



STATE OF NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

ROY COOPER
GOVERNOR

JAMES H. TROGDON, III
SECRETARY

October 30, 2018

Mr. Scott Lanier
Pea Island National Wildlife Refuge
United States Fish and Wildlife Service
P.O. Box 1969
Manteo, NC 27954

Subject: Special Use Permit for Construction Activities
NC-12 – Rodanthe Breach Long-Term Improvements, Bonner Bridge Replacement Project
Phase IIb in Dare County, North Carolina; TIP Project B-2500B, Federal Aid Project No.
BRNHF-0012(56); WBS Element 32635.3.FR7

As you are aware, the North Carolina Department of Transportation (NCDOT) proposes construction of the NC-12 Rodanthe Bridge as part of the Rodanthe Breach Long-Term Improvements project (TIP Project B-2500B (Phase II)) in Dare County, North Carolina.

We are aware that you have prepared a Draft FONSI for an Amendment to the Right-of-Way Easement for NC 12 that is currently on/ or recently removed from Public Notice. In an effort to expedite the start of selective, non-permanent activities noted in the Amendment, as well as to authorize impacts refined during the design process. We are submitting a completed Special Use Permit Application with drawings for your review.

The proposed improvement project is approximately 2.8 miles in length, including 2.4 miles of bridge. The bridge will extend approximately 1,400 ft into Pamlico Sound at its farthest point. NC 12 will leave the existing NC 12 easement within the Refuge boundary at a point approximately 1.8 miles north of the Refuge boundary with Rodanthe and enter Pamlico Sound. The bridge will be in Pamlico Sound until a point north of the emergency ferry terminal, where the relocated NC 12 will turn east and enter Rodanthe. The road will then re-join NC 12 just north of the Liberty Service Station/Island Convenience Store.

Included for your reference and review are roadway drawings from the 404/401/CAMA permit application (that are relevant to the Refuge), and the USFWS and NOAA Biological and Conference Opinions for Endangered Species Act Section 7 consultation.

Previous Coordination

NCDOT and FHWA completed the National Environmental Policy Act (NEPA) studies for B-2500B and issued a Record of Decision (ROD) in December 2016. Following the issuance of the ROD, NCDOT awarded a design-build contract for B-2500B and requested that the Design-Build Team design the new bridge such that it reduces the amount of new easement needed within the Refuge and the National Seashore from what was estimated in the ROD. Since the team began the final design process, NCDOT has coordinated with your office on that design and its potential impacts to the Refuge. This application reflects this final design.

Proposed Schedule

Project construction has commenced in Rodanthe, with proposed completion of the new bridge by September 2020. The proposed schedule is subject to change, depending on permit approvals and the resolution of litigation related to the Project.

Easement Minimization

The Design-Build Team and NCDOT have closely coordinated to minimize impacts to the Refuge and avoid or minimize easement requirements for the Project. The primary goal was to align the bridge so that impacts to the Refuge were as minimal as feasible while adhering to NCDOT and FHWA design standards.

Permanent New Easement

New easement within the Refuge is necessary for the northern approach to the new bridge. The northern approach, within the Refuge and the Seashore, is located to the west of current NC 12 in order to avoid potential future breaches that could wash out NC 12. This new easement area is 2.937 acres. NCDOT will abandon NC 12 easement south of this new easement, with will return 18.925 acres back to the Refuge.

NCDOT will incorporate several Best Management Practices (BMPs) into the design and construction of the Project has been reviewed and approved by state and federal resource agencies. Wetland areas and environmentally sensitive areas immediately adjacent to but not affected by the Project will be protected from unnecessary encroachment using tree protection fencing or an equivalent measure. The project will be consistent with those measures outlined in the Project Commitments of the ROD. Individual avoidance and minimization measures that affect the Refuge include the following:

Design Measures

- Stormwater will be collected on both bridge approaches (107 ft southern end left, 239 ft southern end right, and 121 ft northern end right) and discharged away from jurisdictional features.
- Deck drains will be installed at variable distances throughout the entire length of the bridge and will be a minimum of 14 ft or more off the surface water.

Protected Species Measures

- A pre-construction lighting design coordination meeting to establish the parameters of the lighting set-up was conducted with representatives of UFWS on August 13, 2018.
- The August 13, 2018 meeting also discussed how to minimize disturbance to sea turtles and other protected species. Night lighting will meet the requirements specified in the attached USFWS Biological and Conference Opinions, unless otherwise specified by USFWS.
- On-site personnel will implement the “Guidelines for Avoiding Impacts to the West Indian Manatee: Precautionary Measures for North Carolina Waters.”
- On-site personnel will follow the NOAA Fisheries document “Sea Turtle and Smalltooth Sawfish Construction Conditions.”

Advancing Rail System

A specially designed advancing rail system that runs along both sides of the new bridge will be used for construction. The system will have an open grate to allow for sunlight to minimize shading impacts to SAV. Cranes will run along the rail system and be used for construction. The rail system will be approximately 1,300 ft in length at each end. Each span of the rail system will be in place for approximately 4 months prior to being moved forward, which is what allows the rail system to be limited to the 1,300 ft length on each end. Impacts due to the pipe piles for the rail system will be limited as much as possible.

Construction Staging Measures

- On the southern end, staging of construction equipment or storage of construction supplies will occur within the lay-down yard as designated on the plans. This area was chosen due to its proximity to the roadway and minimizes impacts to the driving public.
- On the northern end, staging will occur in a parking area adjacent to NC 12 and under the bridge to minimize disturbance within the Refuge. Wetlands that are not otherwise impacted will be avoided.
- The contractor will minimize traffic impacts to Refuge visitors, while also minimizing the footprint of personnel access (parking vehicles, etc.) by utilizing the staging areas, unopened bridge deck, and off-site parking lots.
- Lighting required at the staging areas and for construction was reviewed in a meeting with USFWS and NMFS on August 13, 2018 to ensure no adverse effects to nesting sea turtles.
- Fueling stations will be contained to avoid inadvertent spills reaching surface waters. Any spills will be controlled and reported as applicable.

Jetting Measures

In order to minimize the effects of the jetting process for pile installation, the contractor will utilize primary and secondary containment systems to capture the jetting effluent. The primary and secondary containment systems will be used at bents 6 through 91 in the open water. A similar system will be used in wetlands and upland to capture the sediment prior to leaving the containment area, which are bents 4 and 5 and 92 through 101. The setup may vary due to other constraints such as wetlands and shorelines. A concrete sheet pile wall will also be jetted in place, within the refuge, needed for construction of the bridge approach. Similar containment measures will be employed.

- Jetting spoils will be contained within the primary containment area until access is available to remove via the bridge deck (approximately 8 months). Spoils will be transported from the containment area to a temporary stockpile at the bridge approaches for drying. The spoils will then be incorporated into the project or disposed of in accordance with standard NCDOT waste agreement protocol.

General Construction Measures

- NCDOT will carry out the stipulations in the Section 106 Programmatic Agreement that outlines mitigative measures pertaining to the Refuge.
- NCDOT has elected to use more hand clearing rather than mechanized clearing within wetlands where feasible to minimize impacts.
- To ensure that borrow and waste activities occur on high ground, except as authorized by permit, the NCDOT shall require its contractors to identify areas to be used to borrow material, or to dispose of dredged, fill or waste material. Documentation of the location and characteristics of all borrow and disposal sites associated with the construction of the Project will be available upon request.
- Sediment and erosion control measures shall adhere to the Design Standards in Sensitive Watersheds during construction.
- Special Sediment Control Fence and Environmentally-Sensitive Area fencing will be used where applicable.
- A utility line along NC 12 will be temporarily moved during construction, as shown in the attached drawing, and will be returned to existing locations after construction is complete. NOTE: This utility relocation has been modified from that provided for the Draft FONSI.
- Once the new bridge is constructed and traffic can be directed over the bridge, approximately 18.295 acres of abandoned NC 12, which includes approximately 6.5 acres of asphalt within the Refuge, will be removed and the area returned to its natural state. Road demolition material will be shipped to a designated third-party contractor for re-use in construction material.

- The sandbags used to create the dunes in the Refuge just north of the boundary with Rodanthe will be removed once the new bridge is constructed and NC 12 routed onto it. NCDOT will convene a meeting with the Refuge, NC Division of Coastal Management, and contractor prior to commencing the removal to assure it is performed in accordance with Refuge's expectations.
- The Contractor will develop an Environmental Commitment Monitoring Plan that will provide an easily referenced guide of the project commitments that are particularly pertinent for construction personnel.

Construction Sequence

Construction of the south end will begin first with construction of the north end to begin following relocation of a power line utility. A rail system will be used for construction of the bridge. It will run along both sides of the bridge. Cranes will run along the rail system and be used for construction.

The rail system will be approximately 1,300 ft long at each end (north and south). Each span of the rail system will be in place for approximately 4 months prior to being moved forward, which is what allows the rail system to be limited to the 1,300 ft length.

Traffic

Traffic will be maintained on existing NC-12 during construction of the new bridge. In the Refuge, it will be directed onto a short, temporary easement that is necessary to allow the new roadway to tie into existing NC 12. A portable short concrete barrier will be placed between the temporary easement and the work zone for safety. A round-about will be installed at the south end of the Project to tie the new roadway into existing NC 12. Once the new bridge and round-about are complete, then traffic will be moved to the new facility and the abandoned NC 12 within the Refuge will be removed.

Specific Activities Requested for Approval by the USFWS:

The temporary relocation of the utilities

As the Utility Relocation has been finalized by Cape Hatteras Electrical Cooperative (CHEC), the details of this relocation, including impacts to Jurisdictional Resources have become available.

Temporary Impacts to wetlands are necessary to temporarily relocate the high voltage transmission lines to accommodate safe bridge construction. Wetlands would be hand cleared and depending on site conditions, temporary mats will be used to support vehicular equipment.

The relocation is anticipated to take five days to complete at which point any temporary fill will be removed. Once bridge construction is complete, the lines will be returned to their original location, which will take another five days to complete.

Temporary Matting for Jetting Intake Activities

In an effort to minimize impacts/ disturbance to wetlands, temporary mats will be used during the installation and removal of the jetting intake pump, hose, and related equipment.

Advancing Rail System

The final design of the advancing rail system has slightly changed since the design phase. This reconfiguration has an overall footprint reduction.

Temporary re-location of NC 12

In order to accommodate construction of the new bridge, as well as maintain traffic on NC 12, a temporary detour will be created to shift traffic parallel to the existing NC 12. A short portable concrete barrier will be placed between the detour and the work zone for safety.


Regulatory Approvals

NCDOT anticipates that these activities will also be authorized under the following permits:

- USACE Nationwide Permit 404 (issued June 22, 2018)
- NC Division of Water Resources 401 Water Quality Certification (issued June 11, 2018)
- NC Division of Coastal Management CAMA Major Development Permit (issued June 11, 2018)
- US Coast Guard (Applied July 13, 2017 and July 20, 2018, and currently on Public Notice from October 15 to November 16, 2018,)
- US Army Corps of Engineers Nationwide 6 Permit for the geotechnical investigation (SAW- 2017-00540, Issued April 14, 2017)
- US National Park Service Special Use Permit for geotechnical investigation (5700-022, Issued June 15, 2017)
- US Fish and Wildlife Service Species Use Permit for geotechnical investigation (2017-001G, Issued March 25, 2017)
- National Park Service Special Use Permit (Applied June 21, 2018)

We are hereby requesting a Special Use Permit from the USFWS for this activity. If you have any questions or would like additional information, please contact Michael Turchy at maturchy@ncdot.gov or (919) 707-6157. A copy of this application will also be posted at <https://xfer.services.ncdot.gov/pdea/PermApps/>.

Sincerely,

A handwritten signature in blue ink, appearing to read "P. Harris, III", with a horizontal line underneath.

Philip S. Harris, III, P.E., C.P.M., Unit Head
Environmental Analysis Unit

cc: David Herring, Design Build Unit



General Activities Special Use Permit Application

Refuge:

Address:

Attn: (Refuge Official)

E-Mail:

Phone #:

For Official Use Only:

Permit #:

Station #:

Permit Term: from to

Note: We do not require all information for each use. See instructions at the end of the notice and contact the refuge identified above to determine applicability of a particular item. Attach additional sheets to the application if the text spaces provided are inadequate.

1) Identify the type of Permit you are applying for: New Renewal Modification Other

Applicant Information

2) Full Name: 3) Organization:

4) Street Address:

5) City/State/Zip:

6) Phone #: 7) Fax #:

8) E-mail:

9) List known assistants/subcontractors/subpermittees: (Only required if the assistants/subcontractors/subpermittees will be operating on the refuge without the permittee being present.)

Name/Business	Address	Phone #

Activity Information

10) Activity type: Event Wood Cutting Group Visit Educational Activity
 Cabin/Subsistence Cabin Other

Note: Depending on the activity for which you are requesting a permit, we may ask you for the following activity information. Please contact the specific refuge where the activity is being conducted to determine what information is required.

11) Specifically identify timing, frequency, and how the activity is expected to proceed:

12) Activity/site occupancy timeline: (Specifically identify beginning and ending dates, site occupation timeline, hours, clean-up, and other major events.)

13) Expected number of participants, if applicable: Children (1-18) Adults Total

14) Grade level of educational group, if applicable: Grade

15a) Will staff time/assistance be required for group activities? Yes No N/A

15b) If yes, what's the anticipated time frame?

16a) Plan of Operation required? Yes No N/A 16b) Plan of Operation attached? Yes No

17) Specifically identify location(s): (GPS location(s) preferred)

18a) Is map of location(s) required?
 Yes No N/A

18b) Is map of location(s) attached?
 Yes No

Insurance Coverage/License/Certifications/Permits

Note: Contact the specific refuge headquarters office where the activity is going to be conducted to determine if any type of insurance, certification(s), or permit(s) will be required. We may process this Special Use Permit while the applicant obtains them.

19) List any **insurance coverage** you have such as general liability, aviation, grounding liability, contaminants applicator, medical evacuation, or others, if required:

Insurance Type	Carrier Name	Policy Number	Copy Attached? Yes or No

20) Identify licenses, certifications, and permits, if required:

License/Certification/Permit Type	Number (if applicable)	Issued to:	Copy Attached? Yes or No

Logistics and Transportation

Note: Not all information is required for each use. Please contact the specific refuge where the activity is being conducted to determine what information is required. Attach additional sheets to the application if the text spaces provided are inadequate.

21) Does activity require personnel to stay overnight onsite? Yes No

22) List names of personnel involved:

List Names	List Names	List Names
Personnel from Flatiron		
Personnel from NCDOT		
Personnel from Three Oaks Engineering		
Personnel from RK&K		

23) Specifically describe all major equipment/gear and materials used, if required:

Typical construction equipment including an advancing rail system, cranes, and various pickup trucks. See attached cover letter for more details.

24a) Provide detailed information on the logistics for onsite, intersite, and/or ship-to-shore transportation to or on the refuge, if required:

Please see attached cover letter.

24b) Provide descriptions, license plate, or I.D. numbers of vehicles used for onsite, intersite, and/or ship-to-shore transportation, if required:

Type of transportation (onsite, intersite, or ship-to-shore)	Equipment Type	License/I.D./Registration Numbers
intersite	advancing rail system	
onsite	Support truck with trailer	
intersite	various pickup trucks	
onsite	ATV	

25) Specifically describe onsite work and/or living accommodations:

Equipment will be staged off NC 12 as described in the attached letter. Night work will occur periodically throughout the life of the project. Specific names of personnel are not available at this time.

26) Specifically describe onsite hazardous material storage or other onsite material storage space:

Epoxies, concrete form-release oils, and potentially diesel fuel could be stored at the staging area; storage would be per NCDOT requirements.

Sign, date, and print this form and return it to the refuge for processing.

30) Signature of Applicant: Thad C. PC III Date of Application: 10/30/2018
 for Philip S. Harris, III, P.E.

Notice

In accordance with the Privacy Act (5 U.S.C. 552a) and the Paperwork Reduction Act (44 U.S.C. 3501), please note the following information:

The issuance of a permit and collection of fees on lands of the National Wildlife Refuge System are authorized by the National Wildlife Refuge System Administration Act (16 U.S.C. 668dd-ee) as amended, and the Refuge Recreation Act (16 U.S.C. 460k-460k-4).

The information that you provide is voluntary; however, we require submission of requested information to evaluate the qualifications, determine eligibility, and document permit applicants under the above Acts. It is our policy not to use your name for any other purpose. We maintain the information in accordance with the Privacy Act. We will consider all information you provide in reviewing this application. False, fictitious, or fraudulent statements or representations made in the application may be grounds for revocation of the Special Use Permit and may be punishable by fine or imprisonment (18 U.S.C. 1001). Failure to provide all required information is sufficient cause for the U.S. Fish and Wildlife Service to deny a permit.

No Members of Congress or Resident Commissioner shall participate in any part of this contract or to any benefit that may arise from it, but this provision shall not pertain to this contract if made with a corporation for its general benefit.

The Permittee agrees to be bound by the equal opportunity "nondiscrimination in employment" clause of Executive Order 11246.

Routine use disclosures may also be made: (a) to the U.S. Department of Justice when related to litigation or anticipated litigation; (b) of information indicating a violation or potential violation of a statute, rule, order, or license to appropriate Federal, State, local, or foreign agencies responsible for investigating or prosecuting the violation or for enforcing or implementing the statute, rule, regulations, order, or license; (c) from the record of the individual in response to an inquiry from a Congressional office made at the request of the individual (42 FR 19083; April 11, 1977); and (d) to provide addresses obtained from the Internal Revenue Service to debt collection agencies for purposes of locating a debtor to collect or compromise a Federal Claim against the debtor, or to consumer reporting agencies to prepare a commercial credit report for use by the Department of Justice (48 FR 54716; December 6, 1983).

An agency may not conduct or sponsor and a person is not required to respond to a collection of information unless it displays a currently valid OMB control number. OMB has approved this information collection and assigned control number 1018-0102. The public reporting burden for this information collection varies based on the requested specific refuge use. We estimate the relevant public reporting burden for the General Activity Special Use Permit Application form to average 0.5 hours per response, including time for reviewing instructions, gathering and maintaining data, and completing and reviewing the form. Mail comments on this form to the Information Collection Clearance Officer, U.S. Fish and Wildlife Service, 4401 N. Fairfax Drive, MS BPHC, 5275 Leesburg Pike, Falls Church, VA 22041-3803.

General Conditions and Requirements

- 1) Responsibility of Permittee: We shall consider the permittee, by operating on the premises, to have accepted these premises with all facilities, fixtures, or improvements in their existing condition as of the date of this permit. At the end of the period specified or upon earlier termination, the permittee shall give up the premises in as good order and condition as when received except for reasonable wear, tear, or damage occurring without fault or negligence. The permittee will fully repay the Service for any and all damage directly or indirectly resulting from negligence or failure on his/her part, and/or the part of anyone of his/her associates, to use reasonable care.
- 2) Operating Rules and Laws: The permittee shall keep the premises in a neat and orderly condition at all times, and shall comply with all municipal, county, and State laws applicable to the operations under the permit as well as all Federal laws, rules, and regulations governing national wildlife refuges and the area described in this permit. The permittee shall comply with all instructions applicable to this permit issued by the refuge official in charge. The permittee shall take all reasonable precautions to prevent the escape of fires and to suppress fires and shall render all reasonable assistance in the suppression of refuge fires.
- 3) Use Limitations: The permittee's use of the described premises is limited to the purposes herein specified and does not, unless provided for in this permit, allow him/her to restrict other authorized entry onto his/her area; and allows the U.S. Fish and Wildlife Service to carry on whatever activities are necessary for: (1) protection and maintenance of the premises and adjacent lands administered by the U.S. Fish and Wildlife Service; and (2) the management of wildlife and fish using the premises and other U.S. Fish and Wildlife Service lands.
- 4) Transfer of Privileges: This permit is not transferable, and no privileges herein mentioned may be sublet or made available to any person or interest not mentioned in this permit. No interest hereunder may accrue through lien or be transferred to a third party without the approval of the Regional Director of the U.S. Fish and Wildlife Service and the permit shall not be used for speculative purposes.
- 5) Compliance: The U.S. Fish and Wildlife Service's failure to require strict compliance with any of this permit's terms, conditions, and requirements shall not constitute a waiver or be considered as a giving up of the U.S. Fish and Wildlife Service's right to thereafter enforce any of the permit's terms or conditions.
- 6) Conditions of Permit not Fulfilled: If the permittee fails to fulfill any of the conditions and requirements set forth herein, the U.S. Fish and Wildlife Service shall retain all money paid under this permit to be used to satisfy as much of the permittee's obligation as possible.
- 7) Payments: All payment shall be made on or before the due date to the local representative of the U.S. Fish and Wildlife Service by a postal money order or check made payable to the U.S. Fish and Wildlife Service.
- 8) Termination Policy: At the termination of this permit the permittee shall immediately give up possession to the U.S. Fish and Wildlife Service representative, reserving, however, the rights specified in paragraph 11 below. If he/she fails to do so, he/she will pay the U.S. Fish and Wildlife Service, as liquidated damages, an amount double the rate specified in this permit for the entire time possession is withheld. Upon yielding

possession, we will still allow the permittee to reenter as needed to remove his/her property as stated in paragraph 11 below. The acceptance of any fee for the liquidated damages or any other act of administration relating to the continued tenancy is not to be considered as an affirmation of the permittee's action nor shall it operate as a waiver of the U.S. Fish and Wildlife Service's right to terminate or cancel the permit for the breach of any specified condition or requirement.

9) Revocation Policy: The Regional Director of the U.S. Fish and Wildlife Service may revoke this permit without notice for noncompliance with the terms hereof, or for violation of general and/or specific laws or regulations governing national wildlife refuges, or for nonuse. It is at all times subject to discretionary revocation by the Director of the Service. Upon such revocation the U.S. Fish and Wildlife Service, by and through any authorized representative, may take possession of said premises for its own and sole use, and/or may enter and possess the premises as the agent of the permittee and for his/her account.

10) Damages: The U.S. Fish and Wildlife Service shall not be responsible for: any loss or damage to property including but not limited to crops, animals, and machinery; injury to the permittee or his/her relatives, or to the officers, agents, employees, or any other(s) who are instructed to be on the premises; the suffering from wildlife or employees or representatives of the U.S. Fish and Wildlife Service carrying out their official responsibilities. The permittee agrees to hold the U.S. Fish and Wildlife Service harmless from any and all claims for damages or losses that may arise to be incident to the flooding of the premises resulting from any associated government river and harbor, flood control, reclamation, or Tennessee Valley Authority activity.

11) Removal of Permittee's Property: Upon the expiration or termination of this permit, if all rental charges and/or damage claims due to the U.S. Fish and Wildlife Service have been paid, the permittee may, within a reasonable period as stated in the permit or as determined by the U.S. Fish and Wildlife Service official in charge, but not to exceed 60 days, remove all structures, machinery, and/or equipment, etc., from the premises for which he/she is responsible. Within this period the permittee also must remove any other of his/her property including his/her acknowledged share of products or crops grown, cut, harvested, stored, or stacked on the premises. Upon failure to remove any of the above items within the aforesaid period, they shall become the property of the U.S. Fish and Wildlife Service.

Instructions for Completing Application

You may complete the application portion verbally, in person, or electronically and submit to the refuge for review. Note: Please read instructions carefully as not all information is required for each activity. Contact the specific refuge headquarters office where the activity is going to be conducted to determine applicability of a particular item. We may add special conditions or permit stipulations to permit prior to approval.

1) Identify if permit application is for new, renewal, or modification of an existing permit. Permit renewals may not need all information requested. Contact the specific refuge headquarters office where the activity is going to be conducted if you have questions regarding the applicability of a particular item.

2-8) Provide full name, organization (if applicable), address, phone, fax, and e-mail.

9) Provide known names and addresses of assistants, subcontractors or subpermittees. Names and address are only required if the assistants, subcontractors or subpermittees will be operating on the refuge without the permittee being present. Volunteers, assistants, subcontractors or subpermittees that are accompanied by the permittee need not be identified.

10) Activity type: check one of the following categories:

- Event;
- Wood cutting;
- Group visit;
- Cabin/Subsistence cabin (subsistence cabins are only allowed on Alaska Refuges);
- Educational activity; or
- Other—any other activity(s) not mentioned above. Please describe "other" activity.

11) Provide detailed information on the activity, including times, frequency, and how the activity is expected to proceed, etc. Permit renewals may not need activity description if the activity is unchanged from previous permit. Most repetitive activities, such as group visits, do not require an activity description for each visit. Contact the specific refuge headquarters office where the activity is going to be conducted to determine if we require an activity description.

12) Identify beginning and ending dates, site occupation timeline, hours, clean-up, and other major events. Permit renewals may not need an activity/site occupancy timeline, if the activity is unchanged from previous permit. Most repetitive activities, such as group visits, do not require an activity/site occupancy timeline for each visit. Contact the specific refuge headquarters office where the activity is going to be conducted to determine if we require an activity/site occupancy timeline.

13-14) Provide an estimate of the number of adults, and children and grade level of group, if applicable.

15a-15b) Identify if group activities will require onsite refuge staff and the anticipated time frame, if applicable.

16a-16b) Identify and attach a Plan of Operation, if required. Most repetitive activities, such as group visits, do not require a Plan of Operation for each visit. In addition, permit renewals may not require a Plan of Operation if the activity is essentially unchanged from the previous permit. Contact the specific refuge headquarters office where the activity is going to be conducted to determine if a Plan of Operation is required.

17) Identify specific location (GPS coordinates preferred), if not a named facility. Most repetitive activities, such as group visits, do not require a location. In addition, permit renewals may not require a location if the activity is essentially unchanged from the previous permit. Contact the specific refuge headquarters office where the activity is going to be conducted to determine if we require a location.

18a-18b) Attach a map of location, if required, and if the activity is not conducted at a named facility. Most repetitive activities, such as group visits, do not require a map. In addition, permit renewals may not require a map if the activity is essentially unchanged from the previous permit. Contact the specific refuge headquarters office where the activity is going to be conducted to determine if we require a map.

19) Provide name, type, and carrier of insurance, if required. Contact the specific refuge headquarters office where the activity is going to be conducted to determine if we require insurance and type of insurance.

20) Specifically identify type(s) and number(s) of other licenses, certifications or permits, if required. Contact the specific refuge headquarters office where the activity is going to be conducted to determine the type(s) of licenses, certifications or permits required, and to coordinate the simultaneous application of several types of licenses, certifications or permits. We may or may not issue this Special Use Permit (SUP) while the permittee obtains other licenses, certifications, and/or permits.

21-22) Provide name(s) of any personnel required to stay overnight, if applicable.

23) Identify all equipment and materials that will be used, if required. Most repetitive events, such as group visits, do not require a list of equipment. In addition, permit renewals may not require a list of equipment if the event is essentially unchanged from the previous permit. Contact the specific refuge headquarters office where the activity is going to be conducted to determine if we require a list of equipment.

24a-24b) Provide vehicle descriptions and license plate or identification numbers of all vehicles, including boats and airplanes, if required. We only require motor vehicle descriptions for permittee vehicle, and/or if the vehicle will be operated on the refuge without the permittee being present. Motor vehicles accompanied by the permittee as part of a group (convoy) activity need not be identified if cleared in advance by the refuge supervisor. Specifically describe ship-to-shore, intersite (between islands, camps, or other sites) and onsite transportation mechanisms, and license plate or identification numbers, if required.

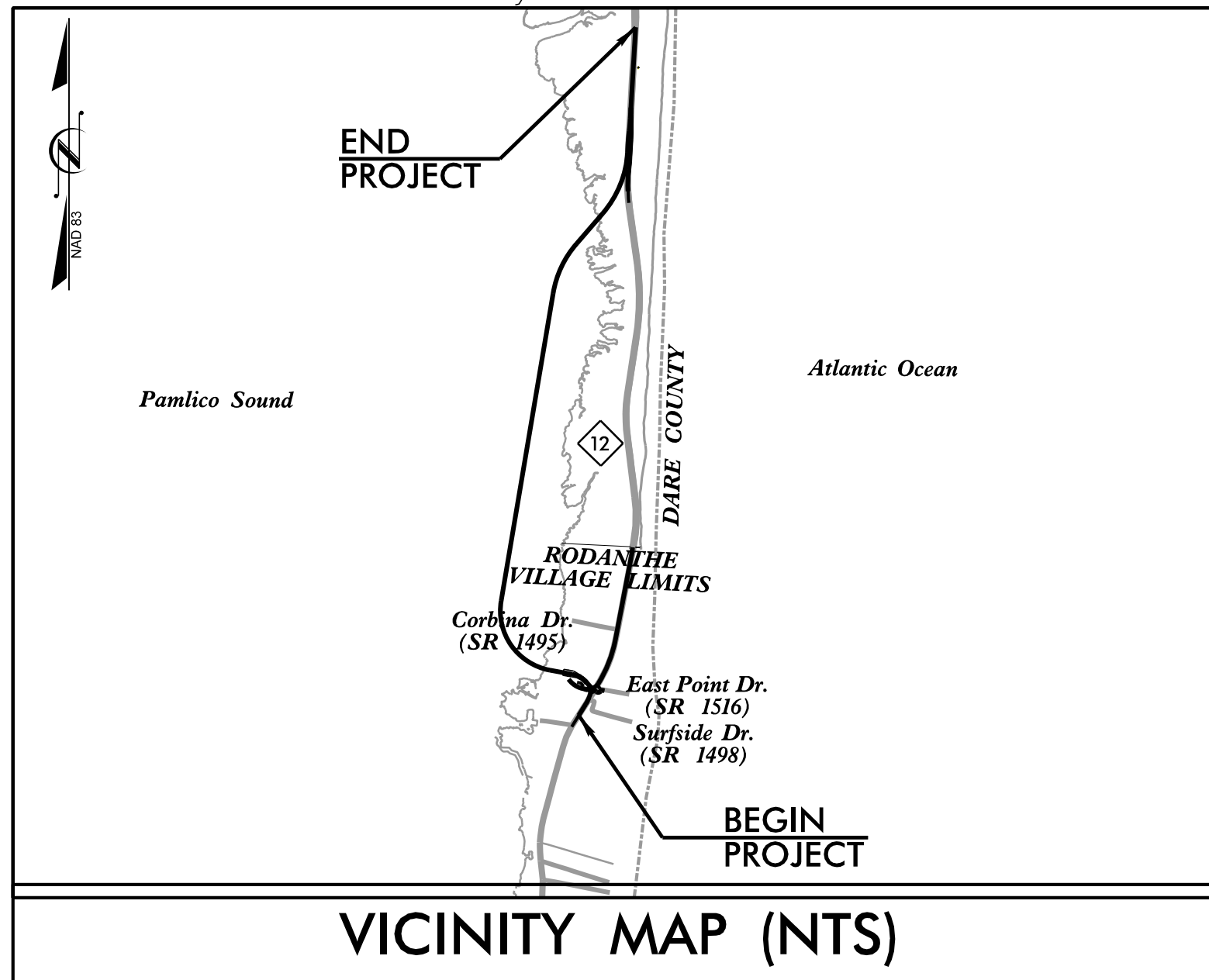
25) Specifically describe onsite work and/or living accommodations, if applicable.

26) Specifically describe onsite hazardous material storage, or other onsite material storage space (including on and offsite fuel caches).

27) Sign, date, and print the application. Click on the Print button to print the application (if using the fillable version). The refuge official will review and, if approved, fill out the remaining information, sign, and return a copy to you for signature and acceptance.

