ALTERNATIVES STUDY REPORT

for

NC 12 – Pea Island Long-Term Improvements
Bonner Bridge Replacement Project Phase IIa

Federal-Aid No. BRNHF-0012(56)

NCDOT Project Definition: 32635
TIP Project No. B-2500A
Dare County, North Carolina

Federal Highway Administration

North Carolina Department of Transportation

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1.0 Study Purpose and Process

This report documents an alternatives study for NC 12 – Pea Island Long-Term Improvements, Bonner Bridge Replacement Project in the Phase IIa project area. For this alternatives study, the Phase IIa project area presented in the October 2013 Phase IIa Record of Decision (ROD) is expanded south to the northern boundary of the Phase IIb project area. The expanded Phase IIa project area is shown in Figure 1. Figure 2 shows the expanded Phase IIa project area in relation to the balance of the area containing the Bonner Bridge Replacement Project (B-2500), including the location of the Phase I and Phase IIb projects.

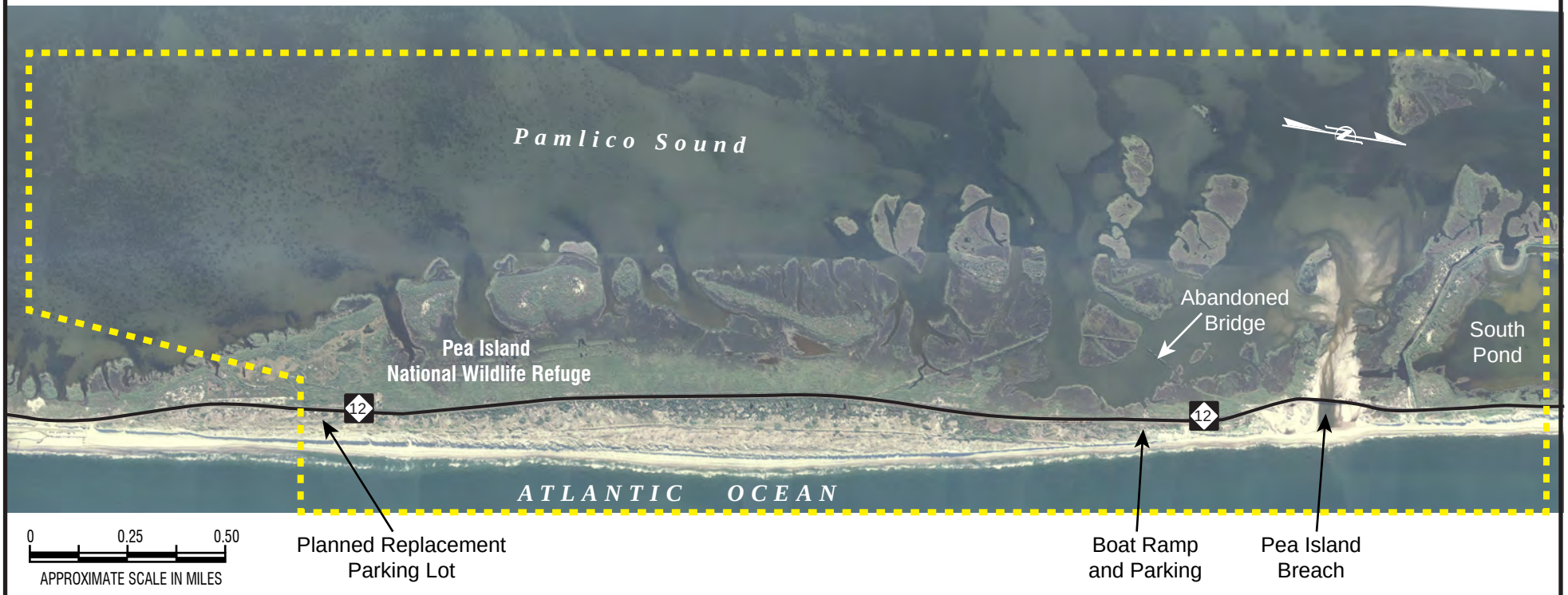
1.1 Study Purpose

The purpose of this alternatives study is to:

- Reexamine potential Phase IIa alternatives, including the Bridge within Existing NC 12 Easement Alternative that was chosen as the Selected Alternative in the 2013 Phase IIa ROD and a new Bridge on New Location Alternative.
- Provide information and evaluation sufficient to support reconsideration of Phase IIa Concurrence Points 2 (detailed study alternatives carried forward) and 2A (bridging decisions and alignment review) by the project's National Environmental Policy Act (NEPA)/Section 404 Merger Team.
- Inform the analysis that could be necessary for future environmental impact documentation under NEPA, a future Section 4(f) Evaluation, and revisiting the NEPA/Section 404 Merger Team Concurrence Point 3 LEDPA decision.

This alternatives study is being done in accordance with commitments made in the April 2015 agreement that settled the Bonner Bridge Replacement Project lawsuits brought forth by the Defenders of Wildlife and the National Wildlife Refuge Association. In relation to this alternatives study, the settlement agreement states:

> NCDOT shall prepare a report on the Phase II Extension Alternative within one and one-half years of the [lawsuit] dismissals referred to in paragraph l.h. The report shall contain information and evaluation sufficient to support Concurrence Points 2 and 2A for the Phase II Extension, and shall inform the analysis necessary for Concurrence Point 3 and for the Section 4(f) evaluation. The report shall, without limitation:
>
> – Describe the environmental features of the Phase II Extension study area, including performing new studies or updating existing studies of the

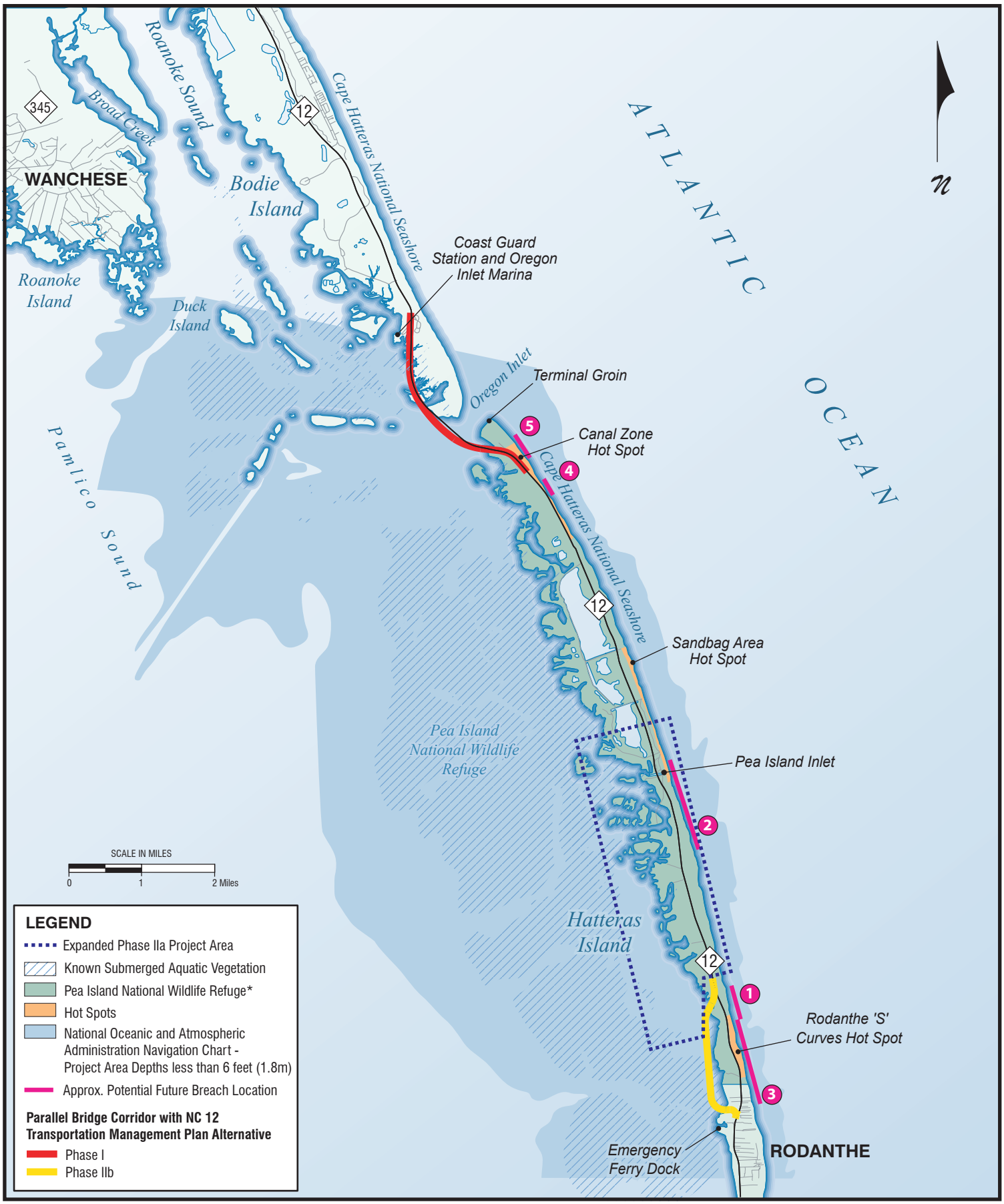


Aerial date: 2014

Expanded Project Area Boundary

EXPANDED PHASE IIa PROJECT AREA

Figure
1



VICINITY MAP

Figure 2

topography, coastal condition, wetland and open water habitat, protected species, essential fish habitat, historic properties, and utilities.

- Identify preliminary corridors that address the Purpose and Need for the project and consider the environmental constraints within the study area, including preparing conceptual/functional designs with horizontal and vertical alignments, edge of pavements, slope stakes, and right of way limits on digital orthophotography, as needed.

- Include meeting summaries describing recommendations from members of the Merger Team, stating the rationale for retaining or dropping conceptual alternatives. Based on the input from the Merger Team, NCDOT shall identify the alternatives to be carried forward for more detailed design (preliminary level design).

- Describe the development of the preliminary designs and, after coordination with key federal and State agencies, identify environmental impacts and possible measures to minimize such impacts.

- Provide cost estimates and identify funding alternatives based on the preliminary design.

The Phase II Extension Alternative refers to an option that extends the Phase IIb Bridge on New Location Alternative to the north end of the Phase IIa study area. The Phase II Extension Alternative concept was first presented to the Merger Team in a meeting on September 11, 2014. For this study, the Phase II Extension Alternative has been renamed as the **Phase IIa Bridge on New Location Alternative**.

The settlement agreement also states:

> NCDOT and FHWA shall not design Phase IIa and Phase IIb of the Project so as to preclude the construction of subsequent phases within Pamlico Sound.

In order to address this requirement, this alternatives study also presents the opportunities available to extend to Oregon Inlet via Pamlico Sound the Phase IIa Bridge on New Location Alternative alignments developed for this report and the Bridge within Existing NC 12 Easement Alternative (Selected Alternative in the 2013 Phase IIa ROD).

1.2 Process

The following process was followed for completion of this alternatives study:

- Identification of an expanded Phase IIb project area (Figure 1) that extends the project area shown in the 2013 Phase IIa ROD further south to the end of the Phase

IIb Selected Alternative on NC 12 and to the point on the Phase IIb bridge in the sound where an extension of that bridge further north could begin.

- Environmental features update for use in the Section 4.0, "Existing Conditions," of this report, including:
  - Contacting representatives from the Cape Hatteras National Seashore (Seashore) and Pea Island National Wildlife Refuge (Refuge) to obtain current facilities and planning data for these resources from the northern end of Phase IIb to Oregon Inlet and confirmation of the boundaries of these resources within Pamlico Sound.
  - Reviewing the Bonner Bridge Replacement Project (B-2500) coastal monitoring program's 2014 update report (Overton, 2015).
  - Preparation of new biotic community mapping for the expanded Phase IIa Project Area (updating 2005 biotic communities mapping) where Phase IIa study alternatives are being considered, as well as preparation of US Army Corps of Engineers (USACE) jurisdictional resource delineations for the parts of the expanded Phase IIa Project Area not covered in January 2013 delineations.
  - Updates of available protected species, essential fish habitat, submerged aquatic vegetation (SAV), and bird data to account for information made available since the 2013 Phase IIa EA, as well as to take into account the expansion of the Phase IIa project area. This included obtaining the latest available infrared photography for the expanded Phase IIa project area.
  - Contacting the State Historic Preservation Office (HPO) to determine if the expanded Phase IIa project area includes additional historic resources or contributing features to the Refuge's National Register of Historic Places (NRHP) historic landscape.
- Development of conceptual alignments for a Bridge on New Location Alternative taking into consideration: potential SAV bed locations, natural resource features, minimizing new NC 12 easement in the Refuge, minimizing the bridging of or other impacts to CAMA wetlands, minimizing fill in jurisdictional resources, avoiding direct impacts to contributing historic features in the Refuge, and minimizing impacts to Refuge operations and visitor use of the Refuge.
- Development of conceptual centerline alignments in Pamlico Sound for extending both the Bridge on New Location Alternative alignments and the Bridge within Existing NC 12 Easement Alternative to Oregon Inlet.

- Assessment of the conceptual alignments for a Bridge on New Location Alternative, including the preparation of an assessment report for discussion with the NEPA/Section 404 Merger Team (see Appendix).

- Holding a Merger Team informational meeting on October 19, 2016 to discuss the Phase IIa alternatives study, the conceptual alternatives report, and the conceptual alignments for a Bridge on New Location Alternative.

- Selection of conceptual Bridge on New Location Alternative alignments for preliminary design.

- Preparation of preliminary designs for the selected Bridge on New Location Alternative conceptual alignments (two were selected) and the Bridge within Existing NC 12 Easement Alternative, including construction period traffic maintenance plans. These alternatives are referred to as the Phase IIa study alternatives in the balance of this report.

- Preparation of cost estimates for each Phase IIa study alternative.

- Preparation of a discussion of funding options for the Phase IIa study alternatives.

