00 through 0+00 and Oak Island transects 1 to 6) were investigated to determine baseline and threshold values for potential project impacts. An overview of the survey transects in the project area is presented in Figure C-9. Table C-3 presents tidal datums for the project site, using the Yaupon Beach, Oak Island NOAA station.

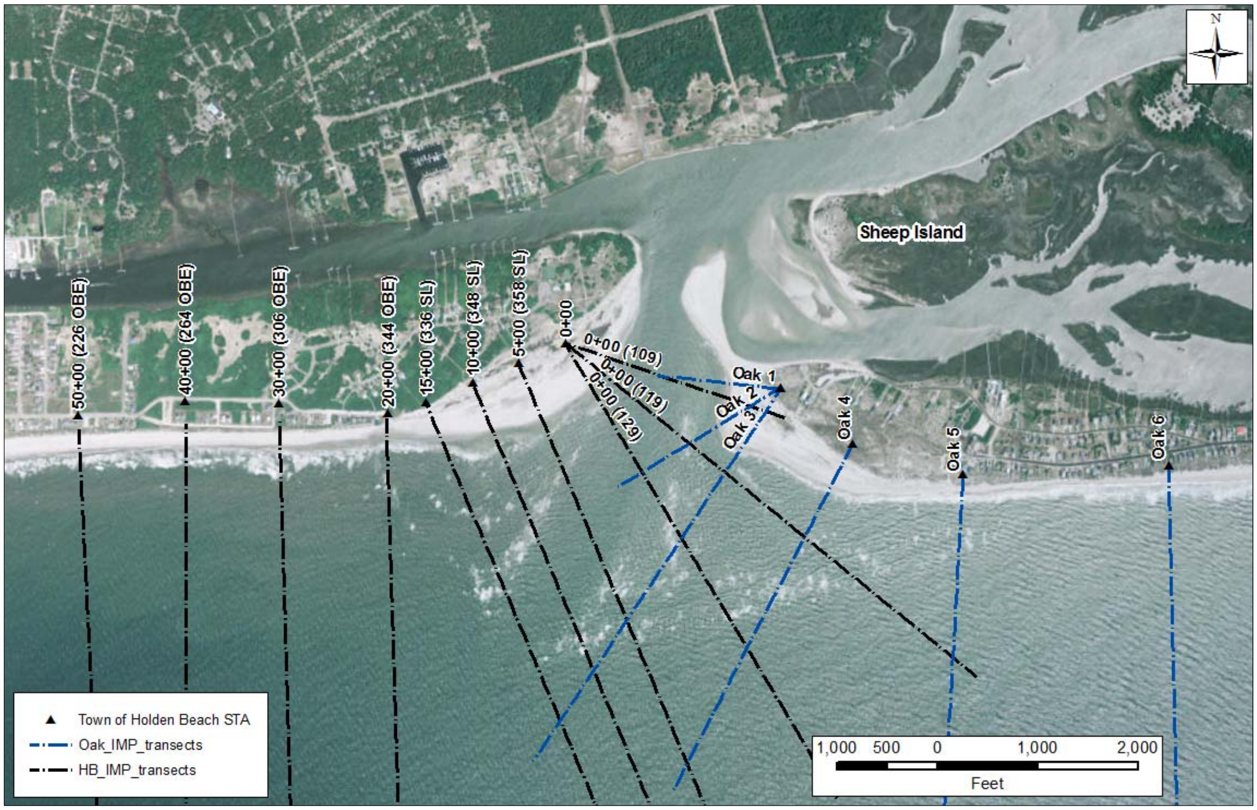

Figure C-9. Pre- and Post-Project Physical Monitoring Transects.

Table C-3. Project Site Tidal Datums

NOAA Station: Yaupon Beach, Oak Island	Feet (NAVD88=0)
MHHW	2.2
MHW	1.8
NAVD88	0.0
MSL	-0.5
MTL	-0.6
NGVD29	-1.1
MLW	-2.9
MLLW	-3.1

3.3.1 HOLDEN BEACH EAST END (STATIONS 50+00 – 0+00)

Surveys of Holden Beach monitoring transects Stations 0+00 (109,119,129) through 50+00 (ten stations) were analyzed to determine MHW contour (+1.8 ft NAVD88) variations. Historical transect survey profiles for Stations 5+00 and 15+00 are presented in Figure C-10 for reference.

Table C-4 presents MHW shoreline locations (measured as distance seaward along transects from starting location station monument), change between consecutive surveys, and annualized change rates for Holden Beach East End monitoring stations. Survey data is about a year apart in most cases; however, annualization of rates was required in some cases.

Table C-4. Holden Beach East End Monitoring Stations 0+00 (129+00) to 15+00 – Historic MHW Positions, Consecutive Survey MHW Changes and Baseline Annualized MHW Changes (red indicates erosion).