**This application form is not valid as a permit
but may be used as a reference document attached to the official permit.
Only official refuge personnel may assign a valid permit number and permit term
to this application form after the permit has been approved.**

See Sheet 1-A For Index of Sheets
See Sheet 1-B For Conventional Symbols



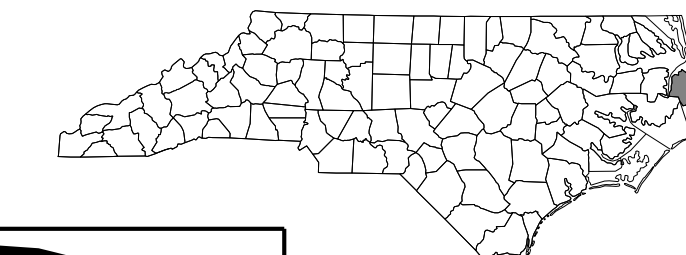
STATE OF NORTH CAROLINA
DIVISION OF HIGHWAYS

DARE COUNTY

LOCATION: NC 12 - RODANTHE BREACH LONG TERM IMPROVEMENTS (PHASE IIB)

TYPE OF WORK: GRADING, DRAINAGE, PAVING, SIGNING & STRUCTURES

STATE	STATE PROJECT REFERENCE NO.	SHEET NO.	TOTAL SHEETS
N.C.	B-2500B	1	
STATE PROJ. NO.	F.A. PROJ. NO.	DESCRIPTION	
32635.3.FR7	BRNH-0012(56)		



RFC

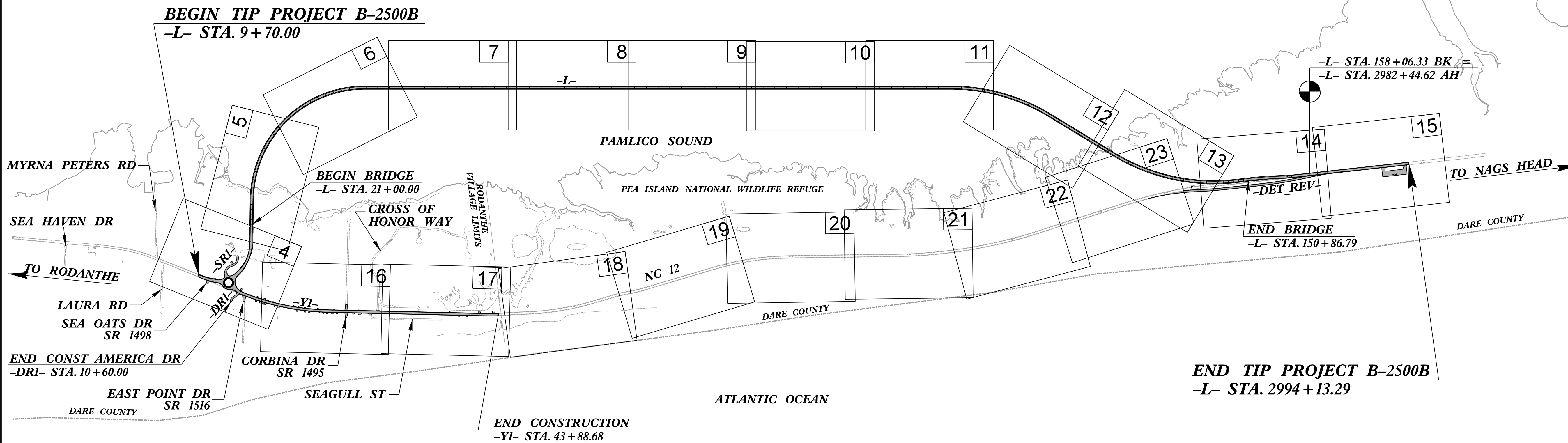
RELEASED FOR CONSTRUCTION

CONSTRUCTION REVISION
SUBMITTAL NO.: S-064
DATE: 10-19-18



TIP PROJECT: B-2500B

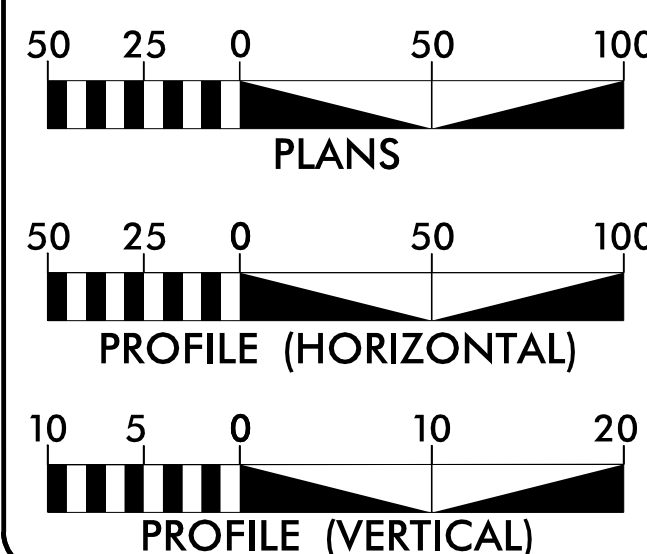
CONTRACT: C203474



THIS IS A PARTIAL CONTROLLED-ACCESS PROJECT WITH ACCESS BEING LIMITED TO POINTS AS SHOWN ON PLANS.

DOCUMENT NOT CONSIDERED FINAL
UNLESS ALL SIGNATURES COMPLETED

GRAPHIC SCALES



DESIGN DATA

ADT 2017 = 9,800
ADT 2037 = 14,200
V = 40 /60 MPH
FUNC. CLASSIFICATION =
RURAL COLLECTOR

PROJECT LENGTH

LENGTH ROADWAY TIP PROJECT B-2500B.....0.572 mi
LENGTH STRUCTURE TIP PROJECT B-2500B.....2.460 mi
TOTAL LENGTH TIP PROJECT B-2500B.....3.032 mi

NCDOT CONTACT

K. Zak Hamidi, P.E.
PROJECT ENGINEER - DESIGN-BUILD GROUP

PLANS PREPARED BY:



FOR NORTH CAROLINA
DEPARTMENT OF TRANSPORTATION

2012 STANDARD SPECIFICATIONS

LETTING DATE:
JANUARY 25, 2017

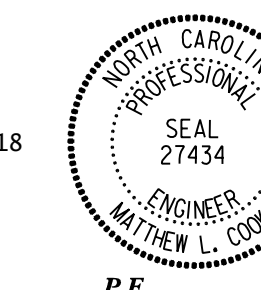
B. Keith Skinner, P.E.
PROJECT ENGINEER

Brandon J. McInnis, P.E.
PROJECT DESIGN ENGINEER

HYDRAULICS ENGINEER

10/18/2018

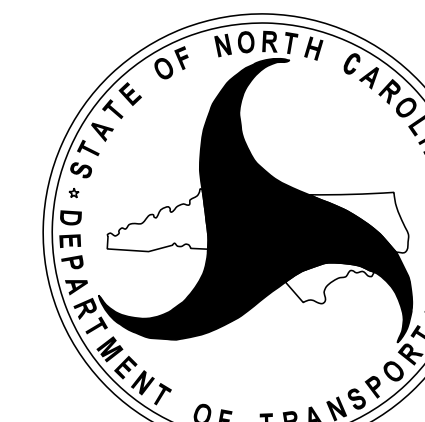
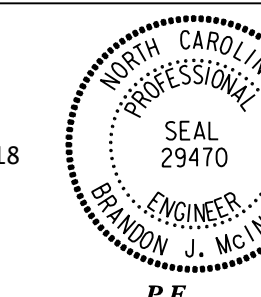
DocuSigned by:
Matthew L. Cook
SIGNATURE:



ROADWAY DESIGN ENGINEER

10/19/2018

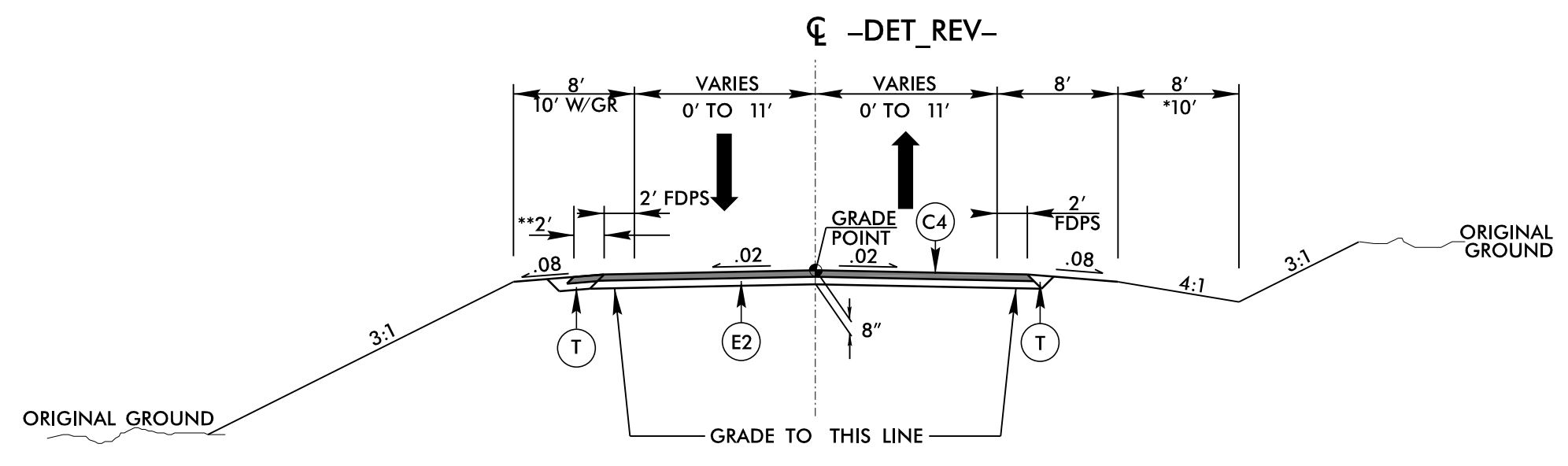
DocuSigned by:
Brandon J. McInnis
SIGNATURE:



PAVEMENT SCHEDULE	
C4	3" S9.5B
E2	5" B25.0B
T	EARTH

REVISIONS
 CONSTRUCTION REVISION: DATE: 5/23/2018 - REVISED TEMPORARY ON-SITE DETOUR.
 CONSTRUCTION REVISION: DATE: 10/18/2018 - ADD 2' PAVED SHOULDER LEFT STA. 16+05 TO STA. 28+00 FOR TEMPORARY BARRIER TO BE PLACED ON.

10/18/2018
 \\saway\proj\B2500B_Rdy_tjip.dgn



TYPICAL SECTION NO. 9
 -DET_REV- STA. 13+54.77 TO STA. 31+27.49
 * STA. 23+39.93 TO STA. 25+36.53 LT
 ** STA. 16+05.00 TO STA. 28+00.00 LT
 FOR TEMPORARY BARRIER TO BE PLACED ON

PROJECT REFERENCE NO. <i>B-2500B</i>	SHEET NO. <i>2A-3</i>
ROADWAY DESIGN ENGINEER BRANDON J. MCNEILS SEAL 029470 10/19/2018 DocuSigned by: Brandon J. McNeils	PAVEMENT DESIGN ENGINEER SHANE JOHNSON SEAL 037422 10/18/2018 DocuSigned by: Shane Johnson
DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED	

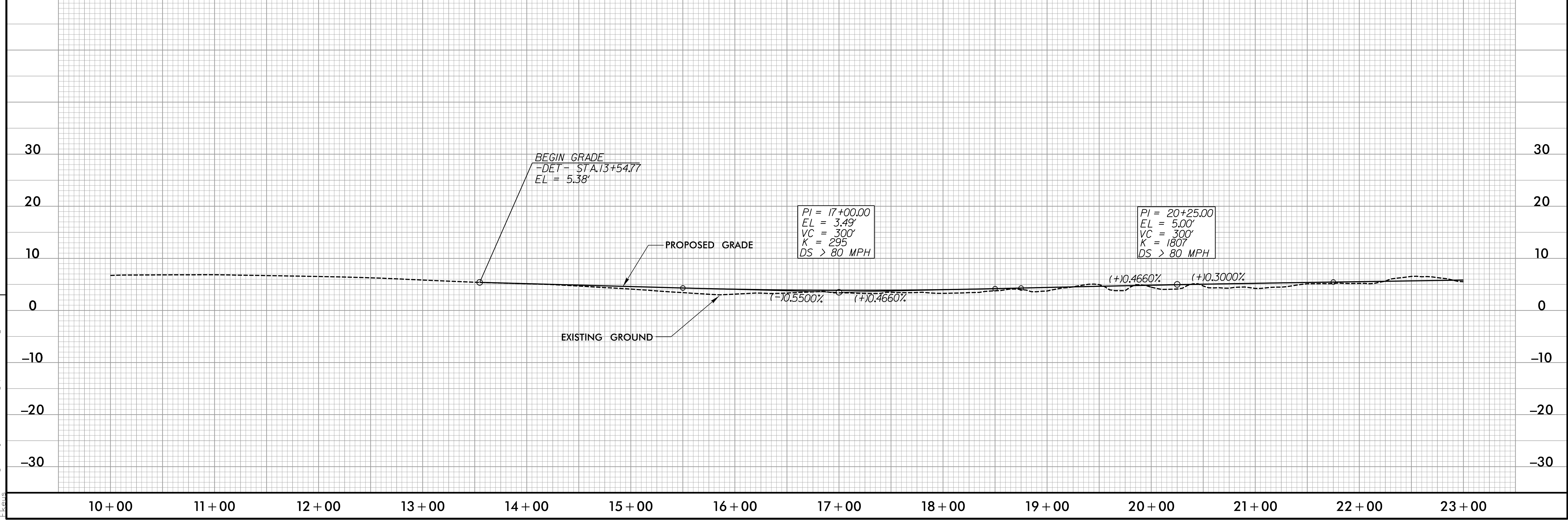
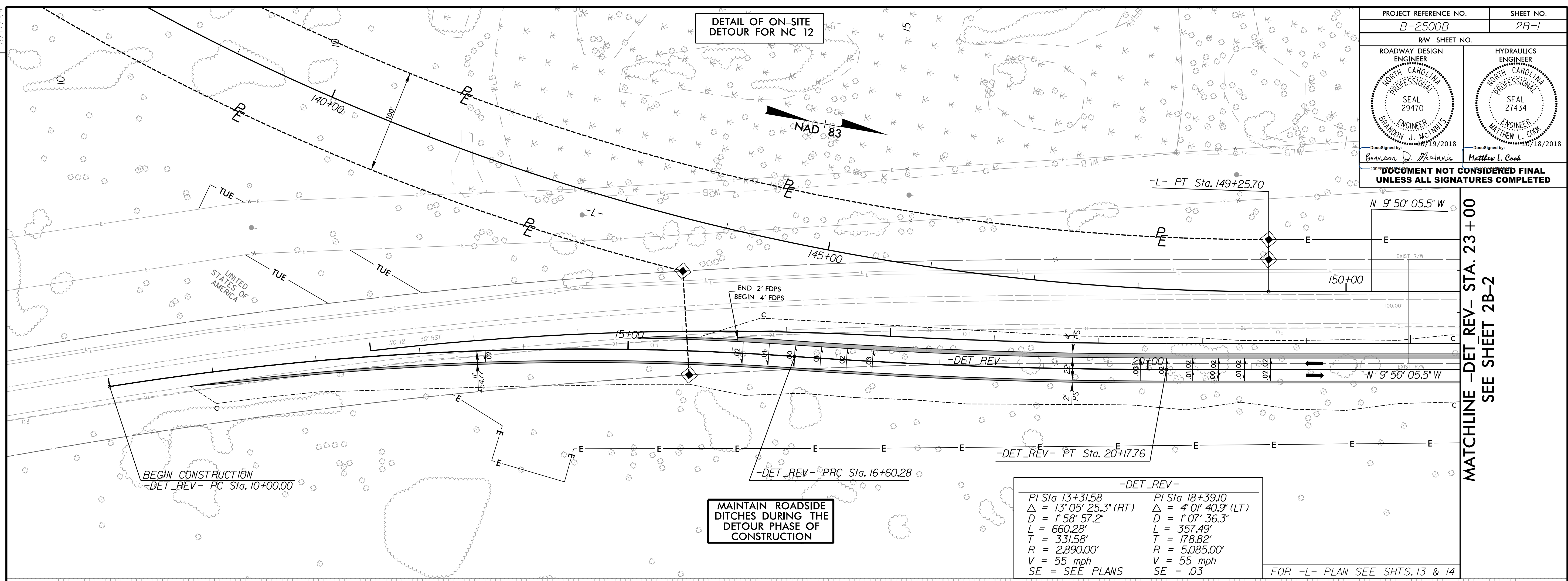
PLANS PREPARED BY :

 RUMMEL, KLEPPER & KAHL, LLP
 900 RIDGEFIELD DRIVE SUITE 350
 RALEIGH, NORTH CAROLINA 27609-3960
 NC LICENSE NO. F-0112 • (919) 878-9560

PROJECT REFERENCE NO. B-2500B	SHEET NO. 2B-1
RW SHEET NO.	
ROADWAY DESIGN ENGINEER NORTH CAROLINA PROFESSIONAL SEAL 29470 BRANDON J. McMINN 10/19/2018	HYDRAULICS ENGINEER NORTH CAROLINA PROFESSIONAL SEAL 27434 MATTHEW L. COOK 10/18/2018

DOCUMENT NOT CONSIDERED FINAL
UNLESS ALL SIGNATURES COMPLETED

REVISIONS
 CONSTRUCTION REVISION: DATE: 5/23/2018 - REVISED TEMPORARY ON-SITE DETOUR, TEMPORARY EASEMENT, AND MATCH LINES.
 CONSTRUCTION REVISION: DATE: 10/19/2018 - ADDED 2' PAVED SHOULDER ON TEMPORARY DETOUR LEFT STA. 16+05 TO STA. 28+00 FOR TEMPORARY BARRIER TO BE PLACED ON.



MATCHLINE -DET REV- STA. 23+00
 SEE SHEET 2B-2

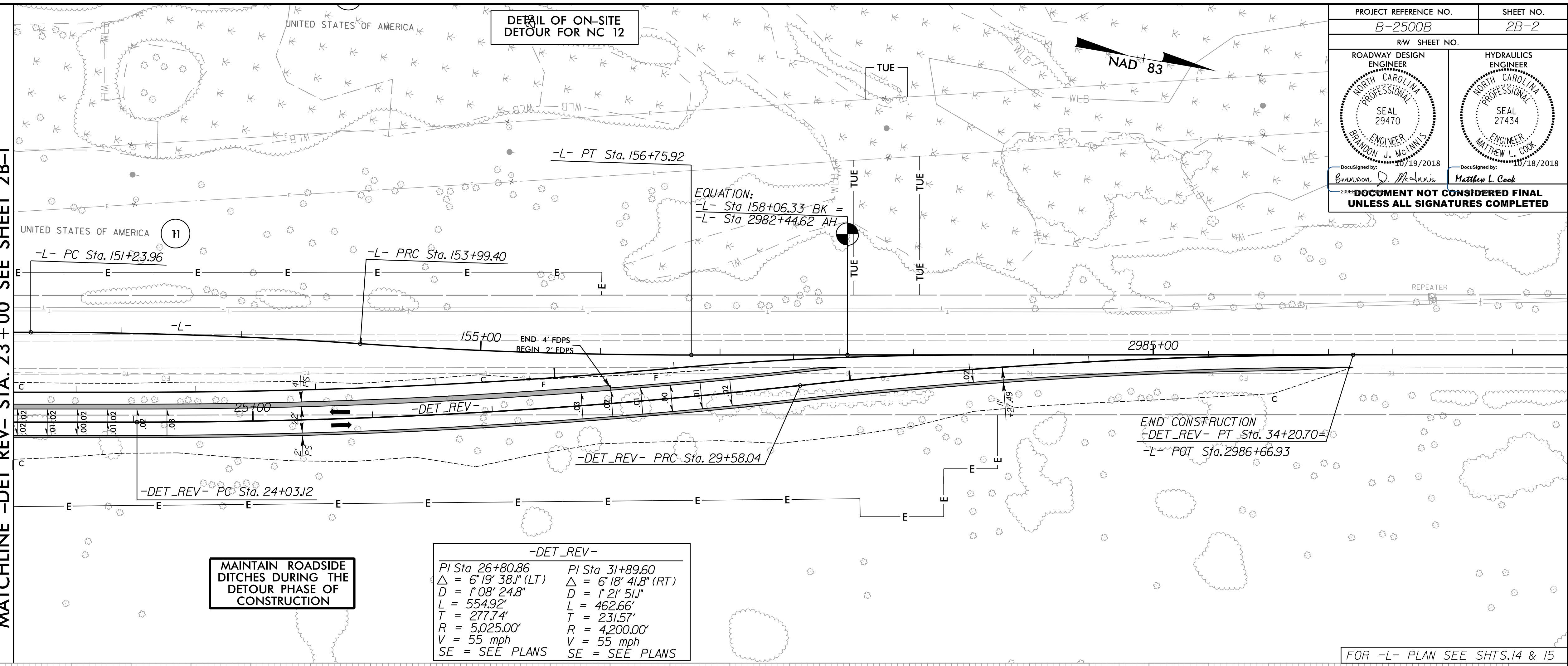
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REVISIONS
CONSTRUCTION REVISION: DATE: 5/23/2018 - REVISED TEMPORARY ON-SITE DETOUR, TEMPORARY EASEMENT, AND MATCH LINES.
CONSTRUCTION REVISION: DATE: 10/19/2018 - ADDED 2' PAVED SHOULDER ON TEMPORARY DETOUR LEFT STA. 28+00 FOR TEMPORARY BARRIER TO BE PLACED ON.

10/18/2018
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MATCHLINE -DET REV- STA. 23+00 SEE SHEET 2B-1

DETAIL OF ON-SITE DETOUR FOR NC 12

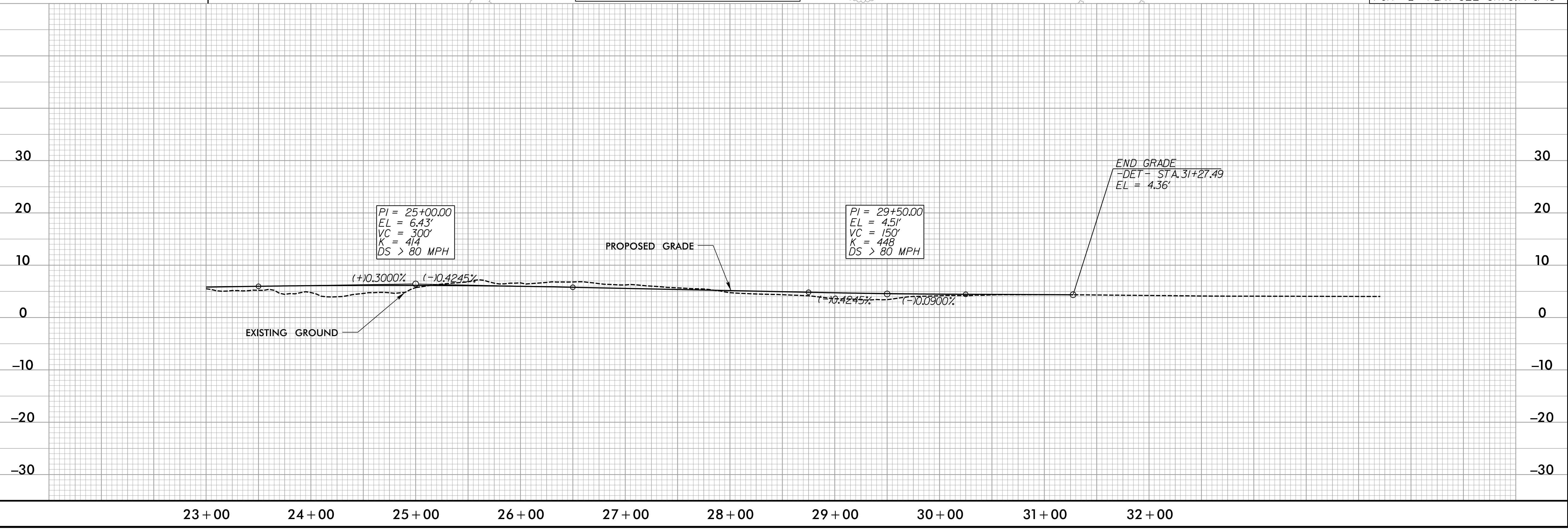


MAINTAIN ROADSIDE DITCHES DURING THE DETOUR PHASE OF CONSTRUCTION

-DET_REV-	
PI Sta 26+80.86	PI Sta 31+89.60
$\Delta = 6^{\circ}19'38.1''$ (LT)	$\Delta = 6^{\circ}18'41.8''$ (RT)
D = 1'08'24.8"	D = 1'21'51.1"
L = 554.92'	L = 462.66'
T = 277.74'	T = 231.57'
R = 5,025.00'	R = 4,200.00'
V = 55 mph	V = 55 mph
SE = SEE PLANS	SE = SEE PLANS

PROJECT REFERENCE NO. B-2500B	SHEET NO. 2B-2
RW SHEET NO.	
ROADWAY DESIGN ENGINEER NORTH CAROLINA PROFESSIONAL SEAL 29470 BRANDON J. MCINNIS 10/19/2018	HYDRAULICS ENGINEER NORTH CAROLINA PROFESSIONAL SEAL 27434 MATTHEW L. COOK 10/18/2018
DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED	

FOR -L- PLAN SEE SHTS. 14 & 15



PI = 25+00.00
EL = 6.43'
VC = 300'
K = 414
DS > 80 MPH

PI = 29+50.00
EL = 4.51'
VC = 150'
K = 448
DS > 80 MPH

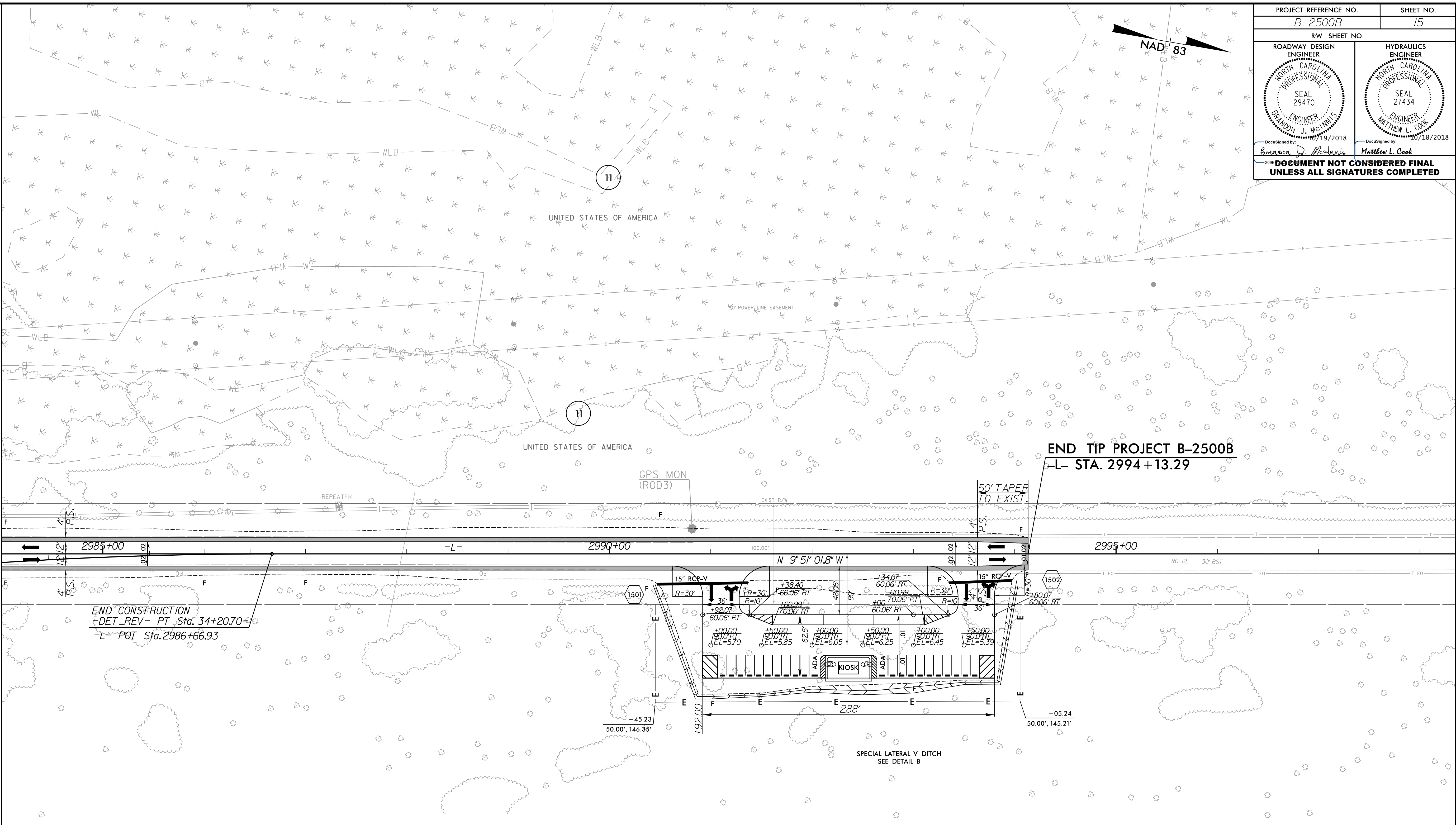
END GRADE
-DET- STA. 31+27.49
EL = 4.36'

8/17/99

PROJECT REFERENCE NO. B-2500B	SHEET NO. 15
RW SHEET NO.	
ROADWAY DESIGN ENGINEER BRANDON J. MCINNIS NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 29470 10/19/2018	HYDRAULICS ENGINEER MATTHEW L. COOK NORTH CAROLINA PROFESSIONAL ENGINEER SEAL 27434 10/18/2018
Documented by: <i>Brandon J. McInnis</i> / 10/19/2018 Documented by: <i>Matthew L. Cook</i> / 10/18/2018 DOCUMENT NOT CONSIDERED FINAL UNLESS ALL SIGNATURES COMPLETED	

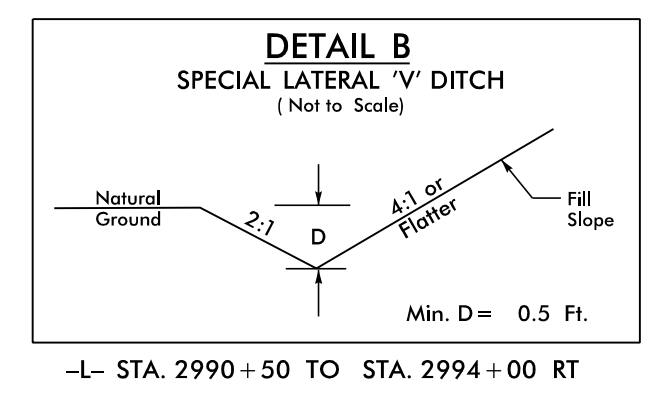
REVISIONS
CONSTRUCTION REVISION: DATE: 5/23/2018 - REVISED TEMPORARY ON-SITE DETOUR.
CONSTRUCTION REVISION: DATE: 10/19/2018 - REVISED SLOPES ON PARKING LOT.

MATCHLINE -L- STA. 2984+00 SEE SHEET 14



END CONSTRUCTION
-DET_REV- PT Sta. 34+20.70=
-L- POT Sta. 2986+66.93

END TIP PROJECT B-2500B
-L- STA. 2994+13.29



PLANS PREPARED BY :

RK&K

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FOR -L- PROFILE SEE SHT.29
FOR -DET_REV- SEE SHT.2B-2

10/18/2018
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United States Department of the Interior

FISH AND WILDLIFE SERVICE
Raleigh Field Office
Post Office Box 33726
Raleigh, North Carolina 27636-3726

July 10, 2008

John F. Sullivan, III, P.E.
Federal Highway Administration
310 New Bern Avenue, Suite 410
Raleigh, North Carolina 27601

Dear Mr. Sullivan:

This transmits the U.S. Fish and Wildlife Service (USFWS) Raleigh Field Office's biological and conference opinions based on our review of the proposed replacement of the Herbert C. Bonner Bridge (Bridge No. 11 over Oregon Inlet) in Dare County, North Carolina (TIP No. B-2500). These opinions assess the effects of the project on the piping plover (*Charadrius melodus*), loggerhead sea turtle (*Caretta caretta*), green sea turtle (*Chelonia mydas*), and leatherback sea turtle (*Dermochelys coriacea*), and proposed critical habitat for wintering piping plovers. These opinions are provided in accordance with section 7(a)(2) of the Endangered Species Act of 1973 (ESA), as amended (16 U.S.C. 1531 *et seq.*). This document addresses the requirements of the ESA but does not address other environmental statutes such as the National Environmental Policy Act or Fish and Wildlife Coordination Act. Your March 5, 2008 request for formal consultation was received on March 6, 2008.

Since the proposed project is a multi-phased project which will be staggered over more than 24 years, and since final designs for each phase are not yet developed, the USFWS plans to proceed with a form of a programmatic consultation known as an appended consultation. In this appended programmatic consultation, the USFWS has conducted the required analysis of the entire project based on what is known at the present time, and one programmatic biological and conference opinion has been developed for the overall project. In the following opinions we have determined that the project is not likely to jeopardize the continued existence of the piping plover, loggerhead sea turtle, green sea turtle, and leatherback sea turtle, and is not likely to destroy or adversely modify proposed critical habitat for wintering piping plovers. The USFWS has issued incidental take for these species which reflect the maximum potential take for the entire project over the proposed extended timeframe of the project.