- Preparation of this Alternatives Analysis Report.

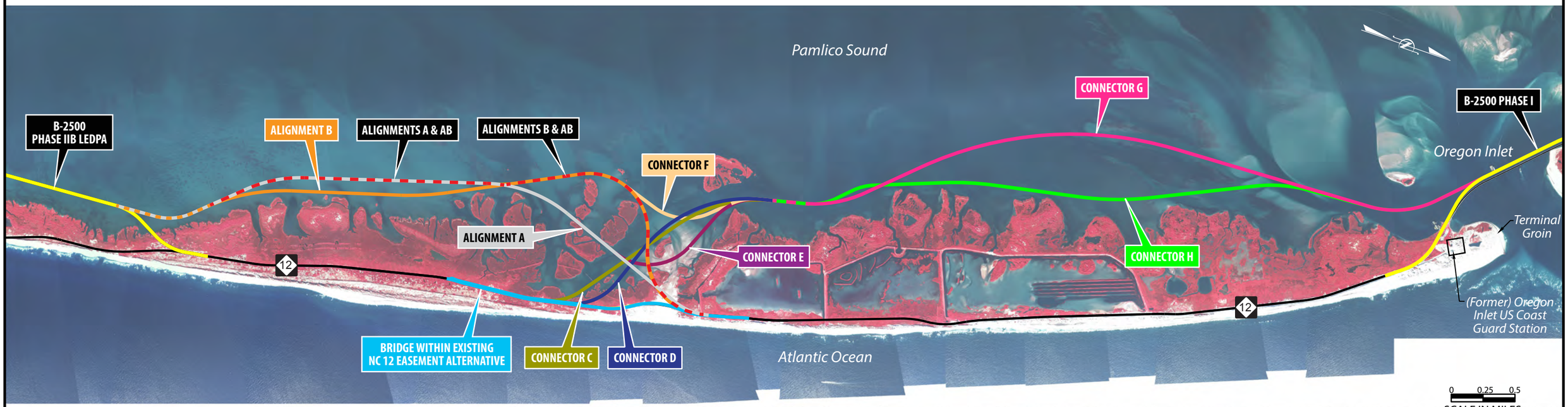
A second Merger Team informational meeting is planned to review the findings of this report.

2.0 Alternatives

2.1 Alternative Development

2.1.1 Conceptual Bridge on New Location Alternative Alignments

The conceptual alignment alternatives for the Bridge on New Location Alternative were developed taking into consideration: potential SAV bed locations, natural resource features, minimizing new NC 12 easement in the Refuge, minimizing the bridging of and impacts to CAMA wetlands, minimizing fill in jurisdictional resources, avoiding direct impacts to contributing historic features in the Refuge, and minimizing impacts to Refuge operations and visitor use of the Refuge. The alignment development criteria and conceptual alignments are presented in the October 2016 conceptual alignment assessment report contained in the Appendix. The conceptual alignments are shown in Figure 3. They were labeled Alignment A, Alignment B, and Alignment AB.



Aerial date: 2016

CONCEPTUAL ALIGNMENTS FOR BRIDGE ON NEW LOCATION ALTERNATIVE AND CONNECTORS TO OREGON INLET

Figure 3

An assessment of the conceptual alternatives was prepared for discussion with the Merger Team (see Appendix). For each Bridge on New Location conceptual alignment it considered:

- Length of bridge over Pamlico Sound and the Refuge
- Length of bridge over SAV, CAMA wetlands, and Pea Island breach overwash
- Acres of wetlands filled
- Proximity to estuarine shoreline
- New NC 12 easement required in the Refuge
- Proximity to marsh islands
- Proximity to pond dikes (the closest historic feature)
- Design speed, minimum horizontal curve, and number of horizontal curves

The assessment of conceptual alternatives (see Appendix) was presented at a Merger Team informational meeting that was held on October 19, 2016. Feedback was requested from the Merger Team on the following topics:

- Do you have any notable concerns with any of the alignments, and what are those concerns?
- What refinements to the alignments do you suggest be examined?
- Are there other alignments you suggest and why?
- What other important environmental issues need to be considered in the alternatives screening?
- Do you have results of studies you have done in this area that would be useful to the alternatives analysis? Are there persons you think the NCDOT study team should contact to learn more about the study area?
- Other observations and comments?

The meeting summary is included in the Appendix. Additional comments were requested by October 31. None were received.

2.1.2 Bridge on New Location Alternative Alignments Selected for Preliminary Design and Assessment

Following the Merger Team informational meeting, the study team held a separate meeting to identify the Phase IIa Bridge on New Location Alternative alignments to be carried forward for preliminary design and agree on refinements to the conceptual alignments. The following was agreed to:

- Elimination of the southern section Alignment B up to its junction with Alignment A because the bridge centerline would be closer than 200 feet from marsh islands. At the Merger Team meeting, the USFWS indicated that they considered the marsh islands to be a part of the Refuge, and the NPS indicated that if the marsh islands were a part of the Refuge, then they had jurisdiction 150 feet from the marsh islands.

- Increasing the radius of the curve at Alignment A's connection with the Phase IIb bridge.

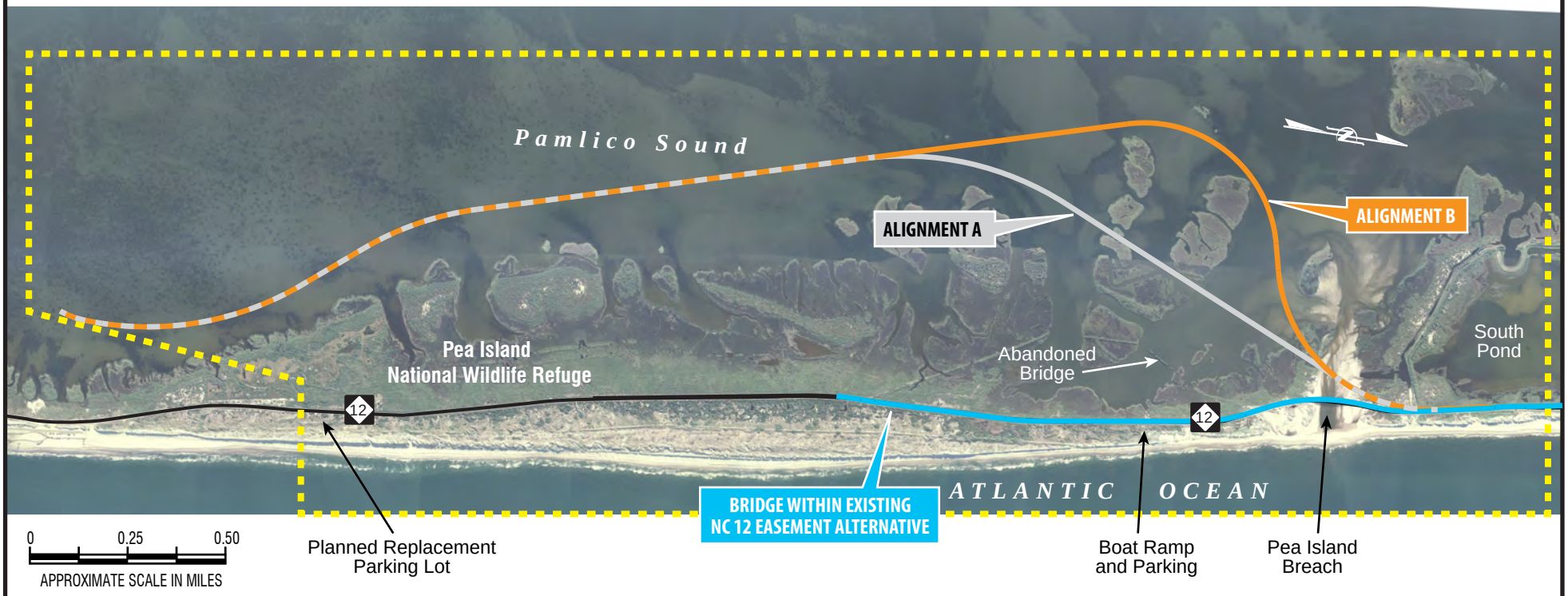
The final alignments were labeled Alignment A and Alignment B and are shown in Figure 4. With the elimination of the southern section of Alignment B, Alignments A and B share a common alignment in the southern section of the project area. This eliminated the need for Alignment AB shown in Figure 3. A preliminary design was developed for Alignments A and B, including plans for maintenance of traffic during construction

2.1.3 Bridge within Existing NC 12 Easement Alternative

The Bridge within Existing NC 12 Easement Alternative is the Selected Alternative in the 2013 Phase IIa ROD. As an alternative that was previously identified as a detailed study alternative by the Merger Team, it also is assessed in this Phase IIa alternatives study. The preliminary design for this alternative was based on a final design developed in 2013. For this alternatives study, that design was revised in the Pea Island breach area to take into account the replacement of the temporary steel bridge (that is on the ocean side of the NC 12 easement) with a new interim concrete bridge (which will be on the sound side of the NC 12 easement) over Pea Island breach. As a result, the full length of the Bridge within Existing NC 12 Easement Alternative bridge is on the ocean side of the NC 12 easement. Plans for maintenance of traffic were revised to take into account the bridge design revisions, placing the entire temporary traffic maintenance road on the sound side of the NC 12 easement. The location of the Bridge within Existing NC 12 Easement Alternative also is shown in Figure 4.

2.1.4 Connectors to Oregon Inlet

To account for the requirement within the settlement agreement that NCDOT and FHWA not design Phase IIa and Phase IIb of the Project so as to preclude the construction of subsequent phases within Pamlico Sound, centerline connectors to the new Oregon Inlet Bridge were developed for the Bridge on New Location Alternative



Aerial date: 2014

Bridge within Existing NC 12 Easement

Bridge on New Location Alternative

Alignment A

Alignment B

Expanded Project Area Boundary

PHASE IIa STUDY ALTERNATIVES

Figure 4

(both alignments) and the Bridge within Existing NC 12 Easement Alternative. They are shown in Figure 3. They were developed using the same criteria as the conceptual alignments for this study's Bridge on New Location Alternative. They demonstrate that all of the Phase IIa study alternatives could be extended in Pamlico Sound to Oregon Inlet. In turn, since all of the Phase IIa study alternatives connect into existing NC 12, all of them also could be extended to Oregon Inlet in the existing NC 12 easement, as well as a surface road on new NC 12 easement, a bridge on new NC 12 easement, and retaining the existing surface road through beach nourishment and dune maintenance. These alternatives on Hatteras Island were those assessed in the 2008 FEIS and the 2010 EA and included in the range of options for implementing Parallel Bridge Corridor/Transportation Management Plan (PBC/TMP) Alternative in phases beyond Phase I. The PBC/TMP Alternative was identified as the Selected Alternative for the Bonner Bridge Replacement Project (B-2500) in its 2010 ROD.

The connectors are labeled C to H. Connectors C and D pass through the immediate Pea Island breach area to bring the Bridge within Existing NC 12 Easement Alternative out into the sound in a potential future phase. Alignment C would create as little new easement in the Refuge as possible, but bridges a part of the remains of a bridge over New Inlet, while Alignment D requires more new NC 12 easement in the Refuge but avoids bridging New Inlet bridge remains. The connectors are 2.1 and 2.2 miles long (as shown on Figure 3). If at the time of such an extension, the connection to the Refuge were removed, approximately 1.2 to 1.1 miles of bridge would be removed. The total bridge added or removed is 3.3 miles.

Connector E brings Bridge on New Location Alternative Alignment A back out into the sound in a potential future phase. The connector is 1.45 miles long. If at the time of such an extension, the connection of Alignment A to the Refuge were removed, 0.86 miles of bridge would be removed. The total bridge added or removed is 2.31 miles.

Connector F brings Bridge on New Location Alternative Alignment B back out into the sound in a potential future phase. The connector is 1.27 miles long. If at the time of such an extension, the connection to the Refuge were removed, 1.29 miles of bridge would be removed. The total bridge added or removed is 2.56 miles.

Connectors G and H illustrate two ways of extending the Phase IIa project north to the new Oregon Inlet bridge while seeking to avoid SAV beds as much as possible. They join the new Oregon Inlet bridge where the superstructure changes from concrete box girders to beams, facilitating constructability, while remaining more than 200 feet from the shoreline.

2.2 Description of Phase IIa Study Alternatives

The Phase IIa study alternatives are shown in Figure 4. All the Phase IIa study alternatives would have the following characteristics:

- Two 12-foot lanes with 8-foot shoulders on the bridge and approach roads, similar to Phases I and IIb of the Bonner Bridge Replacement Project (B-2500). Four feet of the 8-foot shoulder would be paved on the approach road portions. The roadway and the bridge would be located within a 100-foot easement.
- 110- to 120-foot main spans with 60-foot approach spans.
- Pile foundation with a pile cap supporting the spans between the foundations.
- 15.8 feet of clearance under the bridge spans above mean high water (17 feet from zero elevation), as with Phase IIb. The bridge deck would be at an elevation of approximately 25 feet.
- Bicycle safe bridge rail mounted on a 36-inch concrete parapet to partially block headlights that otherwise could affect the success of turtle nesting on the beach.
- Like Phase IIb, runoff would be collected from the ends of a Phase IIa bridge where they end over land and then piped to a riprap apron, which would drain to roadside swales to promote infiltration. Bridge drainage for the main bridge spans would be from deck drains (openings) at the outer edges of the deck. The bridge would be high enough to allow wind to disperse the deck drain discharge before it reaches the ground or inlet surface. Approach roadway runoff would drain into roadside ditches.