Survey Date	MHW Shoreline Location, ft				MHW Shoreline Change, ft				Annualized MHW Shoreline Change, ft			
	0+00 (129)	5+00	10+00	15+00	0+00 (129)	5+00	10+00	15+00	0+00 (129)	5+00	10+00	15+00
Jan-00	506	379	187	143								
Jun-02	225	150	226	256	(281)	(229)	39	113	(117)	(96)	16	47
Jan-03	114	337	361	296	(110)	187	135	40	(181)	307	221	66
Jun-03	248	323	420	340	134	(14)	60	44	324	(35)	144	106
Nov-03	176	361	496	336	(73)	38	76	(4)	(171)	89	178	(10)
Jul-04	580	522	386	305	404	162	(110)	(31)	615	246	(167)	(47)
Dec-04	--	463	442	307	--	(60)	56	2	--	(143)	134	4
Jan-06	686	505	467	288	--	43	25	(18)	70	39	23	(17)
Jun-06	617	532	420	336	(69)	27	(47)	48	(167)	65	(115)	116
Jul-07	492	430	378	293	(125)	(103)	(42)	(44)	(119)	(98)	(41)	(42)
Apr-08	392	286	324	230	(100)	(144)	(54)	(63)	(127)	(182)	(68)	(80)
Oct-08	393	343	292	252	1	57	(32)	22	2	113	(63)	44
Jun-09	402	291	327	237	10	(52)	35	(15)	15	(79)	53	(23)
Mar-10	420	390	289	267	18	99	(38)	30	24	132	(51)	41
May-11	579	522	475	397	159	132	186	130	136	113	159	111
Apr-12	446	551	490	373	(132)	29	16	(24)	(144)	31	17	(26)
Apr-13	413	597	582	345	(33)	46	92	(28)	(33)	46	92	(28)
Apr-14	468	609	536	377	55	12	(46)	32	55	12	(46)	32
Apr-15	478	917	470	395	10	307	(66)	18	10	307	(66)	18
Max (Accretional)	686	917	582	397	404	307	186	130	615	307	221	116
Min (Erosional)	114	150	187	143	(281)	(229)	(110)	(63)	(181)	(182)	(167)	(80)

Note that in Table C-4, the MHW shoreline changes for Station 0+00 are only for Radial 129+00 (the most north-south oriented of the Holden Beach Station 0+00 radial transects). The MHW change analysis for Stations 0+00 (Radials 109+00 and 119+00) as well as Stations 20+00 to 50+00 is presented at the end of this document (Table C-9).

Table C-4 and Figures C-10a and C-10b on the following page illustrate the large fluctuations that can occur along Holden Beach's East End, adjacent to Lockwoods Folly Inlet. These large fluctuations can generally be attributed to inlet effects, as discussed in Section 3.1, as well as the severe chronic Holden Beach East End erosion on which the current project is predicated. For example, between June 2006 and July 2007 (~1yr), the Station 0+00 (Radial 129+00) MHW shoreline eroded 125 ft. The following year (July 2007 to April 2008) exhibited 100 feet of additional MHW erosion. This area subsequently stabilized and even accreted in the following years, before undergoing another erosional episode.

These severe, extended periods of erosion and accretion must be considered when determining post project thresholds and mitigation triggers, discussed in following sections. Nourishment activity will also be taken into account. Note that placement of material occurs west of Station 20+00, therefore Stations 15+00, 10+00, 5+00, and 0+00 only experience spreading benefits.

Also note that USACE East End nourishments in this area are generally rather small, where only ~20 to ~35 feet of beach is added (following equilibration) between Stations 20+00 and 40+00 (~2,000 feet of shoreline). However nourishment activity within the study area (including Holden Beach and Oak Island transects) can result in significant changes to the MHW shoreline position, especially during the first year due to equilibration and spreading effects.