As additional design information is developed for subsequent phases of the project, this information must be provided to us so that it may be appended to the existing biological opinion. The USFWS will then analyze the new information for each subsequent phase of the project to insure that the take associated with each future phase, cumulatively, does not exceed the maximum amount of take authorized in the incidental take statement included in this biological opinion. If the scope of future phases of the project should differ significantly from the

conceptual design information, or if the cumulative amount of take should exceed that authorized, then consultation will need to be reinitiated. The reasonable and prudent measures, and associated terms and conditions, contained within this biological opinion apply to the overall project; however, as designs for subsequent phases are developed, additional reasonable and prudent measures may be necessary to minimize the level of take.

If you have any questions concerning this biological opinion, please contact me at (919) 856-4520 (Ext. 11).

Sincerely,

Pete Benjamin
Field Supervisor

Attachment

cc: Ken Graham, USFWS, Atlanta, GA
Ann Hecht, USFWS, Sudbury, MA
Sandy MacPherson, USFWS, Jacksonville, FL
Mike Bryant, USFWS, Manteo, NC
Bill Biddlecome, USACE, Washington, NC
Greg Thorpe, NCDOT, Raleigh, NC
Logan Williams, NCDOT, Raleigh, NC
Clay Willis, NCDOT, Edenton, NC
David Harris, NCDOT, Raleigh, NC
Chris Militscher, USEPA, Raleigh, NC
Travis Wilson, NCWRC, Creedmoor, NC
Cathy Brittingham, NCDOT, Raleigh, NC
David Wainwright, NCDWQ, Raleigh, NC

E-32

The following opinions are based on information provided in the March 2008 biological assessment (BA)(FHWA and NCDOT 2008a), the April 8, 2008 addendum to the BA (FHWA and NCDOT 2008b, *in litt.*), the *Supplement to the 2005 Supplemental Draft Environmental Impact Statement and Draft Section 4(f) Evaluation* (SSDEIS)(FHWA and NCDOT 2007), meetings, telephone conversations, emails, field investigations, and other sources of information. A complete administrative record of this consultation is on file at this office.

CONSULTATION HISTORY

1997 – The Federal Highway Administration (FHWA) initiates formal consultation on an earlier version of the proposed project.

1998 – After several months of discussions between the USFWS and the North Carolina Department of Transportation (NCDOT), both parties agreed that formal consultation was premature.

December 12, 2007 – The USFWS met with FHWA and NCDOT to discuss the preparation of a BA.

March 6, 2008 – The USFWS received a letter from the FHWA, dated March 5, 2008, with the attached BA, requesting formal consultation for the replacement of the Herbert C. Bonner Bridge.

March 13, 2008 – The USFWS sent a letter to FHWA stating that all information required for initiation of consultation was either included with their March 5, 2008 letter or was otherwise available.

April 9, 2008 – The USFWS received an addendum to the BA dated April 8, 2008. The addendum clarified several issues and provided revised Figures 1 and 4.

June 4, 2008 – The USFWS provided the FHWA and NCDOT with a draft biological opinion.

June 11, 2008 – The USFWS met with the FHWA and NCDOT to discuss the draft biological opinion and reasonable and prudent measures.

July 9, 2008 – The USFWS met with NCDOT to discuss the draft reasonable and prudent measures.

BIOLOGICAL AND CONFERENCE OPINIONS

I. DESCRIPTION OF PROPOSED ACTION

The existing Bonner Bridge is a two-lane bridge that takes NC 12 across Oregon Inlet and connects Bodie Island with Hatteras Island in Dare County, North Carolina. Bonner Bridge is 2.4 miles long and is located at the northern end of the action area. Existing NC 12 within the

action area is a two-lane paved road extending southward from the southern end of the bridge for approximately 13.5 miles to the southern project terminus at Rodanthe. The total length of the project from the north terminus to the south terminus is 16.1 miles long. However, construction will only occur along approximately 14.0 miles. The proposed action, known as the Phased Approach/Rodanthe Bridge Alternative, is a four-phased project which includes the following:

- Phase I – replace the existing Bonner Bridge with a new 2.6 mile long bridge slightly to the west of the existing bridge – approximate construction timeframe 2009-2013
- Phase II – elevate approximately 5.6 miles of NC 12 onto three bridges – to begin approximately 2013-2015
- Phase III – elevate approximately 1.9 miles of NC 12 onto one bridge – to begin approximately 2019-2020
- Phase IV – elevate approximately 2.6 miles of NC 12 onto two bridges – to begin approximately 2029-2030

On Hatteras Island, NCDOT asserts that construction will be confined to the existing NC 12 right-of-way. A more detailed project description of the Phased Approach/Rodanthe Bridge Alternative can be found in Section 2.2 of the SSDEIS (FHWA and NCDOT 2007).

The timing of the construction of Phases II to IV is based on assumptions corresponding to forecast shoreline erosion trends and maintaining minimum 230-foot buffer distance between the existing NC 12 edge of pavement and the active shoreline. These assumptions are based on worst-case scenario modeling of shoreline erosion and the location and likelihood of future breaches on Hatteras Island. Since these are forecasts only, the exact timing and scope of each phase could change based on the reality of future shoreline erosion. As such, project descriptions of Phases II, III and IV should be viewed as approximations. The USFWS suspects that one substantial hurricane in the interim could dramatically change the predictions of worst-case scenario modeling. Although Phases II to IV will initially be built over land ostensibly within existing NCDOT right-of-way, based on shoreline erosion models, up to 8.0 miles of the bridges may ultimately be in open water by 2060.

Action Area

The action area lies within the North Carolina Outer Banks and is comprised of a dynamic barrier island system formed by wind and wave action. The barrier islands that make up the Outer Banks are sand ridges with underlying layers of limestone, sand, and clay. The action area extends from Rodanthe on Hatteras Island north to the southern end of Bodie Island and includes that portion of Hatteras Island (from the east to west shore), the arca of the Atlantic Ocean one-half mile east of the Hatteras Island shoreline, portions of Oregon Inlet, and the southern tip of Bodie Island. It passes through the Cape Hatteras National Seashore (CAHA) and encompasses the Pea Island National Wildlife Refuge (PINWR). Though largely undeveloped, most of the action area consists of natural vegetation communities that have been influenced by past and present human disturbances. The construction and maintenance of an artificial sand berm along the seaward side of NC 12 has significantly interrupted the natural barrier island ecosystem processes (e.g. limiting overwash and disrupting island migration).

Conservation Measures

Conservation measures represent actions, pledged in the project description, that the action agency will implement to minimize the effects of the proposed action and further the recovery of the species under review. Such measures should be closely related to the action and should be achievable within the authority of the action agency. Since conservation measures are part of the proposed action, their implementation is required under the terms of the consultation. The FHWA and NCDOT have proposed the following conservation measures.

- The Phased Approach/Rodanthe Bridge Alternative will allow natural shoreline migration and the formation of new inlet habitats to occur.
- The project will incorporate the most current BMPs to reduce habitat degradation from stormwater runoff pollution.
- Phase I of the project will be built at least 125 feet farther west of the Bonner Bridge and currently occupied piping plover habitat.
- NCDOT does not anticipate the use of explosives during construction or demolition of the existing bridge.
- The NCDOT contractor will use pipeline or clamshell dredging, rather than a hopper dredge to minimize effects to sea turtles.
- No permanent light fixtures will be installed on the bridge or the approaches (with the exception of navigation lights as required by the U.S. Coast Guard).
- Seabeach amaranth surveys will be conducted at least one year prior to initiating bridge construction activities.
- Temporary facilities such as haul roads that affect proposed critical habitat will be removed as soon as possible.

II. STATUS OF THE SPECIES/CRITICAL HABITAT

A. Species/critical habitat description

Piping plover

The piping plover is a small, pale-colored shorebird, about seven inches long with a wingspan of about 15 inches (Palmer 1967). 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). 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 (Elliott-Smith and Haig 2004). Information from

observation of color-banded piping plovers indicates that the winter ranges of the breeding populations overlap to a significant degree.

The recovery objective for the Great Lakes population includes:

at least 150 pairs (300 individuals), for at least five 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; five-year average fecundity is 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; ensure protection and long-term maintenance of essential breeding and wintering habitat, sufficient in quantity, quality, and distribution to support the recovery goal of 150 pairs (300 individuals); genetic diversity within the population is deemed adequate for population persistence and can be maintained over the long-term; and, agreements and funding mechanisms are in place for long-term protection and management activities in essential breeding and wintering habitat (USFWS 2003).

The recovery objective for the northern Great Plains population includes:

sustaining 2,300 pairs of birds for at least 15 years, meeting recovery objectives for birds in prairie Canada, and providing long term protection of essential breeding and wintering habitat.

The recovery objective for the Atlantic Coast population includes:

verification of the adequacy of a 2,000-pair population of piping plovers to maintain heterozygosity and allelic diversity over the long term; achieve five-year average productivity of 1.5 fledged chicks per pair in each of the four recovery units; institute long-term agreements among cooperating agencies, landowners, and conservation organizations to assure protection and management sufficient to maintain the target populations in each recovery unit and average productivity; and, ensure long-term maintenance of wintering habitat, sufficient in quantity, quality, and distribution to maintain survival rates for a 2,000-pair population (USFWS 1996).

The recovery plan for the Atlantic Coast population of the piping plover (USFWS 1996) delineates four recovery units within the population: Atlantic Canada, New England, New York-New Jersey, and Southern (Delaware, Maryland, Virginia, and North Carolina). Extensive efforts to observe and report sightings of greater than 1,400 Atlantic Coast piping plovers color-banded in Virginia, Maryland, Massachusetts, and five Eastern Canadian provinces between 1985 and 2003 have documented many inter-year movements among sites within recovery units, but few records of plovers breeding outside the recovery unit where they were banded (Loefering 1992, Cross 1996, USFWS 1996, Amirault et al. 2005), supporting the premise that immigration and emigration have relatively little influence on abundance trends at the scale of the recovery unit.

Recovery criteria established within the recovery plan defined population and productivity goals for each recovery unit, as well as for the population as a whole. The recovery objective for the Atlantic Coast population is to increase and maintain for five years a total of 2,000 breeding pairs, distributed among the four recovery units – Atlantic Canada, 400 pairs; New England, 625

pairs; New York-New Jersey, 575 pairs; and, Southern, 400 pairs. Attainment of these goals for each recovery unit is an integral part of a piping plover recovery strategy that seeks to reduce the probability of extinction for a population with low rates of inter-regional dispersal by: (1) contributing to the population total, (2) reducing vulnerability to environmental variation (including catastrophes such as hurricanes, oil spills, or disease), (3) increasing likelihood of genetic interchange among subpopulations, and (4) promoting re-colonization of any sites that experience declines or local extirpations due to low productivity or temporary habitat succession. The plan further states: "A premise of this plan is that the overall security of the Atlantic Coast piping plover population is profoundly dependent upon attainment and maintenance of the minimum population levels for the four recovery units. Any appreciable reduction in the likelihood of survival of a recovery unit will also reduce the probability of persistence of the entire population."

The USFWS has designated critical habitat for the piping plover on three occasions. Two of these designations protected different breeding populations of the piping plover. Critical habitat for the Great Lakes breeding population was designated May 7, 2001 (USFWS 2001a), and critical habitat for the northern Great Plains breeding population was designated September 11, 2002 (USFWS 2002). The USFWS designated critical habitat for wintering piping plovers on July 10, 2001 (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. The three separate designations of piping plover critical habitat demonstrate the diversity of constituent elements among the two breeding populations and wintering piping plovers.

Designated critical habitat for wintering piping plovers originally included approximately 1,798 miles of mapped shoreline and 165,211 acres of mapped area along the coasts of North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, and Texas.

The primary constituent elements for piping plover wintering habitat are those biological and physical features that are essential to the conservation of the species. These areas typically include those coastal areas that support intertidal beaches and flats and associated dune systems and flats above annual high tide (USFWS 2001b). Primary constituent elements of wintering piping plover critical habitat include sand or mud flats or both with no or sparse emergent vegetation. Adjacent unvegetated or sparsely vegetated sand, mud, or algal flats above high tide are also important, especially for roosting piping plovers (USFWS 2001b). The units designated as critical habitat are those areas that have consistent use by piping plovers and that best meet the biological needs of the species. The amount of wintering habitat included in the designation appears sufficient to support future recovered populations, and the existence of this habitat is essential to the conservation of the species. Additional information on each specific unit included in the designation can be found at 66 [Federal Register](#) 36038 (USFWS 2001b).

Since the designation of wintering critical habitat, four units in North Carolina were vacated and remanded back to the USFWS for reconsideration by Court order ([Cape Hatteras Access Preservation Alliance v. U.S. Department of Interior](#) (344 F. Supp. 2d 108 (D.D.C. 2004))). The four critical habitat units vacated were NC-1, NC-2, NC-4, and NC-5, and all occurred within CAHA. On June 12, 2006, the USFWS proposed to amend and re-designate these four units as

critical habitat for wintering piping plover (USFWS 2006a). These units encompass the primary constituent elements found at Bodie Island Spit, Cape Point, Hatteras Spit and Ocracoke Spit within CAHA. On May 15, 2008, the USFWS proposed a revised designation of critical habitat which would add areas to units NC-1 and NC-4 (USFWS 2008d).

Loggerhead sea turtle

The loggerhead sea turtle, listed as a threatened species on July 28, 1978 (NMFS and USFWS 1978), inhabits the continental shelves and estuarine environments along the margins of the Atlantic, Pacific, and Indian Oceans. Loggerhead turtles nest within the continental U.S. from Louisiana to Virginia. Major nesting concentrations are found on the coastal islands of North Carolina, South Carolina, and Georgia, and on the Atlantic and Gulf coasts of Florida (Hopkins and Richardson 1984).

Adults and sub-adults have a reddish-brown carapace (top of shell). Scales on the top and sides of the head and top of the flippers are also reddish-brown, but have yellow borders. The neck, shoulders and limb bases are dull brown on top and medium yellow on the sides and bottom. The plastron (underside of shell) is also medium yellow. Adult average size is 36 inches straight carapace length; average weight is 253 pounds. Hatchlings are dull brown in color. Average size at hatching is 1.8 inches long; average weight is 0.7 ounces. Mating takes place from late March to early June, and eggs are laid throughout the summer (NMFS and USFWS 1991b).

The recovery objectives for the southeastern U.S. population of the loggerhead turtle (NMFS and USFWS 1991b) include:

over a period of 25 years, the adult female population in Florida is increasing, and in North Carolina, South Carolina, and Georgia nesting numbers are returning to pre-listing levels. For North Carolina, that equates to 800 nests per year. For South Carolina and Georgia nesting numbers must be 10,000 and 2,000 nests per year, respectively. These above conditions must be met with data from standardized surveys which will continue for at least five years after recovery. Furthermore, at least 25 percent of all available nesting beaches must be in public ownership, distributed over the entire nesting range and encompassing at least 50 percent of the nesting activity within each state. In addition, all priority one tasks identified in the recovery plan must be successfully implemented (NMFS and USFWS 1991b).

No critical habitat has been designated for the loggerhead turtle. However, on March 5, 2008, the National Marine Fisheries Service (NMFS) announced a 90-day finding for a petition to reclassify loggerhead turtles in the western North Atlantic Ocean as a Distinct Population Segment with endangered status and designate critical habitat (NMFS 2008).

Green sea turtle

The green sea turtle was federally listed as a protected species on July 28, 1978 (NMFS and USFWS 1978). Breeding populations of the green turtle in Florida and along the Pacific Coast of Mexico are listed as endangered; all other populations are listed as threatened. The green turtle has a worldwide distribution in tropical and subtropical waters. Major green turtle nesting

colonies in the Atlantic occur on Ascension Island, Aves Island, Costa Rica, Suriname, and Trinidad Island, Brazil.

Adult green turtles may reach a size of 39 inches in length and weigh 397 pounds. The carapace is smooth and is gray, green, brown, and black. The plastron is yellowish white. Hatchlings weigh about 0.9 ounces and are about two inches long. Hatchlings are black on top and white on the bottom (NMFS and USFWS 1991a).

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 USFWS 1991a). 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 Collier County in Southwest Florida (FFWCC 2006b). Green turtles have been known to nest in Georgia, but only on rare occasions (GDNR 2004). The green turtle also nests sporadically in North Carolina and South Carolina (Woodson and Webster 1999, South Atlantic Fishery Management Council 2008).

Recovery objectives for the U.S. population of the green turtle (NMFS and USFWS 1991a) include:

over a period of 25 years, that the level of nesting in Florida has increased to an average of 5,000 nests per year for at least six years where nesting data are based on standardized surveys; at least 25 percent of all available nesting beaches is in public ownership and encompasses at least 50 percent of the nesting activity; and a reduction in stage class mortality is reflected in higher counts of individuals on foraging grounds. In addition, all priority one tasks identified in the recovery plan must be successfully implemented (NMFS and USFWS 1991a).

Critical habitat for the green sea turtle has been designated for the water surrounding Culebra Island, Puerto Rico and its outlying keys.

Leatherback sea turtle

The leatherback sea turtle, listed as an endangered species on June 2, 1970 (USFWS 1970), nests on shores of the Atlantic, Pacific, and Indian Oceans. Non-breeding animals have been 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 1982). Nesting grounds are distributed circumglobally, with the Pacific Coast of Mexico once supporting the world's largest known concentration of nesting leatherbacks (Pritchard 1982). The largest nesting colonies in the wider Caribbean region are found in Suriname/French Guiana, Trinidad, Costa Rica, Panama, Colombia, and Guyana (NMFS and USFWS 1992; National Research Council 1990; Tröng et al. 2004).

The leatherback is the largest living turtle, and is so distinctive as to be placed in a separate taxonomic family, Dermochelyidae. The carapace is distinguished by a rubber-like texture, about 1.6 inches thick, and made primarily of tough, oil-saturated connective tissue. No sharp angle is formed between the carapace and the plastron, resulting in the animal being somewhat

barrel-shaped. The average curved carapace length for adult turtles is 61 inches and weight ranges from 441 to 1,543 pounds. Hatchlings are mostly black on top 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. Hatchlings average 2.4 inches long and 1.6 ounces in weight. In the adult, the skin is black and scaleless. The undersurface is mottled pinkish-white and black. The front flippers are proportionally longer than in any other sea turtle, and may span 106 inches in an adult. In both adults and hatchlings, the upper jaw bears two tooth-like projections (NMFS and USFWS 1992).

The leatherback regularly nests in Puerto Rico, the U.S. Virgin Islands, and along the Atlantic coast of Florida (NMFS and USFWS 1992). Leatherback turtles have been known to nest in Georgia, South Carolina, and North Carolina, but only on rare occasions (Rabon et al. 2003, GDNR 2004). Leatherback nesting also has been reported on the northwest coast of Florida (LeBuff 1990).

The recovery objective for U.S. population of the leatherback turtle include:

when 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, and nesting habitat encompassing at least 75 percent of nesting activity in the U.S. Virgin Islands, Puerto Rico, and Florida is in public ownership. In addition, all priority one tasks identified in the recovery plan must be successfully implemented (NMFS and USFWS 1992).

Critical habitat has been designated for the leatherback sea turtle in the U.S. Virgin Islands.

B. Life History

Piping plover

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). Males establish and defend territories and court females (Cairns 1982). Piping plovers are monogamous, but usually shift mates between years (Wilcox 1959, Haig and Oring 1988, MacIvor 1990) and less frequently between nesting attempts in a given year (Haig and Oring 1988, MacIvor 1990, Strauss 1990). Plovers may 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. Observations suggest that this species exhibits a high degree of nest site fidelity (Wilcox 1959, Haig 1985, Haig and Oring 1988).

Piping plover nests can be found 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, and in washover areas cut into or between dunes. The birds may also nest on areas where suitable dredge material has been deposited. Nest sites are shallow, scraped depressions in substrates ranging from fine-grained sand to mixtures of sand and pebbles, shells or cobble (Bent 1929, Burger 1987a, Cairns 1982, Patterson 1988, MacIvor 1990, Strauss 1990, Flemming et al. 1992). Nests are usually found in areas with little or no vegetation; although, on

occasion, piping plovers will nest under stands of American beachgrass or other vegetation (Patterson 1988, MacIvor 1990, Flemming et al. 1992). Plover nests may be very difficult to detect, especially during the 6 to 7 day egg-laying phase when the birds generally do not incubate (Goldin 1994).

Eggs may be present on the beach from early April through late July. Clutch size for an initial nest attempt is usually four eggs, one laid every other day. Eggs are pyriform in shape, and variable buff to greenish brown in color, marked with black or brown spots. The incubation period usually lasts 27 to 28 days. Full-time incubation usually begins with the completion of the clutch and is shared equally by both sexes (Wilcox 1959, Cairns 1977, MacIvor 1990). Eggs in a clutch usually hatch within 4 to 8 hours of each other, although the hatching period of one or more eggs may be delayed by up to 48 hours (Cairns 1977, Wolcott and Wolcott 1999).

Piping plovers generally fledge only a single brood per season, but may re-nest several times if previous nests are lost. Chicks are precocial (Wilcox 1959, Cairns 1982). They may move hundreds of yards from the nest site during their first week of life (see Table 1 in USFWS 1996), and chicks may increase their foraging range up to 3,000 feet before they fledge (Loefering 1992). Chicks remain together with one or both parents until they fledge at 25 to 35 days of age. Depending on date of hatching, flightless chicks may be present from mid-May until late August, although most fledge by the end of July (Patterson 1988, Goldin et al. 1990, MacIvor 1990, Howard et al. 1993).

Cryptic coloration is a primary defense mechanism for this species; nests, adults, and chicks all blend in with their typical beach surroundings. Chicks sometimes respond to vehicles and/or pedestrians by crouching and remaining motionless (Cairns 1977, Tuill 1984, Goldin 1993b, Hoopes 1993). Adult piping plovers also respond to intruders (avian and mammalian) in their territories by displaying a variety of distraction behaviors, including squatting, false brooding, running, and injury feigning. Distraction displays may occur at any time during the breeding season but are most frequent and intense around the time of hatching (Cairns 1977).

Plovers feed on invertebrates such as marine worms, fly larvae, beetles, crustaceans, and mollusks (Beal 1929, Cairns 1977, Nicholls 1989). Important feeding areas include intertidal portions of ocean beaches, washover areas, mudflats, sand flats, wrack lines, sparse vegetation, and shorelines of coastal ponds, lagoons, or salt marshes (Gibbs 1986, Coutu et al. 1990, Hoopes et al. 1992, Loefering 1992, Goldin 1993a, Elias-Gerken 1994). 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, Loefering 1992, Goldin 1993a, Hoopes 1993, Elias-Gerken 1994) and by stage in the breeding cycle (Cross 1990). Adults and chicks on a given site may use different feeding habitats in varying proportion (Goldin et al. 1990). Feeding activities of chicks are particularly important to their survival. Most time budget studies reveal that chicks spend a high proportion of their time feeding. Cairns (1977) found that piping plover chicks typically tripled their weight during the first two weeks post-hatching; chicks that failed to achieve at least 60 percent of this weight gain by the twelfth day were unlikely to survive.

During courtship, nesting, and brood rearing, feeding territories are generally contiguous to nesting territories (Cairns 1977), although instances where brood-rearing areas are widely

separated from nesting territories are common. Feeding activities of both adults and chicks may occur during all hours of the day and night (Staine and Burger 1994), and at all stages in the tidal cycle (Goldin 1993a, Hoopes 1993).

Both spring and fall migration routes of Atlantic Coast breeders are believed to occur primarily within a narrow zone along the Atlantic Coast (USFWS 1996). Some mid-continent breeders travel up or down the Atlantic Coast before or after their overland movements (Stucker and Cuthbert 2006). Use of inland stopovers during migration is also documented (Pompei and Cuthbert 2004). The pattern of both fall and spring counts at many Atlantic Coast sites demonstrates that many piping plovers make intermediate stopovers lasting from a few days up to one month during their migrations (NPS 2003, Noel et al. 2005, Stucker and Cuthbert 2006). In addition, this species exhibits a high degree of both intra- and inter-annual wintering site fidelity (Drake et al. 2001, Noel et al. 2005, Stucker and Cuthbert 2006).

A growing body of information shows that overwash-created and -perpetuated habitats, including accessible bayside flats, unstabilized and recently healed inlets, and moist sparsely vegetated barrier flats are especially important to piping plover productivity and carrying capacity in the New York-New Jersey and Southern recovery units.

In New Jersey, Burger (1994) studied piping plover foraging behavior and habitat use at three sites that offered the birds: ocean, dune, and backbay habitats. The primary focus of the study was on the effect of human disturbance on habitat selection, and it found that both habitat selection and foraging behavior correlated inversely with the number of people present. In the absence of people on an unstabilized beach, plovers fed in ocean and bayside habitats in preference to the dunes.

Loefering and Fraser (1995) found that chicks on Assateague Island, Maryland that were able to reach bay beaches and the island interior had significantly higher fledgling rates than those that foraged solely on the ocean beach. Higher foraging rates, percentage of time spent foraging, and abundance of terrestrial arthropods on the bay beach and interior island habitats supported their hypothesis that foraging resources in interior and bayside habitats are key to reproductive rates on that site. Their management recommendations stressed the importance of sparsely vegetated cross-island access routes maintained by overwash, and the need to restrict or mitigate activities that reduce natural disturbance during storms.

Dramatic increases in plover productivity and breeding population on Assateague since the 1991-1992 advent of large overwash events corroborate Loefering and Fraser's conclusions. Piping plover productivity, which had averaged 0.77 chicks per pair during the five years before the overwash, averaged 1.67 chicks/pair in 1992-96. The nesting population on the northern five miles of the island also grew rapidly, doubling by 1995 and tripling by 1996, when 61 pairs nested there (MacIvor 1996). Habitat use is primarily on the interior and bayside.

In Virginia, Watts et al. (1996) found that piping plovers nesting on 13 barrier islands between 1986 and 1988 were not evenly distributed along the islands. Beach segments used by plovers had wider and more heterogeneous beaches, fewer stable dunes, greater open access to bayside

foraging areas, and proximity to mudflats. They note that characteristics of beaches selected by plovers are maintained by frequent storm disturbance.

At Cape Lookout National Seashore in North Carolina, 13 to 45 pairs of plovers have nested on North and South Core Banks each year since 1992 (NPS 2007d). While these unstabilized barrier islands total 44 miles long, nesting distribution is patchy, with all nests clustered on the dynamic ends of the barrier islands, recently closed and sparsely vegetated "old inlets," expansive barrier mudflats, or new ocean-to-bay overwashes. During a 1990 study, 96 percent of brood observations were on bay tidal flats, even though broods had access to both bay and ocean beach habitats (McConnaughey et al. 1990).

At CAHA, distribution of nesting piping plovers is also "clumped," with nesting areas characterized by a wide beach, relatively flat intertidal zone, brackish ponds, and temporary pools formed by rainwater and overwash (Coutu et al. 1990).

Notwithstanding the importance of bayside (soundside) flats, ephemeral pools, and sparsely vegetated barrier flats for piping plover nest site selection and chick foraging, ocean intertidal zones are also used by chicks of all ages. For example, between 1993 and 1996 on the Maryland end of Assateague Island, four to 12 percent of annual observations of plover broods occurred on the ocean beach (NPS and Maryland DNR 1993-1996). A three-year study of piping plover chick foraging activity at six sites on four Virginia barrier islands (Cross and Terwilliger 2000) documented chick use of the ocean intertidal zone at three of six study sites. Intensive observations at Chincoteague National Wildlife Refuge Overwash Zone in 2004, where chicks had unimpeded access to a large undisturbed bayside flat, documented occasional visits to the ocean intertidal zone by six of eleven broods ranging in age from one to 24 days (Hecht 2004, *in litt.*).

Wintering and migrating piping plovers on the Atlantic Coast are generally found at the accreting ends of barrier islands, along sandy peninsulas, and near coastal inlets. Wintering piping plovers appear to prefer sand flats adjacent to inlets or passes, sandy mud flats along prograding spits (areas where the land rises with respect to the water level), and overwash areas as foraging habitats. These substrate types may have a richer infauna than the foreshore of high energy beaches and often attract large numbers of shorebirds. Roosting plovers are generally found along inlet and adjacent ocean and estuarine shorelines and their associated berms and on nearby exposed tidal flats (Nicholls and Baldassarre 1990). Since tidal conditions and weather often cause plovers to move among habitat patches, diverse habitat patches may be especially important to plovers and may concentrate wintering piping plovers when roosting and feeding areas are adjacent (Johnson and Baldassarre 1988, Nicholls and Baldassarre 1990, Drake et al. 2001). Wintering plovers with small home ranges which contain safe roosts and abundant food should experience low commuting costs, and would be expected to have higher survival (Drake et al. 2001).

Cohen et al. (in press) conducted a study on wintering piping plovers at and near the Oregon Inlet during the winter of 2005/2006. They found that all plover habitat use fell into one of three habitat zones: ocean beach, sound beach, and sound island (dredged material, shoal, and other marsh and mudflat/sandflat islands). In the study, plovers were more likely to use sound islands

than ocean beach or sound beach when the intertidal area of sound islands was exposed during low tide. Plovers using ocean beach spent less time foraging (18%) than when on sound beaches (88%) and sound islands (83%).

Factors affecting the piping plover during its life cycle

Predation has been identified as a major factor limiting piping plover reproductive success at many Atlantic Coast sites (Burger 1987a, MacIvor 1990, Cross 1991, Patterson et al. 1991, Elias-Gerken, 1994). As with other limiting factors, the nature and severity of predation is highly site specific. Predators of piping plover eggs and chicks include foxes, skunks, raccoons, rats, opossums, crows, gulls, grackles, American kestrels, domestic and feral dogs and cats, and ghost crabs.

Substantial evidence exists that human activities are affecting types, numbers, and activity patterns of predators, thereby exacerbating natural predation. Non-native species such as feral cats and rats are considered significant predators at some sites (Goldin et al. 1990, Post 1991). Humans have also indirectly influenced predator populations by abetting the expansions in the populations and/or range of other species such as gulls (Drury 1973). Strauss (1990) found that the density of fox tracks on a beach area was higher during periods of more intensive human use.

Predation and nest abandonment because of predators have been implicated as a cause of low reproductive success (Cooper 1990, Coutu et al. 1990, Kuklinski et al. 1996). Predator trails (of foxes, dogs, and cats) have been seen around areas of the last known location of piping plover chicks. Predatory birds also are relatively common during their fall and spring migration along the Atlantic Ocean coastline, and there is a possibility they may occasionally take plovers.

Piping plover habitats (breeding and non-breeding) are dependent on natural forces of creation and renewal. However, storms and severe cold weather are believed to take their toll on plovers. After an intense snowstorm swept the entire North Carolina coast in late December 1989, high mortality of many coastal bird species was noted (Fussell 1990). Piping plover numbers decreased significantly from about 30 to 40 birds down to 15 birds. While no dead piping plovers were found, circumstantial evidence suggests that much of the decrease was mortality (Fussell 1990). Hurricanes may also result in direct mortality or habitat loss, and if piping plover numbers are low enough or if total remaining habitat is sparse relative to historical levels, population responses may be impaired even through short-term habitat losses. Wilkinson and Spinks (1994) suggest that, in addition to the unusually harsh December 1989 weather, low plover numbers seen in South Carolina in January 1990 (11 birds, compared with more than 50 during the same time period in 1991 to 1993) may have been influenced by effects on habitat and food availability caused by Hurricane Hugo in September 1989. Hurricane Elena struck the Alabama coast in September 1985 and subsequent surveys noted a reduction of intertidal foraging habitat on Dauphin and Little Dauphin Islands (Johnson and Baldassarre 1988). Birds were observed foraging at Sand Island, a site that was used little prior to the hurricane.

Unrestricted use of motorized vehicles on beaches is a serious threat to piping plovers and their habitats. Vehicles can crush eggs (Wilcox 1959, Tull 1984, Burger 1987b, Patterson et al. 1991, Shaffer and Laporte 1992) as well as adults and chicks. However, the mobility of newly hatched

chicks and adults does not lessen the susceptibility to mortality by vehicles. For example, in Massachusetts and New York, biologists documented 14 incidents in which 18 chicks and two adults were killed by vehicles between 1989 and 1993 (Melvin et al. 1994). Goldin (1993b) compiled records of 34 chick mortalities (30 on the Atlantic Coast and four on the northern Great Plains) due to vehicles. Biologists that monitor and manage piping plovers believe that many more chicks are killed by insufficiently-managed vehicles than are found and reported (Melvin et al. 1994). Beaches used by vehicles during nesting and brood-rearing periods generally have fewer breeding plovers than available nesting and feeding habitat can support. In contrast, plover abundance and productivity has increased on beaches where vehicle restrictions during chick-rearing periods have been combined with protection of nests from predators (Goldin 1993b).