2.2.1 Bridge within Existing NC 12 Alternative

The Bridge within Existing NC 12 Easement Alternative (alignment illustrated in Figure 4), would involve building a bridge in the existing NC 12 easement to replace the existing surface road. The total length of this alternative is approximately 2.4 miles. The bridge component, approximately 2.1 miles in length, is designed to account for the potential reopening and migration of the current inlet in the future in that it bridges the entire area considered geologically susceptible to breaches in the Pea Island inlet area. (See Figure 2). It would start near the southern end of the Refuge's South Pond, within the southern portion of the Sandbag Area Hot Spot (see Figure 2), continue to the south past the southern end of the area considered susceptible to breaches in the Pea Island breach area, and end at the northern end of the 2.1-mile section of NC 12 in the southern half of the Refuge that is not expected to be threatened by shoreline erosion prior to 2060

(see Figure 2). The Bridge within Existing NC 12 Easement Alternative would likely encompass the following characteristics unique to the alternative:

- Bridge location on the ocean side of the NC 12 easement. A temporary traffic maintenance road would be built on the sound side of the NC 12 easement. As described in Section 2.1.3, this is a change from the alternative selected in the 2013 Phase IIa ROD. It is the only change.

- Permanent access road within the existing easement between the southern end of the alternative and the Refuge's boat ramp/parking lot.

- Approach fills at each end of the bridge (including an approximately 580-foot-long fill section at the south end of the bridge and a 687-foot-long fill section at the north end) with the fill held by a retaining wall where needed to keep approach fills within the NC 12 easement.

- Construction activity would be primarily confined to the existing NC 12 easement, including a temporary traffic maintenance road. However, approximately 0.8 acres of temporary construction easement would be needed to construct Phase IIa. A narrow (5 feet or less) temporary construction easement is included for approximately 680 feet of the alternative on at least one side of the existing NC 12 easement, and on both sides in four locations for short distances. The purpose of this narrow easement would be primarily to provide room for construction workers to erect erosion control measures (fencing) along the edge of the existing NC 12 easement. Pile jetting pipe easements likely would be placed between NC 12 and the Pamlico Sound on 10-foot wide temporary easements.

2.2.2 Bridge on New Location Alternative

The Bridge on New Location Alternative (two alignments illustrated in Figure 4), would involve leaving existing NC 12 easement within the Refuge at a point nearing the southern end of South Pond. It would follow the Pamlico Sound shoreline until connecting at its south end with the Phase IIb Bridge on New Location Alternative selected for implementation in the 2016 Phase IIb ROD. Alignment A is approximately 5.14 miles long. Alignment B is approximately 5.5 miles long. The alignments are designed such that NC 12 is on a bridge when it leaves the existing easement in the Refuge at their north ends. The bridge is approximately 5.05 miles long with Alignment A and approximately 5.4 miles long with Alignment B. This alternative would bypass the area within the expanded Phase IIa project area considered geologically susceptible to breaches. This alternative also would bypass the 2.1 miles of NC 12 within the expanded Phase IIa project area that would not be affected by shoreline erosion through 2060 and is not of geologically susceptible to breaching. The designs of the Bridge on

New Location Alternative alignments assume the following characteristics unique to the alternative:

- A 475-foot-long approach fill section that would include a retaining wall where needed to keep approach fills within the existing NC 12 easement.
- Approximately 4.3 miles of existing NC 12 pavement within the Refuge would be removed and that portion of the transportation easement would be returned to the Refuge. The Phase IIb bridge connection to the Refuge would be removed. The option of retaining, as a Refuge owned and maintained road, the Phase IIb bridge connection to the Refuge, as well as the pavement along a portion of the 4.3 miles of the NC 12 existing easement returned to the Refuge, is discussed in Section 5.3.2.
- Construction activity would be primarily confined to the existing or new easement. A temporary construction easement would be needed for a temporary traffic maintenance road to take traffic around the northern bridge approach. This temporary easement would be approximately 0.26 acre in size.

3.0 Cost and Funding Alternatives

3.1 Cost

Costs for the Phase IIa study alternatives are shown in Table 1. The Bridge on New Location Alternative would cost approximately 2.5 to 2.7 times as much as the Bridge within Existing NC 12 Easement Alternative for two primary reasons. First, the Bridge on New Location alignments are substantially longer, 5.1 and 5.5 miles long versus 2.4 miles long. The Bridge within Existing NC 12 Easement Alternative is shorter because 2.1 miles of NC 12 not threatened by shoreline erosion through 2060 or geologically susceptible to breaching is retained. Second, building a bridge in the sound is more expensive, requiring a temporary work bridge to transport bridge components to the work site and erecting the bridge. This can be done from the ground with the Bridge within Existing NC 12 Easement Alternative.

3.2 Project Finance Options and Analysis

3.2.1 Highway Program Funding Sources

NCDOT's State Fiscal Year (SFY) 2016-17 transportation program budget was $4.7 billion. The funding sources include Motor Fuel Taxes comprising 38.1 percent of the total funding. Other sources of funding include 26.9 percent from Federal Funds, 15.1 percent in Highway Use Taxes, 11.6 percent from Department of Motor Vehicles (DMV) registrations, and 8.3 percent from licenses, title fees, and other funding sources.

Table 1. Phase IIa Study Alternatives Cost

Type of Cost	Bridge within Existing NC 12 Easement Alternative
Construction	$99,300,000
Right-of-Way	$0.0
Utilities[1]	$0.0
TOTAL	$99,300,000
Type of Cost	**Bridge on New Location Alternative—Alignment A**
Construction	$250,100,000
Right-of-Way	$0.0
Utilities[1]	$0.0
TOTAL	$250,100,000
Type of Cost	**Bridge on New Location Alternative—Alignment B**
Construction	$267,300,000
Right-of-Way	$0.0
Utilities[1]	$0.0
TOTAL	$267,300,000

[1]NCDOT pays utility relocation costs when its projects directly affect utilities outside NCDOT's existing right-of-way or directly affect utilities within NCDOT's existing right-of-way where the utility's easement rights pre-date NCDOT's right-of-way ownership.

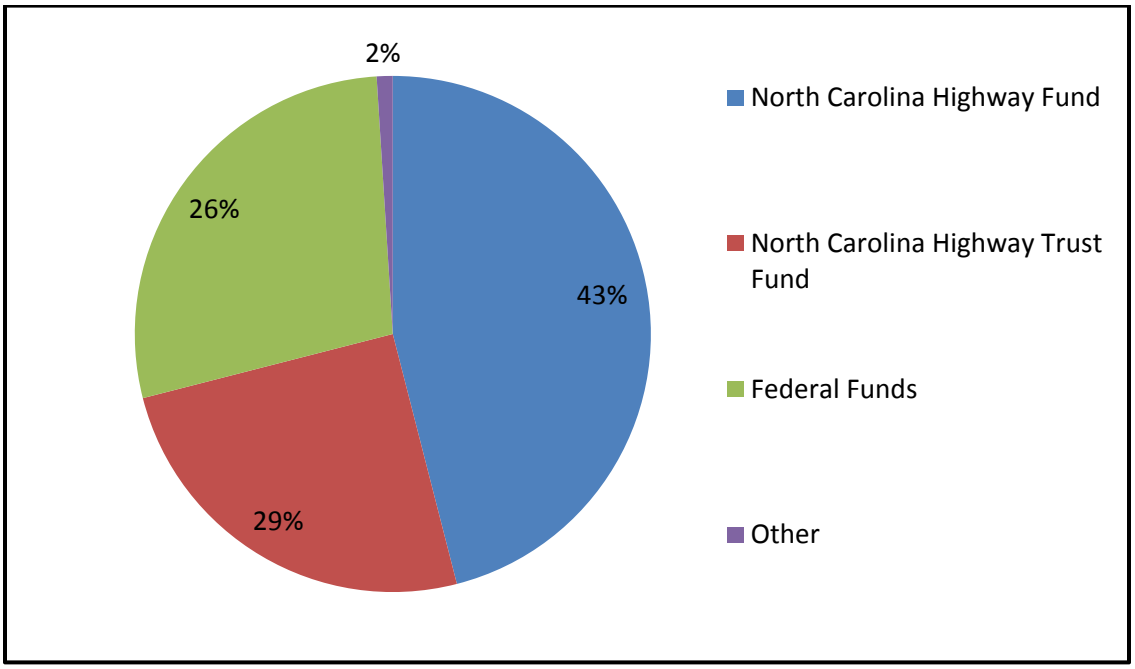
The funding generated from the Motor Fuel Taxes and DMV fees are distributed to both the NC Highway Fund and the NC Highway Trust fund based on legislatively mandated splits. The Highway Use Tax goes entirely to the NC Highway Trust Fund. The resulting breakdown of funds is shown in Figure 5.

These general categories of funding are described in more detail below.

3.2.2 Federal Funding Programs

Federal funds include federal highway dollars, general fund dollars, and other funds that go towards transit, rail, and airport projects. There are several programs or sources through which federal funding is available: National Highway Performance Program (NHPP) makes up 55 percent of federal funding; the Surface Transportation Block Grant Program (STBG) makes up 26 percent of federal funding; and the Highway Safety Improvement Program (HSIP) makes up 6 percent of federal funding. Other programs include the National Highway Freight Program (NHFP) (3 percent). Congestion Mitigation and Air Quality (CMAQ) (5 percent), and various other federal funding programs (5 percent). These programs and the eligibility of a Phase IIa project to use these funds are described below. Phase IIa is **eligible** for NHPP, STBG, and Federal

Figure 5. NCDOT Transportation Program Funding Sources



Lands Access Program (FLAP) funding. Several of these funding sources are subject to the STIP programming process described below in Section 3.2.4.

National Highway Performance Program

The NHPP funding provides support for the condition and performance of the National Highway System (NHS), for the construction of new facilities on the NHS, and to ensure that investments of federal-aid funds in highway construction are directed to support progress toward the achievement of performance targets established in a state's asset management plan for the NHS. Phase IIa is **eligible** for this funding source.

Surface Transportation Block Grant Program

The STBG program has many sub-categories each with different rules. The major sub-categories are Off-System Bridge Program (funds restricted to bridges located off the federal-aid system), Urban/Direct Attributable (funds restricted to urbanized areas), and Non-Urban/Any Area (fund allocation subject to prioritization). Phase IIa is **not eligible** for funds in the Off-System Bridge Program or Urban/Direct Attributable categories; however, it is **eligible** for Non-Urban/Any Area funding.

Highway Safety Improvement Program

The Fixing America's Surface Transportation (FAST) Act continues the Highway Safety Improvement Program (HSIP) to achieve a significant reduction in traffic fatalities and serious injuries on all public roads, including non-state-owned public roads and roads on tribal lands. The HSIP requires a data-driven, strategic approach to improving

highway safety on all public roads that focuses on performance. Phase IIa is **not eligible** for this funding source.

National Highway Freight Program

The National Highway Freight Program (NHFP) is a new formula program to improve efficient movement of freight on the National Highway Freight Network (NHFN). Phase IIa is **not eligible** for this funding source.

Congestion, Mitigation and Air Quality

CMAQ program provides a flexible funding source to state and local governments for transportation projects and programs to help meet the requirements of the Clean Air Act. Funding is available to reduce congestion and improve air quality for areas that do not meet the National Ambient Air Quality Standards (NAAQS) for ozone, carbon monoxide, or particulate matter (nonattainment areas) and for former nonattainment areas that are now in compliance (maintenance areas). Phase IIa is **not eligible** for this funding source. Dare County is a NAAQS attainment area.

Ferry Boat Program (FB)

The Ferry Boat Program funds the construction of ferry boats and ferry terminal facilities. The Phase IIa alternatives considered in this report do not involve ferry service and are **not eligible** for this funding source.

Federal Lands Access Program

FLAP provides funds for projects on Federal Lands Access Transportation Facilities that are on or adjacent to, or that provide access to federal lands. Phase IIa is **eligible** for this funding source but it is a competitive grant process and the funding is small.

Transportation Alternatives (TAP)

TAP funds encompass a variety of smaller-scale transportation projects such as pedestrian and bicycle facilities, recreational trails, safe routes to school projects, community improvements such as historic preservation and vegetation management, and environmental mitigation related to stormwater and habitat connectivity. Phase IIa is **not eligible** for this funding source.

3.2.3 State Funding Programs

North Carolina Highway Trust Fund

The North Carolina Highway Trust Fund (N.C. Gen. Stat. Chap. 136-176) is made up of funding from state gas tax, motor vehicle use tax, and certain fees. These are for NCDOT to fund projects in the State Transportation Improvement Program (STIP) that are selected through the Transportation Investment Strategy Formula (N.C. Gen. Stat. 136-189.11). In addition, this source of funds may be used to match federal-aid projects that are selected through the Transportation Investment Strategy Formula prioritization process described in Section 3.2.4. Phase IIa is **eligible** for this funding source.

North Carolina Highway Fund

The Highway Fund is made up of funding from state gas tax, motor vehicle registration fees, and title fees. These funds are for use on highway construction and maintenance, the State Highway Patrol, the Division of Motor Vehicles, public transportation, and rail programs. The General Assembly determines how the Highway Fund is used, including which construction projects can use monies from the fund. Construction is not an eligible expense from the Highway Fund; however, future maintenance of a new facility constructed in the Phase IIa project area would use monies from this funding source.

3.2.4 State Transportation Improvement Plan – Programming

The STIP, as described in N.C. Gen. Stat. § 143B-350(f)(4), is a schedule – approved by the North Carolina Board of Transportation – of all major transportation improvement projects and their anticipated cost. The schedule is updated every two years based on a data-driven process called Strategic Transportation Investments (STI), as well as the latest state and federal financial situation, and the status of preconstruction activities. Passed in 2013, the STI Law allows NCDOT to use its funding more efficiently and effectively to enhance the state's infrastructure, while supporting economic growth, job creation, and a higher quality of life.

STI established the Transportation Investment Strategy Formula in N.C. Gen. Stat. § 136-189.11, which allocates available revenues based on data-driven scoring and local input. Through the process, called "Prioritization," potential transportation improvement projects are submitted to NCDOT to be scored and ranked through the formula at the statewide, regional and division levels, based on approved criteria such as safety, congestion, benefit-cost, and local priorities. These scores and other factors are used to determine whether a project receives funding. The funding for the different categories is as follows: 40 percent Statewide, 30 percent Regional, and 30 percent Division. Phase IIa is located on NC 12 and is eligible to compete in the Regional Category. The formula does allow a project to compete in a lower category, so this project can also compete in the Division Category. Phase IIa is not eligible to compete in the Statewide Category.