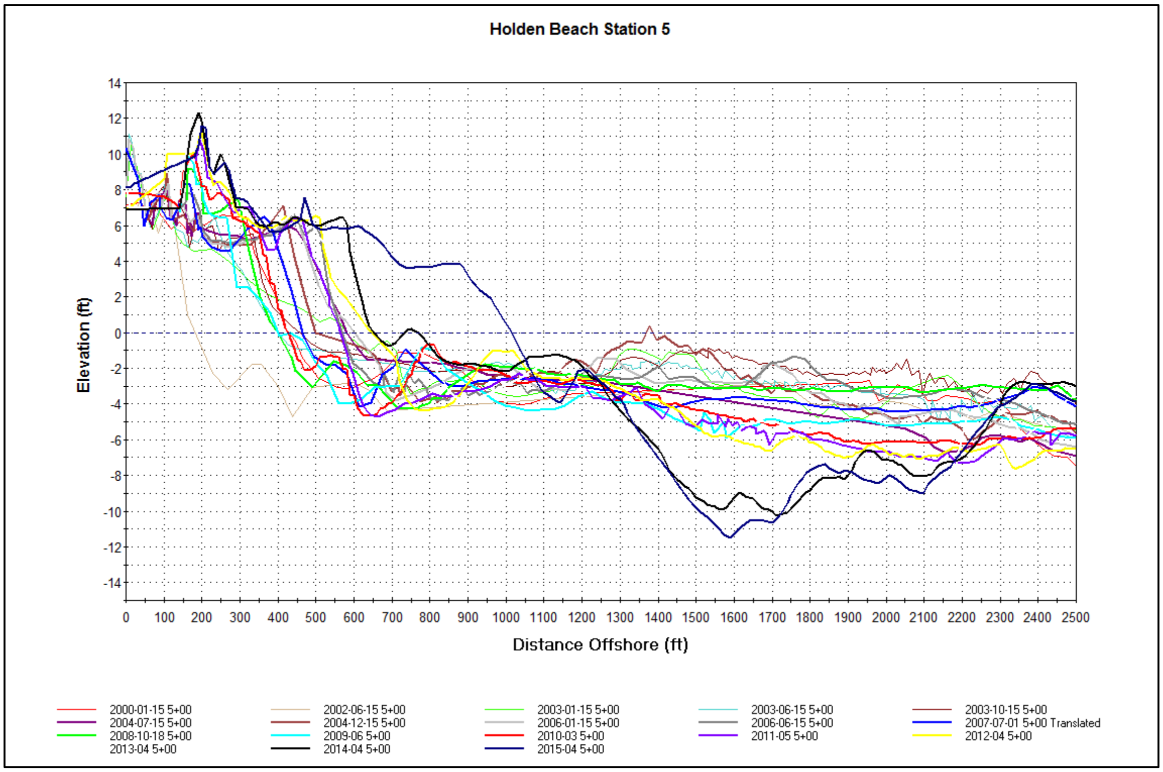

Figure C-10a. Holden Beach Historic Survey Profiles; Station 5+00. Elevations in NGVD29 (subtract 1.1 feet for NAVD88).

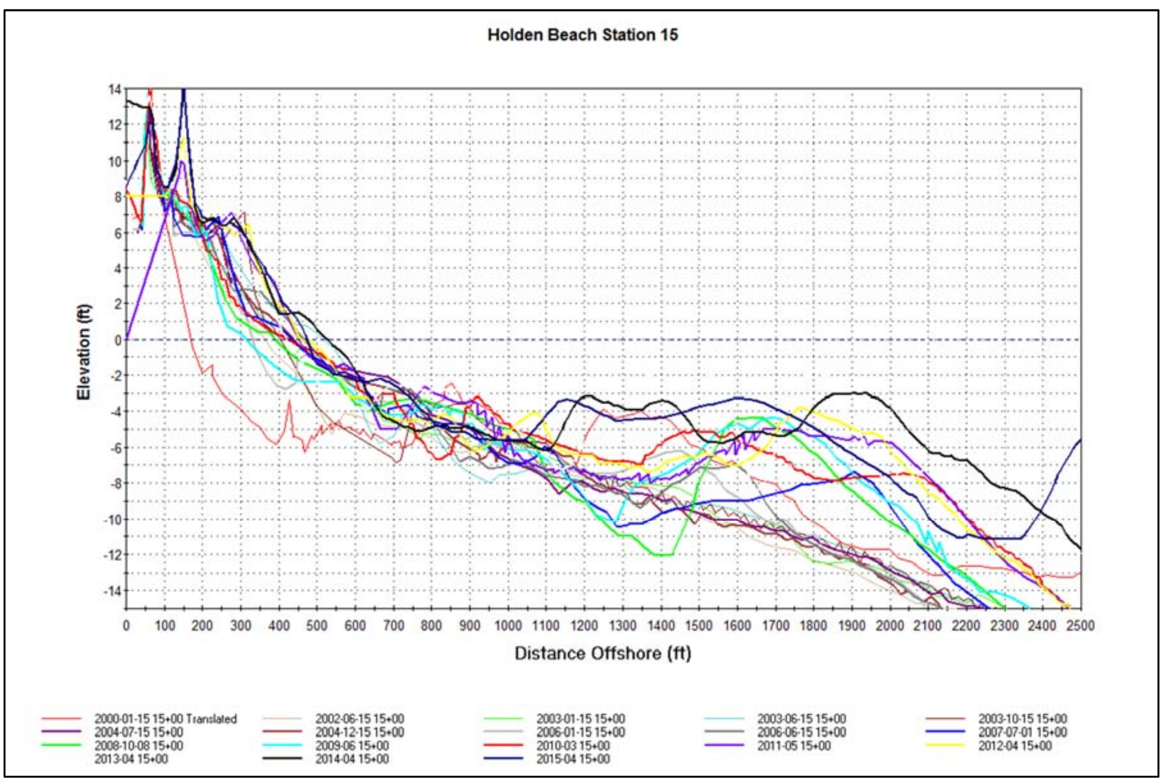

Figure C-10b. Holden Beach Historic Survey Profiles; Station 15+00. Elevations in NGVD29 (subtract 1.1 feet for NAVD88).

3.3.2 OAK ISLAND WEST END

The Town of Holden Beach began monitoring seven (7) transects on the west end of Oak Island in 2012 (Figures C-9 and C-12). The Town of Oak Island has also performed some independent monitoring of the island shoreline since as early as 1997 through annual surveys extending from the dune out to approximately MLW. These Town of Oak Island monitoring transects are shown in Figure C-11.