Typical behaviors of piping plover chicks increase their vulnerability to vehicles. Chicks frequently move between the upper berm or foredune and feeding habitats in the wrack line and intertidal zone. These movements place chicks in the paths of vehicles driving along the berm or through the intertidal zone. Chicks stand in, walk, and run along tire ruts, and sometimes have difficulty crossing deep ruts or climbing out of them (Strauss 1990, Eddings 1991, Howard et al. 1993). Chicks sometimes stand motionless or crouch as vehicles pass by, or do not move quickly enough to get out of the way (Tull 1984, Hoopes et al. 1992, Goldin 1993b).

Vehicles also significantly degrade piping plover habitat or disrupt normal behavior patterns. They may harm or harass plovers by crushing wrack into the sand and making it unavailable as cover or a foraging substrate (Hoopes et al. 1992, Goldin 1993b), by creating ruts that can trap or impede movements of chicks (Jacobs 1988, *in litt.*), and by preventing plovers from using habitat that is otherwise suitable (MacIvor 1990, Strauss 1990, Hoopes et al. 1992, Goldin 1993b, Hoopes 1994). Zonick (2000) found that ORV density negatively correlated with abundance of roosting, nonbreeding plovers on the ocean beach in Texas. Studies elsewhere (e.g. Wheeler 1979) demonstrate adverse effects of ORV driving on soundside beaches on the abundance of infauna essential to piping plover foraging requirements.

Lighting may also negatively affect piping plovers. While the extent that artificial lighting (including vehicle lights) affects piping plovers is unknown, there is evidence that American oystercatcher (*Haematopus palliatus*) chicks and adults are attracted to vehicle headlights and may move toward areas of ORV activity. During a 2005 study at Cape Lookout National Seashore, adult and chick oystercatchers were observed running or flying directly into the headlights of oncoming vehicles, and two two-day old oystercatcher chicks were run over by an all-terrain vehicle after being observed foraging with the adults near the high tide line at night (Simons et al. 2005).

Pedestrian and non-motorized recreational activities can be a source of both direct mortality and harassment of piping plovers. There are a number of potential sources for pedestrians on the beach, including those individuals driving and subsequently parking on the beach, those originating from off-beach parking areas (hotels, motels, commercial facilities, beachside parks, etc.), and those from beachfront and nearby residences.

Pedestrians on beaches may crush eggs (Burger 1987b, Shaffer and Laporte 1992, NPS 1993), or flush plovers from nests exposing their eggs to predators. Concentrations of pedestrians may also deter piping plovers from using otherwise suitable habitat. Ninety-five percent of Massachusetts plovers (n = 209) observed by Hoopes (1993) were found in areas that contained less than one person per 2 acres of beach. Elias-Gerken (1994) found that piping plovers on Jones Beach Island, New York, selected beachfront that had less pedestrian disturbance. Sections of beach at Truston Pond National Wildlife Refuge in Rhode Island were colonized by piping plovers within two seasons of their closure to heavy pedestrian recreation. Burger (1991, 1994) found that the presence of people at several New Jersey sites caused plovers to shift their habitat use away from the ocean front to interior and bayside habitats; the time plovers devoted to foraging decreased and the time spent alert increased when more people were present. Burger (1991) also found that when plover chicks and adults were exposed to the same number of people, the chicks spent less time foraging and more time crouching, running away from people, and being alert than did the adults.

Pedestrians may flush incubating plovers from nests, exposing eggs to excessive temperatures. Repeated exposure of shorebird eggs on hot days may cause overheating, killing the embryos (Bergstrom 1989); excessive cooling may kill embryos or retard their development, delaying hatching dates (Welty 1982). Pedestrians can also displace unfledged chicks (Strauss 1990, Burger 1991, Hoopes et al. 1992, Loegering 1992, Goldin 1993b), forcing them out of preferred habitats, decreasing available foraging time, and causing expenditure of energy.

Fireworks are highly disturbing to piping plovers (Howard et al. 1993). Plovers are also intolerant of kites, particularly as compared to pedestrians, dogs, and vehicles; biologists believe this may be because plovers perceive kites as potential avian predators (Hoopes et al. 1992).

Noncompliant pet owners who allow their dogs off leash have the potential to flush piping plovers and these flushing events may be more prolonged than those associated with pedestrians or pedestrians with dogs on leash. Unleashed dogs may chase plovers (McConaughy et al. 1990), destroy nests (Hoopes et al. 1992), and kill chicks (Cairns and McLaren 1980, Boyagian 1994, *in litt.*).

Demographic models for piping plovers indicate that even small declines in adult and juvenile survival rates will cause very substantial increases in extinction risk (Melvin and Gibbs 1994, Larson et al. 2000, Wenner et al. 2001, Calvert et al. 2006). Furthermore, insufficient protection of non-breeding piping plovers has the potential to quickly undermine the progress toward recovery achieved at breeding sites. For example, a banding study conducted between 1998 and 2004 in Atlantic Canada found lower return rates of juvenile (first year) birds to the breeding grounds than was documented for Massachusetts (Melvin and Gibbs 1994), 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 abundance despite very high productivity (relative to other breeding populations) and extremely low rates of dispersal to the U.S. (Calvert et al. 2006). This suggests that maximizing productivity does not ensure population increases; management must focus simultaneously on all sources of stress on the population within management control.

Loggerhead sea turtle

Loggerheads are known to nest on average about four times within a nesting season, ranging from one to seven times (Talbert et al. 1980, Lenarz et al. 1981, Richardson and Richardson 1982, Murphy and Hopkins 1984). The interval between nesting varies around a mean of about 14 days (Dodd 1988). Mean clutch size varies from about 100 to 126 eggs per nest along the southeastern U.S. coast (NMFS and USFWS 1991b). The loggerhead returns at intervals of two to three years, but the number can vary from one to seven years (Dodd 1988). Age at sexual maturity is likely to be greater than 30 years (Snoover 2002).

Green sea turtle

Green turtles deposit from one to nine clutches within a nesting season, but the overall average is about 3.3. The interval between nesting varies around a mean of about 13 days (Hirth 1997). Mean clutch size varies widely among populations. Average clutch size reported for Florida was 136 eggs in 130 clutches (Witherington and Ehrhart 1989). Only occasionally do females produce clutches in successive years. Usually two to four years intervene between breeding seasons (NMFS and USFWS 1991a). Age at sexual maturity is believed to be 20 to 50 years (Hirth 1997).

Leatherback sea turtle

Leatherbacks nest an average of five to seven times within a nesting season, with an observed maximum of 11 (NMFS and USFWS 1992). The interval between nesting is about nine to ten days. Clutch size averages 101 eggs on Hutchinson Island, Florida (Martin 1992). Most leatherbacks return at two to three-year intervals based on data from the Sandy Point National Wildlife Refuge, St. Croix, U.S. Virgin Islands (McDonald and Dutton 1996). Leatherbacks are believed to reach sexual maturity in six to ten years (Zug and Parham 1996).

Factors affecting sea turtles during portions of their life cycle

Artificial lighting is one of the most significant impacts on sea turtle survival, especially of post-emergent hatchlings (Mann 1977, Ehrhart and Witherington 1987, Witherington 1992). Visual cues are the primary sea-finding mechanism for hatchlings (Mrosovsky and Carr 1967, Mrosovsky and Shettleworth 1968, Dickerson and Nelson 1989, Witherington and Bjorndal 1991). Hatchlings show a tropotactic response to light upon emergence, so any visual stimulus in the field of vision has some effect on the direction chosen by the hatchlings (Mrosovsky 1970). Hatchlings instinctively orient to the brightest horizon, which, in the absence of artificial lights, is usually the ocean horizon. It is possible to attract hatchlings out of the surf with a bright light, demonstrating the importance of light stimulus in hatchling behavior (Carr and Ogren 1960, Ehrhart and Witherington 1987).

Artificial lighting cues can cause misorientation (hatchlings travel along a consistent course toward a light source) or disorientation (hatchlings are not able to set a particular course and wander aimlessly) (Philibosian 1976, Mann 1977, Witherington 1990). Hatchlings are frequently attracted to point source lights on buildings and roadways in urban areas (McFarlane

1963, Philibosian 1976, Mann 1978, Witherington 1992). Urban areas may also have a non-point source nighttime glow which may disorient hatchlings from otherwise dark sections of beach (Witherington 1993, Tuxbury and Salmon 2005). Light intensities from sky measurements taken on the beach can be higher than the ocean horizon (Salmon et al. 1995a).

Once disoriented, turtles often enter conflicting light environments as they head landward. As hatchlings approach buildings and roads, they encounter obstacles that may screen the source of artificial light (Salmon et al. 1995b). They may then re-orient themselves correctly toward the ocean or continue along the obstruction (e.g. seawall, deep ruts, buildings) until they can see the original or perhaps another source of artificial light. If the obstructions are high enough and continuous enough to prevent the hatchlings from leaving the beach, the lightening sky as sunrise approaches often becomes a dominant influence and attracts the hatchlings to the surf. Mann (1977) also found that most turtles in artificial light-dominated areas oriented correctly on brightly moonlit nights. On moonless nights, hatchlings were more easily disoriented by artificial lights.

The correlation between level of light-caused disruption and survivorship has not, however, been identified. It has been demonstrated that there are relative degrees of sub-lethal and lethal effects, ranging from mild misorientation of a few hatchlings to strong disorientation of a whole clutch resulting in mortality for many hatchlings (Salmon et al. 1995a, Witherington et al. 1996).

Both Mann (1977) and Ehrhart and Witherington (1987) found high mortality in the emergences where the majority of the hatchlings were strongly disoriented. If the hatchlings do not manage to enter the surf, they may enter the vehicle corridor where they are subject to being run over, trapped in tire ruts and become vulnerable to predators, or become irretrievably lost from finding their way to the surf. The protracted wanderings of disoriented hatchlings also lengthens the time they are susceptible to predation from raccoons, ghost crabs, seabirds, fish crows, night herons and possibly dogs and cats. The prolonged exposure can exhaust and/or dehydrate the turtles to the point of death or limit their chance of survival once in the water. Weakened hatchlings that eventually reach the water may be more vulnerable to marine predators, which are abundant in nearshore waters (Wyneken et al. 1994).

Research has also documented significant reduction in sea turtle nesting activity on beaches illuminated with artificial lights (Witherington 1992). Lights may deter females from coming ashore to nest or disorient females trying to return to the surf after a nesting event. However, artificial lighting does not appear to be as problematic for nesting adult female sea turtles as compared to hatchlings. They seem to use a straight-ahead method to select a nest site. They do not appear to be affected as much by artificial lights along the beach as they are by bright lights immediately in front of them upon emerging from the surf (Salmon et al. 1995b, Witherington 1992). Distant point sources and urban glow are more likely to affect hatchlings than adult females (Salmon et al. 1995b). The effects of lights on the female's decision of where to emerge remain unknown.

Hurricanes and other storms during late summer and fall on the east coast of the U.S. create conditions that often result in beach erosion and the subsequent loss of sea turtle nests. Nests may be washed out or inundated long enough to result in egg mortality. In the last several years,

numerous hurricanes and tropical storms have resulted in substantial impacts to the coastal environment along most of the eastern United States. Erosion resulted in a reduction of beach profile in some areas and an accretion of sand in others. High tides and storm surges from these tropical systems overwashed, washed out, buried, or inundated sea turtle nests. Due to nesting chronology, most of the nests lost to storm events will be loggerhead and a few green sea turtle nests. Leatherback sea turtles typically nest earlier in the season and most, if not all, nests have hatched prior to the peak of the tropical storm season.

The use of ORVs on sea turtle nesting beaches can adversely affect the egg, hatchling, and nesting life stages of sea turtles. Vehicles can directly impact sea turtles by running over nesting females and hatchlings making their way to the ocean; crushing nests; deterring females from nesting and approaching nesting beaches; and changing the beach profile and nesting habitat (e.g., compacting sand and making nest excavation difficult, producing ruts in the sand that trap hatchlings, and creating escarpments that prevent females from accessing the beach). Vehicles on beaches, especially during night hours, run the risk of striking adult females emerging on the beach to nest or hatchlings making their way towards the surf after emerging from the nest (National Research Council 1990).

Driving on dune systems alters beach habitat for turtle nesting. Vehicles change the character of the beach profile (Hosier and Eaton 1980), thus increasing the chance of unsuitable nesting habitat for turtles and reducing the number of nests laid and/or hatchlings produced. Erosion can increase in areas with vehicular traffic (National Research Council 1990), which can create escarpments that prevent females from reaching the nesting area of the beach or act as obstacles to hatchlings trying to reach the ocean.

Ruts caused by ORVs reduce the number of hatchlings that make it to the ocean (Lamont et al. 2002). The ruts act as barriers which trap hatchlings making them prone to desiccation and predation. Live and desiccated turtles have been observed in deep vehicle ruts (LeBuff 1990). The ruts can also act as pathways, leading hatchlings away from the ocean. Apparently, hatchlings become diverted not necessarily because they cannot physically climb out of the rut (Arianoutsou 1988, 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). If hatchlings are detoured along vehicle ruts, they are at greater risk to vehicles, predators, fatigue, and desiccation. However, hatchling turtles also have a greater probability of overturning when they have to maneuver over ruts in the sand (Hosier 1981; Hosier et al. 1981), which can expose them to desiccation and predation. At least two studies have confirmed hatchling disorientation by vehicular ruts (Cox et al. 1994, Hosier et al. 1981).

Sand compaction resulting from ORVs may increase the length of time required for female sea turtles to excavate nests. If sediments become too compacted, a female turtle may have difficulty excavating an egg chamber of adequate depth or dimensions (Raymond 1984, Ryder 1990, Carthy 1994). Compression of sand by vehicles also causes reduced hatching success of loggerhead turtle nests (Mann 1977). Nesting areas with vehicle traffic have a lower hatchling emergence due to egg chamber cave-ins, making it harder for hatched turtles to emerge to the surface (Mann 1977). Mortality while hatching out of eggs is also higher on beaches open to public access than beaches with restricted access (Kudo et al. 2003).

Pedestrian traffic on the beach can have a wide variety of adverse effects on sea turtles. People often walk on beaches at night seeking encounters with nesting female sea turtles. These interactions can interfere with the successful excavation of a nest chamber and/or deposition of eggs and may result in abandonment of nesting attempts (McFarlane 1963, Johnson et al. 1996). Once a turtle leaves the beach, she may return to the same location or select a new site later that night or the following night. However, repeated interruption of nesting may cause a turtle to construct her nest in a sub-optimal incubation environment, postpone nesting for several days, prompt movement many miles from the original chosen nesting site, or cause the turtle to shed her eggs at sea (Murphy 1985). Studies of pedestrian impacts on loggerhead sea turtle nests in Japan have shown that beaches with full pedestrian access have significantly lower emergence success, compared to nests laid on beaches with restricted pedestrian access (Kudo et al. 2003). The full extent to which nighttime beach use by humans may affect sea turtles is not known.

Increased pedestrian use increases the amount of trash left behind on the beach. This waste becomes a threat to hatchlings and adult turtles on the beach and in the water. Sea turtles ingest waste products, especially plastics, due to their resemblance to jellyfish, a turtle food source (National Research Council 1990). Bugoni et al. (2001) found as much as 60 percent of the turtles investigated had ingested marine debris. Beach trash can also impede the movement of hatchlings to the ocean.

Dogs running freely on beaches have been identified as potential predators of eggs, hatchlings and even adult sea turtles (Dodd 1988, Santos and Godfrey 2001).

C. Population dynamics

Piping plover

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. Russell (1983) reviewed historical records to estimate the pre-settlement populations of the plover throughout this range. While estimates may be high for some Great Lakes states, no other historic estimates are available. Total population estimates ranged from 492 to 682 breeding pairs in the Great Lakes region; Michigan alone may have had the most with as many as 215 pairs. When listed, the Great Lakes population numbered only 17 known breeding pairs that nested in northern Michigan. Gradual increases in this population have been documented since listing and these birds are now known to have expanded to the south and west (USFWS 2003). Twenty-nine breeding pairs were observed in 2001 (Ferland and Haig 2002). As of 2007, there were an estimated 63 nesting pairs (Dingledine 2008, *in litt.*).

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.

Northern Great Plains Population

The Northern Great Plains plover breeds from Alberta to Manitoba, Canada and south to Nebraska; although some nesting has recently occurred in Oklahoma. Currently the most westerly breeding piping plovers in the United States occur in Montana and Colorado.

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. Breeding surveys in the early 1980s reported 2,137 to 2,684 adult plovers in the northern Great Plains/Prairie region (Haig and Oring 1985). In 1991, 2,032 adult plovers were observed in the U.S. portion of the northern Great Plains (Haig and Plissner 1993). The number declined to 1,599 in 1996 (Plissner and Haig 1997), a reduction of 21 percent from 1991. Part of this reduction may be an artifact of increased numbers of plovers nesting in Canada in 1996 due to high water levels in the U.S. (Plissner and Haig 1997). Overall in both the U.S. and Canadian portion of the northern Great Plains, 3,469 adult piping plovers were observed in 1991; 3,286 were observed in 1996; and 2,953 were observed in 2001 (Ferland and Haig 2002). The 2001 figure includes 1,291 breeding pairs.

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. While piping plovers do nest on shorelines of reservoirs created by the dams, 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.

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 (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 1996). 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.

The Atlantic Coast population has increased from 790 pairs since listing to a preliminary estimate of 1,887 pairs in 2007 (USFWS 2008a)(final 2006 estimate of 1,749 pairs, USFWS 2006b). Population growth has been greatest in the New England and New York-New Jersey recovery units, with a more modest and recent increase in the Southern unit and an even smaller increase in Atlantic Canada. Periodic rapid declines in abundance of breeding pairs at the level of the recovery unit, including a 68 percent decline in the southern half of the Virginia barrier island chain and North Carolina between 1995 and 2001, illustrate continued population vulnerability. As of 2007, the Southern recovery unit had 333 nesting pairs (USFWS 2008a). The abundance objectives for the Atlantic Coast population and the Southern recovery unit are 2,000 and 400 breeding pairs, respectively, and must be sustained for five years (USFWS 1996).

Species as a whole

The 2001 International Piping Plover Breeding Census resulted in 2,747 breeding pairs distributed across all three breeding populations (Ferland and Haig 2002). Total population numbers have fluctuated over time with some areas experiencing increases and others decreases.

Loggerhead sea turtle

From 1989 to 1998, total estimated loggerhead nesting in the southeastern U.S. ranged from approximately 53,000 to 92,000 nests per year, with well over 90% of the nests occurring in Florida (Turtle Expert Working Group 2000). In 1998, 85,988 nests were documented in Florida alone. However, that number had declined to 49,776 nests in 2006 (FFWCC 2006a). An analysis of nesting data from the Florida Index Nesting Beach Survey (INBS) Program from 1989 to 2007, a more consistent and accurate index survey that includes a subset of the total Florida beach length, showed an overall decrease in loggerhead nesting of 37% (FFWCC 2007).

Standardized monitoring of nearly all ocean-facing beaches in North Carolina was implemented in the mid-1990s. Data collected to date on annual numbers of nests in North Carolina are insufficient to detect a trend. An analysis of a longer-term dataset available for several nesting beaches in the southern reach of North Carolina showed that there was no increasing or decreasing trend in annual nest numbers (Hawkes et al. 2005). Additional, long-term nesting data are needed to determine whether current declines in nesting are part of the inherent variability in sea turtle nesting patterns or the result of other factors.

From a global perspective, the southeastern U.S. nesting aggregation is of importance to the survival of the species and is second in size only to that which nests on islands in the Arabian Sea off Oman (Ross 1982, Ehrhart 1989, NMFS and USFWS 1991b). The status of the Oman loggerhead nesting population, reported to be the largest in the world (Ross 1979), is uncertain because of the lack of long-term standardized nesting or foraging ground surveys and its vulnerability to increasing development pressures near major nesting beaches and threats from fisheries interactions on foraging grounds and migration routes (Possardt 2005, *in litt.*). The loggerhead nesting aggregations in Oman, the southeastern U.S., and Australia have been estimated to account for about 88 percent of nesting worldwide (NMFS and USFWS 1991b).

Green sea turtle

Based on an analysis of 46 green turtle nesting concentrations worldwide, approximately 109,000 to 151,000 females nest annually (NMFS and USFWS 2007a). However, this is a crude estimate since not all nesting sites are included, and some data are not fully verifiable. Since 1989, approximately 579 to 9,642 green turtles have annually nested in Florida, with the all-time high number occurring in 2005 (FFWCC 2006a). Green turtles sporadically nest in North Carolina, South Carolina and Georgia in small numbers. In 2007, 15 green turtles nests were observed in North Carolina (SCDNR 2007). 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 USFWS 1998). Elsewhere in the U.S. Pacific, nesting takes place at scattered locations in the Commonwealth of the Northern Marianas, Guam, and American Samoa. In the western Pacific, the largest green turtle nesting aggregation in the world occurs on Raine Island, Australia, where tens of 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).

Leatherback sea turtle

Pritchard (1982) estimated 115,000 female leatherback turtles worldwide, of which 60% nested along the Pacific coast of Mexico. Spotila et al. (1996) later estimated that only 34,500 females (with confidence limits of 26,200 to 42,900) remained worldwide. The most recent population size estimate for North America alone is from 34,000 to 94,000 adult leatherbacks (Turtle Expert Working Group 2007). A dramatic drop in nesting numbers has been recorded on major nesting beaches along the Pacific Ocean, although a sizeable nesting population exists in Papua-Indonesia (Dutton et al. 2007, Hitipeuw et al. 2007). Severe declines in leatherback nesting have occurred over the last two decades along the Pacific coasts of Mexico and Costa Rica (Spotila et al. 2000). The Pacific Mexican leatherback nesting population, once considered to be the world's largest leatherback nesting population (historically estimated to be 65 percent of worldwide population), is now less than one percent of its estimated size in 1980 (Pritchard 1982, Sarti Martínez et al. 2007). The Malaysian nesting population has collapsed and is near extirpation (Chan and Liew 1996). In the Atlantic Ocean, overall, there appears to be an increasing or stable population trend in all regions except the Western Caribbean and West Africa (for the latter, no long-term data are available)(Turtle Expert Working Group 2007).

The largest nesting populations at present occur in the western Atlantic Ocean in Trinidad and Suriname/French Guiana (4,500 to 7,500 females nesting/year) and in the eastern Atlantic Ocean in Gabon (Billes et al. 2000). In the U.S., most nesting occurs in Florida, U.S. Virgin Islands and Puerto Rico. From 1989 to 2006, 98 to 935 nests were observed in Florida (FFWCC 2006a). An analysis of the Florida Index Nesting Beach Survey shows an overall increase in leatherback nesting from 1989 to 2006 (FFWCC 2007). The U.S. Virgin Islands and Puerto Rico nesting populations also appear to be increasing (Dutton et al. 2005, Turtle Expert Working Group 2007). Leatherback nesting is low in number and sporadic in North Carolina. In 2007, 10 leatherbacks nested in North Carolina (SCDNR 2007).

D. Status and distribution

Piping plover

Populations of piping plovers have declined from historic numbers. Unregulated hunting drove plovers to near extinction in the early 1900s, but protective legislation resulted in population recovery by the mid-1920s. However, piping plover numbers declined again in the 1940s and 1950s due to shoreline development. River flow alteration, channelization, and reservoir construction also contributed to declines during this period.

The endangered Great Lakes population is at a low level. From an all-time low of 12 nesting pairs in 1990, the population has increased to an estimated 63 nesting pairs in 2007 (Dingledine 2008, *in litt.*). During this period most nesting occurred in Michigan, but recently, as many as five pairs have nested along the Lake Superior shoreline in Wisconsin. Also, in 2007 the first successful nesting pair in over 30 years was recorded in the Great Lakes region of Ontario, Canada (Dingledine 2008, *in litt.*).

The Northern Great Plains breeding population continues to decline. Overall, there were an estimated 1,291 northern Great Plains nesting pairs in the U.S. and Canada in 2001. Current estimates of piping plover survival rates are limited, but most mortality was thought to occur during migration or on wintering grounds (Root et al. 1992). The decline of this population has been attributed to the construction of reservoirs that result in the loss of sandbar habitat.

The Atlantic Coast breeding population has experienced an overall increase since listing, but these increases are regionally variable with some areas continuing to experience periodic population declines (USFWS 2008b). The Atlantic Coast population of piping plovers has increased from 790 nesting pairs in 1986 to a preliminary estimate of 1,887 nesting pairs in 2007 (USFWS 2008a). However, the increase is unevenly distributed (with most pairs occurring in New England and New York-New Jersey). Growth of the Atlantic Coast population has followed intensive, expensive, and sustained protection of breeding pairs by USFWS, Canadian Wildlife Service, state, and provincial wildlife agencies; federal, state, municipal, and private landowners; non-government organizations, academic organizations, and interested individuals.

Much of the plover's historic habitat along the Atlantic Coast has already been destroyed or permanently degraded by development and human use. The construction of houses and commercial buildings on and adjacent to barrier beaches directly removes plover habitat and

results in increased human disturbance. Additional disturbance comes in the form of recreational use of beach habitats. While legal restrictions on coastal development may slow the future pace of physical habitat destruction, the trend in habitat availability for this species is inexorably downward. Furthermore, habitat availability for the species is compromised by the ever increasing human access to, and recreational use of, these coastal habitats. The decrease in habitat availability, especially with regard to the dynamic nature of these coastal areas, may force birds to nest in suboptimal habitats, the effects of which could manifest itself in poor future reproductive success.

The decrease in the functional suitability of the plover's habitat due to accelerating recreational activity on the Atlantic Coast may impact productivity. Functional habitat loss occurs when suitable nesting sites are made unusable because high human and/or animal use precludes the birds from successfully nesting. Population growth along both the U.S. and Canadian coasts fosters an ever increasing demand for beach recreation. In 2004, about 30 percent of the U.S. Atlantic Coast population of piping plovers nested on federally owned beaches where some protection is afforded under section 7 of the ESA. The remaining 70 percent of the birds nested on state, town, or privately-owned beaches where plover managers are implementing protections in the face of increasing disturbance from recreation and development. Unfortunately for the piping plover, recreational activities and public use of federally owned beaches have also increased. Pressure on Atlantic Coast beach habitat from development and human disturbance continues (USFWS 1996).

Piping plovers winter in coastal areas of the U.S. from North Carolina to Texas and in portions of Mexico and the Caribbean. Birds from the three breeding populations overlap in their use of wintering habitat. In 2001, 2,389 piping plovers, accounting for approximately 40 percent of the known breeding birds recorded during a breeding census were located during a winter census (Haig et al. 2005). While only 16 percent of all nonbreeding birds counted during the 2001 census were found on the Atlantic Coast, observations of banded migrating and wintering piping plovers from the Great Lakes and Atlantic Canada breeding populations were heavily concentrated on the southern U.S. Atlantic Coast (Amirault et al. 2005, Stucker and Cutler 2006). The status of wintering piping plovers is difficult to assess, but threats to piping plover wintering habitat identified by the USFWS 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 wintering areas. Conservation efforts at some locations have likely resulted in the enhancement of wintering habitat.

We are aware of the following site-specific conditions that affect the status of several wintering piping plover habitats, 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, thus decreasing the likelihood of automobile disturbance to plovers. In Florida, land acquisition has been initiated within portions of one critical habitat unit in the panhandle. The USFWS remains in a contractual agreement with the U.S. Department of Agriculture for predator control within limited coastal areas in the panhandle, including portions of some critical habitat units. Continued removal of potential terrestrial predators is likely to enhance survivorship of wintering

piping plovers. In North Carolina, one critical habitat unit was afforded greater protection when the local Audubon chapter agreed to manage the area specifically for piping plovers and other shorebirds following the relocation of the nearby inlet channel.

Loggerhead sea turtle

Genetic research involving analysis of mitochondrial DNA has identified five different loggerhead subpopulations/nesting aggregations in the western North Atlantic:

- Northern subpopulation occurring from North Carolina to around Cape Canaveral, Florida (about 29° N.);
- South Florida subpopulation occurring from about 29°N on Florida's east coast to Sarasota on Florida's west coast;
- Dry Tortugas, Florida, subpopulation;
- Northwest Florida subpopulation occurring at Eglin Air Force Base and the beaches near Panama City; and
- Yucatán subpopulation occurring on the eastern Yucatán Peninsula, Mexico.

These data indicate that maternally based gene flow between these five regions is very low. If nesting females are extirpated from one of these regions, regional dispersal will not be sufficient to rapidly replenish the depleted nesting subpopulation (Bowen 1995, *in litt*; Bowen et al. 1993; Encalada et al. 1998; Pearce 2001).

The Northern subpopulation has declined substantially since the early 1970s. Standardized ground surveys of 11 North Carolina, South Carolina and Georgia nesting beaches showed a significant declining trend of 1.9% annually from 1983 to 2005 (NMFS and USFWS 2007b). Nest totals from aerial surveys conducted by the South Carolina Department of Natural Resources showed a 3.1% annual decline from 1980 to 2002 (NMFS and USFWS 2007b). Although long-term data are not available for all beaches in North Carolina, an analysis of annual nest totals on beaches in the southern part of NC showed no discernable increasing or decreasing trend (Hawkes et al. 2005).

An analysis of nesting data from the Florida Index Nesting Beach Survey (INBS) Program from 1989 to 2007 showed an overall decrease in loggerhead nesting of 37% (FFWCC 2007). The Florida Panhandle subpopulation shows a significant declining trend of 6.8% annually from 1995 to 2005 (NMFS and USFWS 2007b).

Current threats include loss or degradation of nesting habitat from coastal development and beach armoring; confusion of hatchlings by beachfront lighting; excessive nest predation by native and non-native predators; degradation of foraging habitat; marine pollution and debris; watercraft strikes; disease; and incidental take from channel dredging and commercial trawling, longline, and gill net fisheries. There is particular concern about the extensive incidental take of juvenile loggerheads in the eastern Atlantic by longline fishing vessels from several countries (Lutcavage et al. 1997, Lewison et al. 2004).

Green sea turtle

Total population estimates for the green turtle are unavailable, and trends based on nesting data are difficult to assess because of large annual fluctuations in numbers of nesting females. Some nesting localities appear to be stable or increasing, while others appear to be declining. Trend data are unavailable for many locations (NMFS and USFWS 2007a). The endangered Florida nesting population appears to have increased from 1989 to 2006. This may partially be due to increased protections through state legislation in Florida (NMFS and USFWS 2007a).

A major factor contributing to the green turtle's decline worldwide has been commercial harvest for eggs and food. Fibropapillomatosis, a disease of sea turtles characterized by the development of multiple tumors on the skin and internal organs, is also a mortality factor and has seriously impacted green turtle populations in Florida, Brazil, Hawaii, and other parts of the world. The tumors interfere with swimming, eating, breathing, vision, and reproduction. Heavy tumor burdens are fatal to the turtles (Herbst 1994). Other threats include loss or degradation of nesting habitat from coastal development and beach armoring; confusion of hatchlings by beachfront lighting; excessive nest predation by native and non-native predators; degradation of foraging habitat; marine pollution and debris; watercraft strikes; and incidental take from channel dredging and commercial fishing operations (Luicavage et al. 1997).

Leatherback sea turtle

Leatherbacks are less common in the Indian Ocean and in very low numbers in the western Pacific Ocean. The East Pacific and Malaysia leatherback populations have collapsed. 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. 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. The largest populations are in the Atlantic Ocean, in Suriname/French Guiana, Gabon, Trinidad and Costa Rica/Panama (Troëng et al. 2004). The North Atlantic population is estimated at 34,000 to 94,000 adults (Turtle Expert Working Group 2007) and appears stable.

The crash of the Pacific leatherback population is believed primarily to be the result of exploitation by humans for the eggs and meat, as well as incidental take in numerous commercial fisheries of the Pacific (Chan and Liew 1996, Spotila et al. 2000). Other factors threatening leatherbacks globally include loss or degradation of nesting habitat from coastal development, confusion of hatchlings by beachfront lighting, excessive nest predation by native and non-native predators, degradation of foraging habitat, marine pollution and debris, and watercraft strikes (Luicavage et al. 1997).

E. Analysis of the species/critical habitat likely to be affected

Piping plovers

Piping plovers from the Atlantic Coast population are the focus of these biological and conference opinions when referencing breeding birds. Since recovery units have been established in an approved recovery plan for the piping plover (USFWS 1996), these biological and conference opinions will also consider the effects of the proposed project on plovers in the Southern recovery unit. Piping plovers from all three breeding populations are referenced when discussing effects of the proposed action on migrating and wintering plovers. The proposed action has the potential to adversely affect nesting and non-nesting adults, eggs, chicks, and juveniles during the nesting season, and adults and juveniles during the migrating and wintering seasons within the proposed project area.

Sea turtles - all species

The proposed action has the potential to adversely affect nesting females, eggs, hatchlings, and post-hatchling washbacks within the action area. The effects of the proposed action on sea turtles will be considered further in the remaining sections of these biological and conference opinions. For loggerhead turtles, specifically, the focus of these biological and conference opinions will consider the effects of the proposed action on nesting loggerheads from North Carolina and the Northern subpopulation, as well as the southeastern U.S. population as a whole.