The replacement of Bonner Bridge (B-2500), the construction of a bridge at the Pea Island breach (B-2500A), and at Rodanthe (B-2500B) were all considered "Transition Projects" when the STI law passed and did not have to compete in a prioritization process. The replacement of the Bonner Bridge and the construction of an interim Pea Island breach bridge are currently under construction. The construction of a permanent Pea Island breach bridge was halted as the result of the April 2015 settlement agreement with the Defenders of Wildlife and the National Wildlife Refuge Association, collectively represented by the Southern Environmental Law Center. The decision to build the interim bridge rather than the permanent bridge reduced the contract cost of the Phase IIa bridge from approximately $79.6 million to $14.2 million. NCDOT, however, spent $22 million on the permanent Phase IIa bridge selected in the 2013 Phase IIa ROD, including project costs prior to cancelation and costs associated with demobilization by

the contractor and restoration of the NC 12 easement to its original condition. In addition, NCDOT spent an additional $34.5 million on the Bonner Bridge replacement (Phase I) contract because of the length of time between awarding the contract and actually beginning construction. The remaining approximately $8.9 million of the $79.6 million will go back into the state transportation budget and will be used for other projects. Since these projects were transition projects and did not count against Division 1 in allocating funds statewide, Division 1 cannot use the $8.9 million on Division 1 projects.

The amount of money available for any given STIP cycle is estimated based on an annual reassessment of available federal and state revenues. Based on revenues received to date and the constraints attached to each federal and state funding source, NCDOT forecasts how much revenue will be available for the next ten years. This is a consensus forecast developed in conjunction with the North Carolina Office of State Budget and Management.

Based upon the amount of revenue projected to be available to NCDOT, it is estimated that $7.673 billion will be available to NCDOT for the years 2018 to 2027, the next STIP cycle. This amount is, however, a draft projection and is subject to change based on actual collected revenues. The proposed Draft STIP was released in January 2017 and is out for public review and comment. The Board of Transportation will be asked to approve the 2018 to 2027 STIP in the summer of 2017. It includes no funding for Bonner Bridge Replacement phases beyond the Bonner Bridge Replacement (B-2500), the Phase IIa interim bridge over Pea Island breach, and Phase IIb at Rodanthe.

3.2.5 Highway Appropriation and Cash Flow Management

Appropriations made for transportation projects are subject to provisions in federal and state law and budget acts. Per NC Gen. Stat. § 143C-6-11, Transportation Project funds shall be budgeted, expended, and accounted for on a "cash flow" basis. Though NCDOT can estimate the amount available for any given STIP cycle, the entire amount is not provided to NCDOT at the beginning of that cycle. Instead, NCDOT receives a portion of the total STIP appropriation annually, based on total revenues collected. To manage transportation projects on a cash-flow basis, NCDOT has established management controls, as well as financial reports supported by statistical models, that allow NCDOT to estimate the cash that will be available each year of the STIP cycle. Transportation project contracts are planned and limited so that payments due at any given time will not exceed the cash available to pay them. Therefore, if a new project is introduced on the STIP (e.g. such as a permanent Phase IIa project), or if a current STIP project is found to cost more than previously estimated, NCDOT may not only have to delay projects in that particular Division, but also on a statewide basis in order to maintain enough cash to fund the increased project cost.

3.2.6 Alternative Financing

FHWA and NCDOT previously discussed other financing options and their applicability to STIP Project B-2500 in the October 2009 Revised Final Section 4(f) Evaluation. The Alternative financing issues with Phase IIa would be similar. As discussed in the 2009 evaluation, the General Assembly requires that, in order to convert an existing route to a toll facility, a free alternative route must be available. NC 12 from Bodie Island is currently the only free route available to access Hatteras Island. Further, a toll analysis conducted by NCDOT concluded that toll revenues would not support the debt service of required bonds.

Other financing and loan programs, such as Public-Private Partnerships, Transportation Infrastructure Finance and Innovation Act (TIFIA) loans, and others, require a project to have an outside stream of revenue in order to guarantee a return on investment. As the project will not be tolled, bonds would have to be issued against future state revenues, which would require a statewide public referendum. In the past, the state has been able to issue similar bonds for programmatic-level transportation efforts across the state, but not for a single project. When a long-term Phase IIa project is listed in the STIP during a future prioritization process, NCDOT would explore financing such as GARVEE Bonds to allow NCDOT to spread highway program funding for the project over a long period to ensure that NCDOT can afford the project.

4.0 Existing Conditions

This section summarizes and updates affected environment information for the expanded Phase IIa project area relevant to the consideration of the environmental impacts of the Phase IIa study alternatives in Section 5.0. Topics covered are:

- Topography
- Visual Characteristics
- Cultural Resources
- Park and Recreation/Wildlife Refuge
- Floodplains
- Coastal Conditions
- Natural Systems
- Utilities

4.1 Topography

The topography in the expanded Phase IIa project area is generally flat at 2 to 3 feet in elevation. The highest elevations are the dunes that parallel the shoreline (generally ranging from 10 to 20 feet) and the dike around South Pond (7 to 8 feet). NC 12 is generally at an elevation of 3 feet except where it rises to approximately 6 feet to meet the temporary bridge over the Pea Island breach.

4.2 Visual Characteristics

The entire Refuge, and in turn the entire expanded Phase IIa project area, is a visually sensitive resource from the perspectives of its natural character, its uniqueness as an undeveloped barrier island and the designation of NC 12 through the Refuge as a Scenic Byway by the NCDOT.

Views in the Refuge have a generally consistent character, which is mostly of natural features with expansive wetlands to the west towards Pamlico Sound and of vegetated dunes to the east towards the Atlantic Ocean. Human-made features in the expanded Phase II project area are the southern end of South Pond and its dikes, the dunes between NC 12 and the ocean, a boat ramp with parking, and an additional parking lot being built as a part of the Phase IIb project. The remnants of a bridge over the former New Inlet is visible from NC 12.

Within the expanded Phase IIa project area, the land is generally flat on the west side of NC 12, with small brush and some views of the backwater creeks that wind between the smaller islands between Pamlico Sound and Hatteras Island. Pamlico Sound is seldom visible from NC 12. The Atlantic Ocean also is not visible in most places from NC 12 because of dunes. The Pea Island breach area is generally flat and not vegetated from the ocean to the sound.

Viewers include visitors stopping and participating in recreational activities within the Refuge, as well as the users of NC 12. NC 12 is generally visible while people participate in recreational activities such as birding, fishing, surfing and boating. Individuals participating in activities on the beach generally do not have views of NC 12, but only of the dunes that lie between NC 12 and the Atlantic Ocean. The longest distance views in the Refuge are generally from the top of these dunes.

4.3 Cultural Resources

Section 106 of the National Historic Preservation Act of 1966 as amended (16 USC 470f) affords consideration of those properties that are listed or eligible for listing on the NRHP.

4.3.1 Pea Island National Wildlife Refuge Historic Landscape

The Refuge is eligible for inclusion in the NRHP under Criterion A of the National Historic Preservation Act of 1966, as amended, in the areas of conservation and social history. A letter dated September 17, 2003 from the North Carolina State Historic Preservation Office (HPO) affirms this finding (see Appendix A in the 2008 FEIS). The Refuge is the only NRHP-eligible historic resource in the expanded Phase IIa project area. There are no NRHP-listed historic resources in the expanded Phase IIa project area.

The federal government established the Refuge in 1938 within the Cape Hatteras National Seashore. The Refuge is an outstanding example of the national wildlife refuges that arose during the early twentieth century. With its manmade dikes and dunes, the Refuge also illustrates the efforts of the Civilian Conservation Corps (CCC) on the Outer Banks to protect and revitalize natural resources. The US Congress established the CCC in 1933 during the Great Depression to employ young men in the conservation and development of natural resources. The HPO confirmed in October 2016 that there has been no change in the NRHP status of the Refuge and dikes around the ponds, as well as the dune system. These features are still among the contributing elements that must be considered as eligible for the NRHP.

Remnants of three wooden bridges that had been connected to a sand footpath/roadway are found in the expanded Phase IIa project area. The bridges were built in 1935 or shortly thereafter. Investigations were made by NCDOT that complied with the requirements of Section 106 of the National Historic Preservation Act of 1966, as amended, other state and federal regulations, and NCDOT's current *Historic Architecture Group Procedures and Work Products and the North Carolina Historic Preservation Office's Report Standards for Historic Structure Survey Reports/Determinations of Eligibility/ Section 106/110 Compliance Reports in North Carolina*. The survey report recommended that the bridges and roadway are not eligible for NRHP listing, either as individual resources or as contributing resources within the NRHP-eligible Refuge or any other potential historic district, because of their loss of integrity. The survey report has been submitted to the HPO. The HPO concurred with survey findings in a February 7 letter to NCDOT.

4.3.2 Archaeological Resources

Past background research found that the North Carolina Office of State Archaeology site files contain no record of terrestrial cultural resources in the Bonner Bridge Replacement Project (B-2500) project area, which includes the expanded Phase IIa project area. The environment of the Outer Banks provides little of the stability necessary for good terrestrial archaeological preservation. Thus, the potential for significant archaeological properties in the Refuge was low. The HPO concurred that no additional terrestrial archaeological work was warranted beyond the background research because the potential for archaeological resources eligible for the NRHP in the Refuge is minimal (see 2008 FEIS Section 3.4.2.1 and a 2005 HPO letter in 2008 FEIS Appendix A).

For the Phase IIa Bridge on New Location Alternative corridor, an underwater archaeological survey was conducted in the Pamlico Sound. A comprehensive remote sensing survey was conducted between February 28 and May 26, 2016. The survey utilized a magnetometer, sidescan sonar, and subbottom profiler. Forty anomalies and 11 sonar targets were recorded in the Phase IIa Bridge on New Location Alternative corridor; however, no anomalies or targets were determined to be significant (Panamerican Consultants, Inc., September 2016). A review of the subbottom data did not detect any buried paleofeatures that would have the potential to contain submerged prehistoric sites.

A portion of the Phase IIa Bridge on New Location Alternative corridor could not be surveyed because Pamlico Sound was too shallow. Panamerican concluded that a survey of this area is not likely to be required based on the HPO's conclusions related to terrestrial archaeology that were described in the first paragraph of this section. The State Historic Preservation Office concurred with the findings of Panamerican's report in a letter dated October 27, 2016.

The Bridge on New Location Alternative Alignment A briefly passes outside the survey area established for the underwater archaeological survey in the area it passes across the marsh islands as it approaches its northern terminus. If Alignment A were to be pursued as an alternative to be considered in future environmental documentation, additional underwater archaeology surveys could be needed. At this time, it is assumed that like the area surveyed, no significant anomalies or targets or buried paleofeatures are likely to be found.

4.4 Park and Recreation/Wildlife Refuge

4.4.1 Cape Hatteras National Seashore

The Cape Hatteras National Seashore (Seashore) stretches north to south across three islands: Bodie, Hatteras, and Ocracoke. The Seashore contains 30,319 acres of land and 70 miles of open, virtually unspoiled beach. The State of North Carolina donated approximately 10,000 acres of the Seashore's land in 1937. The characteristics of the Seashore are described in detail in Section 3.5.1 of the 2008 FEIS.

The Seashore is a park and recreation area that is owned by the federal government and administered by the NPS. The Seashore boundary on Hatteras Island, between Oregon Inlet and Rodanthe, extends to the mean low water mark along the ocean-side and extends 150 feet from the shoreline into Pamlico Sound on the sound side. The shoreline includes the marsh islands just west of Hatteras Island. The NPS and the USFWS share management duties where the boundaries of the Seashore overlap with those of the Refuge at the northern end of Hatteras Island. Within the Refuge, the NPS is responsible for visitors and visitor facilities, while the USFWS is responsible for wildlife management.

The *General Management Plan and Amended Environmental Assessment for Cape Hatteras National Seashore* (NPS, 1984) and the *Draft Revised Statement for Management* (NPS, 1991) serve as the current NPS plans for the Seashore (see 2008 FEIS Section 3.1.3.3 for additional detail). These plans focus on restoration and maintenance of existing facilities. The *Cape Hatteras National Seashore Long-Range Interpretive Plan* (September, 2007) provides a vision for the future of interpretation at the Seashore (see 2008 FEIS Section 3.1.3.3). The plan includes goals related to improving personal services and visitor facilities, but none of the visitor facilities referenced for improvement are in the expanded Phase IIa project area.

4.4.2 Pea Island National Wildlife Refuge

The Refuge is within the Seashore on Hatteras Island north of Rodanthe. The primary purpose of the Refuge is to serve as a refuge and breeding ground for migratory birds and other wildlife. The Refuge is comprised of ocean beach, dunes, upland, fresh and brackish water ponds, salt flats, and salt marsh. The objectives of the Refuge are to:

- Provide nesting, resting, and wintering habitat for migratory birds, including the greater snow geese and other migratory waterfowl, shorebirds, wading birds, raptors, and neotropical migrants.

- Provide habitat and protection for endangered and threatened species, such as Loggerhead sea turtles.

- Provide opportunities for public enjoyment of wildlife and wildlands resources. (Pea Island National Wildlife Refuge web site, February 10, 2016.)

As noted in Section 4.3.1, the Refuge also is a significant historic site eligible for inclusion in the NRHP.

The boundaries of the Refuge within the expanded Phase IIa project area are the estuarine shoreline, including the marsh islands immediately west of Hatteras Island. Proclamation Boundary Waters also were established in 1938 around the Refuge but are not a part of the Refuge. This is an area that extends into Pamlico Sound to protect migratory birds from hunters in areas adjacent to the Refuge. The Pamlico Sound portion of the expanded Phase IIa project area is within the Proclamation Boundary Waters. The characteristics of the Refuge are described in detail in Section 3.5.2 of the 2008 FEIS.