For the purposes of this document, the transects performed by the Town of Oak Island will be referred to as the “Cleary” transects, and the “Oak” transects refer to those collected by the Town of Holden Beach. Note that Cleary transect data collection was discontinued after December 2011.

Cleary Transects 10 and 9 align well with two (2) of Holden Beach’s Oak Island monitoring stations (Oak 5 and Oak 6). Figure C-12 shows the proximity of these sets of monitoring transects. Similar to Station 0+00 on Holden Beach, the westernmost Holden Beach monitoring station on Oak Island is the starting location for three transects (Oak 1-3), considered for the baseline and threshold analyses. Transects Oak 4,5 and 6 are also used in the analysis.

In addition to the Cleary transects, portions of NCDEQ historical shoreline data were also investigated on Oak Island. Figure C-13 shows historic shorelines along Oak Island’s west end. Of special note is shoreline variation near the Oak 5 and Cleary 10 transects. Shoreline variation near these proximal transects exhibits similar patterns and magnitudes. Because the Cleary monitoring transects date back to as early as 1997 and due to the similarities in shoreline change and proximity of the Oak and Cleary transects, erosion rates at Cleary transect 10 will be used to supplement data at Oak 5. Similarly, erosion rates at Cleary transect 9 will be used to supplement data at Oak 6.

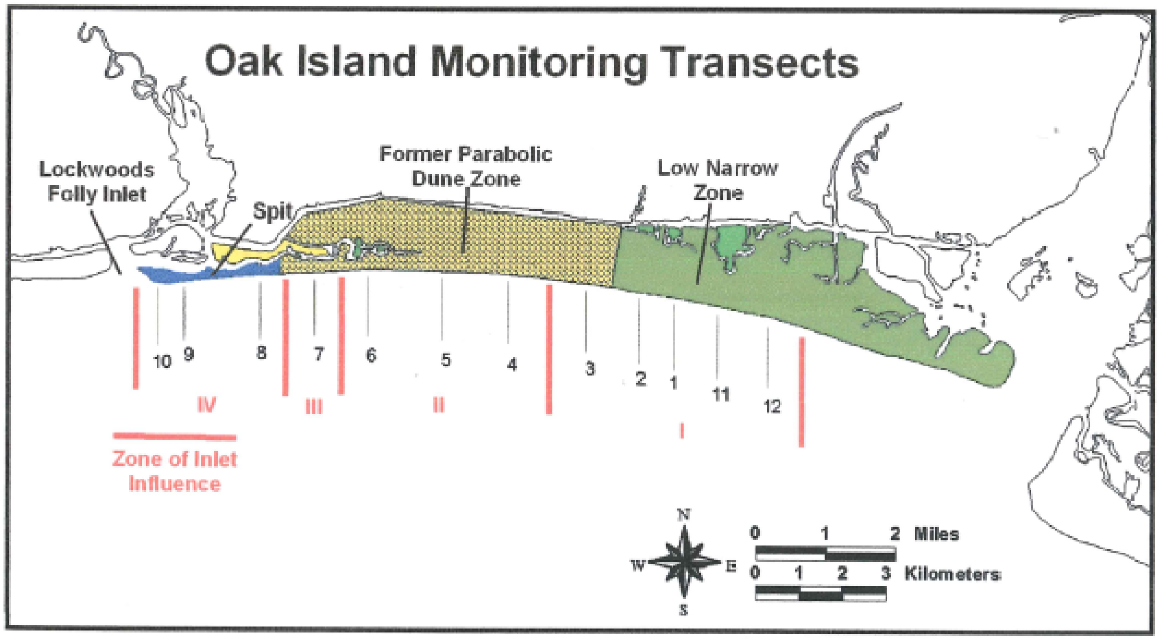

Figure C-11. Town of Oak Island Monitoring Transects, identified as the "Cleary" Transects within this document (Source: Cleary, 2012).