Other Species

In addition to the four species and proposed critical habitat that are the subject of this formal consultation and conference, the FHWA has determined that, based on lack of habitat, the project will have no effect on the red-cockaded woodpecker (*Picoides borealis*) and red wolf (*Canis rufus*). We concur with these determinations. Also, the FHWA has determined that the project may affect, but is not likely to adversely affect the roseate tern (*Sterna dougallii*), West Indian manatee (*Trichechus manatus*) and seabeach amaranth (*Amaranthus pumilus*). Based on available information, the USFWS concurs with these determinations. The hawksbill sea turtle (*Eretmochelys imbricata*) and Kemp's ridley sea turtle (*Lepidochelys kempii*) do not normally nest in North Carolina, but occur in waters off the North Carolina coast. These two turtle species, along with the shortnose surgeon (*Acipenser brevirostrum*), fall within the purview of the NMFS. The species discussed in this paragraph will not be considered further in this consultation.

III. ENVIRONMENTAL BASELINE

Under section 7(a)(2) of the ESA, when considering the "effects of the action" on federally listed species, the USFWS is required to take into consideration the environmental baseline. The environmental baseline includes past and ongoing natural factors and the past and present impacts of all federal, state, or private actions and other activities in the action area (50 CFR 402.02), including federal actions in the area that have already undergone section 7 consultation.

and the impacts of state or private actions which are contemporaneous with the consultation in process.

A. Status of the Species Within the Action Area

Piping Plover

Piping plover habitat within the action area occurs within an area affected by dynamic coastal processes and ongoing human uses. Suitable piping plover habitat appears to be present at and near Oregon Inlet, Green Island and along the ocean shoreline. Along the existing NC 12, artificial berms are constructed and maintained to protect NC 12 from rising high tide lines and erosion. The longshore transport of sediments continues to operate, but not the cross-island transport that maintains optimal piping plover habitat. This may result in the species currently concentrating near Oregon Inlet.

There is minimal piping plover breeding activity within the action area. Breeding activity has only been observed along both sides of Oregon Inlet. One breeding pair has been recorded at Bodie Island Spit on the north side of Oregon Inlet during five out of the last ten years (2001, 2002, 2004, 2006 and 2007)(Cameron 2008a, *in litt.*; NCWRC 2008b). During this same timeframe, one nest was observed in each of the years 2001, 2002, 2004 and 2007. In 2007, three chicks hatched, and one fledged, from a nest on Bodie Island Spit approximately 1700 feet, northeast of the existing Bonner Bridge (NPS 2007a, NPS 2007b). One or two breeding pairs were observed on the south side of Oregon Inlet on PINWR during each of the years from 1998 to 2003 (Cameron 2008a, *in litt.*; NCWRC 2008b), with one nest being observed in 2001 and 2002 (Sue Cameron, NCWRC waterbird biologist, pers. comm. March 24, 2008). Vegetation succession on the south side of Oregon Inlet has reduced favorable nesting habitat there. In 2007, the action area accounted for only 1.6% of piping plover breeding activity within North Carolina (one out of 61 breeding pairs)(Cameron 2008b, *in litt.*; NCWRC 2008c).

The number of piping plovers within the action area during the winter or migration is more difficult to assess. Regular surveys have not been conducted for non-breeding (including migrating and overwintering) plovers. However, non-breeding piping plovers have been observed within the action area, primarily at Bodie Island Spit (Cameron 2008, *in litt.*; NCWRC 2008a, NPS 2007a, NPS 2006b). Cohen et al. (in press) found that wintering plovers used ocean beach, sound beach and sound islands near Oregon Inlet. They estimated a minimum total wintering population of 11 birds in the vicinity of Oregon Inlet (including Green Island) during the winter of 2006/2007.

Proposed critical habitat for wintering piping plovers, Unit NC-1 Oregon Inlet, lies within the action area (USFWS 2008d). This unit contains a mix of intertidal beach and sand and/or mud flats (between annual low tide and annual high tide) with no or very sparse emergent vegetation, and adjacent areas of unvegetated or sparsely vegetated dune systems and sand and/or mud flats above annual high tide. Unit NC-1 is the northernmost critical habitat unit proposed within the wintering range of the piping plover. Consistent use by wintering plovers has been reported at Oregon Inlet dating from the mid-1960s. As many as 39 plovers have been reported from single day surveys during the fall migration (NCWRC 2008a). Cohen et al. (in press) reported

wintering birds using portions of the proposed Unit NC-1. Recent surveys have also recorded use of proposed Unit NC-1 by at least one banded piping plover from the endangered Great Lakes breeding population, with at least nine other birds recorded at other sites within the Dare County portion of the Outer Banks (Stucker and Cuthbert 2006). Until recently, limited banding has been done in the Great Plains population, so it is uncertain whether or to what extent birds from this population winter in this unit.

Loggerhead sea turtle

Loggerhead turtles usually nest from late April or early May through mid-September (Meylan et al. 1995). From 1996 to 2006, there were a total 126 loggerhead nests observed within the action area, averaging 11.5 nests per year (Godfrey 2008, *in litt.*).

Green sea turtle

Green turtles usually nest from late May or early June to early or mid-September (Woodson and Webster 1999). From 1996 to 2006, there were 5 or 6 green turtle nests observed within the action area, averaging 0.5 nests per year (Godfrey 2008, *in litt.*; USFWS 2008c, *in litt.*).

Leatherback sea turtle

Nesting by leatherback turtles is rare in North Carolina, with only 10 nests documented statewide in 2007 (SCDNR 2007). From 1996 to 2006, no leatherback nests were documented within the action area (Godfrey 2008, *in litt.*).

Summary of the status of sea turtles at within the action area

From 2000 to 2006, the extent of sea turtle nesting within the action area annually represented 0.9 to 2.3% of total sea turtle nesting in North Carolina (Godfrey 2008, *in litt.*; NPS 2007c). Although the USFWS recognizes sea turtles can occur and will nest within the action area, the total number of turtle nests potentially affected is relatively small when compared to the recovery and survival needs of each species.

B. Factors affecting species environment within the action area

A number of ongoing anthropogenic and natural factors may affect the species addressed in these biological and conference opinions. Many of these effects have not been evaluated with respect to biological impacts on the species. In addition, some are interrelated and the effects of one cannot be separated from others. Known or suspected factors affecting the species addressed in these biological and conference opinions are discussed below.

Manteo (Shallowbag) Bay Project

The Army Corps of Engineers (COE) completed formal consultation, pursuant to section 7 of the ESA, with the USFWS in December 1990 for maintenance dredging at Oregon Inlet that would place about 1.5 million cubic yards of dredged sediments per year on the ocean beaches at

PINWR. The COE subsequently reinitiated consultation four times, with the USFWS subsequently providing amendments to the original biological opinion on July 12, 1991; August 1, 2001; June 11, 2002; and May 22, 2008. The June 2002 amendment addressed the modification of the inlet dredging to include the removal of 1.3 to 1.8 million cubic yards of sediments from the inlet and the southern end of Bodie Island spit and disposal of the material on the beaches of PINWR. The biological opinion allowed incidental take of up to one sea turtle nest. This take could take the form of burial or crushing of a nest, or inhibition of nesting due to beach disturbance or scarp formation associated with the placement of dredge material on the beach.

Terminal Groin

Oregon Inlet is part of a migrating barrier island system. Oregon Inlet is migrating south-southwest and historically was eroding the north end of Hatteras Island. In order to protect the Bonner Bridge, the NCDOT completed the construction of a terminal groin on the north end of Hatteras Island in 1991. This structure armored the north shore of Hatteras Island and ended the migration of the north end of the island. As a result, the natural barrier island processes which create piping plover habitat have stopped at the south side of Oregon Inlet. Furthermore, armoring the shore has resulted in increased vegetation coverage and succession which reduces the quantity and quality of piping plover habitat.

Sand Berm Construction

The NCDOT regularly reconstructs the sand berms along portions of NC 12 in PINWR and CAHA. The project varies in scale and scope, but typically entails placing sand that has washed or blown from the seaward dune onto the road back into the footprint of the seaward dune, and is intended to maintain access along NC Highway 12. Typically, the federal nexus for these projects are the required special use permits issued by PINWR and CAHA. Before a special use permit can be issued, the appropriate office must first consult with the USFWS's Raleigh Field Office under the provisions of the ESA.

The sand berm construction occurs in areas potentially used by piping plovers for foraging. Anticipated impacts of sand berm construction on piping plovers include:

- harassment in the form of disturbing foraging, migrating or wintering birds;
- preclusion of cross-island transport processes that form and maintain optimal habitat; and,
- destruction of foraging habitat.

Sand berm construction also occurs in areas used by sea turtles for nesting. Anticipated impacts of sand berm construction on sea turtles include:

- destruction of sea turtle nests and deposited eggs that may have been missed by a nest survey and egg relocation program;
- reduced hatching success due to egg mortality during relocation and adverse conditions at the relocation site;

- harassment in the form of disturbing or interfering with female sea turtles attempting to nest within the construction area or adjacent beaches as a result of construction activities;
- disorientation of hatching sea turtles on beaches adjacent to the construction area as they emerge from nests and crawl to the water because of project lighting; and
- limiting the width of the nesting beach.

Lighting

The extent that lighting affects piping plovers is unknown. However, there is evidence that American oystercatcher (*Haematopus palliatus*) chicks and adults are attracted to vehicle headlights and may move toward areas of ORV activity. During a 2005 study at Cape Lookout National Seashore, adult and chick oystercatchers were observed running or flying directly into the headlights of oncoming vehicles, and two two-day old oystercatcher chicks were run over by an all-terrain vehicle after being observed foraging with the adults near the high tide line at night (Simons et al. 2005). ORV driving is prohibited within most of the action area, being limited to the northernmost portion of the action area on the southern end of Bodie Island at Oregon Inlet, and approximately 1.1 miles of beach southward from the southern boundary of PINWR.

Although extensive monitoring of the effects of lighting on sea turtles has not been conducted within the action area, the southern end of the action may be affected by light originating from the village of Rodanthe.

Predation

Predation of piping plovers has not been directly observed within the action area, but predation and nest abandonment because of predators have been implicated as a cause of low reproductive success at CAHA (Cooper 1990, Coutu et al. 1990, Kuklinski et al. 1996). Mammalian and avian predators are relatively common within the action area. Red foxes (*Vulpes vulpes*) are relatively recent arrivals within the action area. Red foxes were first observed within CAHA on Bodie Island in 1996 and on Hatteras Island in 2000 (NPS 2001). Due to the presence of tracks, red foxes are suspected in disappearances of piping plovers and nest abandonment. Predation of sea turtle nests and hatchlings at CAHA has been documented. Red foxes and ghost crabs (*Ocypode* spp.) have been known to depredate sea turtle nests (NPS 2007c).

Stochastic (Random) Events

The impacts of tropical storms and associated coastal erosion on piping plovers within the action area have not been assessed. However, such events have the potential to destroy nests. Extremely cold temperatures may also adversely affect wintering birds.

High tides and storm surges from tropical weather systems can overwash, wash out, or inundate sea turtle nests. In the last several years, hurricanes and tropical storms have resulted in substantial impacts to the coastal environment along the action area. Erosion resulted in a reduction of beach profile in some areas and an accretion of sand in others. In the last ten years

(1998 to 2007), zero to nine sea turtle nests per year were lost within PINWR to storms and inundation (USFWS 2008c).

Habitat Management and Protection

With the exception of the southern terminus of the action area near Rodanthe, the coastline of the action area is under public ownership, either as CAHA or PINWR. Public ownership confers some conservation benefit to listed species, but land use decisions by the government agencies managing these lands ultimately determines the extent of conservation value these areas will have for threatened or endangered species.

In all cases, public ownership removes some threats that might otherwise be present if the properties were owned by private landowners and subsequently developed according to existing zoning regulations. In most cases, public ownership precludes the need for coastal armoring or beach nourishment, since these activities on public lands are rarely deemed appropriate (but see Manteo Bay Project section above). Thus, adverse effects to sea turtles and piping plovers associated with these activities are avoided or minimized on public lands. Public ownership also minimizes the likelihood that light pollution from homes and other development will become a significant problem since no commercial and residential development will occur on public lands. Therefore, along the shoreline of public parcels, disorientation of adult or hatchling sea turtles or piping plovers due to artificial lighting of homes or businesses will have been avoided or greatly reduced with public ownership.

Vehicle Use on the Beach

Oregon Inlet is one of the first beach access points for ORVs within CAHA when traveling from the developed coastal communities of Nags Head, Kill Devil Hills, Kitty Hawk, and Manteo. As such, the inlet spit is a popular area for ORV users to congregate. A recent visitor use study of the park reported that Oregon Inlet is the second most popular ORV use area in the park (Vogelsohn 2003). As a result, sandy beach and mud and sand flat habitat being proposed as critical habitat in this unit may require special management considerations or protection. The Bodie Island Spit and an approximately 1.1 mile section of beach south of the southern boundary of PINWR are the only portions of the action area where vehicles are allowed on the beach.

Vehicles can significantly degrade piping plover habitat and disrupt normal behavior patterns of the birds. ORV users routinely violate bird closure areas (NPS 2006a, NPS 2007a). While there are no records of plover mortality at Oregon Inlet due to vehicles or tire ruts, the prospects of finding a dead, small, sand-colored bird or chick is unlikely. During the winter of 2005/2006, Cohen et al. (in press) found that when piping plovers used ocean beach habitat at Oregon Inlet, plovers were far more likely to use the PINWR side of Oregon Inlet (96% of the time; no ORV use) than the Bodie Island side (4% of the time). The lesser use of the Bodie Island side coincides with the ORV use there. They also found that piping plovers commonly roosted on the PINWR side, but only rarely roosted on the Bodie Island side, despite the fact that the Bodie Island side was closer to their foraging sites. They recommended controlled management experiments to determine if recreational disturbance drives roost site selection at Oregon Inlet, and if control of disturbance might lead to increased use of the northern beach as a roost area.

As a result of a recent lawsuit in federal court, a settlement was agreed upon that would increase protection for breeding plovers within CAHA. Terms of the consent decree will result in buffers being established during portions of the spring and summer around bird breeding and nesting areas, including creating a 1000 meter vehicle perimeter around piping plover chicks until they have fledged (NPS 2008b).

The use of ORVs on sea turtle nesting beaches can adversely affect the egg, hatchling, and nesting life stages of sea turtles. There are no specific records of vehicles colliding with nesting turtles or hatchlings within the action area, but the potential exists since ORV users have been reported to violate closed areas (NPS 2007c). Impacts from vehicles running over sea turtle nests have been reported at other locations within CAHA (NPS 2007c).

Vehicular ruts create obstacles for sea turtle hatchlings moving from the nest to the ocean. Possible mortality of hatchlings can occur due to being trapped in tire ruts. In addition, indirect effects may occur from weakened individuals dying at sea or made more vulnerable to predators. CAHA implements measures (including closures around known nests) to manage these effects. Another potential indirect effect of vehicular traffic is compaction of beach sediments under the weight of vehicles, thus creating suboptimal nesting habitat conditions.

Pedestrian Use of the Beach

Though no statistics exist to quantify the amount of pedestrian traffic on the beaches within the action area, evidence exist that people walking on the beach affects nesting and wintering piping plovers and nesting sea turtles and their nests, eggs, and hatchlings. Closure areas are established to protect plovers and sea turtles, but pedestrians sometimes violate these (NPS 2008a, NPS 2007a, NPS 2007c). Pedestrians have been documented harassing nesting sea turtles within CAHA (e.g. crowding around nesting turtle and taking flash photographs) and digging within turtle nests (NPS 2007c). Pedestrian use is allowed day and night within CAHA, but only during the day within PINWR.

Dog Use on the Beach

Dogs on a leash are allowed within both CAHA and PINWR, except in designated areas where no dogs are allowed. However, violations occur and enforcement is difficult because of the limited number of NPS and USFWS staff. Dogs running freely on beaches are potential predators of piping plover eggs and chicks, and can harass nesting, migrating or wintering adults. Dogs are also potential predators of sea turtle eggs, hatchlings, and even adult sea turtles. Unleashed dogs have been observed digging into nests. However, the extent of the effects from these actions to plovers and sea turtles within the action area is unknown.

IV. EFFECTS OF THE ACTION

Under section 7(a)(2) of the Act, "effects of the action" refers to the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are

interrelated or interdependent with that action. The federal agency is responsible for analyzing these effects. The effects of the proposed action are added to the environmental baseline to determine the future baseline, which serves as the basis for the determination in these biological and conference opinions. Should the effects of the federal action result in a situation that would jeopardize the continued existence of the species, we may propose reasonable and prudent alternatives that the federal agency can take to avoid a violation of section 7(a)(2). The discussion that follows is our evaluation of the anticipated direct and indirect effects of the proposed project. Indirect effects are those caused by the proposed action that occur later in time but are still reasonably certain to occur (50 CFR 402.02).

A. Factors to be considered

Piping plovers

Proximity of the action: The proposed action occurs within the nesting range of the Atlantic Coast piping plover breeding population. Since recovery units have been established in an approved recovery plan, these biological and conference opinions consider the effects of the proposed project on plovers in the Southern recovery unit, as well as the Atlantic Coast population and the entire species. The proposed action also occurs within the migrating and overwintering range of all three breeding populations of the piping plover. Additionally, the proposed action would occur within one proposed critical habitat unit for wintering plovers.

Distribution: The expected disturbance from the proposed action is likely to occur throughout the action area, but in a staggered manner over time.

Timing: The proposed action will occur throughout the year. Specifically, the proposed action will occur during the breeding, migrating and wintering seasons of the piping plover.

Nature of the effect: The project may affect breeding, nesting, migrating, roosting, or foraging activities of piping plovers. This may take the form of habitat loss, new habitat creation, preclusion of habitat utilization, harassment/disturbance resulting in behavior modification, and mortality in the form of egg, chick or adult death. Also considered are the potential effects on the primary constituent elements within one proposed critical habitat unit.

Duration/Disturbance frequency: The proposed project will be built in four phases, with Phase I beginning in 2009 and Phase IV beginning approximately 2029 or 2030. Each phase will involve 3 - 3.5 years of construction. The construction of each phase will be continuous from start to finish, operating year-round. Therefore, construction will be staggered over an approximately 25 year time span, with gaps of no construction between each phase. Each phase will only affect a portion of the action area at any one time.

The phasing of the construction of Phases II to IV is based on assumptions corresponding to forecast shoreline erosion trends and maintaining minimum 230-foot buffer distance between the existing NC 12 edge of pavement and the active shoreline. These assumptions are based on worst-case scenario modeling of shoreline erosion and the location and likelihood of future breaches on Hatteras Island. Since these are forecasts only, the exact timing and scope of each

phase could change based on the reality of future shoreline erosion. As such, the duration of the construction should be viewed as an approximation. Since piping plovers may be present throughout the year, plovers could be affected at any time during any of the phases or during subsequent maintenance of the facility.

Although construction activity will be a temporary affect, the new structures will permanently alter the habitat for piping plovers, although not necessarily all negatively in the long-term. Natural barrier island processes, which are currently precluded along much of the action area by the maintenance of NC 12, will be allowed to resume to an extent. Also, maintenance of the facility will be an ongoing activity on both a periodic and as-needed basis.

Disturbance intensity: Although the potential for disturbance to the piping plovers throughout the action area is high, the intensity of the disturbance is only expected to be high at and near Oregon Inlet. The rest of the action area currently has relatively little use by plovers. Therefore, Phase I has the greatest potential to affect plovers. The intensity of disturbance will likely be greatest for nesting piping plovers (April 1 through August 31) since they are tied to a point on the landscape with a nest, or when rearing young that have not yet fledged. However, relatively little nesting occurs within the action area. The intensity of disturbance may also be high for wintering plovers at Oregon Inlet. However, the small loss of proposed critical wintering habitat will likely have a discountable effect.

Disturbance severity: Although Phase I has the potential to affect nesting piping plovers, the severity of the affect, considering all the Atlantic Coast nesting, is relatively minor. Impacts to wintering plovers are of particular concern for the endangered Great Lakes breeding population. At least one individually identifiable Great Lakes piping plover has been observed at Oregon Inlet (Stucker and Cuthbert 2006).

Sea turtles – all species

Proximity of the action: The proposed action occurs within the northern nesting range of the loggerhead, green, and leatherback sea turtles. Specifically, the proposed action occurs within the range of the Northern subpopulation of the loggerhead turtle.

Distribution: The expected disturbance from the proposed action is likely to occur on all ocean facing beaches throughout the action area.

Timing: The proposed action will occur throughout the year. Any effects to sea turtles are expected to occur primarily during the sea turtle nesting and hatching seasons from May 1 through November 15. The greatest effects may occur at night from construction lighting and lights from vehicles traveling on the finished facility.

Nature of the effect: The project may affect nesting sea turtles, eggs, and hatchlings. This may take the form of habitat alteration, new habitat formation, preclusion of habitat utilization, harassment/disturbance resulting in behavior modification, and mortality in the form of egg, hatchling or adult death. Based on nesting records for the last ten years, we expect

approximately 96% of all effects to sea turtles will involve loggerhead sea turtles and 4% will involve green and leatherback sea turtles.

Duration/ Disturbance frequency: The duration/disturbance frequency to sea turtles is similar to that described above for piping plovers; except that the effects will primarily occur during nesting and hatching seasons from May 1 through November 15.

Disturbance intensity: The potential for disturbance to the sea turtle populations throughout the action area is highest for possible effects of construction lighting at night and lights from vehicles traveling on the finished facility.

Disturbance severity: Since nearly all the sea turtle nesting that occurs within the action area is by loggerheads, the severity of the disturbance to green and leatherback turtles is expected to be minimal. However, the effects to loggerheads could lessen the contribution of those turtles to the recovery goal for the northern nesting subpopulation of loggerheads. However, this may be balanced by possible habitat creation resulting from allowing natural barrier island processes to occur within more of the action area.

B. Analysis for effects of the action

Beneficial effects:

Since NCDOT maintains an artificial berm along the seaward side of NC 12 through most of the project area, natural barrier island processes such as ocean overwash, island migration and inlet formation have been mostly precluded, thus severely limiting the formation of new habitat for piping plovers. Elevating most of NC 12 onto a bridge will allow for the maintenance of the artificial berm to be discontinued, thus allowing the natural barrier island processes to resume. Ocean overwash and possible new inlets would likely create new potential habitat for plovers. Eventually, westward migration of the island would result in some portion of the bridges to be in the ocean eastward of the beach.

Similarly, elevating NC 12 onto bridges may potentially improve sea turtle nesting habitat. Currently, most of the beach along the seaward side of NC 12 is narrow, steep and subject to high wave energy. The potential nesting area is constrained to a narrow width along much of the action area by the artificial berm along NC 12. Elevating most of NC 12 onto bridges would allow the natural barrier island processes to widen the beach area available for nesting; however, as portions of the beach migrate westward underneath the bridge, some of the beach may not be suitable nesting habitat for some period of time as it would be underneath the bridge and subject to shading effects (thus affecting hatching and sex ratios). Eventually, portions of the beach would migrate westward beyond the bridge and potentially provide suitable nesting habitat. Turtles would have to crawl or swim between bridge piles in order to utilize the newly widened beach. The effect that the bridge piles would have on emerging sea turtles is expected to be minimal. Bouchard et al. (1998) found that simulated piles did not totally preclude nesting activity of loggerhead and green sea turtles at Melbourne Beach, Florida, but did reduce nesting in an area with piles on the beach by 41%. However, the simulated piles used in the study were

spaced 17 feet apart, whereas the piles for the Phase II, III and IV bridges will be 100-120 feet apart. This wider distance would likely have a much lesser effect on nesting activity.

Piping plover

Direct effects:

The most quantifiable effect on piping plovers pertains to breeding. The only nesting activity recorded within the action area has occurred at Oregon Inlet. Although no breeding pairs have been observed at the north end of Hatteras Island near the Inlet since 2003 (Cameron 2008a, *in litt.*; NCWRC 2008b), and habitat quality for nesting has declined in recent years due to vegetation encroachment, habitat quality can improve quickly with severe storms, so the site still has the potential for nesting activity. At the Bodie Island Spit, a single nest in each of the years 2001, 2002, 2004 and 2007 has been observed >0.25 mile east of the existing Bonner Bridge (NPS 2007b). The new bridge will be constructed 125-500 feet farther west of the existing bridge, thus farther from the known nesting sites. However, demolition of the old bridge will require the presence of heavy equipment and noise ~0.25 mile from the known nesting area. Although it is unlikely that any nesting habitat would be physically disturbed, it is possible that the presence of construction equipment, construction activity and associated noise may preclude or disrupt breeding behaviors, including courtship, egg laying, incubation, and chick rearing on part or all of Bodie Island Spit or the northern end of Hatteras Island for some portion of the construction of Phase I and demolition of the existing Bonner Bridge. In addition, the northern end of Phase II may have similar effects to the potential nesting area on the north end of Hatteras Island. These effects will be temporary, covering a subset of each of the estimated 3-3.5 year construction timeframes for Phases I and II. However, it is uncertain that any breeding pairs would be precluded from nesting. Anecdotal evidence implies that some or all of the preferred nesting sites may be sufficiently distant from the work zones to avoid disturbance effects. Phases III and IV will not be located near any currently suitable plover nesting habitat.

Due to fill and pile placement in Phase I, there will be a direct loss of <0.1 acre of beach that is potential foraging and roosting habitat. It is not anticipated that the presence of the completed new bridge will preclude piping plovers from foraging since plovers currently forage at the existing Bonner Bridge. Phases II, III and IV will not result in the direct loss of any current foraging or roosting habitat.

Perhaps the most likely and most widespread, but the least quantifiable, direct effect is disturbance and/or flushing of foraging or roosting plovers during the construction of each of the phases. The presence of heavy equipment, construction activity and associated noise will be in close proximity to potential foraging and roosting habitat. Phase I and the northern end of Phase II have the greatest likelihood of disturbing foraging or roosting plovers and/or precluding foraging/roosting habitat from being used on portions of Bodie Island Spit and the north end of Hatteras Island. Also, Phase I comes within 0.3 mile of soundside ephemeral intertidal shoals or flats that are used by foraging plovers. The rest of Phase II and all of Phases III and IV have the potential to effect foraging or roosting plovers, however these phases are located adjacent to portions of the action area that currently have less foraging/roosting activity. This effect will be

temporary and staggered over time and location, lasting for some subset of the estimated 3-3.5 year construction timeframe for each phase.

The biological effects of disturbance to foraging or roosting plovers are difficult to quantify. In general, however, we know that plovers require food and shelter. Any actions that limit their ability to feed or shelter probably have adverse effects on individual birds because flushed birds expend energy to avoid disturbance (Stillman et al. 2007). The degree that piping plovers are adversely affected depends largely on how much time they are precluded from feeding or sheltering in relation to the amount of time they would feed or shelter if they were not flushed. To evaluate the biological effects of flushing, the identity of individual piping plovers would have to be known and the amount and extent of flushing would need to be documented consistently over time for each bird. Furthermore, these individual birds would need to be followed throughout the year to determine if their survival rates or nesting success were lower than other birds not subjected to flushing. Given there are other factors that affect the survival or reproductive success of piping plovers (predation, weather, food availability and quality, etc.) it would be difficult to isolate the effects of flushing. A large number of individual birds would have to be studied over a relatively long period in order to attempt to quantify the effects of flushing. We are aware of no such long term and statistically robust studies.

Effects to proposed critical habitat:

Proposed critical habitat Unit NC-1 currently supports the primary constituent elements essential for the conservation of the species and does support consistent use by wintering piping plovers. Although the new bridge in Phase I will cross through approximately 1700 feet of proposed critical habitat on Bodie Island, the direct loss to fill and pile placement is <0.1 acre. The existing Bonner Bridge crosses through approximately 3680 feet of proposed critical habitat on Bodie Island, but is not part of the proposed critical habitat. The demolition of the existing bridge and the construction of the new bridge will likely have temporary direct effects to primary constituent elements (e.g. haul roads, ruts, hydrological effects, etc.). After construction and demolition are completed, all temporary structures will be removed and the habitat restored to pre-disturbance conditions. Therefore, the effect will be short-term (i.e. considerably less than the estimated 3.5 years for completion of Phase I). A portion of Phase II on Hatteras Island will occur adjacent to proposed critical habitat, but not within it.

Interrelated and interdependent effects:

The effects of the action under consultation are analyzed together with the effects of other activities that are interrelated to, or interdependent with, that action. An interrelated activity is an activity that is part of the proposed action and depends on the proposed action for justification. An interdependent activity is an activity that has no independent utility apart from the action under consultation.

Periodic bridge maintenance or repair activities may require the presence of inspectors and equipment to operate in the vicinity of potential piping plover habitat, thus causing disturbance to foraging/roosting plovers or precluding the use of habitat. These effects are difficult to

quantify. Disturbance from human recreation is already present, and thus the effect of maintenance and repair work would be additive to an existing level of disturbance.

In addition, the maintenance or repair activities may have temporary effects to the primary constituent elements of the proposed critical habitat. However, these effects would likely be short in duration since all disturbed areas would be restored to pre-disturbance conditions once the maintenance or repair is completed.

Indirect effects:

Indirect effects are caused by or result from the proposed action, are later in time, and are reasonably certain to occur. If, by the elevation of much of NC 12 onto bridges and allowing natural barrier island processes to resume, new piping plover habitat is created in the future (see Beneficial Effects above), new conditions will exist for indirect effects. These indirect effects will be identical to the direct effects described above (i.e. effects on nesting, disturbance/flushing of foraging/roosting plovers, and precluding habitat use) during maintenance or repair activities; however, they will be to plovers using habitat that does not currently exist. If new piping plover habitat is created, portions of the beach will eventually move westward underneath the new bridges. The effect of having a bridge immediately overhead or adjacent to potential nesting habitat is unknown. Foraging under or adjacent to bridges is not expected to preclude foraging since plovers currently forage adjacent to the existing Bonner Bridge.

Depending on final design of each bridge, the new bridges could provide perches for predators (e.g. gulls, crows, etc.) that may prey on piping plover adults, chicks or eggs. However, these predators currently fly over piping plover habitat, so the extent of any additional effect would be difficult to determine.

Sea Turtles - All Species

Direct effects:

None of the project will be built within existing sea turtle nesting habitat; therefore, there will be no direct loss of turtle nesting habitat. However, all four phases will be built in close proximity to turtle nesting beaches. The greatest potential direct effects will likely be those caused by the use of construction lighting.

The USFWS recognizes that lights have the potential to disorient both hatchlings and nesting females. Artificial lighting can cause misorientation or disorientation (Philibosian 1976, Mann 1977, Witherington 1990). Misorientation can result in fatigue, dehydration, and increased likelihood of predation (Witherington et al. 1996). The correlation between level of light-caused disruption and survivorship has not, however, been identified. It has been demonstrated that there are relative degrees of sub-lethal and lethal effects (Salmon et al. 1995a; Witherington et al. 1996).

The effects of construction lighting will be temporary and staggered over space and time as each of the four phases is built. The effect will be year-round during the 3-3.5 year construction

timeframe for each phase, with periods of no effect between each phase. There will be no permanent lighting on bridge.

Other possible direct effects include disturbance of nesting females from noise or vibration from construction equipment. These effects would also be temporary and staggered over space and time.

Interrelated and interdependent effects:

Periodic bridge maintenance or repair activities may require the presence of inspectors and equipment to operate in the vicinity of potential sea turtle nesting habitat, thus causing disturbance to nesting females or emerging hatchlings, or precluding the use of nesting habitat. It is assumed that maintenance or repair activities would not occur at night, therefore minimizing the level of effects. When, in the future, portions of the beach migrate west of the bridge and sea turtle nesting beach is adjacent to the bridge, any vehicles or equipment driving on the beach for maintenance or repair activities could run over undetected turtle nests.

Indirect effects:

If, by the elevation of much of NC 12 onto bridges and allowing natural barrier island processes to resume, new sea turtle nesting habitat is created in the future, or if existing sea turtle nesting beach is widened and improved in quality (see **Beneficial Effects** above), new conditions will exist for indirect effects. Sea turtle nesting beach is currently limited in width by the artificial berm along the seaward side of NC 12. In Phases II, III and IV, the berm will be incrementally eliminated, and sea turtles may nest farther inland on the newly widened beach. This may result in sea turtles nesting near, under or beyond the new bridges. The presence of bridge piles and bridge superstructure overhead will alter light levels, beach morphology, and sand characteristics. It is important to note that the following indirect effect would occur to sea turtle nesting habitat that does not currently exist, but would be expected to exist sometime in the future.