The USFWS prepared a *Pea Island National Wildlife Refuge Comprehensive Conservation Plan* (USFWS, 2006) to guide the management of the Refuge. The plan, which was published in September 2006, outlines programs and corresponding resource needs for the proceeding 15 years, as mandated by the National Wildlife Refuge System Improvement Act of 1997. The purpose of the plan is to identify the role that the Refuge will play in support of the mission of the National Wildlife Refuge System and to

provide long-term guidance to the Refuge's management programs and activities (see Section 3.1.3.4 of the 2008 FEIS for addition details).

The Refuge is comprised of ocean beach, dunes, upland, fresh and brackish water ponds, salt flats, and salt marsh. Its bird list boasts more than 365 species; the wildlife list has 25 species of mammals, 24 species of reptiles, and 5 species (low number because of salt environment) of amphibians. (Pea Island National Wildlife Refuge web site, December 7, 2016). Information on biotic communities, wetlands, wildlife, birds, and protected species in the expanded Phase IIa project area within the Refuge are presented in Section 4.7, as well as Section 4.7 of the 2008 FEIS and Section 4.1 of the 2013 Phase IIa EA.

4.5 Floodplains

The entire expanded Phase IIa project area is within flood zones mapped by the Federal Emergency Management Agency (FEMA) under the National Flood Insurance Program. As shown in Figure 6, the Atlantic Ocean shoreline for the length of the expanded Phase IIa project area is a velocity hazard (VE zone). The portion of the expanded Phase IIa project area in Pamlico Sound also is in a VE zone from the southern boundary of the expanded Phase IIa project area to marsh islands in Pamlico Sound just south of the Pea Island breach.

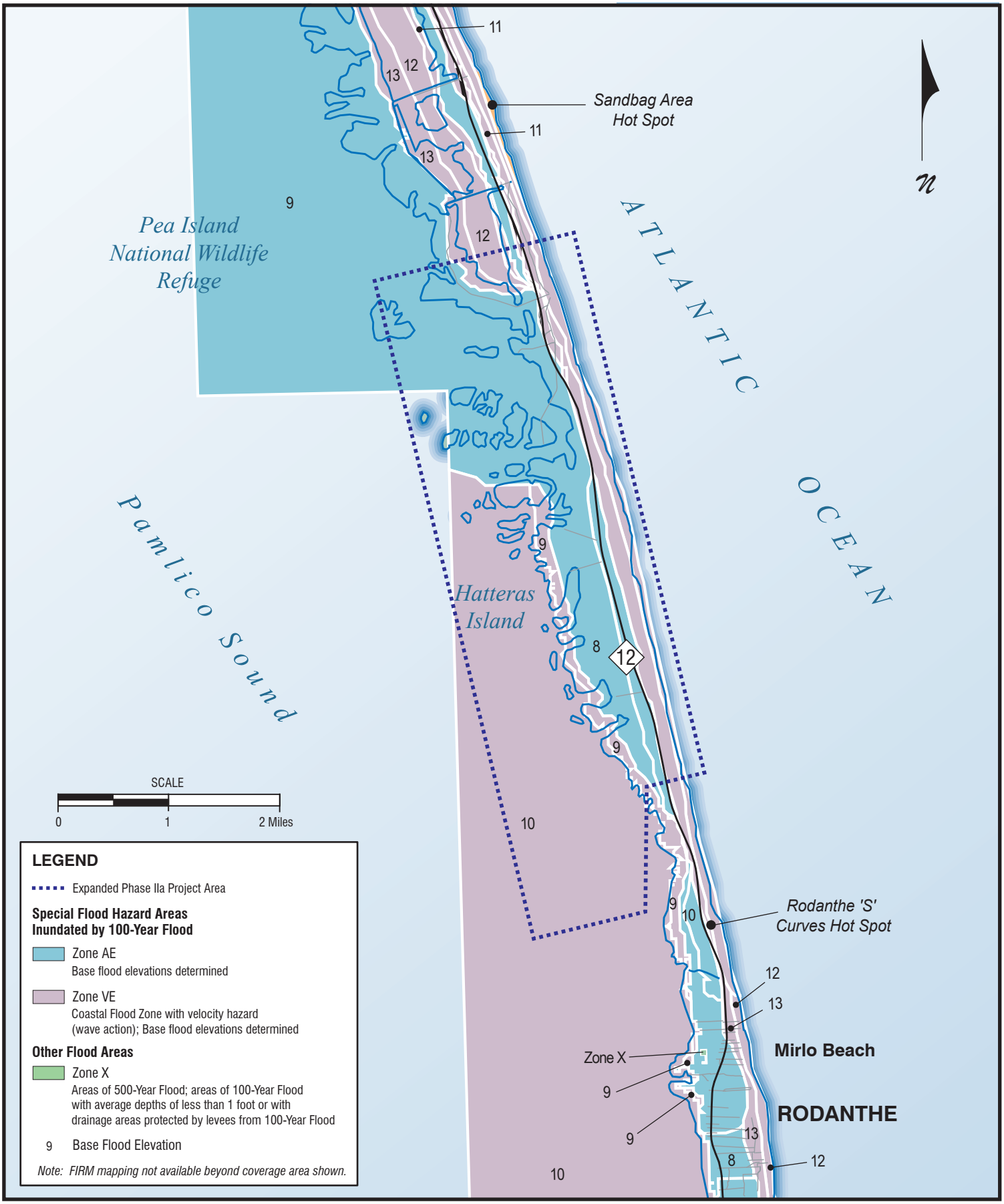
The expanded Phase IIa project area is subject to coastal flooding caused by both hurricanes in the summer and fall months and nor'easters in the winter and spring, both of which can raise water levels substantially via storm surge. The tidal surge comes into shore with the storm, and then begins to retreat almost immediately once the storm moves on. See Section 3.6.1 in the 2008 FEIS for further explanation of tidal flood processes and the benefits of coastal floodplains.

4.6 Coastal Conditions

Existing coastal conditions for the entire Phase II project area are described in Section 3.6 of the 2008 FEIS. Changes since 2009 are related to the formation of the Pea Island breach (and its subsequent closure) and revised shoreline erosion forecasts that were described in the 2013 Phase IIa EA and the 2016 Revised Phase IIb EA.

In the 2010 ROD, a component of the Selected Alternative for the Bonner Bridge Replacement Project (B-2500) is a detailed coastal monitoring program designed to assist the agencies in deciding when the planning efforts for future phases of B-2500 should begin. The coastal monitoring program includes detailed annual monitoring reports that summarize data collected by NCDOT and other agencies. The current update report is: *Coastal Monitoring Program, NC 12 Transportation Management Plan, TIP Project B-2500, 2014 Update Report* (Overton 2015).

The following sections address Atlantic Ocean shoreline erosion, accelerated sea level rise, potential for island breaches, and NC 12 vulnerability to coastal processes.



Source: Flood Insurance Rate Maps dated September 20, 2006.

FLOODPLAINS

Figure 6

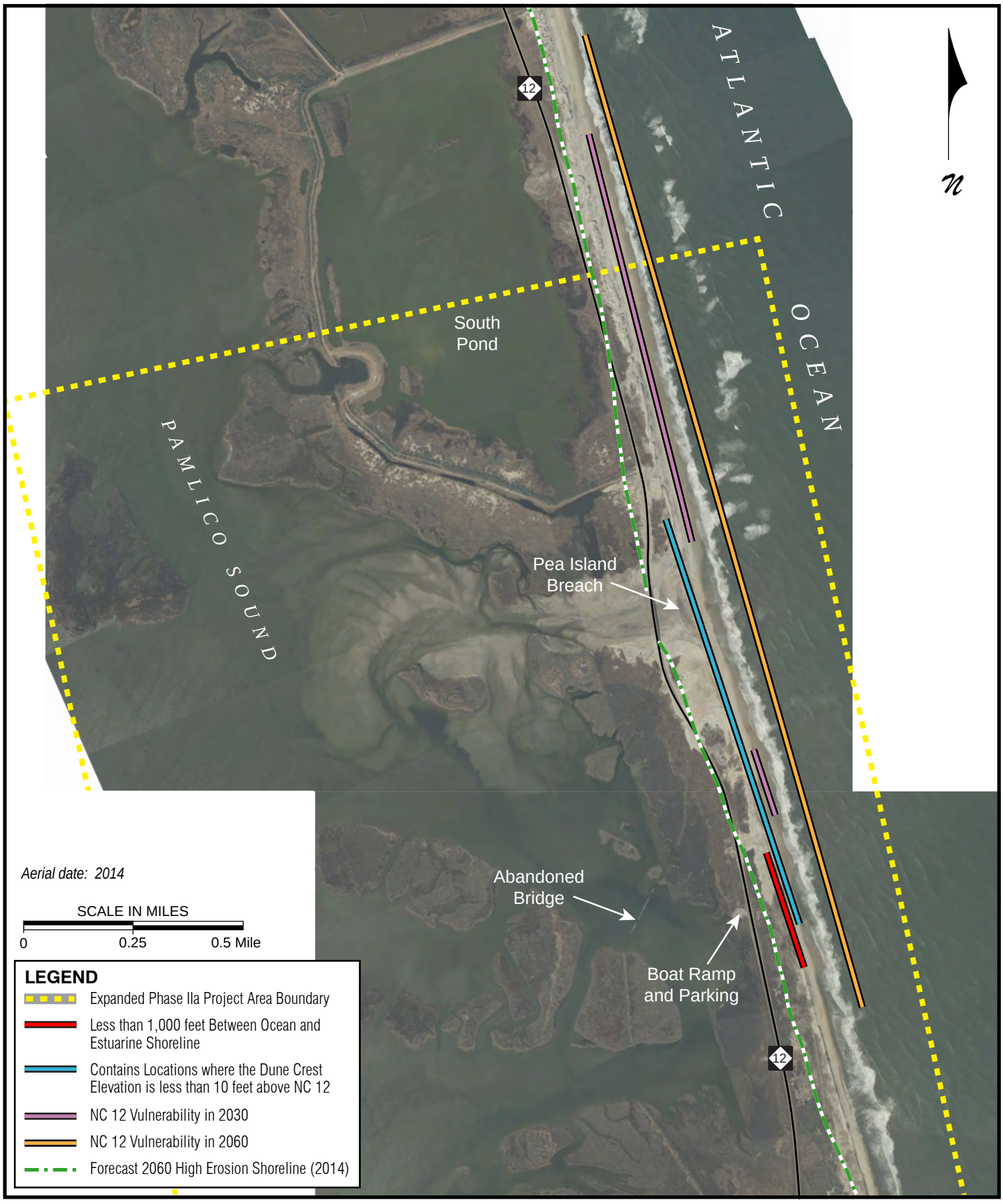
4.6.1 Atlantic Ocean Shoreline Erosion

Many decisions related to improvements to NC 12 have been based on a forecast 2060 high-erosion shoreline from Oregon Inlet to Rodanthe. The 2060 high-erosion shoreline forecast was updated in 2012 using shoreline change data through the end of 2011 and was discussed in Section 4.1.2.6 of the Phase IIa EA. Since then, two new shoreline forecasts have been generated, one using 2012 erosion data (see Appendix D of the 2013 Phase IIb EA) and a 2014 shoreline forecast in the 2016 Revised Phase IIb EA. The 2060 high erosion shoreline developed from 2014 coastal monitoring program data is shown in Figure 7.

4.6.2 Accelerated Sea Level Rise

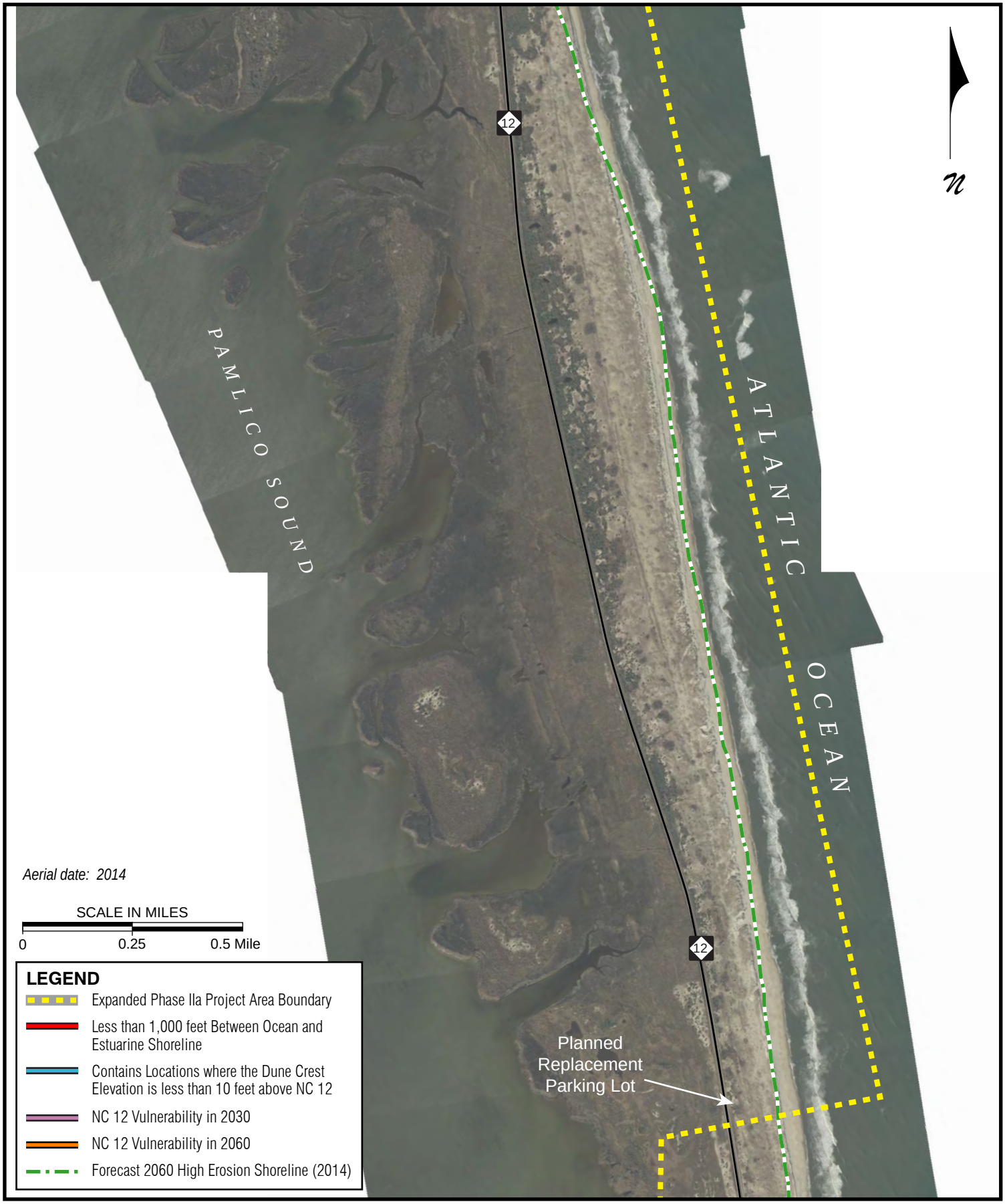
As described in Section 3.6.3.3 of the 2008 FEIS, the potential for shoreline change because of accelerated sea level rise along the Mid-Atlantic region was reported by Gutierrez et al (2007) using four scenarios. The time frame was defined in that report as long-term, or up through the end of this century (i.e., 2100). Gutierrez's report said that for its scenario 2 it is "virtually certain" morphological change such as overwash, erosion and inlet formation will continue, and that it is "very likely" that portions of the barriers will exhibit "threshold behavior." Indicators of threshold behavior are "a) rapid landward recession of the ocean shoreline, b) decrease in barrier width and height, c) increased overwash during storms, d) increased barrier breaching and inlet formation, and e) chronic loss of beach and dune sand volume." Scenario 2 assumes the 20th century rate of sea level rise plus 0.08 inches per year.