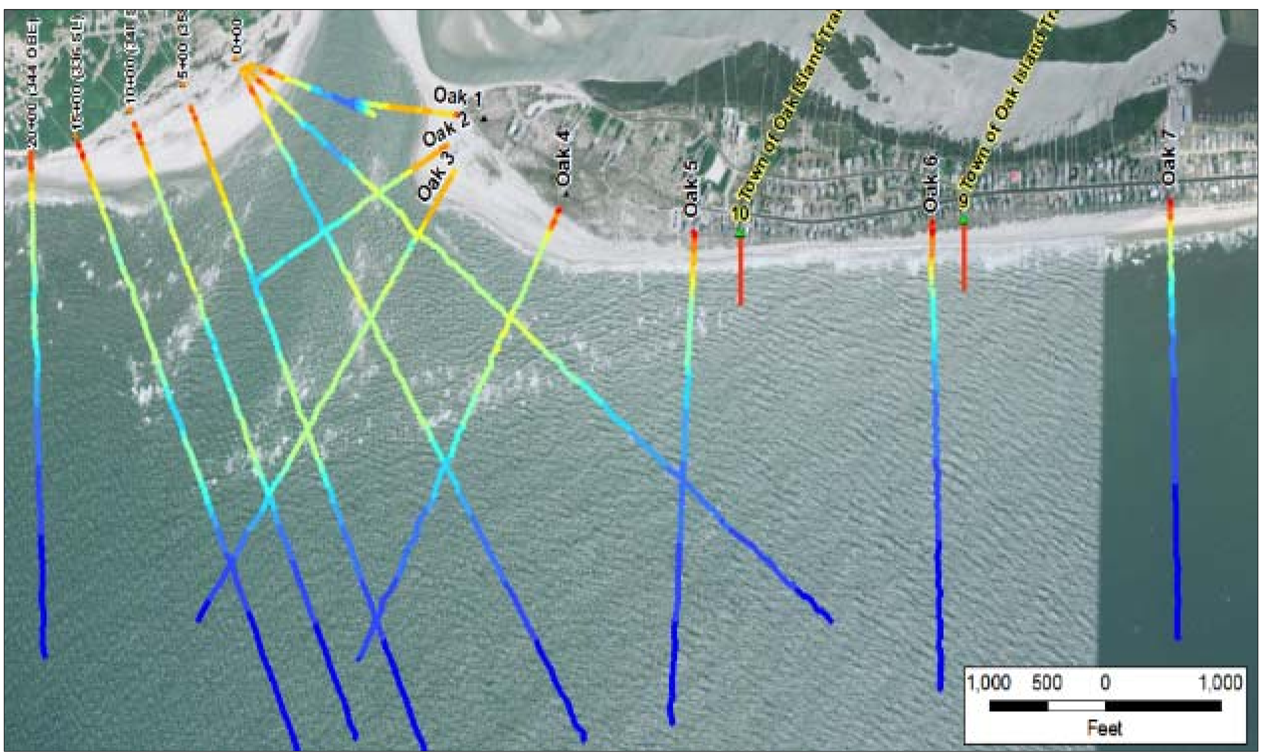

Figure C-12. Town of Oak Island (Cleary) Monitoring Transects (text with yellow halo) (Source: Cleary, 2012). Holden Beach transects shown with white halo.