From 2020 to 2060, it is estimated that up to 1.8 miles of NC 12 will be over dry beach at any one time, shading up to 9.5 acres of potential turtle nesting habitat. Shading would provide overall less desirable nesting conditions since beach sands shaded by the bridge would be expected to have a lower temperature. Temperature is negatively correlated with egg development time, so eggs under the bridge may display increased incubation time thus potentially exposing them to increased threats (e.g. predation, tidal inundation). Temperature also strongly determines gender of the hatchlings (Yntema and Mrosovsky 1982, Standora and Spotila 1985). Higher temperatures produce females, while lower temperatures produce males. Therefore beach shading by the bridge may alter the sex ratio of hatchlings. Since most nesting females emerge from the ocean at night, females may not be aware they are nesting underneath a bridge. These effects would be temporary since the beach would be expected to continue migrating westward.

As beach migration continues westward, portions of the nesting beach will eventually be located landward of the bridges. Turtles would have to crawl or swim between bridge piles in order to

utilize the newly widened beach. Over the life of the project, up to 3.3 miles of beach could have piles at any one time, thus potentially causing some level of deterrent to nesting. The effect that the bridge piles would have on emerging sea turtles is expected to be minimal. Bouchard et al. (1998) found that simulated piles did not totally preclude nesting activity of loggerhead and green sea turtles at Melbourne Beach, Florida, but did reduce nesting in an area with piles on the beach by 41%. However, the simulated piles used in the study were spaced 17 feet apart, whereas the piles for the Phase II, III and IV bridges will be 100-120 feet apart. This wider distance would likely have a much lesser affect on nesting activity. Again, this effect would be on nesting habitat that does not currently exist.

As portions of the beach migrate westward of the bridge, some bridge piles will be located within the nearshore waters. These bridge piles may attract and concentrate predatory fish. Predation on turtle hatchlings can be high in nearshore waters (Stancyk 1982, Wyneken and Salmon 1996). However, with bridge bents spaced 100-120 feet apart, increased predation due to the presence of bridge piles will likely be minimal.

Another indirect effect is that of vehicle lights traveling on the finished bridges. It is unknown whether vehicle lights moving parallel to the beach would discourage the emergence of nesting females. It is also unknown whether vehicle lights would misorient or disorient turtle hatchlings. Vehicle lights would not be a stationary source of light and would vary with differing levels of traffic. However, a higher traffic volume would likely occur during the summer tourist season, which overlaps with turtle nesting season. The height of the bridges and height of bridge barriers may mitigate some of the negative effects.

C. Species' response to proposed action

Piping plover

Numbers of individuals/populations in the action area affected: One breeding pair has been recorded at Bodie Island Spit on the north side of Oregon Inlet during five out of the last ten years (2001, 2002, 2004, 2006 and 2007)(Cameron 2008a, *in litt.*; NCWRC 2008b). During this same timeframe, one nest was observed in each of the years 2001, 2002, 2004 and 2007. In 2007, three chicks hatched, and one fledged, from a nest on Bodie Island Spit approximately 1700 feet northeast of the existing Bonner Bridge (NPS 2007a, NPS 2007b). One or two breeding pairs were observed on the south side of Oregon Inlet on PINWR during each of the years from 1998 to 2003 (Cameron 2008a, *in litt.*; NCWRC 2008b), with one nest being observed in 2001 and 2002 (Sue Cameron, NCWRC waterbird biologist, pers. comm. March 24, 2008). In 2007, the action area accounted for only 1.6% of piping plover breeding activity within North Carolina (one out of 61 breeding pairs)(Cameron 2008b, *in litt.*; NCWRC 2008c). Overall, 0-3 breeding pairs have been observed in the action area for each of the last ten years.

The number of piping plovers within the action area during the winter or migration is more difficult to assess. Regular surveys have not been conducted for non-breeding (including migrating and overwintering) plovers. Cohen et al. (in press) estimated a minimum total wintering population of 11 birds in the vicinity of Oregon Inlet (including Green Island) during the winter of 2006/2007. As many as 39 piping plovers have been reported from single day

surveys during the fall migration at Bodie Island Spit, and as many as 41 plovers have been reported from single day Christmas Bird Counts at Oregon Inlet (NCWRC 2008a).

The total amount of proposed critical habitat to be permanently lost is <0.1 acre. An unknown acreage (though likely small amount) of proposed critical habitat will be temporarily affected during the construction phase.

Sensitivity to change: Piping plovers are sensitive to negative impacts during the breeding and non-breeding periods. Plovers may be deterred from nesting in given area where disturbance occurs. Sensitivity to change for non-breeding birds is difficult to assess. However, effects could be more detrimental for non-breeding plovers from the endangered Great Lakes population. Stucker and Cuthbert (2006) recorded at least one identifiable individual from the Great Lakes population wintering at Oregon Inlet, with at least nine other individuals of that population observed within CAHA outside the action area.

Resilience: Unless new inlets form within the action area, the breeding population of piping plovers is likely to remain low. However, elevating much of NC 12 onto bridges would allow natural barrier island processes to resume, potentially creating new inlets and plover habitat. Piping plover productivity has historically been low in all of North Carolina (NCWRC 2008c). However, improved protective measures and substantial decreases in disturbance to promote nesting opportunities and protect established nests and chicks could increase productivity.

The proposed critical wintering habitat within the action area is highly dynamic and resilient. Temporary disturbances will be unrecognizable in a short time.

Recovery rate: Piping plover habitat is inherently dynamic and carrying capacity fluctuates accordingly. The breeding population within the action has varied from zero to three pairs over the last ten years. At these low population levels, extirpation may occur for any number of reasons, including factors unrelated to the proposed action. While the specific recovery rate of piping plovers within the action area is unknown, the recovery rate is expected to be moderate if the birds are protected from all stressors. For example, several areas within the Atlantic Coast breeding population quadrupled their population size in as few as five years (USFWS 1996).

The specific effects of disturbance on non-breeding plovers are less well understood. However, reduced ability to rest and decreased food abundance could reduce survivorship of migrating and wintering birds. Demographic models for piping plovers, including two Atlantic Coast studies (Melvin and Gibbs 1994, Amirault et al. 2005), show that even small declines in adult and juvenile survival rates will cause substantial increases in extinction risk.

Other than the minimal amount of proposed critical habitat that would be permanently lost, the primary constituent elements within temporarily affected proposed critical habitat would recover very quickly after project construction ends.

Sea turtles – all species

Numbers of individuals/populations in the action area affected: From 1996 to 2006, there were a total 126 loggerhead nests observed within the action area, averaging 11.5 nests per year. From 1996 to 2006, there were 5 or 6 green turtle nests observed within the action area, averaging 0.5 nests per year. From 1996 to 2006, there were no leatherback turtle nests observed (Godfrey 2008, *in litt.*; USFWS 2008c, *in litt.*). From 2000 to 2006, the extent of sea turtle nesting within the action area annually represented 0.9 to 2.3% of total sea turtle nesting in North Carolina (Godfrey 2008, *in litt.*; NPS 2007c).

Sensitivity to change: Sea turtles are relatively sensitive to changes in the nesting environment, especially artificial light. There is high potential for nesting females and hatchlings to be misoriented or disoriented by construction lighting and possibly vehicle lights from the finished bridges. Sea turtle eggs are also sensitive to the nesting environment. The sex of an embryonic sea turtle is determined by the temperature of the nest environment. Shading effects on beach that has migrated underneath the bridges may change the nest environment by lowering sand temperature and changing the sex ratio.

Resilience: If fewer sea turtle hatchlings reach the ocean after hatching due to misorientation or disorientation from artificial light, fewer females will then return to nest at that location in the future. Also, loggerhead nests on North Carolina beaches (and in the Northern subpopulation) produce a greater proportion of males than do beaches in the southern part of the species' range. A reduction in the number of males contributed to the greater population may have adverse effects on future reproduction in the population. However, the extent of this effect is unknown.

Recovery rate: In general, the recovery rate of sea turtles is slow. Sea turtles reach sexual maturity at different ages depending on the species. Leatherback turtles can reach sexual maturity as early as six or seven years of age. However, loggerhead and green sea turtles do not reach sexual maturity until 20 to 50 years of age. If there is a reduction in the number of nests laid within the action area, and a subsequent reduction in the number of hatchlings produced, it may take decades before those hatchlings are contributing reproductively to the population.

V. CUMULATIVE EFFECTS

Cumulative effects include the effects of future state, local, or private actions that are reasonably certain to occur in the action area considered in these biological and conference opinions. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the RSA.

Any maintenance activities on existing NC 12 that are conducted entirely within the NCDOT right-of-way do not have any federal nexus. These activities are most likely to occur after storm events in which sand is blown or washed over the road. Removal of the sand and reconstruction of the existing artificial berm would not be conducted within either piping plover or sea turtle habitat; however, the activities would be immediately adjacent to potential habitat. Disturbance from presence of heavy equipment, noise and vibration may flush piping plovers and preclude

foraging, roosting or nesting. This disturbance may also disturb nesting female sea turtles. Lights from construction equipment may misorient or disorient sea turtle hatchlings. These effects would be expected to be short in duration for each maintenance event, but have historically occurred several times a year. As portions of NC 12 are elevated onto bridges in Phases II, III and IV, these types of maintenance events would decrease.

The relocation of the former Oregon Inlet US Coast Guard Station may also have a similar short-term effect on piping plovers and sea turtles. However, this would be a one-time event.

VI. CONCLUSION

After reviewing the current status of the piping plover, loggerhead sea turtle, green sea turtle and leatherback sea turtle; the environmental baseline for the action area; and all effects of the proposed project, it is the USFWS's biological and conference opinion that the proposed replacement of the Bonner Bridge and subsequent phases of elevating portions of NC 12 onto bridges (TIP No. B-2500), as proposed, is not likely to jeopardize the continued existence of these species, and is not likely to destroy or adversely modify proposed critical wintering habitat for piping plover. No critical habitat has been designated for the loggerhead sea turtle; therefore, none will be affected. Critical habitat has been designated for the green sea turtle in Puerto Rico, and critical habitat has been designated for the leatherback sea turtle in the U.S. Virgin Islands; however, this action does not affect these areas and no destruction or adverse modification of that critical habitat is anticipated.

This non-jeopardy opinion is based, in part, on the following facts:

Piping plover

The Atlantic Coast nesting population of piping plover is a component of the entity listed as threatened which encompasses all breeding piping plovers except the Great Lakes breeding population. The Atlantic Coast population has increased from 790 pairs since listing to a preliminary estimation of 1,887 pairs in 2007 (USFWS 2008a). While the Great Plains populations experienced a decline of about 13 percent between 1991 and 2001, the overall status of the listed entity is likely to be increasing. The Southern recovery unit has gained 163 pairs since listing. As of 2007, the Southern recovery unit had 333 breeding pairs (USFWS 2008a). The abundance component of the recovery objective for the Atlantic Coast population and the Southern recovery unit is 2,000 and 400 breeding pairs, respectively (USFWS 1996).

The current number of breeding pairs using the action area (0-3 in the past ten years) is only a small part of the breeding population of the Southern recovery unit and the overall Atlantic Coast breeding population. In an unlikely worst case scenario, up to three breeding pairs could be precluded from nesting. However, it is uncertain that any breeding pairs would be precluded from nesting. Some or all of the preferred nesting sites may be sufficiently distant from the work zones to avoid disturbance effects.

The current number of piping plovers using the action area during migration and winter is significant, and the action area is an important migratory stopover site and over winter destination. Although the action area is relatively large, the adverse effects due to disturbance from construction will be staggered over space and time; therefore, only portions of the action area will see disturbance at any one time. The effects may contribute to a lessening of survivorship; however, this would be extremely difficult to determine.

Although uncertain, the project may have significant beneficial effects for piping plovers. As Phases II, III, and IV are constructed; the artificial berm along existing NC 12 will no longer be maintained, thus allowing natural barrier island processes such as island overwash, island migration and inlet formation to resume. At some point new habitat may be created for breeding, migrating, and wintering plovers via these natural processes.

Sea turtles

From 2000 to 2006, the extent of sea turtle nesting within the action area annually represented 0.9 to 2.3% of total sea turtle nesting in North Carolina (Godfrey 2008, *in litt.*; NPS 2007c). Over the past ten years, the action area averaged only 11.5 loggerhead nests and 0.5 green turtle nests per year. No leatherback turtles have been observed to nest within the action area (Godfrey 2008, *in litt.*). For loggerheads, the number represents only a minuscule contribution to the Northern subpopulation.

Other than the chance of a future maintenance or repair activity crushing an undetected nest, it is unlikely that any sea turtle nests will be directly lost. The most likely effect involves artificial lighting affecting nesting females and hatchlings during project construction. The total extent of this effect is unknown. However, artificial light from construction will be temporary and staggered throughout the action area over space and time. There will be no permanent light fixtures on the bridge. The permanent effect of vehicle lights traveling parallel to the beach is unknown. Other causes of disturbance due to construction will also be temporary.

Though uncertain, the project may have significant beneficial effects for nesting sea turtles. As Phases II, III, and IV are constructed; the artificial berm along existing NC 12 will no longer be maintained, thus allowing natural barrier island processes such as island overwash and island migration to resume. The existing beach along much of the action area is narrow, steep and subject to high energy wave action. With the elimination of the artificial berm along NC 12, the beach will widen and flatten out. Although the quality of the widened beach habitat may not be ideal for some period of time (i.e. while the bridge is overhead), and the permanent effects of vehicle lights overhead are unknown, there is the potential to eventually provide additional beach nesting opportunities where nests are less likely to be destroyed due to inundation and severe wave action.

Proposed species/critical habitat

The one proposed critical habitat unit for wintering piping plovers within the action area will continue to support primary constituent elements essential for the conservation of the species. The total permanent loss of proposed critical habitat will be <0.1 acre. Due to the dynamic

nature of the primary constituent elements, all temporary effects to the proposed unit will be indiscernible soon after construction is completed. For this reason it is our conference opinion that the proposed action is not likely to destroy or adversely modify proposed critical habitat.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and federal regulations pursuant to Section 4(d) of the ESA prohibit the taking of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to engage in any such conduct. Harm is further defined by the USFWS to include significant habitat modification or degradation that results in death or injury to listed species by significantly impairing essential behavioral patterns such as breeding, feeding or sheltering. Harass is defined by the USFWS 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, the carrying out of 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 taking under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by the FHWA so that they may become binding conditions of any grant or permit issued to the NCDOT, as appropriate, for the exemption in section 7(o)(2) to apply. The FHWA has a continuing duty to regulate the activity covered by this Incidental Take Statement. If the FHWA (1) fails to assume and implement the terms and conditions or (2) fails to require the NCDOT 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. To monitor the impact of incidental take, the FHWA or the NCDOT must report the progress of the action and any impact on the species to the USFWS.

Amount or Extent of Take Anticipated

Piping plovers

- **Breeding piping plovers:** The USFWS expects incidental take of breeding plovers will be difficult to detect. The take would be the lost potential for nesting due to disturbance of breeding pairs at the nesting sites from nearby construction activity. It would be impossible to determine whether the lack of nesting or the absence of breeding pairs was due to the project or some other unrelated factor. It would only be possible to infer that the project directly caused the loss of a nest if an established nest was abandoned at the time construction began in the vicinity. Also, plover nests are cryptic and easily overlooked. However, this undetected level of take may occur near Oregon Inlet at historical nesting locations. Based on historical nesting data, the maximum level of incidental take is three breeding pairs per year precluded from nesting or caused to abandon nests during

construction for Phases I and II during each nesting season (i.e. April 1 to July 15) and the harassment of the associated breeding pairs.

- **Migrating and wintering piping plovers:** The USFWS expects incidental take of non-breeding plovers will be difficult to detect for the following reasons: sub-lethal effects are not easily determined; harassment which contributes to lessened survivorship may only be apparent on the breeding grounds the following year; and dead plovers may not be detectable. However, take of all migrating and wintering plovers throughout the extent of suitable habitat within the action area can be anticipated in all four phases of the project by the disturbance of feeding or roosting plovers from nearby construction activity.

Sea turtles - all species

The USFWS expects incidental take of all species of sea turtles will be difficult to detect for the following reasons:

- 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;
- the total number of hatchlings per undiscovered nest is unknown;
- an unknown number of females may avoid the project beach and be forced to nest in a less than optimal area; and
- lights may misdirect an unknown number of hatchlings and cause death

However, take of all sea turtles throughout the extent of nesting habitat within the action area can be anticipated in all four phases of the project by harm or harassment due to the effects of artificial light and disturbance from construction and future maintenance and repair activities on nesting females and hatchlings. Also, as portions of the beach migrate westward, take of all undetected nests throughout the extent of the nesting habitat can be anticipated from future maintenance or repair activities that may crush undetected nests. Finally, as portions of the beach migrate westward, take of all nesting sea turtles throughout the extent of nesting habitat within the action area can be anticipated from reduced nesting by females deterred by bridge piles on the beach and by shading effects on sex ratios of eggs in nests constructed underneath the bridges.

Effect of the Take

In the accompanying biological and conference opinions, the USFWS determined that this level of anticipated take is not likely to result in jeopardy to the species, or destruction or adverse modification of designated or proposed critical habitat.

Reasonable and Prudent Measures

The USFWS believes the following reasonable and prudent measures are necessary and appropriate to minimize take of the piping plover, loggerhead sea turtle, green sea turtle, and

leatherback sea turtle. These nondiscretionary measures include, but are not limited to, the terms and conditions outlined in this biological and conference opinion.

Piping plover

1. Avoid disturbing nesting piping plovers.
2. To the extent possible, avoid disturbing foraging and roosting plovers.
3. To minimize the effect of harassment on foraging plovers, provide alternative foraging areas.
4. Avoid or minimize opportunities for avian predator perches.

Sea turtles – all species

1. Avoid disturbing nesting sea turtles, nests and hatchlings.
2. Educate construction contractors and pertinent NCDOT staff as to the adverse effects of artificial lighting on sea turtles.
3. Minimize the effects of construction lighting on nesting sea turtles and hatchlings.
4. Minimize the effects of vehicle headlights from the completed bridge.
5. Avoid permanent light fixtures.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, the NCDOT must comply with the following terms and conditions, which implement the reasonable and prudent measures described previously. These terms and conditions are nondiscretionary.

Piping plover

1. All construction equipment and personnel must avoid all bird closure areas within CAHA and PINWR.

All future routine maintenance activities of bridge structures that would occur within or adjacent to current or future plover nesting areas must occur outside the nesting season (April 1 – July 15).

All future repair work on bridge structures that would occur within or adjacent to current or future plover nesting areas must occur outside the nesting season (April 1 – July 15) unless emergency or human safety considerations require otherwise. In this event, the area must be surveyed for nesting plovers and avoided to the extent possible.

2. During the construction of Phases II, III and IV, keep all construction equipment and activity within the existing right-of-way.

Do not moor any construction barges within 300 feet of the following islands: Green Island, Wells Island, Parnell Island, Island MN, Island C, the small unnamed island immediately east of Island C, Island D, and Island G (see figure 1).

3. All dredge spoil excavated for construction barge access must be used to augment either existing dredge-material islands or to create new dredge-material islands for use by foraging plovers. This must be accomplished as per the specifications of the North Carolina Wildlife Resources Commission. The point of contact is Sue Cameron at 910-325-3602. If the dredge material is used outside the current defined action area, the action area is assumed to be expanded to cover the beneficial placement of the material.
4. To the maximum extent practical, while ensuring the safety of the traveling public, limit or avoid the use of road signs or other potential predator perches adjacent to plover nesting or foraging areas. Where signs or other structures are necessary, determine if alternative designs would be less conducive for perching on by avian predators (gulls, crows, grackles, hawks, etc.). For example, minimize or avoid the use of large cantilever signs in favor of smaller and shorter designs.

Sea turtles – all species

1. All construction equipment and personnel must avoid all marked sea turtle nests.

Construction material and equipment staging areas must not be located seaward of the artificial dune.

All future routine maintenance activities of bridge structures that would occur within or adjacent to current or future sea turtle nesting habitat, and which would require vehicles or equipment on the beach or the use of night lighting (excluding navigation lights required by the U.S. Coast Guard), must occur outside the nesting season (May 1 – November 15).

All future repair work of bridge structures that would occur within or adjacent to current or future sea turtle nesting habitat, and which would require vehicles or equipment on the beach or the use of night lighting (excluding navigation lights required by the U.S. Coast Guard) must occur outside the nesting season (May 1 – November 15) unless emergency or human safety considerations require otherwise. In this event, the area must be surveyed for sea turtle nests and avoided to the extent possible.

2. Provide an opportunity for the USFWS or an USFWS designee to educate construction contractor managers, supervisors, foremen and other key personnel and resident NCDOT personnel with oversight duties (division engineer, resident engineer, division

environmental officer, etc.) as to adverse effects of artificial lighting on nesting sea turtles and hatchlings, and to the importance of minimizing those effects.

3. During turtle nesting season (May 1 – November 15), use the minimum number and the lowest wattage lights that are necessary for construction.

During turtle nesting season, portable construction lighting must be of the low-pressure sodium-vapor type.

During turtle nesting season, utilize directional shields on all portable construction lights, and avoid directly illuminating the turtle nesting beach at night.

During turtle nesting season, all portable construction lights must be mounted as low to the ground as possible.

During turtle nesting season, turn off all lights when not needed.

4. For Phases II, III and IV, on the ocean side, design the bridge structure in a manner which will shield the beach on the east side from direct light emanating from passenger vehicle headlights. For the small portion of Phase I over land on Hatteras Island, retrofit the bridge structure at the time that Phase II connects with Phase I. The specific design of the bridge will be developed in consultation with the USFWS prior to re-evaluation of the environmental document for Phase II.
5. Avoid retrofitting the bridges and approach roads with permanent light fixtures in the future (excluding navigation lights required by the U.S. Coast Guard).

Coordination of Incidental Take Statements with Other Laws, Regulations, and Policies

The USFWS will not refer the incidental take of any migratory bird for prosecution under the Migratory Bird Treaty Act of 1918, as amended (16 USC § 703-712), if such take is in compliance with the terms and conditions (including amount and/or number) specified herein.

CONSERVATION RECOMMENDATIONS

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

Piping plovers

The FHWA and/or NCDOT could contribute funding to the current CAHA predator removal program or any future PINWR predator removal program.

The pond located behind the terminal groin at the north end of Hatteras Island has historically provided foraging habitat for plovers whenever NCDOT has mined sand from it. The NCDOT could continue to utilize this pond as a source of sand for construction/maintenance purposes. The NCDOT could remove the sand such that the elevation and shape of the mined area is restored to a moist/wet sand habitat conducive to plover foraging. This should be coordinated with the PINWR. The point of contact is Dennis Stewart at 252-473-1131 ext. 231.

Sea turtles – all species

The FHWA and/or NCDOT could contribute funding to the Network for Endangered Sea Turtles (N.E.S.T.), a nonprofit organization dedicated to the preservation and protection of sea turtle habitat in the Outer Banks from the Virginia border to Oregon Inlet. N.E.S.T. monitors this area for nesting activity.

In order for the USFWS to be kept informed of actions minimizing or avoiding adverse effects or benefiting listed species or their habitats, we request notification of the implementation of any conservation recommendations.

REINITIATION/CLOSING STATEMENT

This concludes formal consultation on the action outlined in your March 5, 2008 request for formal consultation. As provided in 50 CFR section 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; (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.

You may ask the USFWS to confirm the conference opinion as a biological opinion issued through formal consultation, if the critical habitat is designated. The request must be in writing. If the USFWS reviews the proposed action and finds that there have been no significant changes in the action as planned or information used during the conference, the USFWS will confirm the conference opinion as a biological opinion on the project and no further section 7 consultation will be necessary.

Literature Cited

Amirault, D.L., F. Shaffer, K. Baker, A. Boyne, A. Calvert, J. McKnight, and P. Thomas. 2005. Preliminary results of a five year banding study in Eastern Canada – support for expanding conservation efforts to non-breeding sites? Unpublished Canadian Wildlife Service report.

- Arianoutsou, M. 1988. Assessing the impacts of human activities on nesting of loggerhead sea turtles (*Caretta caretta* L.) on Zakynthos Island, Western Greece. *Environmental Conservation* 15:327-334.
- Bent, A.C. 1929. Life histories of North American shorebirds. U.S. Natural Museum Bulletin 146:236-246.
- Bergstrom, P.W. 1989. Incubation temperatures of Wilson's plovers and killdeers. *Condor* 91:634-641.
- Billes, A., J. Moundomba, and S. Gontier. 2000. Campagne Nyamu 1999-2000: Rapport de fin de saison. Protomac, Libreville, Gabon.
- Bouchard, S., K. Moran, M. Tiwari, D. Wood, A. Bolten, P. Elizazar, and K. Bjorndal. 1998. Effects of exposed pilings on sea turtle nesting activity at Melbourne Beach, Florida. *Journal of Coast Research* 14(4):1343-1347.
- Bowen, B. 1995. October 26, 1995 letter to Sandy MacPherson, National Sea Turtle Coordinator, U.S. Fish and Wildlife Service, Jacksonville, Florida. Director, Genetic Analysis Core, Biotechnology for the Evolutionary, Ecological, and Conservation Sciences, University of Florida, Gainesville, Florida.
- Bowen, B., J.C. Avise, J.L. Richardson, A.B. Meylan, D. Margaritoulis, and S.R. Hopkins-Murphy. 1993. Population structure of loggerhead turtles (*Caretta caretta*) in the northwestern Atlantic Ocean and Mediterranean Sea. *Conservation Biology* 7:834-844.
- Boyagian, Z. 1994. Written communication with Anne Hecht. Piping plover incident report 7-16-94, South Beach, Chatham, MA. Piping plover monitor, Massachusetts Audubon Society, Chatham, Massachusetts.
- Bugoni, L., L. Krause, and M.V. Petry. 2001. Marine debris and human impacts on sea turtles in southern Brazil. *Marine Pollution Bulletin* 42:1330-1334.
- Burger, J. 1987a. Physical and social determinants of nest site selection in piping plover in New Jersey. *Condor* 98:811-818.
- Burger, J. 1987b. New Jersey endangered beach-nesting bird project: 1986 research. Unpublished report to New Jersey Department of Environmental Protection, Trenton, New Jersey.
- Burger, J. 1991. Foraging behavior and the effect of human disturbance on the piping plover (*Charadrius melodus*). *Journal of Coastal Research* 7:39-52.
- Burger, J. 1994. The effect of human disturbance on foraging behavior and habitat use in piping plover (*Charadrius melodus*). *Estuaries* 17:695-701.
- Cairns, W.E. 1977. Breeding biology and behaviour of the piping plover *Charadrius melodus* in southern Nova Scotia. M.S. Thesis. Dalhousie University, Halifax, Nova Scotia.
- Cairns, W.E. 1982. Biology and behavior of breeding piping plovers. *Wilson Bulletin* 94:531-545.
- Cairns, W.E., and I.A. McLaren. 1980. Status of the piping plover on the east coast of North America. *American Birds* 34:206-208.
- Calvert, A.M., D.L. Amirault, F. Shaffer, R. Elliot, A. Hanson, J. McKnight, and P.D. Taylor. 2006. Population assessment of an endangered shorebird: the piping plover (*Charadrius melodus melodus*) in eastern Canada. *Avian Conservation and Ecology* 1(3): 4. Accessed on April 30, 2008 at <http://www.acc-cco.org/voll1/iss3/art4/>
- Cameron, S. 2008a. March 24, 2008 email from Sue Cameron to Gary Jordan. Piping plover observation and breeding activity data. North Carolina Wildlife Resources waterbird biologist.
- Cameron, S. 2008b. March 24, 2008 email from Sue Cameron to Gary Jordan. Piping plover breeding activity data. North Carolina Wildlife Resources waterbird biologist.
- Carr, A.F., and L. Ogren. 1960. The ecology and migrations of sea turtles IV. The green turtle in the Caribbean Sea. *Bulletin of the American Museum of Natural History* 121:4-48.
- Carthy, R.R. 1994. Loggerhead nest morphology: effects of female body size, clutch size, and nesting medium on nest chamber size. Pages 25-27 in Bjorndal, K.A., A.B. Bolten, D.A. Johnson, and P.J. Elizazar (Compilers). Proceedings of the fourteenth annual symposium on sea turtle biology and conservation. NOAA Technical Memorandum NMFS-SEFSC-351.
- Chan, E., and H. Liew. 1996. Decline of the leatherback population in Terengganu, Malaysia, 1956-1995. *Chelonia Conservation and Biology* 2(2):196-203.
- Cohen, J.B., S.M. Karpanty, D.H. Catlin, J.D. Fraser, and R.A. Fischer. In Press. Winter ecology of piping plovers at Oregon Inlet, North Carolina. *Waterbirds*.
- Cooper, S. 1990. Notes on piping plover nesting at Cape Hatteras National Seashore during 1987. *Chat* 54:1-6.
- Coutu, S.D., J.D. Fraser, J.L. McConnaughey, and J.P. Loegering. 1990. Piping plover distribution and reproductive success on Cape Hatteras National Seashore. Unpublished report to the National Park Service.
- Cox, J.H., H.F. Percival, and S.V. Colwell. 1994. Impact of vehicular traffic on beach habitat and wildlife at Cape San Blas, Florida. Florida Cooperative Fish and Wildlife Research Unit Technical Report Number 50.