The 2015 update to the *North Carolina Sea Level Rise Assessment Report* (NC Coastal Resources Commission Science Panel, 2015) found that the relative sea level rise at Oregon Inlet using tide gauge projections was a mean of 4.3 inches over 30 years or an average of 0.14 inches per year. Since tide gauges only measure past sea levels, the Science Panel used the most recent report of the Intergovernmental Panel on Climate Change (IPCC) to provide scenario-based global sea level rise projections. The scenarios chosen to model sea level rise over the next 30 years were the IPCC's low greenhouse gas emissions scenario (Representative Concentration Pathway [RCP] 2.6) and the high greenhouse gas emissions scenario (RCP 8.5), as all other scenario projections fall within the range of these two. RCPs are greenhouse gas concentration trajectories. These scenarios are used in climate modeling and research and represent possible climate futures depending on the amounts of greenhouse gases emitted in the years to come. These values were combined with rates of vertical land movement (subsidence) determined by an analysis of tide gauge records and provided by the Nation Oceanic and Atmospheric Administration to develop a range of values across the North Carolina coast. For the RCP 2.6 scenario the relative sea level rise at Oregon Inlet was a mean of 6.3 inches over 30 years or an average of 0.21 inches per year. This represents an increase from tidal gauge projections of 0.07 inches per year, similar to the 0.08 inches of Gutierrez's Scenario 2. For the RCP 8.5 scenario the relative sea level rise at Oregon Inlet was a mean of 7.3 inches over 30 years or an average of 0.24 inches per year. This



NC 12 VULNERABILITY

Figure 7a



NC 12 VULNERABILITY

Figure 7b

represents an increase from tidal gauge projections of 0.10 inches per year. The mean of 7.3 inches included a high rate at Oregon Inlet of 9.9 inches over 30 years or an average of 0.33 inches per year. This represents an average increase from tidal gauge projections of 0.19 inches per year

The shoreline issues addressed in Bonner Bridge Replacement Project (B-2500) planning are consistent with Gutierrez's indicators of "threshold behavior" under scenario 2. These indicators are a consideration in the project's coastal monitoring program and reflected in shoreline forecasts being developed as a part of the on-going coastal monitoring program. Thus, the use of the high erosion shoreline forecasts in assessing the Phase IIa study alternatives is considered sufficient to account for a portion of sea level rise caused by future changes in climate.

The characterization of Gutierrez's scenario 3 is that sea level will rise at such a fast rate that the barrier islands will not have a chance to "roll over." That is, the naturally expected overwash, deposition on the back barrier, and erosion on the oceanside will not occur. Though not stated by Gutierrez, this would lead to further loss of island width and "threshold behavior" leading to island segmentation and disintegration. Scenario 3 assumes the 20th century rate of sea level rise plus 0.28 inches per year. This rate is higher than the highest annual increase from tidal gauge projections of 0.19 inches per year at Oregon Inlet presented in the Science Panel's 2015 report.

4.6.3 Potential for Island Breaches

As discussed in Section 3.6.3.4 of the 2008 FEIS and shown on Figure 2, potential breach location 2 is within the expanded Phase IIa project area. This is the site of the historic New Inlet. The Pea Island breach opened in 2011 at the northern end of this potential breach location and has since closed.

4.6.4 NC 12 Vulnerability

The 2014 Update Report for the NC 12 Transportation Management Plan coastal monitoring program (Overton, 2015) presents vulnerability criteria for NC 12 on Hatteras and Pea Islands. These reports are being prepared annually to fulfill a commitment included in the selected PBC/TMP Alternative in the Bonner Bridge Replacement Project (B-2500) 2010 ROD. That commitment is presented in Section 3.3.2 of the 2010 ROD and says: "NCDOT will fund and implement a coastal monitoring program on Hatteras Island within the project study area. The results of the monitoring program will be used to determine when planning of future phases of the project should begin."

The three vulnerability criteria presented are:

1. Island width (measured as distance from ocean to estuarine shoreline on Pamlico Sound) less than 1,000 feet

2. Dune crest elevation less than 10 feet above NC 12

3. The critical buffer where the NC 12 edge of pavement was within 230 feet of the present ocean shoreline, forecast 2030 ocean shoreline, and forecast 2060 ocean shoreline

The vulnerability of NC 12 is assessed at a series of transects spaced 150 feet apart along the entire length of NC 12 between Oregon Inlet and Rodanthe. The current vulnerability at each transect is assessed by creating a composite of the three criteria above, and comparing this composite against the project "baseline," developed in 2011. The vulnerability criteria findings in the expanded Phase IIa project area are shown in Figure 7.

Island Width Less Than 1,000 Feet

In the 2014 update report, island width is listed as a vulnerability indicator for island breaching, and 1,000 feet was selected based on the island widths at the locations of the two breaches (Pea Island breach and Rodanthe breach) caused by Hurricane Irene in August 2011. Both breaches are currently closed.

As of January 5, 2015, there was one location in the expanded Phase IIa project area where the distance from the ocean to the estuarine shoreline was less than 1,000 feet. The island width is less than 1,000 feet for approximately 1,200 feet along the shoreline at a location approximately 2,000 feet south of the Pea Island breach.

Dune Crest Elevation Less Than 10 feet Above NC 12

The dune crest elevation between the edge of pavement and the ocean shoreline was compared with the NC 12 elevation at transect. Where the maximum elevation is less than 10 feet above NC 12, there is considered to be an increase in vulnerability. Monitoring in 2014 found that approximately 1 mile of NC 12 in the expanded Phase IIa project area contained dunes where the dune crest elevation is less than 10 feet above NC 12. Most of this distance is in the portion of the island affected by the Pea Island breach.

Critical Buffer of 230 Feet from the Ocean Shoreline to the NC 12 Edge of Pavement

NC 12 is considered vulnerable to repetitive overwash and sand deposits resulting in excessive maintenance costs at locations where the distance from the NC 12 edge of pavement to the active ocean shoreline (mean high water [MHW]) is less than or equal to 230 feet. This conclusion was based on a review of NCDOT maintenance records for NC 12. This 230-foot critical buffer distance originated with the first NC 12 vulnerability study completed in 1991.

The critical buffer distance was considered in four ways in the 2014 coastal monitoring update report:

1. The present position of the ocean shoreline using the January 5, 2015 orthophotography

2. The predicted position of the ocean shoreline in 5 years (2019)

3. The predicted position of the ocean shoreline in 2030

4. The predicted position of the ocean shoreline in 2060

A range was established for each predicted position between what was considered a "low-erosion" and a "high-erosion" case using a 95 percent confidence interval range.

The findings in the 2014 update report were that there were no current or 5-year vulnerable locations in the expanded Phase IIa project area. The predominate change in the forecast shorelines, as related to the expanded Phase IIa project area, is the area north of the Pea Island breach. By 2030, approximately 4,736 feet of NC 12 immediately north of the Pea Island breach would be potentially vulnerable, as shown on Table 6 of the 2014 update report and illustrated in Figures 50 and 51 of the update. There also would be a 735-foot vulnerable area south of the Pea Island breach. Between the Phase IIa area and Oregon Inlet, an additional 2 miles of NC 12 would be vulnerable. By 2060, the 4,736 feet would increase to 5,815 feet, as shown in Table 7 of the 2014 update report and illustrated in Figures 57 and 58 of the update. The 2 miles between Phase IIa and Oregon Inlet would increase to 3.2 miles. The 735 feet south of the Pea Island breach would increase to 4,497 feet.

Composite Current NC 12 Vulnerability

The composite current vulnerability reflects the combination of the above factors with the locations of current primary concern being those for which more than one vulnerability factor applies. Only one location in the expanded Phase IIa project area contains more than one current vulnerability factor. This is an approximately 1,070-foot length south of the Pea Island breach that is vulnerable both because of low dune height and narrow island width. All other locations meet one or no current vulnerability criterion. As described in the previous section, it is not until the 2030 shoreline forecasts that a notable portion of the expanded Phase IIa project area shoreline is less than 230 feet from the NC 12 edge of pavement for 0.8 mile in the Pea Island breach area. In 2060, the location in the expanded project area shoreline less than 230 feet from the NC 12 edge of pavement lengthens to 1.6 miles but remains solely in the Pea Island breach area.

4.7 Natural Systems

This section summarizes and updates natural system characteristics in the expanded Phase IIa project area for surface waters and water quality, biotic communities, wetlands

and open water, unique and rare habitats, essential fish habitat, birds, and protected species.

4.7.1 Surface Waters and Water Quality

The water bodies in the expanded Phase IIa project area are Pamlico Sound, a portion of a manmade impoundment (South Pond), and tidal creeks along the sound side of the Outer Banks. These resources and their quality are described in detail in Section 3.7.2 of the 2008 FEIS. Since the 2008 FEIS, the Pea Island breach opened and closed.

The Pamlico Sound is a large estuarine water body separating the Outer Banks and the mainland of North Carolina. Water depth in the project area generally is less than 4 feet. Waters associated with Pamlico Sound are classified as SA waters (Class A saltwaters) with a supplemental classification as High-Quality Waters (HQW).

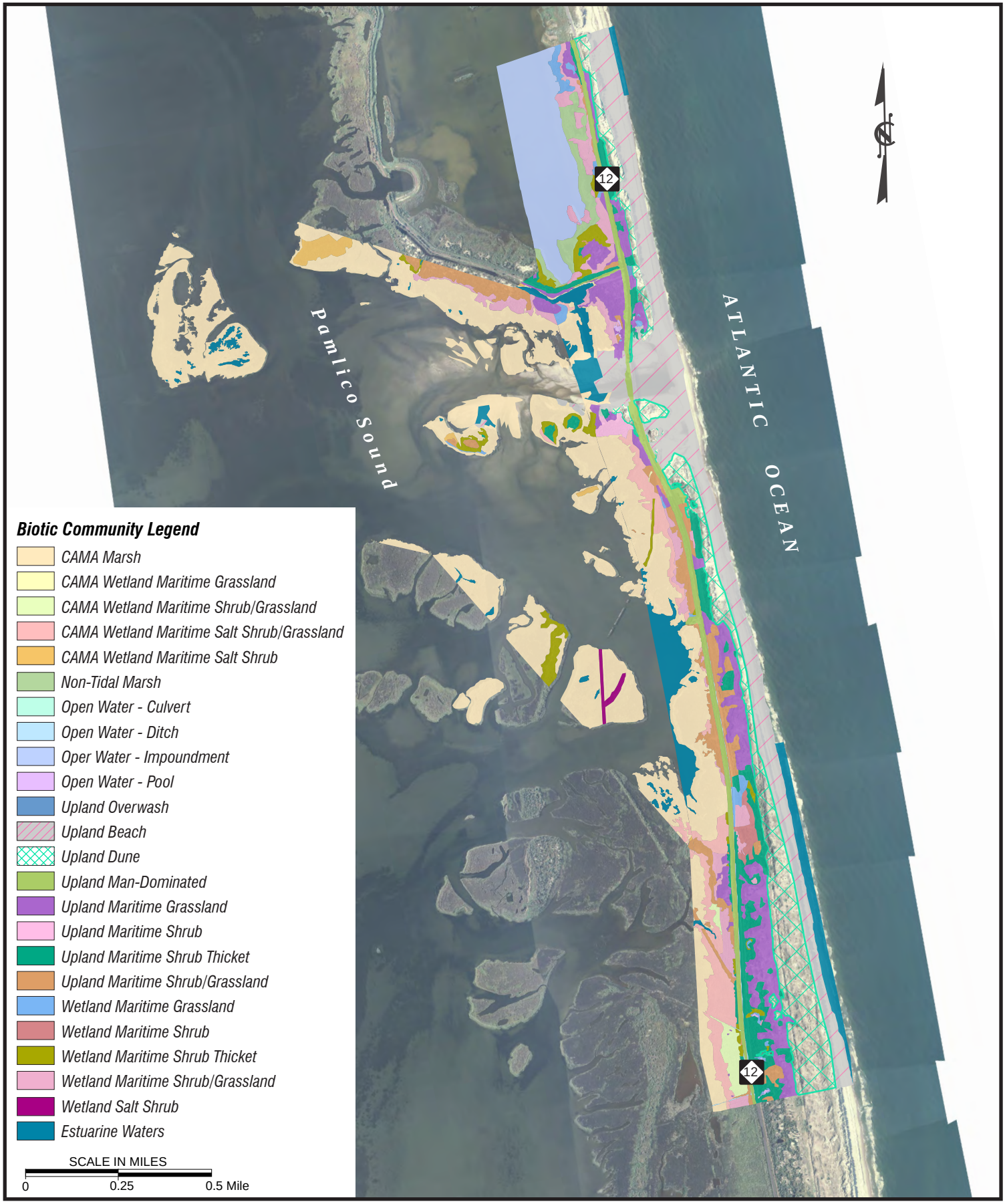
Water quality impacts associated with current NC 12 operations are mainly related to the potential for contamination of receiving surface waters by runoff from impervious roadway surfaces.