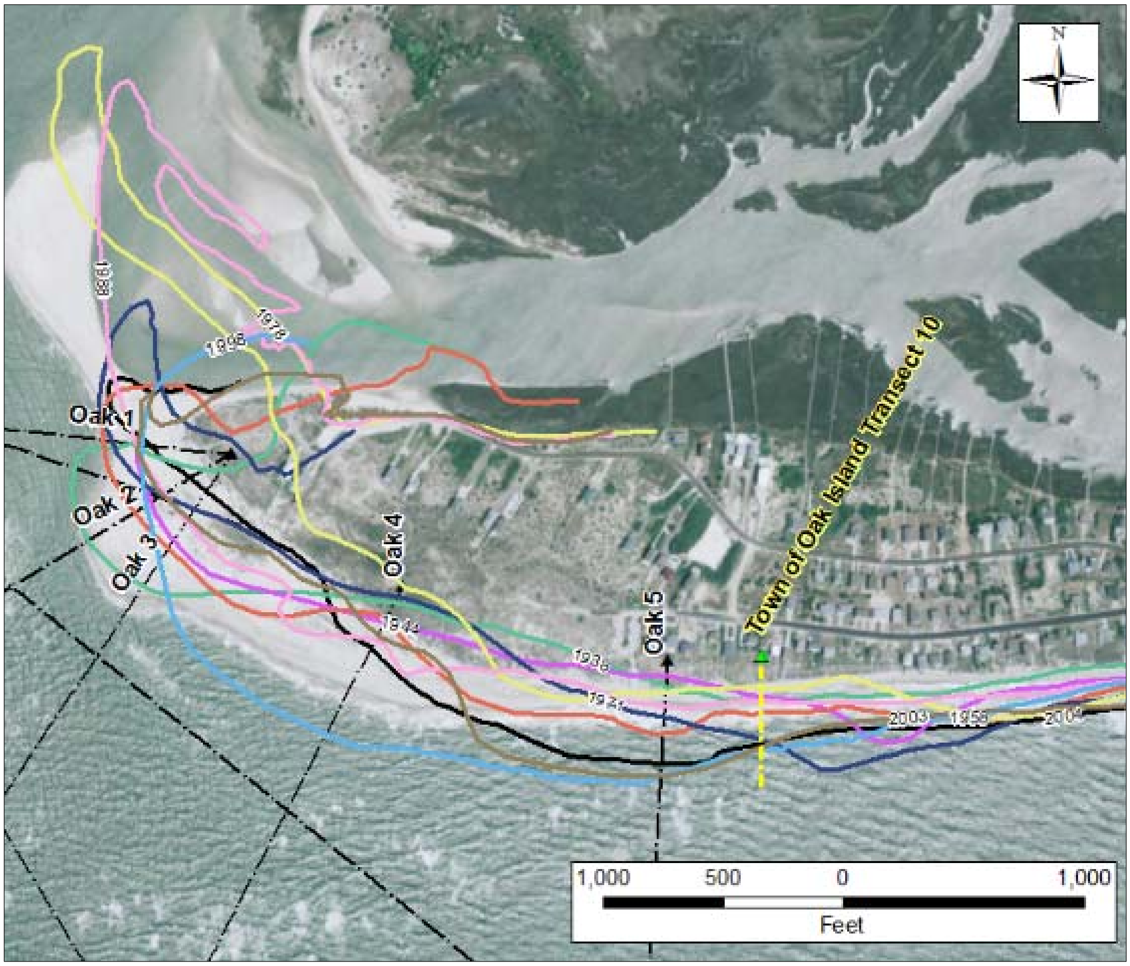

Figure C-13. NCDEQ Historic Shorelines along Oak Island West End.

Tables C-5 and C-6 present MHW shorelines and changes for monitoring transects along Oak Island's west end. Table C-7 presents a summary of only those monitoring transects proposed for use in baseline and threshold determination.

Table C-5. Town of Holden Beach's Oak Island West End Monitoring Stations – Historic MHW Positions and MHW Changes. Red indicates erosion.

Survey Date	MHW Shoreline Location, ft							MHW Shoreline Change, ft						
	Oak 1	Oak 2	Oak 3	Oak 4	Oak 5	Oak 6	Oak 7	Oak 1	Oak 2	Oak 3	Oak 4	Oak 5	Oak 6	Oak 7
Apr-12	497	977	995	587	303	181	115	-	-	-	-	-	-	-
Apr-13	563	544	657	512	211	173	129	65	(433)	(338)	(75)	(92)	(7)	14
Apr-14	511	650	677	460	198	169	143	(52)	106	19	(52)	(13)	(4)	14
Apr-15	842	737	979	326	293*	333*	126	331	87	302	(134)	94*	163*	(17)
Max (Accretional)	842	977	995	587	303	333	143	331	106	302	(52)	94	163	14
Min (Erosional)	497	544	657	326	198	169	115	(52)	(433)	(338)	(134)	(92)	(7)	(17)

**Note – a nourishment on the west end of Oak Island occurred at these transects prior to the April 2015 survey (Spring, 2015).*

Table C-6. Oak Island's West End Monitoring Stations –MHW Changes (Cleary, 1997-2012) between surveys (initial survey date is July 1997).

Survey Date	MHW Shoreline Change, ft	
	Cleary 10	Cleary 9
Jun-98	(16)	7
Jun-99	10	26
Jun-00	39	(23)
Jun-01	(48)	69
Jun-02	(25)	46
Jun-03	65	(26)
Jun-04	36	10
Jun-05	(15)	49
Jun-06	(114)	(56)
Aug-07	52	(35)
Jul-09	(38)	(39)
Nov-10	18	16
Dec-11	6	31
Max (Accretional)	65	69
Min (Erosional)	(114)	(56)

Table C-7. Oak Island West End Summary Baseline Annualized MHW Changes.

Monitoring Transect	Maximum MHW Shoreline Change, ft*
Holden Beach - Oak 1	+ 331, - 52
Holden Beach - Oak 2	+ 106, - 433
Holden Beach - Oak 3	+ 302, - 338
Holden Beach - Oak 4	- 52, - 134
Holden Beach - Oak 5*	+ 65, - 114
Holden Beach - Oak 6*	+ 69, - 56

**Includes max MHW change from Cleary transects 9 and 10 (1997-2011) and Holden Beach transects 5 and 6 (2012-present).*

3.4 THRESHOLDS

The information presented in Sections 3.1 through 3.3 indicates that the naturally occurring processes of the inlet channel and shoal migration, as well as significant storm events may overshadow potential effects (positive and/or negative) of the proposed groin on adjacent shorelines. Previous studies and the physical history of the project site also reveal a profoundly dynamic morphological environment, specifically within the inlet area and along adjacent shorelines.

While in a regional sense, Holden Beach is downdrift of the terminal groin, locally, the sediment transport is directed into LWF Inlet. While the chief concern of potential terminal groin detrimental impacts is downdrift of the structure, which include Stations 0+00 (Radials 109,119,129) through 15+00, all sixteen (16) stations presented previously in Figure C-9 will be utilized in the threshold analysis. This includes both Holden Beach and Oak Island stations. Potential groin impacts (positive and/or negative), however, are not anticipated on Oak Island due to regional and local sediment transport process patterns.

NCDEQ DCM long-term shoreline erosion rates at individual DCM transects along Holden Beach's East End can reach over ten (10) feet per year (Figure C-6); however the trigger methodology must also take into account short-term shoreline change rates as well because of the frequency of the surveys.

In general, there will be two layers to the methodology for evaluation of potential post-project impacts related to thresholds: 1) comparison of post-project MHW shoreline change rates to historical (i.e., background) erosion rates, using recent (2000-present) statistical variations as a guide; 2) comparison of post-project shoreline change rates within the monitoring area to adjacent shoreline reach post-project and historical change rates. The second comparison is anticipated to be needed if significant nor'easter(s), tropical system(s), or an extended period of higher wave activity occurs where shorelines over the entire region experience higher than typical erosion rates. More discussion on these components is presented in the following paragraphs.