- Cross, R.R. 1990. Monitoring, management and research of the piping plover at Chincoteague National Wildlife Refuge, summer 1990. Unpublished report. Virginia Department of Game and Inland Fisheries, Richmond, Virginia.
- Cross, R.R. 1991. Monitoring, management, and research of the piping plover at Chincoteague National Wildlife Refuge, summer 1991. Unpublished report. Virginia Department of Game and Inland Fisheries, Richmond, Virginia.
- Cross, R.R. 1996. Breeding ecology, success, and population management of the piping plover at Chincoteague National Wildlife Refuge, Virginia. M.S. Thesis. College of William and Mary, Virginia.
- Cross, R.R., and K. Terwilliger. 2000. Piping plover chicks: prey base, activity budgets, and foraging rates in Virginia. Final report to the Virginia Department of Game and Inland Fisheries, Richmond, VA.
- Dickerson, D.D., and D.A. Nelson. 1989. Recent results on hatchling orientation responses to light wavelengths and intensities. Pages 41-43 in Eckert, S.A., K.L. Eckert, and T.H. Richardson (compilers). Proceedings of the 9th annual workshop on sea turtle conservation and biology. NOAA Technical Memorandum NMFS-SEFC-232.
- Dingledine, J. 2008. Email to Gary Jordan regarding piping plover nesting updates for Great Lakes region. Great Lakes piping plover coordinator, U.S. Fish and Wildlife Service, East Lansing, Michigan.
- Dodd, C.K., Jr. 1988. Synopsis of the biological data on the Loggerhead sea turtle *Caretta caretta* (Linnaeus 1758). U.S. Fish and Wildlife Service Biological Report 88(14).
- Drake, K.R., J.E. Thompson, K.L. Drake, and C. Zonick. 2001. Movements, habitat use, and survival of nonbreeding piping plovers. *Condor* 103:259-267.
- Drury, W. H. 1973. Population changes in New England seabirds. *Bird Banding* 44:267-313.
- Dutton, D.L., P.H. Dutton, M. Chaloupka, and R.H. Boulon. 2005. Increase of a Caribbean leatherback turtle *Dermochelys coriacea* nesting population linked to long-term nest protection. *Biological Conservation* 126:186-194.
- Dutton, P.H., C. Hitiupeuw, M. Zein, S.R. Benson, G. Petro, J. Pita, V. Rei, L. Ambio, and J. Bakarbesy. 2007. Status and genetic structure of nesting populations of leatherback turtles (*Dermochelys coriacea*) in the Western Pacific. *Chelonian Conservation and Biology* 6:47-53.
- Eddings, K.J. 1991. Productivity, activity patterns, limiting factors, and management of piping plovers at Sandy Hook, Gateway National Recreation Area, New Jersey. M.S. Thesis. Colorado State University, Fort Collins, Colorado.
- Ehrhart, L.M. 1989. Status report of the loggerhead turtle. Pages 122-139 in Ogren, L., F. Berry, K. Bjorndal, H. Kumpf, R. Mast, G. Medina, H. Reichart, and R. Witham (eds.). Proceedings of the 2nd Western Atlantic turtle symposium. NOAA Technical Memorandum NMFS-SEFC-226.
- Ehrhart, L.M., and B.E. Witherington. 1987. Human and natural causes of marine turtle nest and hatchling mortality and their relationship to hatchling production on an important Florida nesting beach. Florida Game and Fresh Water Fish Commission, Nongame Wildlife Program, Technical Report No. 1. Tallahassee, Florida.
- Elias-Gerken, S.P. 1994. Piping plover habitat suitability on central Long Island, New York barrier islands. M.S. Thesis. Virginia Polytechnic Institute and State University, Blacksburg, Virginia.
- Elliot-Smith, E., and S.M. Haig. 2004. Piping plover (*Charadrius melodus*), the birds of North America online (Poole, A., Ed.). Ithaca: Cornell Lab of Ornithology. Accessed on April 7, 2008 at <http://bna.birds.cornell.edu/bna/species/002/articles/introduction>
- Encalada, S.E., K.A. Bjorndal, A.B. Bolten, J.C. Zurita, B. Schroeder, E. Possardt, C.J. Sears, and B.W. Bowen. 1998. Population structure of loggerhead turtle (*Caretta caretta*) nesting colonies in the Atlantic and Mediterranean as inferred from mitochondrial DNA control region sequences. *Marine Biology* 130:567-575.
- Ferland, C.L., and S.M. Haig. 2002. 2001 International piping plover census. U.S. Geological Survey, Forest and Rangeland Ecosystem Science Center, Corvallis, Oregon.
- Flemming, S.P., R. D. Chiasson, and P.J. Austin-Smith. 1992. Piping plover nest-site selection in New Brunswick and Nova Scotia. *Journal of Wildlife Management* 56:578-583.
- [FHWA and NCDOT] Federal Highway Administration and North Carolina Department of Transportation. 2007. Supplement to the 2005 supplemental draft environmental impact statement and draft section 4(f) evaluation. NC 12 replacement of Herbert C. Bonner Bridge.
- [FHWA and NCDOT] Federal Highway Administration and North Carolina Department of Transportation. 2008a. Biological assessment for NC 12 replacement of Herbert C. Bonner Bridge. Bridge No. 11 over Oregon Inlet.
- [FHWA and NCDOT] Federal Highway Administration and North Carolina Department of Transportation. 2008b. April 9, 2008 email from Rob Ayers (FHWA) to Peic Benjamin (USFWS) with attached BA addendum in the form of memo from Beth Smyre (NCDOT) to Rob Ayers.
- [FFWCC] Florida Fish and Wildlife Conservation Commission. 2006a. Statewide sea turtle nesting database, unpublished data. Accessed on March 31, 2008 at

[http://research.mvfwc.com/engine/download_redirection_process.asp?file=Statewide Totals_1979 - 2006.pdf&objid=11812&dctype=article](http://research.mvfwc.com/engine/download_redirection_process.asp?file=Statewide_Totals_1979_-_2006.pdf&objid=11812&dctype=article)

- [FFWCC] Florida Fish and Wildlife Conservation Commission. 2006b. Florida statewide nesting beach survey data – 2006 season. Accessed on April 10, 2008 at http://research.mvfwc.com/features/print_article.asp?id=11812
- [FFWCC] Florida Fish and Wildlife Conservation Commission. 2007. Long-term monitoring program reveals a continuing loggerhead decline, increases in green turtle and leatherback nesting. Accessed March 31, 2008 at http://research.mvfwc.com/features/print_article.asp?id=27537
- Fussell, J.O. 1990. Census of piping plovers wintering on the North Carolina Coast, 1989-1990. Unpublished report to the North Carolina Wildlife Resources Commission.
- [GDNR] Georgia Department of Natural Resources. 2004. Accessed April 10, 2008 at <http://crd.dnr.state.ga.us/content/displaycontent.asp?txtDocument=365>
- Gibbs, J.P. 1986. Feeding ecology of nesting piping plovers in Maine. Unpublished report to Maine Chapter, The Nature Conservancy, Topsham, Maine.
- Godfrey, M. 2008. March 17, 2008 email from Matthew Godfrey to Gary Jordan. Sea turtle nesting data within action area.
- Goldin, M.R. 1993a. Piping Plover (*Charadrius melodus*) management, reproductive ecology, and chick behavior at Goosewing and Briggs Beaches, Little Compton, Rhode Island, 1993. The Nature Conservancy, Providence, Rhode Island.
- Goldin, M.R. 1993b. Effects of human disturbance and off-road vehicles on piping plover reproductive success and behavior at Breezy Point, Gateway National Recreation Area, New York. M.S. Thesis. University of Massachusetts, Amherst, Massachusetts.
- Goldin, M.R. 1994. Breeding history of, and recommended monitoring & management practices for piping plovers (*Charadrius melodus*) at Goosewing Beach, Little Compton, Rhode Island (with discussion of Briggs Beach). Unpublished report to U.S. Fish and Wildlife Service, Hadley, Massachusetts.
- Goldin M.R., C. Griffin, and S. Melvin. 1990. Reproductive and foraging ecology, human disturbance, and management of piping plovers at Breezy Point, Gateway National Recreation Area, New York, progress report - 1989. Unpublished report to National Park Service Cooperative Research Unit, Rutgers University, New Brunswick, New Jersey.
- Griffin, C.R. and S.M. Melvin. 1984. Research plan on management, habitat selection, and population dynamics of piping plovers on outer Cape Cod, Massachusetts. University of Massachusetts. Research proposal submitted to U.S. Fish and Wildlife Service, Newton Corner, Massachusetts.
- Haig, S.M. 1985. The status of the piping plover in Canada. A status update prepared for the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). Ottawa, Ontario.
- Haig, S.M. 1992. Piping plover. In Poole, A., P. Stettenheim, and F. Gill (eds.), *The birds of North America*, No. 2. The Academy of Natural Sciences of Philadelphia.
- Haig, S.M., and L.W. Oring. 1985. The distribution and status of the piping plover throughout the annual cycle. *Journal of Field Ornithology* 56:334-345.
- Haig, S.M., and L.W. Oring. 1987. The piping plover. *Audubon Wildlife Report*, Pp. 509-519.
- Haig, S.M., and L.W. Oring. 1988. Mate, site and territory fidelity in piping plovers. *Auk* 105:268-277.
- Haig, S.M., and J.H. Plissner. 1993. Distribution and abundance of piping plovers: Results and implications of the 1991 International census. *Condor* 95:145-156.
- Haig, S.M., C.L. Ferland, F.J. Cuthbert, J. Dingledine, J.P. Goossen, A. Hecht, and N. McPhillips. 2005. A complete species census and evidence for regional declines in piping plovers. *Journal of Wildlife Management* 69:160-173.
- Hake, M. 1993. 1993 summary of piping plover management program at Gateway NRA Breezy Point district. Unpublished report to Gateway National Recreation Area, Long Island, New York.
- Hawkes, L.A., A.C. Broderick, M.H. Godfrey, and B.J. Godley. 2005. Status of nesting loggerhead turtles *Caretta caretta* at Bald Head Island (North Carolina, USA) after 24 years of intensive monitoring and conservation. *Oryx* 39:65-72.
- Hecht, A. 2004. Email sent to David Rabon. Use of ocean intertidal zone by piping plover chicks for foraging. Atlantic Coast piping plover coordinator, U.S. Fish and Wildlife Service, Sudbury, Massachusetts.
- Herbst, L.H. 1994. Fibropapillomatosis of marine turtles. *Annual Review of Fish Diseases* 4:389-425.
- Hirth, H.F. 1997. Synopsis of the biological data on the green turtle *Chelonia mydas* (Linnaeus 1758). U.S. Fish and Wildlife Service, Biological Report 97(1).
- Hitipeuw, C., P.H. Dutton, S. Benson, J. Thebu, and J. Bakarbesy. 2007. Population status and interesting movement of leatherback turtles, *Dermochelys coriacea*, nesting on the northwest coast of Papua, Indonesia. *Chelonian Conservation and Biology* 6(1):28-36.

- Hoopes, E.M. 1993. Relationships between human recreation and piping plover foraging ecology and chick survival. M.S. Thesis. University of Massachusetts, Amherst, Massachusetts.
- Hoopes, E.M. 1994. Breeding ecology of piping plovers nesting at Cape Cod National Seashore - 1994. National Park Service, South Wellfleet, Massachusetts.
- Hoopes, E.M., C.R. Griffin, and S.M. Melvin. 1992. Relationships between human recreation and piping plover foraging ecology and chick survival. Unpublished report to U.S. Fish and Wildlife Service.
- Hopkins, S.R., and J.I. Richardson (eds.). 1984. Recovery plan for marine turtles. National Marine Fisheries Service, St. Petersburg, Florida.
- Hosier, P.E. 1981. Striking a balance: off-road vehicle use and coastal preservation. *Sea Grant Today* 11:10-12.
- Hosier, P.E., and T.E. Eaton. 1980. The impact of vehicles on dune and grassland vegetation on a south-eastern North Carolina barrier beach. *Journal of Applied Ecology* 17:173-182.
- Hosier, P.E., M. Kochhar, and V. Thayer. 1981. Off-road vehicle and pedestrian track effects on the sea-approach of hatchling loggerhead turtles. *Environmental Conservation* 8:158-161.
- Howard, J.M., R.J. Safran, and S.M. Melvin. 1993. Biology and conservation of piping plovers at Breezy Point, New York. Unpublished report. Department of Forestry and Wildlife Management, University of Massachusetts, Amherst.
- Hughes, A.L., and E.A. Caine. 1994. The effect of beach features on hatchling loggerhead sea turtles. Page 237 in Bjorndal, K.A., A.B. Bolten, D.A. Johnson, and P.J. Eliazar (Compilers). Proceedings of the fourteenth annual symposium on sea turtle biology and conservation. NOAA Technical Memorandum NMFS-SEFSC-351.
- Jacobs, J. 1988. Memorandum to Anne Hecht. Observations of piping plovers south of Indian River Inlet following U.S. Army Corps of Engineers project. Biologist, U.S. Fish and Wildlife Service, Annapolis, Maryland.
- Johnson, C.M., and G.A. Baldassarre. 1988. Aspects of the wintering ecology of piping plovers in coastal Alabama. *Wilson Bulletin* 100:214-233.
- Johnson, S.A., K.A. Bjorndal, and A.B. Bolten. 1996. Effects of organized turtle watches on loggerhead (*Caretta caretta*) nesting behavior and hatchling production in Florida. *Conservation Biology* 10:570-577.

- Kudo, H., A. Murakami, and S. Watanabe. 2003. Effects of sand hardness and human beach use on emergence success of loggerhead sea turtles on Yakushima Island, Japan. *Chelonian Conservation and Biology* 4:695-696.
- Kuklinski, M.L., L.M. Houghton, and J.D. Fraser. 1996. Piping plover breeding ecology on Cape Hatteras National Seashore with special reference to the effect of temperature on productivity. Department of Fisheries and Wildlife, Virginia Polytechnic Institute and State University, Blacksburg, VA.
- Lamont, M.M., H.F. Percival, and S.V. Colwell. 2002. Influence of vehicle tracks on loggerhead hatchling seaward movement along a northwest Florida beach. *Florida Field Naturalist* 30:77-82.
- Larson, M.A., M.R. Ryan, and R.K. Murphy. 2002. Population viability of piping plovers: effects of predator exclosures. *Journal of Wildlife Management* 66:361-371.
- LeBuff, C.R., Jr. 1990. The loggerhead turtle in the eastern Gulf of Mexico. *Caretta Research, Inc.* Sanibel Island, Florida.
- Lewis, R.L., S.A. Freeman, and L.B. Crowder. 2004. Quantifying the effects of fisheries on threatened species: the impact of pelagic longlines on loggerhead and leatherback sea turtles. *Ecological Letters* 7:221-231.
- Lenarz, M.S., N.B. Frazer, M.S. Ralston, and R.B. Mast. 1981. Seven nests recorded for loggerhead turtle *Caretta caretta* in one season. *Herpetological Review* 12:9.
- Limpus, C., J.D. Miller, and C.J. Parmenter. 1993. The northern Great Barrier Reef green turtle *Chelonia mydas* breeding population. Pages 47-50 in Smith, A.K. (compiler), K.H. Zevering and C.E. Zevering (editors). *Raine Island and Environs Great Barrier Reef: quest to preserve a fragile outpost of nature.* Raine Island Corporation and Great Barrier Reef Marine Park Authority, Townsville, Queensland, Australia.
- Loefering, J.P. 1992. Piping plover breeding biology, foraging ecology and behavior on Assateague Island National Seashore, Maryland. M.S. Thesis. Virginia Polytechnic Institute and State University, Blacksburg, Virginia.
- Loefering, J.P. and J.D. Fraser. 1995. Factors affecting piping plover chick survival in different brood-rearing habitats. *Journal of Wildlife Management* 59:646-655.
- Lutcavage, M.E., P. Plotkin, B. Witherington, and P.L. Lutz. 1997. Human impacts on sea turtle survival. Pages 387-409 in Lutz, P.L. and J.A. Musick (editors). *The biology of sea turtles.* CRC Press. Boca Raton, Florida.
- MacIvor, L.H. 1990. Population dynamics, breeding ecology, and management of piping plovers on outer Cape Cod, Massachusetts. M.S. Thesis. University of Massachusetts, Amherst, Massachusetts.

- MacIvor, L.H. 1996. Biological assessment for Ocean City water resources feasibility study, immediate restoration of Assateague Island. Woodlot Alternatives, Inc., Topsham, Maine.
- Mann, T.M. 1977. Impact of developed coastline on nesting and hatchling sea turtles in southeastern Florida. M.S. thesis. Florida Atlantic University, Boca Raton, Florida.
- Mann, T.M. 1978. Impact of developed coastline on nesting and hatchling sea turtles in southeastern Florida. Pages 53-55 in Henderson, G.E. (ed.). Proceedings of the Florida and interregional conference on sea turtles, July 24-25, 1976, Jensen Beach, Florida. Florida Marine Research Publication No. 33.
- Martin, R.E. 1992. Turtle nest relocation on Jupiter Island, Florida: an evaluation. Presentation to the fifth annual national conference on beach preservation technology, February 12-14, 1992, St. Petersburg, Florida.
- McConnaughey, J.L., J.D. Fraser, S.D. Coutu, and J.P. Loegering. 1990. Piping plover distribution and reproductive success on Cape Lookout National Seashore. Unpublished report to National Park Service.
- McDonald, D.L., and P.H. Dutton. 1996. Use of PIT tags and photoidentification to revise remigration estimates of leatherback turtles (*Dermochelys coriacea*) nesting in St. Croix, U.S. Virgin Islands, 1979-1995. *Chelonian Conservation and Biology* 2:148-152.
- McFarlane, R.W. 1963. Disorientation of loggerhead hatchlings by artificial road lighting. *Copeia* 1:153.
- Melvin, S.M. 2006. May 10, 2006 email from Scout Melvin to Ann Hecht. Piping plover abundance and productivity on beaches with vehicle restrictions. Senior zoologist, Natural Heritage and Endangered Species Program, Massachusetts Division of Fisheries and Wildlife, Westborough, Massachusetts.
- Melvin, S.M., and J.P. Gibbs. 1994. Appendix E: Population viability analysis in U.S. Fish and Wildlife Service. 1996. Piping plover (*Charadrius melodus*), Atlantic Coast population, revised recovery plan. Hadley, Massachusetts.
- Melvin, S.M., A. Hecht, and C.R. Griffin. 1994. Piping plover mortalities caused by off-road vehicles on Atlantic coast beaches. *Wildlife Society Bulletin* 22:409-414.
- Meylan, A., B. Schroeder, and A. Mosier. 1995. Sea turtle nesting activity in the State of Florida 1979-1992. Florida Marine Research Publications Number 52. St. Petersburg, Florida.
- Mrosovsky, N. 1970. The influence of the sun's position and elevated cues on the orientation of hatchling sea turtles. *Animal Behavior* 18:648-651.
- Mrosovsky, N. and A. Carr. 1967. Preference for light of short wavelengths in hatchling green sea turtles (*Chelonia mydas*), tested on their natural nesting beaches. *Behavior* 28:217-231.
- Mrosovsky, N. and S.J. Shettleworth. 1968. Wavelength preferences and brightness cues in water finding behavior of sea turtles. *Behavior* 32:211-257.
- Murphy, T.M. 1985. Telemetric monitoring of nesting loggerhead sea turtles subject to disturbance on the beach. Paper presented at the Fifth Annual Sea Turtle Research Workshop, February 13-16, 1985, Waverly, Georgia.
- Murphy T.M., and S.R. Hopkins. 1984. Aerial and ground surveys of marine turtle nesting beaches in the southeast region. Unpublished report to National Marine Fisheries Service.
- [NMFS] National Marine Fisheries Service. 2008. Listing endangered and threatened wildlife and designating critical habitat; 90-day finding for a petition to reclassify the loggerhead turtle in the western North Atlantic Ocean. *Federal Register* 73(44):11849-11851.
- [NMFS and USFWS] National Marine Fisheries Service and U.S. Fish and Wildlife Service. 1978. Endangered and Threatened Wildlife and Plants; Listing and protecting loggerhead sea turtles as "threatened species" and populations of green and olive ridley sea turtles as threatened species or "endangered species." *Federal Register* 43(146):32800-32811.
- [NMFS and USFWS] National Marine Fisheries Service and U.S. Fish and Wildlife Service. 1991a. Recovery plan for U.S. population of Atlantic green turtle. National Marine Fisheries Service, Washington, D.C.
- [NMFS and USFWS] National Marine Fisheries Service and U.S. Fish and Wildlife Service. 1991b. Recovery plan for U.S. population of loggerhead turtle. National Marine Fisheries Service, Washington, D.C.
- [NMFS and USFWS] National Marine Fisheries Service and U.S. Fish and Wildlife Service. 1992. Recovery plan for leatherback turtles in the U.S. Caribbean, Atlantic, and Gulf of Mexico. National Marine Fisheries Service, Washington, D.C.
- [NMFS and USFWS] National Marine Fisheries Service and U.S. Fish and Wildlife Service. 1998. Recovery plan for U.S. Pacific populations of the green turtle (*Chelonia mydas*). National Marine Fisheries Service, Silver Spring, Maryland.
- [NMFS and USFWS] National Marine Fisheries Service and U.S. Fish and Wildlife Service. 2007a. Green sea turtle (*Chelonia mydas*): 5-year review: summary and status. Silver Spring, Maryland and Jacksonville, Florida.

- [NMFS and USFWS] National Marine Fisheries Service and U.S. Fish and Wildlife Service. 2007b. Loggerhead sea turtle (*Caretta caretta*): 5-year review: summary and status. Silver Spring, Maryland and Jacksonville, Florida.
- [NPS] National Park Service. 1993. Piping plover nest found trampled by pedestrian. News release. Cape Cod National Seashore, South Wellfleet, Massachusetts.
- [NPS] National Park Service. 2001. 2001 Piping plover breeding activities: Cape Hatteras National Seashore. Manteo, NC.
- [NPS] National Park Service. 2003. Abundance and distribution of non-nesting piping plovers (*Charadrius melodus*) at Cape Lookout National Seashore, North Carolina, 2000-2003. Unpublished report. Cape Lookout National Seashore, Harkers Island, NC.
- [NPS] National Park Service. 2006a. Piping Plover (*Charadrius melodus*) monitoring at Cape Hatteras National Seashore: 2006 annual report. Manteo, NC.
- [NPS] National Park Service. 2006b. Piping Plover (*Charadrius melodus*) monitoring at Cape Hatteras National Seashore: 2006 annual report. Appendix B. Manteo, NC.
- [NPS] National Park Service. 2007a. Cape Hatteras National Seashore 2007 annual piping plover (*Charadrius melodus*) report. Manteo, NC.
- [NPS] National Park Service. 2007b. Cape Hatteras National Seashore 2007 annual piping plover (*Charadrius melodus*) report: Map 4. Manteo, NC.
- [NPS] National Park Service. 2007c. Cape Hatteras National Seashore 2007 sea turtle annual report. Manteo, NC.
- [NPS] National Park Service. 2007d. Piping plover (*Charadrius melodus*) monitoring at Cape Lookout National Seashore. 2007 summary report. Harkers Island, NC.
- [NPS] National Park Service. 2008a. Park to establish pre-nesting areas for 2008 breeding season. March 21, 2008 news release. Manteo, NC.
- [NPS] National Park Service. 2008b. Agreement reached to preserve wildlife and recreation opportunities on Cape Hatteras National Seashore. April 30, 2008 news release. Washington, D.C.
- [NPS and Maryland DNR] National Park Service and Maryland Department of Natural Resources. 1993. Management and monitoring of the piping plover at Assateague Island National Seashore, Maryland: 1993 summary report. Unpublished report.
- [NPS and Maryland DNR] National Park Service and Maryland Department of Natural Resources. 1994. Management and monitoring of the piping plover at Assateague Island National Seashore, Maryland: 1994 summary report. Unpublished report.
- [NPS and Maryland DNR] National Park Service and Maryland Department of Natural Resources. 1995. Management and monitoring of the piping plover at Assateague Island National Seashore, Maryland: 1995 summary report. Unpublished report.
- [NPS and Maryland DNR] National Park Service and Maryland Department of Natural Resources. 1996. Management and monitoring of the piping plover at Assateague Island National Seashore, Maryland: 1996 summary report. Unpublished report.
- National Research Council. 1990. Decline of the sea turtles: causes and prevention. National Academy Press, Washington, D.C.
- Nicholls, J.L. 1989. Distribution and other ecological aspects of piping plovers (*Charadrius melodus*) wintering along the Atlantic and Gulf Coasts. M.S. Thesis. Auburn University, Auburn, Alabama.
- Nicholls, J.L. and G.A. Baldassarre. 1990. Habitat associations of piping plovers wintering in the United States. *Wilson Bulletin* 102:581-590.
- Noel, B.L., C.R. Chandler, and B. Winn. 2005. Report on migrating and wintering piping plover activity on Little St. Simons Island, Georgia in 2003-2004 and 2004-2005. Report to U.S. Fish and Wildlife Service.
- [NCWRC] North Carolina Wildlife Resources Commission. 2008a. Unpublished piping plover observation data.
- [NCWRC] North Carolina Wildlife Resources Commission. 2008b. Unpublished piping plover breeding activity data.
- [NCWRC] North Carolina Wildlife Resources Commission. 2006c. Unpublished statewide piping plover breeding pair database.
- Palmer, R.S. 1967. Piping plover. Pages 168-169 in Stout, G.D. (ed.). *The shorebirds of North America*. Viking Press, New York.
- Patterson, M.E. 1988. Piping plover breeding biology and reproductive success on Assateague Island. M.S. Thesis. Virginia Polytechnic Institute and State University, Blacksburg, Virginia.
- Patterson, M.E., J.D. Fraser, and J.W. Roggenbuck. 1991. Factors affecting piping plover productivity on Assateague Island. *Journal of Wildlife Management* 55:525-531.
- Pearce, A.F. 2001. Contrasting population structure of the loggerhead turtle (*Caretta caretta*) using mitochondrial and nuclear DNA markers. M.S. Thesis. University of Florida, Gainesville, Florida.

- Philibosian, R. 1976. Disorientation of hawksbill turtle hatchlings (*Eretmochelys imbricata*) by stadium lights. *Copeia* 1976:824.
- Plissner, J.H., and S.M. Haig. 1997. 1996 international piping plover census. Report to U.S. Geological Survey, Biological Resources Division, Forest and Rangeland Ecosystem Science Center, Corvallis, Oregon.
- Pompei, V.D., and F.J. Cuthbert. 2004. Spring and fall distribution of piping plovers in North America: implications for migration stopover conservation. Unpublished report submitted to U.S. Army Corps of Engineers.
- Possardt, E. 2005. Oman marine turtle trip reports provided to Sandy MacPherson, international sea turtle coordinator, U.S. Fish and Wildlife Service, Jacksonville, Florida.
- Post, T. 1991. Reproductive success and limiting factors of piping plovers and least terns at Breezy Point, New York, 1990. New York State Department of Environmental Conservation, Long Island City, New York.
- Pritchard, P.C.H. 1982. Nesting of the leatherback turtle, *Dermochelys coriacea*, in Pacific Mexico, with a new estimate of the world population status. *Copeia* 1982:741-747.
- Pritchard, P.C.H. 1992. Leatherback turtle *Dermochelys coriacea*. Pages 214-218 in Moler, P.E. (ed.). Rare and endangered biota of Florida, volume III. Reptiles and amphibians. University Press of Florida, Gainesville, Florida.
- Rabon, D.R., Jr., S.A. Johnson, R. Boettcher, M. Dodd, M. Lyons, S. Murphy, S. Ramsey, S. Roff, and K.R. Stewart. 2003. Confirmed leatherback turtle (*Dermochelys coriacea*) nests from North Carolina, with a summary of leatherback nesting activities north of Florida. *Marine Turtle Newsletter* 101:4-8.
- Raymond, P.W. 1984. The effects of beach restoration on marine turtles nesting in south Brevard County, Florida. M.S. Thesis. University of Central Florida, Orlando, Florida.
- Richardson, J.L. and T.H. Richardson. 1982. An experimental population model for the loggerhead sea turtle *Caretta caretta*. Pages 165-176 in Bjorndal, K.A. (ed.). Biology and conservation of sea turtles. Smithsonian Institution Press. Washington, D.C.
- Root, B.G., M.R. Ryan, and P.M. Mayer. 1992. Piping plover survival in the Great Plains. *Journal of Field Ornithology* 63:10-15.
- Ross, J.P. 1979. Sea turtles in the Sultanate of Oman. World Wildlife Fund Project 1320. May 1979 report.
- Ross, J.P. 1982. Historical decline of loggerhead, ridley, and leatherback sea turtles. Pages 189-195 in Bjorndal, K.A. (ed.). Biology and conservation of sea turtles. Smithsonian Institution Press, Washington, D.C.
- Ross, J.P., and M.A. Barwani. 1995. Review of sea turtles in the Arabian area. Pages 373-383 in Bjorndal, K.A. (ed.). Biology and conservation of sea turtles. Revised edition. Smithsonian Institution Press, Washington, D.C.
- Russell, R., 1983. The piping plover in the Great Lakes region. *American Birds* 37(6):951-955.
- Ryder, C.E. 1990. The effect of beach renourishment on sea turtle nesting and hatch success, Sebastian Inlet State Recreation Area, east-central, Florida. Unpublished report submitted to the Sebastian Inlet Tax District to fulfill permit requirements of the Florida Department of Environmental Regulation and the Army Corps of Engineers.
- Salmon, M., R. Reiners, C. Lavin, and J. Wyneken. 1995a. Behavior of loggerhead sea turtles on an urban beach. Part 1, correlates of nest placement. *Journal of Herpetology* 29:560-567.
- Salmon, M., M. Garro Tolbert, D. Pender Painter, M. Goff, and R. Reiners. 1995b. Behavior of loggerhead sea turtles on an urban beach. Part 2, hatching orientation. *Journal of Herpetology* 29:568-576.
- Santos, A.S., and M.H. Godfrey. 2001. *Caretta caretta* and *Eretmochelys imbricata*: Predation. *Herpetological Review* 32:37.
- Sarti-Martínez, L., A.R. Barragan, D.G. Muñoz, N. Garcia, P. Huerta, and F. Vargas. 2007. Conservation and biology of the leatherback turtle in the Mexican Pacific. *Chelonian Conservation and Biology* 6:70-78.
- Shaffer, F., and P. Laporte. 1992. Rapport synthèse des recherches relatives au pluvier siffleur (*Charadrius melodus*) effectuées aux Iles-de-la-Madeleine de 1987 à 1991. Association québécoise des groupes d'ornithologues et Service canadien de la faune.
- Simons, T., S. Schulte, C. McGowan, J. Cordes, M. Lyons, and W. Golder. 2005. American oystercatcher (*Haematopus palliatus*) research and monitoring in North Carolina, 2005 annual report. Unpublished report. North Carolina Cooperative Fish and Wildlife Research Unit, Department of Zoology, North Carolina State University.
- Snover, M.L. 2002. Growth and ontogeny of sea turtles using skeletochronology: methods, validation and application to conservation. Ph.D. dissertation. Duke University, Durham, North Carolina.
- South Atlantic Fishery Management Council. 2008. Accessed on April 10, 2008 at http://www.safmc.net/Portals/0/ProtRes/New_PR/Spaccounts_sptable/pdf%20versions/Green%20Sea%20Turtle.pdf.
- [SCDNR] South Carolina Department of Natural Resources. 2007. Loggerheadlines. Accessed March 27, 2008 at <http://www.dnr.sc.gov/seaturtle/Loggerheadlines/lndec07.pdf>

- Spotila, J.R., A. B. Dunham, A. J. Leslie, A.C. Steyermark, P.T. Plotkin, and F.V. Paladino. 1996. Worldwide population decline of *Dermochelys coriacea*: are leatherback turtles going extinct? *Chelonian Conservation and Biology* 2:290-222.
- Spotila, J.R., R.D. Reina, A.C. Steyermark, P.T. Plotkin, and F.V. Paladino. 2000. Pacific leatherback turtles face extinction. *Nature* 405:529-530.
- Staine, K.J., and J. Burger. 1994. Nocturnal foraging behavior of breeding piping plovers (*Charadrius melodus*) in New Jersey. *Auk* 111:579-587
- Stancyk, S.E. 1982. Non-human predators of sea turtles and their controls. Pages 139-152 in Bjorndal, K.A. (ed.). 1982. *Biology and conservation of sea turtles*. Smithsonian Institution Press, Washington D.C.
- Standora, E.A., and J.R. Spotila. 1985. Temperature dependent sex determination in sea turtles. *Copeia* 1985:711-722.
- Stillman, R.A., A.D. West, R.W.G. Caldow, S.E.A. le V. dit Durell. 2007. Predicting the effect of disturbance on coastal birds. *Ibis* 149:73-81.
- Strauss, E. 1990. Reproductive success, life history patterns, and behavioral variation in a population of piping plovers subjected to human disturbance. Ph.D. Dissertation. Tufts University, Medford, Massachusetts.
- Stucker, J.H., and F.J. Cuthbert. 2006. Distribution of non-breeding Great Lakes piping plovers along Atlantic and Gulf of Mexico coastlines: 10 years of band resightings. Report to U.S. Fish and Wildlife Service.
- Talbert, O.R., Jr., S.E. Stancyk, J.M. Dean, and J.M. Will. 1980. Nesting activity of the loggerhead turtle *Caretta caretta* in South Carolina I: a rookery in transition. *Copeia* 1980:709-719.
- Troëng, S., D. Chacon, and B. Dick. 2004. Possible decline in leatherback turtle *Dermochelys coriacea* nesting along the coast of Caribbean Central America. *Oryx* 38:395-403.
- Tull, C.E. 1984. A study of nesting piping plovers of Kouchibouguac National Park 1983. Unpublished report to Parks Canada, Kouchibouguac National Park, Kouchibouguac, New Brunswick.
- Turtle Expert Working Group. 2000. Assessment update for the Kemp's ridley and loggerhead sea turtle populations in the western North Atlantic. NOAA Technical Memorandum NMFS-SEFSC-444.
- Turtle Expert Working Group. 2007. An assessment of the leatherback turtle population in the Atlantic Ocean. NOAA Technical Memorandum NMFS-SEFSC-555.