4.7.2 Biotic Communities

The term "biotic community" is used to designate a distinct assemblage of plants and animals. Biotic community mapping prepared in 2005 was updated for this Phase IIa alternatives study by interpreting current aerial photography in fall 2016, with field verification in December 2016. USACE jurisdictional resource delineations for the original Phase IIa project area were made in January 2013 and are still valid. Delineations in the parts of the expanded Phase IIa project area not covered in 2013 were conducted in December 2016. The new biotic community mapping, which includes delineated wetland/upland boundaries, are presented for the expanded Phase IIa project area in Figure 8. Biotic communities were not re-identified south of the terminus of the Bridge within Existing NC 12 Easement Alternative because the only potential change in this area with any of the Phase IIa study alternatives would be the removal of the existing NC 12 pavement with the Bridge on New Location Alternative. They were only mapped west of NC 12 at the north end of the expanded Phase IIa project area where the Bridge on New Location Alternatives would reenter the Refuge from Pamlico Sound.

The following biotic communities/habitats were identified within the expanded Phase IIa project area:

- Estuarine waters – Pamlico Sound
- Open water – culvert, ditch, pool and impoundment Upland beach
- Upland dune
- Upland man-dominated
- Wetland maritime grassland
- Upland maritime grassland
- Upland overwash



Note: Biotic Communities not surveyed in 2016 south of southern end of the Bridge within Existing NC 12 Easement Alternative because no improvements to NC12 proposed.

BIOTIC COMMUNITIES

Figure 8

- Wetland maritime shrub thicket
- Upland maritime shrub thicket
- Wetland maritime shrub
- Upland maritime shrub
- Wetland salt shrub
- Non-tidal marsh
- Wetland maritime shrub/grassland
- Upland maritime shrub/grassland
- CAMA marsh
- CAMA wetland maritime grassland
- CAMA wetland salt shrub/grassland
- CAMA wetland maritime shrub/grassland
- CAMA wetland salt shrub

The man-dominated communities and reed stands are the result of human disturbance. Open water and sound areas exist naturally within the expanded Phase IIa project area; however, some open water areas in the Refuge, such as South Pond are the result of human disturbance. The remaining communities are considered "natural" systems. The characteristics of each biotic community are described in detail in Section 3.7.3 of the 2008 FEIS.

4.7.3 Wetlands and Open Water Habitat

Wetlands are defined by the USACE (33 Code of Federal Regulations [CFR] 328.3) and the US Environmental Protection Agency (USEPA, 40 CFR 230.3) as "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions." Wetlands possess three essential characteristics: hydrophytic vegetation, hydric soils, and wetland hydrology.

Eight wetland communities occur within the expanded Phase IIa project area: wetland maritime grassland, wetland overwash, wetland maritime shrub thicket, non-tidal marsh, wetland maritime shrub/grassland, CAMA marsh, CAMA wetland maritime grassland, CAMA wetland salt shrub/grassland. Wetland habitat boundaries are depicted in Figure 8. Detailed descriptions of these wetland communities are in Section 3.7.3 of the 2008 FEIS. Table 3-19 of the 2008 FEIS presents the classification of each wetland type based on Classifications of Wetlands and Deepwater Habitats of the United States (Cowardin et al., 1979).

Open water habitats are permanently flooded lands below the deepwater boundary of wetlands. These habitats include environments where surface water is permanent and often deep, so that water, rather than air, is the principal medium within which the dominant organisms live (Cowardin et al., 1979). Open water habitats of the expanded Phase IIa project area are found primarily in association with the surface water of South Pond, Pamlico Sound, and the Atlantic Ocean.

Coastal wetlands are marshy areas subject to regular or occasional flooding by lunar or wind tides. These wetlands play a vital role in the productivity of estuaries. Coastal wetlands are areas that contain at least one of the following species: smooth cordgrass (*Spartina alterniflora*), black needlerush (*Juncus roemerianus*), glasswort (*Salicornia spp.*), saltgrass (*Distichlis spicata*), sea lavender (*Limonium carolinianum*), bulrush (*Scirpus robustus and Scirpus americanus*), saw grass (*Cladium jamaicense*), cattail (*Typha* spp.), saltmeadow grass (*Spartina patens*), and giant cordgrass (*Spartina cynosuroides*).

4.7.4 Unique and Rare Habitat

The North Carolina Department of Natural and Cultural Resources (DNCR) designates Natural Heritage Natural Areas (NHNA) as a part of the Natural Heritage Program (NHP), previously called Significant Natural Heritage Areas (SNHA). The Refuge is a NHNA. It is the only NHNA in the expanded Phase IIa project area. Because of its value to migratory waterfowl, the Refuge was given a priority ranking of A, meaning that the site contains the "best" occurrences of migratory birds known to exist anywhere in the United States; "best" usually is defined as the top five sites.

The Wilderness Act of 1964 established the National Wilderness and Preservation System. Under the 1964 Act, the US Secretary of the Interior must review the suitability for preservation of all designated Wilderness areas in the National Wildlife Refuge (NWR) system. Included under designated Wilderness areas are roadless islands within the NWR system. Therefore, in 1974 the USFWS recommended for Wilderness status "recognizable" islands on the sound side of the Refuge (USFWS, 1975). Most of the proposed unnamed islands identified in the 1975 report are within the expanded Phase IIa project area just southwest of South Pond and within 1 mile of Hatteras Island. Also recommended for Wilderness designation, but outside the expanded Phase IIa project area, is the Oregon Inlet Shoal, which is west of the northern end of Hatteras Island. The islands are dominated in the low marsh by black needlerush, marsh elder (*Iva frutescens*), bulrush, and spikerushes (*Elocharis sp.*); there is saltmarsh cordgrass along the island perimeter. In total, approximately 180 acres were proposed as Wilderness. While a final decision was never made as to the islands' status, USFWS manages them as if they are Wilderness areas. Although some of these islands might have changed since 1975, the criterion for Wilderness status is the same and applies to currently recognizable islands on the sound side of the Refuge.

4.7.5 Essential Fish Habitat

The Magnuson-Stevens Fishery Conservation and Management Act (16 USC 1801 *et seq.*) requires the US Secretary of Commerce to develop guidelines assisting regional fisheries management councils in identifying and creating management and conservation plans for essential fish habitat (EFH). EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity" (16 USC 1802(10)).

EFH habitat types and their presence in the Bonner Bridge Replacement Project (B-2500) area (SAFMC, 1998) are described in Section 3.7.6.3 the 2008 FEIS. Since the FEIS, the EFH data was updated in the 2013 Phase IIa EA and in the 2016 Revised Phase IIb EA.

The expanded Phase IIa project area extends further into the Pamlico Sound and encompasses substantial areas of known SAV and other EFH, including:

- Estuarine emergent (coastal marshes)
- Seagrass (SAV)
- Intertidal flats
- Estuarine water column.

All four are described in the 2008 FEIS in Section 3.7.6.3.

SAV is important spawning, breeding, feeding, and refuge habitat for a variety of fish and other aquatic wildlife. In addition to providing nursery functions, SAV provides oxygen, absorbs wave energy, and has the ability to uptake nutrients and export carbon, nitrogen, and phosphorous to coastal food webs. Denser SAV offers more cover and food resources compared to patchy SAV for the same area. The latest available SAV bed location information for the Phase IIa project area consists of mapping produced by the NC Department of Environmental Quality Division of Marine Fisheries (NCDEQ-DMF) using data from 2006 to 2008 and infrared aerial photography taken by NCDOT in 2016. This information is shown in Figure 9. In Figure 9 the areas identified as SAV beds in DMF mapping are indicated with green shading.

The darker blue areas on the infrared photography and the mapped areas by DMF are considered in this report as representative of dense SAV beds. The two data sources are generally comparable except in the vicinity the Pea Island breach. At the breach, overwash has resulted in a loss of SAV beds in some areas, as seen by the sandy areas at the breach in the photograph.

4.7.6 Birds

The Refuge is known for attracting a wide variety of bird species and large numbers of birds. The expanded Phase IIa project area occurs in the southern half of the Refuge and includes a portion of the southernmost impoundment, South Pond, managed by the Refuge for waterbirds.

The Pea Island breach was formed by Hurricane Irene in August 2011. This shallow breach has reopened and closed several times since being opened (it is currently closed) and now offers a dynamic habitat that is being used by a variety of waterbirds, including the federally-listed piping plover and rufa red knot. Waterbirds frequently concentrate in this area in a variety of habitats, including shallow waters, pools, intertidal areas, and adjacent open sandy areas. Much of the inlet flood delta is found in the expanded Phase IIa project area west of NC 12 along the eastern edge of the Pamlico



Aerial date: 2016

Darker blue areas in Pamlico Sound indicate likely Submerged Aquatic Vegetation (SAV) beds.

NC Division of Marine Fisheries SAV mapping using 2006 and 2008 data.

Expanded Project Area Boundary

POTENTIAL SUBMERGED AQUATIC VEGETATION BEDS WITHIN THE EXPANDED PHASE IIa PROJECT AREA

Figure 9

Sound. In addition to the complex of habitats around Pea Island breach, there are additional waters of the Pamlico Sound in the expanded Phase IIa project area. Waterfowl and wading birds use the waters of the Pamlico Sound and managed impoundments, as well as adjacent marshes and surrounding areas.

Bird use of areas within the expanded Phase IIa project area was identified using data from NCDOT surveys, USFWS surveys, and anecdotal sightings from the eBird website.

NCDOT Data

As part of NCDOT's obligation under Section 7 of the Endangered Species Act (ESA), NCDOT conducted surveys twice per month in 2012 to assess habitat changes and use of habitat at Pea Island breach by federally-listed species and other shorebirds. In 2013, 2014, and 2015 the surveys were conducted once per month and extended the length of the Pea Island breach, the area around the former US Coast Guard Station on the south side of Oregon Inlet, and the sound side of the Pea Island breach area. The NCDOT data were collected as background data for use in environmental documentation (unpublished NCDOT data; Personal Communication, October 21, 2016, Kathy Herring, Biologist, NCDOT and February 5, 2015 NCDOT memorandum summarizing 2012-2014 bird survey data).

Of the areas surveyed by NCDOT, the most species were documented at the Pea Island breach area and the associated overwash flats that provide optimal nesting and foraging habitat for piping plover and colonial nesting birds (NCDOT 2015). Twelve species of conservation concern (i.e., federally threatened, state threatened, state special concern, state significantly rare) were documented nesting or using the Pea Island breach area. Nesting species of interest in the area include least tern, American oystercatcher, black skimmer, and piping plover.

The five most abundant (most sightings) species and their total percentage of all recorded birds for all surveys from the Pea Island breach area from 2012 through 2015 were 1) sanderling at 29.7 percent, 2) least tern at 12.0 percent, 3) herring gull at 7.0 percent, 4) willet at 6.1 percent, and 5) ring-billed gull at 5.0 percent. Of the five most abundant species, only the least tern and willet nest in the expanded Phase IIa project area; the least tern is absent during the winter while the other species can occur year-round.

Pea Island National Wildlife Refuge Data

Refuge staff conduct bird surveys for the entire Refuge three times a month, about every 10 days weather and staff permitting. Since these data are for the entire Refuge, they are a reflection of bird use for a much larger area than the expanded Phase IIa project area. These data are helpful, however, to document bird species using the habitats that also occur within the expanded Phase IIa project area. Refuge surveys are conducted for waterbirds and broken into two different categories; 1) waterfowl from observations recorded September through March and 2) other water/sea/wading/shore birds recorded

throughout the year (unpublished USFWS data; Personal Communication, October 26, 2016, Rebecca Harrison, supervisory wildlife biologist, USFWS).

Waterfowl Data. Data from waterfowl surveys identify over 23 species of ducks, geese, swans, and coots that primarily winter (September through March) at the Refuge. The five most abundant (highest average annual sightings) species and their total percentage of all recorded birds from 2006 through 2015 were 1) northern pintail at 25.6 percent, 2) redhead at 11.7 percent, 3) American coot at 8.1 percent, 4) gadwall at 7.5 percent, and 5) greater/lesser scaup at 4.8 percent. The five most abundant species comprised over 57 percent of all waterfowl recorded. Of the five most abundant wintering waterfowl species, only the gadwall nests in the expanded Phase IIa project area.

Waterbird Data. Data from these year-round waterbird surveys include documentation of over 60 species of birds including grebes, cormorants, pelicans, gannets, gulls and allies, terns, skimmers, and other marsh/wading/shore birds. The five most abundant (highest average annual sightings) species and their total percentage of all recorded birds from 2006 through 2015 were 1) sanderling at 15.0 percent, 2) double-crested cormorant at 13.4 percent, 3) dunlin at 10.2 percent, 4) semipalmated sandpiper at 8.6 percent, and 5) herring gull at 5.2 percent. The top five most abundant species comprised over 52 percent of all waterbirds recorded. None of the five most abundant species nest in the expanded Phase IIa project area; most sightings are associated with wintering and/or migrant species.