At discussed in previous sections, MHW shoreline data can vary significantly from survey to survey, depending on the season and recent wave activity, among other influences. Baseline values are considered the maximum annualized MHW erosion rates as shown in Tables C-4 and C-7 and summarized in Table C-8 on the following page. Severe accretional or erosional conditions can also persist for several years before a cyclical reversal of conditions. Therefore, if monitoring efforts over any consecutive two-year period show consistent annualized erosional conditions surpassing a "baseline plus 25% or more" of the threshold, the TAC, discussed in Section 4 below, will be prompted to review the monitoring and other data and determine whether mitigation is required, and if so, the appropriate mitigation method. The baseline plus 25% MHW change threshold will be assessed at each individual transect and represents a reasonable basis for investigation into potential groin impacts. This baseline and threshold trigger methodology for terminal groins is similar in nature to the approved methodologies at Bald Head Island, NC as well as recently proposed methodologies at Ocean Isle, NC. Baselines and thresholds are summarized in Table C-8.

Table C-8. Summary Baseline and Threshold MHW Changes

Monitoring Transect	Baseline MHW Annualized Shoreline Change, ft/yr	Baseline + 25% Annualized MHW Erosion Threshold, ft/yr
50+00	(129)	(161)
40+00	(130)	(163)
30+00	(152)	(190)
20+00	(106)	(133)
15+00	(80)	(100)
10+00	(167)	(209)
5+00	(182)	(228)
0+00 (109)	(466)	(583)
0+00 (119)	(253)	(316)
0+00 (129)	(181)	(226)
Holden Beach - Oak 1	(52)	(65)
Holden Beach - Oak 2	(433)	(541)
Holden Beach - Oak 3	(338)	(423)
Holden Beach - Oak 4	(134)	(168)
Holden Beach - Oak 5	(114)	(143)
Holden Beach - Oak 6	(56)	(70)

In addition to post-project comparisons to historical rates, nor'easters and tropical storms impacts can also affect individual monitoring events, therefore, relative comparisons (between downdrift and control beaches) are needed. Control beaches may include central portions of Holden Beach and Oak Island.

Mitigation is not required for impacts caused by sources other than the terminal groin project, such as storms or other natural events or unrelated beach/dredging projects (or lack thereof).

As discussed in Section 2.4, volumetric (cy/ft) analysis at each station will occur in addition to the MHW shoreline analysis. Volumetric analysis at each station extends from the dune out to approximately -20 feet NAVD88. In general, there is a good correlation between volumetric and MHW change. However, in some situations, especially following significant storm events, sand on the upper beach can relocate to the nearshore. As a result of this natural response, the MHW line can shift dramatically while volumetric changes are much less severe (due to a net nearshore gain, or sand bar creation). If the MHW analysis indicates a threshold exceedance, volumetric analysis will also be evaluated to determine whether mitigation is appropriate. In situations where the MHW threshold is exceeded, but the volumetric data for that profile is within the threshold (i.e., less than 25% of the volumetric threshold), sand has merely been moved, but remains within the active profile. Therefore, in these situations, mitigation may not be appropriate. While volumetric data provide a useful tool to evaluate profile changes, volumetric data are only available back to 2012 for the Oak Island stations and therefore do not provide as sufficient a baseline as the MHW data. Therefore, volumetric data will be used to evaluate whether mitigation may be appropriate, but will not be used to establish baseline conditions or to evaluate whether a threshold has been exceeded.

4.0 TECHNICAL ADVISORY COMMITTEE (TAC)

The core TAC shall include two (2) licensed professional engineers with substantial expertise and employment experience in coastal engineering, one (1) coastal engineer from the Town of Holden Beach and one (1) coastal engineer from the Town of Oak Island. The core TAC shall be formally established prior to of construction of the terminal groin project. The core TAC will also meet prior to construction of the project and review annual and semi-annual monitoring reports/data. Each town will be responsible for hiring their own consultant for the core TAC (this was agreed upon by both towns in order to minimize conflicts of interest).

If results of monitoring efforts reveal any shoreline change exceeding the thresholds potentially attributable to the terminal groin project, a third coastal engineer will be included in the TAC. The third engineer will act as an independent party and will be hired jointly by Holden Beach and Oak Island.

It will be the duty of the TAC to evaluate the monitoring results and assessments of project, adjacent, and regional shorelines, beach disposal events or delay thereof, and storms and other natural events to determine if there are any shoreline conditions exceeding threshold values that are directly attributable in a material way to the terminal groin project. In addition to the review of MHW change analysis, volume change analysis will also be conducted to assess any nearshore or cross-shore effects. Coordination with USACE and DCM staff will occur during this review process.

Should a majority of the TAC find that a shoreline impact exists that exceeds a threshold value due, in a material way, to the proposed terminal groin project, and is not attributable to other causes, the Town of Holden Beach shall work with the TAC and affected parties to implement appropriate mitigation measures, consistent with the reasonableness and cost-benefit standards of Session Law 2013-384 or subsequent law.