- Tuxbury, S.M., and M. Salmon. 2005. Competitive interactions between artificial lighting and natural cues during seafinding by hatching marine turtles. *Biological Conservation* 121:311-316.
- [USFWS] U.S. Fish and Wildlife Service. 1970. United States list of endangered native fish and wildlife. *Federal Register* 35:8491-8498.
- [USFWS] U.S. Fish and Wildlife Service. 1985. Endangered and threatened wildlife and plants; determination of endangered and threatened status for the piping plover. *Federal Register* 50:50726-50734.
- [USFWS] U.S. Fish and Wildlife Service. 1996. Piping plover (*Charadrius melodus*), Atlantic Coast population, revised recovery plan. Hadley, Massachusetts.
- [USFWS] U.S. Fish and Wildlife Service. 2001a. Endangered and threatened wildlife and plants; final determination of critical habitat for the Great Lakes breeding population of the piping plover. *Federal Register* 66:22938-22969.
- [USFWS] U.S. Fish and Wildlife Service. 2001b. Endangered and threatened wildlife and plants; final determinations of critical habitat for wintering piping plovers. *Federal Register* 66:36038-36143.
- [USFWS] U.S. Fish and Wildlife Service. 2002. Endangered and threatened wildlife and plants; designation of critical habitat for the northern Great Plains breeding population of the piping plover; final rule. *Federal Register* 67:57637-57717.
- [USFWS] U.S. Fish and Wildlife Service. 2003. Recovery plan for the Great Lakes piping plover (*Charadrius melodus*). Fish and Wildlife Service, Fort Snelling, Minnesota.
- [USFWS] U.S. Fish and Wildlife Service. 2006a. Endangered and threatened wildlife and plants; amended designation of critical habitat for the wintering population of the piping plover. *Federal Register* 71:33703-33721.
- [USFWS] U.S. Fish and Wildlife Service. 2006b. 2006 Atlantic coast piping plover abundance and productivity estimates. Accessed April 30, 2008 at <http://www.fws.gov/northeast/pipingplover/pdf/final06.pdf>
- [USFWS] U.S. Fish and Wildlife Service. 2008a. Preliminary 2007 Atlantic coast piping plover abundance and productivity estimates. Accessed April 30, 2008 at <http://www.fws.gov/northeast/pipingplover/pdf/preliminary07.pdf>
- [USFWS] U.S. Fish and Wildlife Service. 2008b. Status updates: Atlantic coast piping plover population. Accessed April 30, 2008 at <http://www.fws.gov/northeast/pipingplover/status/index.html>

- [USFWS] U.S. Fish and Wildlife Service. 2008c. Cumulative sea turtle nesting summary report. Unpublished data from PINWR.
- [USFWS] U.S. Fish and Wildlife Service. 2008d. Endangered and threatened wildlife and plants; revised designation of critical habitat for the wintering population of the piping plover in North Carolina. Federal Register 73:28084-28093.
- Vogelsong, H. 2003. Cape Hatteras National Seashore visitor use study. Unpublished study for the National Park Service, Cape Hatteras National Seashore.
- Watts, B.D., D.S. Bradshaw, and R.R. Cross. 1996. Annual plover survey of the Virginia barrier islands: a ten year summary. Raven 67:84-89.
- Welty, J.C. 1982. The life of birds. Saunders College Publishing, Philadelphia, Pennsylvania.
- Wenmer, L.C., U. Ozesmi, and F.J. Cuthbert. 2001. A habitat-based population model for the Great Lakes population of the piping plover (*Charadrius melodus*). Biological Conservation 99:169-181.
- Wheeler, N.R. 1979. Effects of off-road vehicles on the infauna of Hatches Harbor, Cape Cod National Seashore. Unpublished report to University of Massachusetts, National Park Service Cooperative Research Unit, Amherst, Massachusetts. UM-NPSCRU Report No. 28.
- Wilcox, L. 1939. Notes on the life history of the piping plover. Birds of Long Island 1:3-13.
- Wilcox, L. 1959. A twenty year banding study of the piping plover. Auk 76:129-152.
- Wilkinson, P.M., and M. Spinks. 1994. Winter distribution and habitat utilization of piping plovers in South Carolina. Chat 58:33-37.
- Witherington, B.E. 1990. Photopollution on sea turtle nesting beaches: problems and next-best solutions. Pages 43-45 in Richardson, T.H., J.I. Richardson, and M. Donnelly (compilers). 1990. Proceedings of the tenth annual workshop on sea turtle biology and conservation. NOAA Technical Memorandum NMFS-SEFC-278.
- Witherington, B.E. 1992. Behavioral responses of nesting sea turtles to artificial lighting. Herpetologica 48:31-39.
- Witherington, B.E. 1993. An analysis of reported sea turtle hatchling disorientation events for Florida, 1992. Florida Marine Research Institute, Florida Department of Natural Resources. Tequesta, Florida.
- Witherington, B.E., and L.M. Ehrhart. 1989. Status and reproductive characteristics of green turtles (*Chelonia mydas*) nesting in Florida. Pages 351-352 in Ogren, L., F. Berry, K. Bjorndal, H. Kumpf, R. Mast, G. Medina, H. Reichart, and R. Witham (eds.).
- Proceedings of the second western Atlantic turtle symposium. NOAA Technical Memorandum NMFS-SEFC-226.
- Witherington, B.E. and K.A. Bjorndal. 1991. Influences of artificial lighting on the seaward orientation of hatchling loggerhead turtles (*Caretta caretta*). Biological Conservation 55:139-149.
- Witherington, B., C. Crady, and L. Bolen. 1996. A "hatchling orientation index" for assessing orientation disruption from artificial lighting. Pages 344-347 in Keinath, J.A., D.E. Barnard, J.A. Musick, and B.A. Bell. Proceedings of the fifteenth annual symposium on sea turtle biology and conservation. NOAA Technical Memorandum NMFS-SEFSC-387.
- Wolcott, D.L., and T.G. Wolcott. 1999. High mortality of piping plovers on beaches with abundant ghost crabs: correlation, not causation. Wilson Bulletin 111:321-329.
- Woodson, H.M., and W.D. Webster. 1999. *Chelonia mydas* (Green Sea Turtle). Nesting distribution. Herpetological Review 30:224-225.
- Wyneken, J., M. Goff, and L. Glenn. 1994. The trials and tribulations of swimming in the near-shore environment. Pages 169-171 in Bjorndal, K.A., A.B. Bolten, D.A. Johnson, and P.J. Eliazar (compilers). 1994. Proceedings of the fourteenth annual symposium on sea turtle biology and conservation. NOAA Technical Memorandum NMFS-SEFSC-351.
- Wyneken J., and M. Salmon. 1996. Aquatic predation, fish densities, and potential threats to sea turtle hatchlings from open-beach hatcheries: final report. Technical Report 96-04, Florida Atlantic University, Boca Raton, Florida.
- Yntema, C.L., and N. Mrosovsky. 1982. Critical periods and pivotal temperatures for sexual differentiation in loggerhead sea turtles. Canadian Journal of Zoology 60:1012-1016.
- Zonick, C.A. 2000. The winter ecology of the piping plover (*Charadrius melodus*) along the Texas Gulf Coast. Ph.D. Dissertation. University of Missouri, Columbia, Missouri.
- Zug, G. R., and J. F. Parham. 1996. Age and growth in leatherback turtles, *Dermochelys coriacea* (Testudines: Dermochelyidae): A skeletochronological analysis. Chelonian Conservation and Biology 2:244-249.



United States Department of the Interior

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February 9, 2015

John F. Sullivan, III, P.E.
Federal Highway Administration
310 New Bern Avenue, Suite 410
Raleigh, North Carolina 27601

Dear Mr. Sullivan:

The U.S. Fish and Wildlife Service (Service) has received your January 5, 2015 request for reinitiation of formal consultation under Section 7 of the Endangered Species Act (ESA) for the NC 12 Replacement of Herbert C. Bonner Bridge over Oregon Inlet (Parallel Bridge Corridor with NC 12 Transportation Management Plan Alternative) in Dare County, North Carolina (TIP No. B-2500). The need for reinitiation of Section 7 consultation arises from the recent listing of the rufa red knot (*Calidris canutus rufa*) as a federally threatened species. The following document should be considered an addendum to the previous Biological Opinion issued on July 10, 2008. This addendum is provided in accordance with section 7(a)(2) of the ESA of 1973, as amended (16 U.S.C. 1531 *et seq.*). Your letter and the accompanying Technical Memorandum dated December 2014 were received on January 12, 2015.

If you have any questions concerning this addendum to the Biological Opinion, please contact Mr. Gary Jordan at (919) 856-4520 (Ext. 32).

Sincerely,

Pete Benjamin
Field Supervisor

Electronic copy:

Ron Lucas, FHWA, Raleigh, NC
Wendy Walsh, USFWS, Pleasantville, NJ
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Travis Wilson, NCWRC, Creedmoor, NC

The following addendum to the Biological Opinion is based on information provided in the March 2008 biological assessment (FHWA and NCDOT 2008a), *Supplement to the 2005 Supplemental Draft Environmental Impact Statement and Draft Section 4(f) Evaluation* (FHWA and NCDOT 2007), *Final Environmental Impact Statement and Section 4(f) Evaluation* (FHWA and NCDOT 2008b), *Environmental Assessment for the NC 12 Replacement of Herbert C. Bonner Bridge* (FHWA and NCDOT 2010a), *Record of Decision for NC 12 Replacement of Herbert C. Bonner Bridge* (FHWA and NCDOT 2010b), *Record of Decision for NC 12 – Pea Island Long-Term Improvements for Bonner Bridge Replacement Project Phase IIa* (FHWA and NCDOT 2013a), *Environmental Assessment and Section 4(f) Evaluation for NC 12 – Rodanthe Breach Long-Term Improvements, Bonner Bridge Replacement Project Phase IIb* (FHWA and NCDOT 2013b), *Technical Memorandum on the Effects of Parallel Bridge Corridor with NC 12 Transportation Management Plan Alternative for NC 12 Replacement of Herbert C. Bonner Bridge* (FHWA and NCDOT 2014), meetings, telephone conversations, emails, field investigations, and other sources of information. A complete administrative record of this consultation is on file at this office. **This addendum to the Biological Opinion pertains to the federally threatened rufa red knot only.**

CONSULTATION HISTORY (Since July 10, 2008)

July 10, 2008 – The Service issued a Biological Opinion for all phases of the project.

January 10, 2013 – The FHWA reinitiated formal consultation due to availability of more detailed design information and minor design modifications.

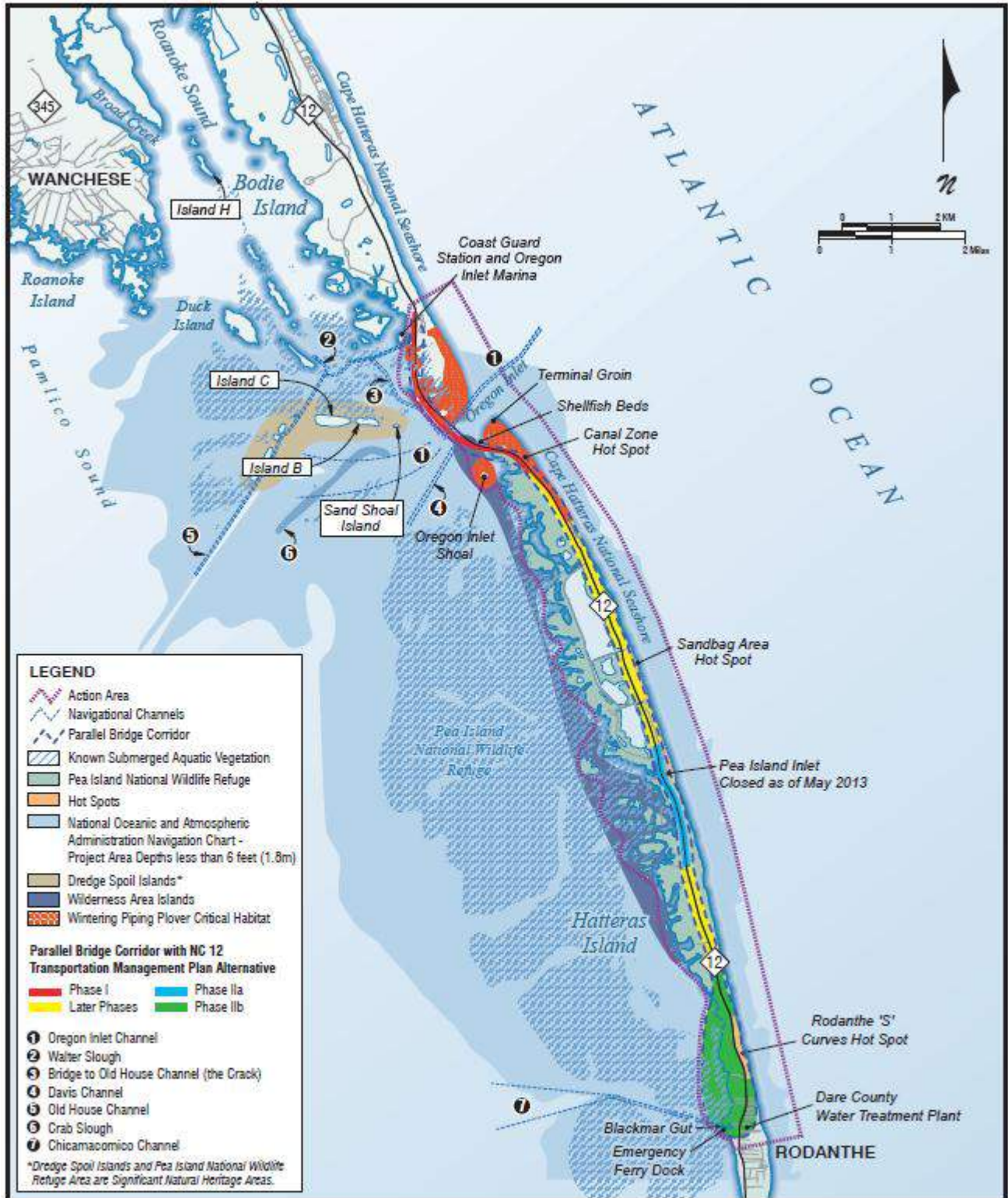
January 22, 2013 – The Service reevaluated the Biological Opinion and made minor revisions in the Terms and Conditions.

May 9, 2013 – The FHWA reinitiated formal consultation due to availability of more detailed design information for Phase IIa of the project.

May 17, 2013 – The Service reevaluated the Biological Opinion and made minor revisions in the Terms and Conditions.

August 14, 2014 – The Service made a minor revision in the Terms and Conditions of the Biological Opinion.

January 12, 2015 – The Service received a letter from FHWA dated January 5, 2015, requesting reinitiation of formal consultation due to the listing of the rufa red knot as a federally threatened species.



BIOLOGICAL ASSESSMENT ACTION AREA AND NATURAL RESOURCE-RELATED FEATURES

Figure 1

ADDENDUM TO BIOLOGICAL OPINION

I. DESCRIPTION OF PROPOSED ACTION

See the July 10, 2008 Biological Opinion. Design changes since 2008 are summarized on pages 8-11 of FHWA and NCDOT (2014). Additional details can be found in the aforementioned National Environmental Policy Act documents.

Action Area

See the July 10, 2008 Biological Opinion for a description of the action area (also see Figure 1 on previous page). Since the 2008 Biological Opinion, the action area was affected by Hurricane Irene in August 2011, Hurricane Sandy in October 2012, and Hurricane Arthur in July 2014. Hurricane Irene breached NC 12 at two locations – in northern Rodanthe and within Pea Island National Wildlife Refuge (PINWR) approximately six miles south of Oregon Inlet (creating the new Pea Island Inlet, a.k.a. New Inlet). The North Carolina Department of Transportation (NCDOT) repaired NC 12 at Rodanthe by filling the breach with sand within the existing right-of-way. The NCDOT repaired the Pea Island breach by constructing a temporary bridge over the Pea Island Inlet. Hurricane Sandy did not substantially change the action area. In 2013 the Pea Island Inlet closed as a result of naturally occurring coastal processes. In July 2014, Hurricane Arthur reopened the Pea Island Inlet; however, flow has subsequently been reduced to limited sheet flow overwash during high tide. Construction began on Phase IIa to replace the temporary bridge over Pea Island Inlet with a permanent bridge in March 2014, but work has been temporarily suspended. To protect NC 12 from encroaching beach erosion, NCDOT completed a 2.3 mile beach nourishment project from Rodanthe northward into PINWR during summer 2014.

Conservation Measures

See the July 10, 2008 Biological Opinion.

II. STATUS OF THE SPECIES/CRITICAL HABITAT

The rufa red knot was listed as a federally threatened species on December 11, 2014. Critical habitat has not yet been designated for the species. See USFWS (2013a) and USFWS (2014) for a current status of the species.

III. ENVIRONMENTAL BASELINE

A. Status of the Species Within the Action Area

Red knot habitat within the action area occurs within an area affected by dynamic coastal processes and ongoing human uses. Suitable red knot habitat appears to be present at and near

Oregon Inlet, Pea Island Inlet, and along the ocean shoreline. Since red knots do not breed in North Carolina, only seasonal foraging and roosting habitat is present within the action area.

Although red knots may be present in coastal North Carolina in every month of the year, the greatest numbers are usually recorded during the spring migration in May and June. The lowest recorded numbers usually occur from January to March (Dinsmore et al. 1998).

Given the transient presence of the species, the number of red knots occurring within the action area during migration or during winter is difficult to assess. From multiple bird surveys in 2013 from February 19 to December 18, NCDOT biologists only observed 33 red knots within the action area (NCDOT 2013). Of the 33 red knots observed during 2013, 30 were observed approximately ¼ mile north of Pea Island Inlet on December 18 (K. Herring, NCDOT biologist, personal communication, December 20, 2013). From multiple bird surveys in 2014 from February 18 to December 11, NCDOT biologists observed 72 red knots within the action area (NCDOT 2014). Most of the red knots observed in 2014 occurred on the beach between Oregon Inlet and Pea Island Inlet. Given the significant amount of survey effort expended, observing only 33 and 72 red knots in 2013 and 2014, respectively, appears to indicate relatively low use of the action area by red knots.

No critical habitat has been designated or proposed within the action area for the rufa red knot.

B. Factors affecting species environment within the action area

See the July 10, 2008 Biological Opinion. With the exception of factors affecting nesting, the factors affecting piping plovers (*Charadrius melodus*) described in the Biological Opinion apply to the red knot.

IV. EFFECTS OF THE ACTION

A. Factors to be considered

Proximity of the action: Rufa red knots travel between their wintering grounds (Tierra del Fuego, northern Brazil, the Caribbean, and U.S. coastal areas from Texas to North Carolina) and their breeding grounds in the central Canadian Arctic (USFWS 2013b). This action will occur within the range of wintering red knots and within a potential stopover area for migrating red knots. However, when compared to seven other locations along the U.S. East Coast, the Outer Banks (which contains the action area) ranked last in regional importance for red knots (Dinsmore et al. 1998). Red knot observations in North Carolina are generally more numerous in the southern half of the coast, which is outside of the action area (Carolina Bird Club 2014).

Distribution: The expected disturbance from the proposed action is likely to occur throughout the action area, but in a staggered manner over time.

Timing: The proposed action may occur throughout the year. Specifically, the proposed action will occur during the migrating and wintering seasons of the rufa red knot.

Nature of the effect: The project may affect migrating, roosting, or foraging activities of red knots. This may take the form of habitat loss, new habitat creation, temporary preclusion of habitat utilization, and harassment/disturbance resulting in behavior modification. Direct lethal effects are not expected.

Duration/Disturbance frequency: The proposed project will be built in at least four phases, with Phase IIa construction already initiated. Phase I was originally intended to have already begun but has been delayed due to litigation. Future phases do not have start dates determined but could be staggered over 25 or more years. Each phase is expected to involve 3-3.5 years of construction. Construction is anticipated to occur year-round. Each phase will only affect a portion of the action area at any one time.

With the exception of Phase I (bridge over Oregon Inlet), the future phasing of the construction is based on assumptions corresponding to forecast shoreline erosion trends and maintaining minimum 230-foot buffer distance between the existing NC 12 edge of pavement and the active shoreline. These assumptions are based on worst-case scenario modeling of shoreline erosion and the location and likelihood of future breaches on Hatteras Island. Since these are forecasts only, the exact timing and scope of each phase could change based on the reality of future shoreline erosion. As such, the duration of the construction should be viewed as an approximation. Since red knots may be present throughout the year, red knots could be affected at any time during any of the phases or during subsequent maintenance of the facilities.

Although construction activity will be a temporary effect, the new structures will permanently alter the habitat for red knots, although not necessarily all negatively in the long-term. Natural barrier island processes, which are currently precluded along much of the action area by the maintenance of NC 12, could be allowed to resume to an extent with the construction of bridges if no associated dune construction occurs. Also, maintenance of the facility will be an ongoing activity on both a periodic and as-needed basis.

Disturbance intensity: Although there is potential for temporary disturbances to the red knot throughout the action area, the intensity of the disturbance would likely be highest between Oregon Inlet and Pea Island Inlet. It is believed that the rest of the action area currently has minimal or no use by red knots.

Disturbance severity: Given the relatively low occurrence rate of red knots within the action area, and given the fact that construction activities will only affect a small portion of the total amount of potential foraging and roosting habitat available within the action area at any one time, the disturbance severity is expected to be minimal.

B. Analysis for effects of the action

Beneficial effects:

Since NCDOT maintains an artificial berm along the seaward side of NC 12 through most of the project area, natural barrier island processes such as ocean overwash, island migration, and inlet

formation have been mostly precluded, thus severely limiting the formation of new habitat for red knots. If selected alternatives elevate much of NC 12 onto bridges, the maintenance of the artificial berm may be discontinued, thus allowing the natural barrier island processes to resume. Ocean overwash and possible new inlets would likely create new potential habitat for red knots. Eventually, westward migration of the island would result in some portion of the bridges to be in the ocean eastward of the beach.

Direct effects:

Due to fill and pile placement in Phase I, there will be a direct loss of <0.1 acre of beach that is potential foraging and roosting habitat. It is not anticipated that the presence of the completed Bonner Bridge replacement will preclude red knots from foraging in the locations where they are currently observed foraging. Depending upon the alternatives selected for future phases, and depending upon whether a beach nourishment component is included in the final designs, future phases may result in the direct loss of potential foraging or roosting habitat. The effects analysis of those future phases will be revisited as more detailed project designs become available.

Perhaps the most likely and most widespread, but the least quantifiable, direct effect is disturbance and/or flushing of foraging or roosting red knots during the construction of each of the phases. The presence of heavy equipment, construction activity, and associated noise will be in close proximity to potential foraging and roosting habitat. This effect will be temporary and staggered over time and location, lasting for some subset of the estimated 3-3.5 year construction timeframe for each phase.

The biological effects of disturbance to foraging or roosting red knots are difficult to quantify. In general, however, we know that red knots require food and shelter. Any actions that limit their ability to feed or shelter probably have adverse effects on individual birds because flushed birds expend energy to avoid disturbance (Stillman et al. 2007). The degree that red knots are adversely affected depends largely on how much time they are precluded from feeding or sheltering in relation to the amount of time they would feed or shelter if they were not flushed. To evaluate the biological effects of flushing, the identity of individual red knots would have to be known and the amount and extent of flushing would need to be documented consistently over time for each bird. Furthermore, these individual birds would need to be followed throughout the year to determine if their survival rates or nesting success were lower than other birds not subjected to flushing. Given there are other factors that affect the survival or reproductive success of red knots (predation, weather, food availability and quality, etc.) it would be difficult to isolate the effects of flushing. A large number of individual birds would have to be studied over a relatively long period in order to attempt to quantify the effects of flushing. We are aware of no such long term and statistically robust studies.

Interrelated and interdependent effects:

Periodic bridge maintenance or repair activities may require the presence of inspectors and equipment to operate in the vicinity of potential red knot habitat, thus causing disturbance to foraging/roosting red knots or precluding the use of habitat. These effects are difficult to

quantify. Disturbance from human recreation is already present, and thus the effect of maintenance and repair work would be additive to an existing level of disturbance.

Indirect effects:

Indirect effects are caused by or result from the proposed action, are later in time, and are reasonably certain to occur. For future phases, if alternatives are selected which elevate much of NC 12 onto bridges without associated dune construction, natural barrier island processes may resume and thus create new red knot habitat in the future. This new habitat could create new conditions for indirect effects. These indirect effects will be identical to the direct effects described above (i.e. disturbance/flushing of foraging/roosting red knots and precluding habitat use) during maintenance or repair activities; however, they will be to red knots using habitat that does not currently exist. If new red knot habitat is created, portions of the beach will eventually move westward underneath the new bridges. It is unknown if the presence of elevated bridges would preclude red knot foraging adjacent to those bridges.

Depending on final design of each bridge, the new bridges could provide perches for avian predators (e.g. gulls, hawks, etc.) that may prey on red knots. However, these predators currently occur within the action area, so the extent of any additional effect would be difficult to determine.

C. Species' response to proposed action

Numbers of individuals/populations in the action area affected: Given the transient nature of the species in North Carolina, the number of red knots within the action area at any given time during the winter or during migration is difficult to assess. In multiple survey efforts, NCDOT biologists only observed 33 red knots in 2013 and 72 red knots in 2014 (NCDOT 2013, NCDOT 2014) within the action area. Nearly all the 2013 observations occurred in December. The 2014 observations occurred May-July, September-October, and in December.

Sensitivity to change: Sensitivity to change for transient migrating or wintering birds is difficult to assess. Given the apparent low-level use of the action area by red knots and the abundance of better quality habitat in other coastal areas of North Carolina, sensitivity to change within the action area is likely not measurable.

Resilience: Since most of the adverse effects will occur as temporary harassment to transient red knots within portions of the action area staggered over time, the species resilience to the effects will likely be high.

Recovery rate: The specific effects of disturbance on non-breeding red knots are not well understood. However, reduced ability to rest and decreased food intake could reduce survivorship of migrating and wintering birds. In Florida, researchers concluded that the greatest threat to wintering red knots was chronic disturbance, thus affecting the ability of the birds to maintain sufficient weight (Niles et al. 2006, Niles et al. 2008, and Niles 2009). Given the relatively low-level of use by red knots in the action area, it is unknown if the disturbance generated from the action will be significant.

V. CUMULATIVE EFFECTS

See the July 10, 2008 Biological Opinion. The cumulative effects assessed for the piping plover would apply to red knots.

VI. CONCLUSION

After reviewing the current status of the rufa red knot, the environmental baseline for the action area, and all effects of the proposed project, it is the Service's biological opinion that the proposed NC 12 Replacement of Herbert C. Bonner Bridge over Oregon Inlet (Parallel Bridge Corridor with NC 12 Transportation Management Plan Alternative) (TIP No. B-2500), as proposed, is not likely to jeopardize the continued existence of the rufa red knot. No critical habitat has been designated for the rufa red knot; therefore, none will be affected.

This non-jeopardy opinion is based on the following rationale:

1. Based on multiple survey efforts in 2013 and 2014, the action area sees a relatively low level of red knot use. Red knots are transients in North Carolina. Dinsmore et al. (1998) found that, when compared to other U.S. East Coast locations, the Outer Banks of North Carolina ranked last in regional importance for red knots.
2. Most of the adverse effects will be temporary in nature and will be in the form of harassment. Although disturbance to foraging and roosting red knots may contribute to a lessening of survivorship, this would be extremely difficult to determine. Direct lethal effects are not anticipated.
3. The adverse effects will be staggered over space and time; therefore, only portions of the action area will have the potential for adverse effects at any one time.

INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and federal regulations pursuant to Section 4(d) of the ESA prohibit the taking of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or 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 such as 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, the carrying out of 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 taking under the ESA provided that such taking is in compliance with the terms and conditions of this Incidental Take Statement.

The measures described below are non-discretionary, and must be undertaken by the FHWA so that they may become binding conditions of any grant or permit issued to the NCDOT, as appropriate, for the exemption in section 7(o)(2) to apply. The FHWA has a continuing duty to regulate the activity covered by this Incidental Take Statement. If the FHWA (1) fails to assume and implement the terms and conditions or (2) fails to require the NCDOT 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. To monitor the impact of incidental take, the FHWA or the NCDOT must report the progress of the action and any impact on the species to the Service.

Amount or Extent of Take Anticipated

The Service expects incidental take of migrating or wintering rufa red knots will be difficult to detect for the following reasons: sub-lethal effects are not easily determined, harassment which contributes to lessened survivorship may only be apparent on the breeding grounds the following year, and dead red knots may not be detectable. However, take of all migrating and wintering red knots throughout the extent of suitable habitat within the action area can be anticipated in all phases of the project by the disturbance of foraging or roosting red knots from nearby construction activity.

Effect of the Take

In the accompanying addendum to the July 10, 2008 Biological Opinion, the Service determined that this level of anticipated take is not likely to result in jeopardy to the species, or destruction or adverse modification of designated or proposed critical habitat.

Reasonable and Prudent Measures

The Service believes the following reasonable and prudent measures are necessary and appropriate to minimize take of the rufa red knot. These nondiscretionary measures include, but are not limited to, the terms and conditions outlined in this addendum to the July 10, 2008 Biological Opinion.

1. To the extent possible, avoid disturbing foraging and roosting red knots.
2. Avoid or minimize opportunities for avian predator perches.

Terms and Conditions

In order to be exempt from the prohibitions of section 9 of the ESA, the NCDOT must comply with the following terms and conditions, which implement the reasonable and prudent measures described previously. These terms and conditions are nondiscretionary.

1. To the extent possible, keep all construction equipment and activity within the existing right-of-way. Avoid staging equipment or materials on the beach or adjacent to inlets.

2. To the maximum extent practical, while ensuring the safety of the traveling public, limit or avoid the use of road signs or other potential predator perches adjacent to red knot roosting or foraging areas. Where signs or other structures are necessary, determine if alternative designs would be less conducive for perching on by avian predators (gulls, crows, hawks, etc.). For example, minimize or avoid the use of large cantilever signs in favor of smaller and shorter designs.

Coordination of Incidental Take Statements 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 § 703-712), if such take is in compliance with the terms and conditions (including amount and/or number) specified herein.

CONSERVATION RECOMMENDATIONS

See July 10, 2008 Biological Opinion.

REINITIATION/CLOSING STATEMENT

This concludes formal consultation on the action outlined in your January 5, 2015 request for reinitiation of formal consultation. As provided in 50 CFR section 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; (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.

Literature Cited

Carolina Bird Club. 2014. Birds of North Carolina: their distribution and abundance. Retrieved on December 4, 2014 at <http://www.carolinabirdclub.org/ncbirds/accounts.php> .

Dinsmore, S.J., J.A. Collazo, and J.R. Walters. 1998. Seasonal numbers and distribution of shorebirds on North Carolina's Outer Banks. *Wilson Bulletin* 110(2):171-181.

FHWA and NCDOT (Federal Highway Administration and North Carolina Department of Transportation). 2007. Supplement to the 2005 supplemental draft environmental impact statement and draft section 4(f) evaluation. NC 12 replacement of Herbert C. Bonner Bridge.

- FHWA and NCDOT (Federal Highway Administration and North Carolina Department of Transportation). 2008a. Biological assessment for NC 12 replacement of Herbert C. Bonner Bridge. Bridge No. 11 over Oregon Inlet.
- FHWA and NCDOT (Federal Highway Administration and North Carolina Department of Transportation). 2008b. Final environmental impact statement and Section 4(f) evaluation. NC 12 replacement of Herbert C. Bonner Bridge.
- FHWA and NCDOT (Federal Highway Administration and North Carolina Department of Transportation). 2010a. Environmental assessment. NC 12 replacement of Herbert C. Bonner Bridge.
- FHWA and NCDOT (Federal Highway Administration and North Carolina Department of Transportation). 2010b. Record of decision for NC 12 replacement of Herbert C. Bonner Bridge.
- FHWA and NCDOT (Federal Highway Administration and North Carolina Department of Transportation). 2013a. Record of decision for NC 12 – Pea Island long-term improvements for Bonner Bridge replacement project Phase IIa.
- FHWA and NCDOT (Federal Highway Administration and North Carolina Department of Transportation). 2013b. Environmental assessment and Section 4(f) evaluation for NC 12 – Rodanthe breach long-term improvements, Bonner Bridge replacement project Phase IIb.
- FHWA and NCDOT (Federal Highway Administration and North Carolina Department of Transportation). 2014. Technical memorandum on the effects of parallel bridge corridor with NC 12 transportation management plan alternative for NC 12 replacement of Herbert C. Bonner Bridge.
- NCDOT. 2013. Summary of birds observed and total sightings 2/19/13 through 12/18/13 PINWR. Unpublished report. North Carolina Department of Transportation Biological Surveys Group, Raleigh, NC.
- NCDOT. 2014. 2014 Pea Island National Wildlife Refuge bird surveys. Unpublished report. North Carolina Department of Transportation Biological Surveys Group, Raleigh, NC.
- Niles, L.J., A.D. Dey, N.J. Douglass, J.A. Clark, N.A. Clark, A.S. Gates, B.A. Harrington, M.K. Peck, and H.P. Sitters. 2006. Red knots wintering in Florida: 2005/6 expedition. Wader Study Group Bulletin 111:86-99.
- Niles, L.J., H.P. Sitters, A.D. Dey, P.W. Atkinson, A.J. Baker, K.A. Bennett, R. Carmona, K.E. Clark, N.A. Clark, and C. Esposito. 2008. Status of the red knot (*Calidris canutus rufa*) in the Western Hemisphere. *Studies in Avian Biology* 36:1-185.

Niles, L. 2009. Red knots wintering on the Florida Gulf Coast 2005-2009. Unpublished final report (Report on Red Knot Surveys in Florida 2008-2009). Neotropical Migrant Bird Conservation Act. Project #3556, Agreement #NJ-N31.

Stillman, R.A., A.D. West, R.W.G. Caldow, and S.E.A. le V. dit Durell. 2007. Predicting the effect of disturbance on coastal birds. *Ibis* 149:73-81.

USFWS (U.S. Fish and Wildlife Service). 2013a. Endangered and threatened wildlife and plants; proposed threatened status for the rufa red knot (*Calidris canutus rufa*); proposed rule. Federal Register 78(189):60024-60098.

USFWS (U.S. Fish and Wildlife Service). 2013b. Rufa red knot. Retrieved on December 4, 2014 at https://www.fws.gov/northeast/redknot/pdf/Redknot_BWfactsheet092013.pdf .

USFWS (U.S. Fish and Wildlife Service). 2014. Endangered and threatened wildlife and plants; threatened species status for the rufa red knot; final rule. Federal Register 79(238):73706-73748.