5.0 MITIGATION

Mitigation work required due to documented adverse impacts resulting from groin effects may include (but is not limited to):

- renourishment of the beach adversely affected by the groin;
- reconfiguration, notching or shortening of the groin;
- complete removal of the groin.

The exact form of mitigation required will depend on the location, type, and extent of the adverse impact as determined by the Technical Advisory Committee. Potential mitigation steps must necessarily be adaptive and tailored to site specific conditions.

When mitigation work is required, it will be completed within the next acceptable environmental window as determined by the TAC and regulatory agencies. The chosen mitigation method may likely be implemented to avoid impacts during sea turtle nesting season or other natural resources concerns (e.g., shorebirds).

Commitment of Funding

The Town is committed to funding the monitoring and any potential mitigation related to the terminal groin over the life of the project. The Town has several sources of funding available, including the Beach Preservation/Access & Recreation/Tourism (BPART) Fund. This fund has regularly financed the Town's nourishments and accompanying projects for the past fifteen (15) years. The BPART fund will be available to finance all monitoring and any mitigation. In addition, the Town has several other financing options as well (e.g., bonds). Detailed financial information; including monitoring costs, TAC costs, a financial assurance package pursuant to N.C. Gen. Stat. § 113A-115.1(e)(6), and a detailed cost estimate for removal of the terminal groin; will be provided to DCM with the CAMA Major Permit application.

6.0 SUMMARY

The Town of Holden Beach remains committed to the successful long-term health of the shoreline in and surrounding the project area. As a result, it will adhere to all monitoring and mitigation as required by regulatory agencies to ensure the success of the proposed project. In this respect, the Town will monitor the project site as well as the inlet management area to document project performance and any potential deviations from what is anticipated to occur. The Town will place nourishment sand when needed and will work in concert with any nourishment activities by the USACE to maintain the health of the project and surrounding inlet management area once the groin has been installed. The Town's inlet management plan will necessarily be adaptive to respond to any issues or concerns that arise over the long-term. The proposed monitoring in this document forms the basis of this long-term management plan.

7.0 REFERENCES

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Table C-9: Mean High Water (MHW) Annualized Shoreline Change for Eight HB Monitoring Stations (Oak Island Transects can be found in Tables C-6 and C-7)

Station	Jan-00	Jun-02	Jan-03	Jun-03	Nov-03	Jul-04	Dec-04	Jan-06	Jun-06	Jul-07	Apr-08	Oct-08	Jun-09	Mar-10	May-11	Apr-12	Apr-13	Apr-14	Apr-15
109+00	-	-	(466)	474	(207)	-	-	73	115	138	(170)	(70)	63	86	(51)	53	(116)	61	5
119+00	-	-	(253)	381	(210)	-	-	170	(40)	(23)	(152)	(9)	15	38	(23)	45	(80)	64	(1)
129+00	-	(117)	(181)	324	(171)	615	-	70	(167)	(119)	(127)	2	15	24	136	(144)	(33)	55	10
5+00	-	(96)	307	(35)	89	246	(143)	39	65	(98)	(182)	113	(79)	132	113	31	46	12	307
10+00	-	16	221	144	178	(167)	134	23	(115)	(41)	(68)	(63)	53	(51)	159	17	92	(46)	(66)
15+00	-	47	66	106	(10)	(47)	4	(17)	116	(42)	(80)	44	(23)	41	111	(26)	(28)	32	18
20+00	-	(29)	166	(39)	50	(70)	6	(12)	231	(106)	30	(93)	74	(27)	22	2	(18)	3	73
30+00	-	11	(100)	62	1	48	30	(39)	353	(114)	47	(152)	101	(42)	99	(82)	(17)	44	(37)
40+00	-	(5)	(22)	100	6	47	39	(69)	172	(31)	63	(130)	110	(82)	43	(47)	19	28	(18)
50+00	-	(14)	40	132	(29)	48	(3)	(55)	108	(10)	69	(129)	98	(54)	21	(32)	5	50	(31)

NOTES: MHW shoreline change was calculated for each consecutive survey. Red indicates erosion. Surveyed MHW change rates are shown for the final date. For example, the January-2000 to June-2002 MHW change rate is shown under the June-2002 column. Rates were annualized (i.e., converted to a yearly erosion rate) based on the measured MHW change and then adjusted by the amount of time between consecutive surveys. Time between surveys is typically about one year (where annualizing is not required), however time between surveys ranges from ~5 months to ~1.2 years (with the exception of the Jan-2000 to Jun-2002 surveys which are ~2.4 yrs apart and the Station 129+00 survey between July-2004 and January-2006 [~1.5 yrs]). As mentioned previously, surveys were taken less frequently for Station 0+00 Radials 109+00 and 119+00 and therefore the time between surveys was longer between 2000 and 2006 (up to ~3 years between the Jan-2000 and Jan-2003, and ~2.2 years between the Nov-2003 and Jan-2006 surveys).