National USFWS Mid-Winter Waterfowl Aerial Survey Data

The USFWS also conducts annual mid-winter waterfowl aerial surveys throughout the country. The survey areas are broken into different zones and segments within each region of the country. There are two USFWS mid-winter survey areas that include portions of the expanded Phase IIa project area. Segment 11B includes eastern portions of the Pamlico Sound along the Dare County Outer Banks. Segment 12 covers the Dare County portion of the Outer Banks between Oregon Inlet and Rodanthe and includes most of the Refuge and all its managed impoundments. Most of these surveys represent a limited number of surveys, often only once a winter, thus are an estimate with considerable variability. A summary of mid-winter waterfowl data from 2006 through 2015 for each of the two areas is presented below (unpublished data provided October 26, 2016, Joseph Fuller, Migratory Game Bird Coordinator, NC Wildlife Resources Commission).

Pamlico Sound (Segment 11B). Mid-winter waterfowl survey data for the Pamlico Sounds (Segment 11B) from 2006 through 2015 documented an annual average of 104,762 birds; which represent an annual average of 2.4 percent (range of 0.66 to 5.85) of all wintering waterfowl in North Carolina. The five most abundant (highest average annual sightings) species and their total percentage of all recorded birds from 2006 through 2015 in Segment 11B were 1) northern pintail at 30.4 percent, 2) greater/lesser scaup at 25.4 percent, 3) bufflehead at 11.5 percent, 4) redhead at 10.0 percent, and 5)

scoters (unidentified) at 6.9 percent. The five most abundant species comprised about 84 percent of all waterfowl recorded. Four of the five most abundant species are "diving" duck species and one, the northern pintail, is a "puddle" duck species. In general puddle ducks prefer shallow waters for feeding and diving ducks prefer deeper water. None of these five most abundant species nest in the expanded Phase IIa project area.

Pea Island National Wildlife Refuge (Segment 12). Mid-winter waterfowl survey data for the Refuge (Segment 12) from 2006 through 2015 documented an annual average of 115,590 birds, which represents an annual average of 3.6 percent (range of 2.35 to 4.78) of all wintering waterfowl in North Carolina. The five most abundant (highest average annual sightings) species and their total percentage of all recorded birds from 2006 through 2015 in Segment 12 were 1) northern pintail at 22.4 percent, 2) bufflehead at 13.1 percent, 3) redhead at 11.8 percent, 4) snow goose at 11.2 percent, and 5) American black duck at 9.5 percent. The five most abundant species comprised about 68 percent of all waterfowl recorded. Two of the five most abundant species are "diving" duck species, two species are "puddle" duck species, and one is a goose. Of the five most abundant wintering waterfowl species, only the American black duck nests in the expanded Phase IIa project area.

eBird Data

In addition to data collected by government agencies, public bird data also are available for the expanded Phase IIa project area. The Cornell Lab of Ornithology and National Audubon Society maintain a real-time, online checklist program, eBird, which provides data sources on bird abundance and distribution at a variety of spatial and temporal scales (http://ebird.org/content/ebird/about/). Data are collected and reported by observers to document the presence or absence of species, as well as abundance through checklist data that identify survey dates and times of observations along with location data. Database search parameters include timeframes, species, and/or locations (i.e., county, refuge, or specific locations within a refuge). Areas frequently visited and surveyed are often designated as an eBird "hotspot" to enable data to be more easily located and referenced. There are several eBird hotspots that occur within the expanded Phase IIa project area, including:

- Pea Island National Wildlife Refuge in general (with 321 documented species)
- South Pond (with 228 documented species)
- Pea Island breach area (with 128 documented species)

In addition to the bird species addressed in sections above, some species are more associated with marshes and surrounding shallow waters, including clapper rails, marsh and sedge wrens, and seaside, Nelson's and saltmarsh sparrows. There are other species that use marshes regularly, but also use a variety of other habitats; examples of these species include herons, egrets, ibis, bitterns, some rails, some shorebird species, common

yellowthroats, and red-winged blackbirds. Many other bird species use terrestrial habitats along the Outer Banks, including many Neotropical migrants that can occur in large numbers during fall migration. Many of the forested and shrub-dominated areas along the entire Outer Banks serve as "pit-stops" for birds to rest and re-fuel during migration.

Areas of Concern

In the expanded Phase IIa project area there are three key areas of high bird use that need to be considered when assessing potential impacts:

1. Pea Island breach area, including associated overwash flats, open sandy areas, intertidal areas, and shallow waters. This area attracts and supports large numbers of waterbirds including nesting colonial waterbirds and federally protected species (rufa red knot and piping plover).

2. South Pond is managed by the Refuge specifically to enhance bird habitat and attract/support large concentrations of migrating and wintering waterfowl, shorebirds, and other waterbirds. In recent years large numbers of redhead and northern pintail have wintered at this site.

3. Pamlico Sound and its associated marshes and submerged aquatic vegetation support a wide variety of waterbirds, especially migrating and wintering waterfowl and double-crested cormorants, as well as other waterbirds. Many of the waterfowl species use a variety of habitats (i.e., water depths and different distances from shore) and are not as concentrated in small areas like at South Pond or the Pea Island breach area. In general, diving duck species (i.e., scaup, scoters, and bufflehead) occur in deeper water areas (often further from shore) compared to puddle duck species (i.e., northern pintail, gadwall, and American black duck), which are more common in shallow waters and marshy areas.

4.7.7 Protected Species

Federally-listed floral and faunal species have been granted protection under the Endangered Species Act of 1973 (16 USC 1531-1543), which mandates federal agencies to ensure that any actions authorized, funded, or carried out by that agency do not jeopardize the "continued existence" of listed species, or result in the destruction or adverse modification of critical habitat (16 USC 1536).

Federally-listed endangered species in Dare County are:

- Red-cockaded woodpecker (*Picoides borealis*)
- Hawksbill sea turtle (*Eretmochelys imbricata*)
- Kemp's ridley sea turtle (*Lepidochelys Kempii*)
- Leatherback sea turtle (*Dermochelys coriacea*)
- West Indian manatee (*Trichechus manatus*)

- Shortnose sturgeon (*Acipenser brevirostrum*)
- Atlantic sturgeon (*Acipenser oxyrinchus oxyrinchus)*
- Roseate tern (*Sterna dougallii*)
- Red wolf (*Canis rufus*)--experimental

Federally-listed threatened species in Dare County are:

- Piping plover (*Charadrius melodus*) and critical habitat (wintering)
- Green sea turtle (*Chelonia mydas*)
- Loggerhead sea turtle (*Caretta caretta*)
- Seabeach amaranth (*Amaranthus pumilus*)
- Rufa red knot (*Calidris canutus rufa*)
- Northern long-eared bat (*Myotis septentrionalis*)

4.8 Utilities

A utility line easement passes through the expanded Phase IIa project area closely paralleling the NC 12 easement on the sound side. It contains land-line telephone (CenturyLink), cable television (Charter Communications), and power lines (Cape Hatteras Electric Membership Corporation).

5.0 Environmental Impacts

This section addresses impacts under the following categories:

- Visual Impacts
- Cultural Resource Impacts
- Pea Island National Wildlife Refuge Impacts
- Natural Resource Impacts
- Utilities Considerations
- Construction Considerations
- Section 4(f)

The following categories of impact typically addressed in environmental impact assessments are not addressed in this report:

- Community and environmental justice impacts because the expanded Phase IIa project area is confined to the Refuge, Seashore, Atlantic Ocean, and Pamlico Sound. It contains no communities.

- Air quality because the project is in an attainment area. In addition, the location in the Bonner Bridge Replacement Project (B-2500) project area that would have the greatest carbon monoxide (CO) emissions is in Rodanthe, and no impact was found in the 2008 FEIS. Finally, none of the Phase IIa study alternatives contain locations where people congregate that could be affected by mobile source air toxics (MSAT) emissions nor would traffic volumes differ between the Phase IIa study alternatives.

- Noise because there are no campgrounds, homes, businesses, or other noise sensitive human-made features in the expanded Phase IIa project area.

- Indirect and cumulative impacts because the relationship between the Phase IIa study alternatives and other potential impact causing activities presented in the 2008 FEIS does not differ between the alternatives.

5.1 Visual Impacts

Section 4.3.2 of the FEIS addresses visual impacts within the Refuge. The FEIS concluded that the Phased Approach Alternatives (Bridge within Existing NC 12 Easement Alternative for this Phase IIa alternatives study) would represent a sizeable intrusion into the landscape of the Refuge. The Bridge within Existing NC 12 Easement Alternative would introduce a sizeable new linear man-made feature for approximately 2.1 miles through the Refuge. The bridge deck would be at an elevation of approximately 25 feet allowing for the bottom of the superstructure to be a minimum of 15.8 feet above mean high water. The bridge would present a contrast with the natural character of the Refuge. The bridge would dominate views from the dunes lining the beach and, as the dunes disappear over time, it also would dominate views of the beach and ultimately the ocean. It would not be characteristic of the undeveloped and protected character of the Refuge that makes it rare along the eastern US seaboard in terms of views and a setting for recreation activities.

The Bridge on New Location Alternative would introduce the bridge into views of Pamlico Sound from the Refuge and into views of Pamlico Sound recreation users. The Bridge on New Location Alternative alignments would be within the Refuge for 2,428 feet with Alignment A and 2,535 feet with Alignment B (both approximately 0.5 mile).

The potential visual impact of extending Phase IIa study alternatives further north in Pamlico Sound would be different in the Pea Island breach area for each Phase IIa study alternative. An extension of Bridge on New Location Alternative Alignment B with Connector F would stay in the sound away from features contributing to the Refuge's historic landscape. Connector E associated with Alignment A would be within 1,300 feet of the south pond dikes, but there are no Refuge trails or recreational facilities on the south pond dikes, so the presence of Connector E would offer a person traveling on the bridge views of the dikes, but there would be few viewers of the bridge from the dikes. This type of impact would be similar to that of the Bridge within Existing NC 12

Easement's Connectors C and D, but at a distances from the dikes of approximately 2,000 feet.

5.2 Cultural Resource Impacts

This section describes the effects of the Phase IIa study alternatives on historic and archaeological resources, in accordance with Section 106 of the National Historic Preservation Act of 1966 (36 Code of Federal Regulations [CFR] Part 800).

5.2.1 Historic Resources

The Pea Island National Wildlife Refuge would be affected by all the Phase IIa study alternatives. As was determined in the assessment of the Bridge within Existing NC 12 Easement Alternative in the 2013 Phase IIa EA and in the assessment of the Bridge on New Location Alternative in the 2016 Revised Phase IIb EA, all the Phase IIa study alternatives likely would have an Adverse Effect.

The nature of the Adverse Effect would be the visual impact of the alternatives on the historic landscape of the Refuge. The bridges of the alternatives would introduce a sizable new, elevated, linear, man-made feature in the Refuge. The bridges would stand in contrast with the natural character of the Refuge and the human-made features contributing to the historic landscape, including the dunes and Refuge ponds with associated dikes built by the Civilian Conservation Corps in 1933.

The extent of the impact would differ between the alternatives in that the Bridge within Existing NC 12 Easement Alternative would be within the Refuge for its full length of approximately 2.4 miles. The Bridge on New Location Alternative alignments would be within the Refuge for approximately 0.5 mile.

The Bridge within Existing NC 12 Easement Alternative would dominate views from the dunes lining the beach and, as the dunes disappear over time, it would also dominate views of the beach and, ultimately, the ocean. The bridge would be uncharacteristic of the existing undeveloped and protected setting of the Refuge, which makes it rare along the eastern US seaboard in terms of views and a resource for recreational activities.

As noted above, the potential visual impact of extending Phase IIa study alternatives further north in Pamlico Sound would be different in the Pea Island breach area for each Phase IIa study alternative. In addition, Connectors C and D (associated with the Bridge with Existing NC 12 Alternative as a means of extending the alternative north into Pamlico Sound as a part of a future phase) also would affect the remnants of one of three wooden bridges and an associated sand footpath/roadway. The Connector D bridge would pass over the road remnant and Connector C would pass over the bridge remnant. Neither the road nor the bridge are eligible for NRHP listing, as discussed in Section 4.3.1.

5.2.2 Archaeological Resources

As described in Section 4.3.2, based on surveys done to date, there are no archaeological resources in the expanded Phase IIa project area.

5.3 Pea Island National Wildlife Refuge Impacts

This section describes the impacts of the Phase IIa study alternatives on the Refuge in terms of land used, changes in access, impacts to recreation use, and impacts to facilities.

5.3.1 Land Use

As indicated in Section 4.2.3.1 of the 2013 Phase IIa EA, the Bridge within Existing NC 12 Easement Alternative would be built and maintained within the existing NC 12 easement. Thus, no new Refuge lands would be permanently used by this alternative. The Bridge within Existing NC 12 Easement Alternative would permanently affect approximately 0.3 acres of land within the existing NC 12 easement from fill and pile placement. In addition, the temporary construction easements described in Section 2.2 would temporarily affect approximately 0.8 acres of Refuge land outside the existing easement, but this land would be restored after construction is completed, per the terms of a Refuge Special Use Permit. The parts of the existing NC 12 roadway replaced by the new bridge and the interim bridge spanning Pea Island breach would be removed.

The approximate impacts to the Refuge of the Bridge on New Location Alternative alignments would be:

- Alignment A:
  - 6.0 acres of new permanent NC 12 easement on Hatteras Island
  - 0.4 acre of new permanent NC 12 easement on marsh islands that are a part of the Refuge
  - 52.1 acres of existing NC 12 easement likely would be returned to the Refuge and restored
  - 0.3 acre of temporary construction easement in the Refuge for a temporary traffic maintenance road to take traffic around the proposed bridge approach
- Alignment B:
  - 5.8 acres of new permanent NC 12 easement on Hatteras Island
  - 0.0 acre of new permanent NC 12 easement on marsh islands that are a part of the Refuge

- 52.2 acres of existing NC 12 easement likely would be returned to the Refuge and restored

- 0.3 acre of temporary construction easement in the Refuge for a temporary traffic maintenance road to take traffic around the proposed bridge approach

The changes in the NC 12 easement described above would continue in the future if these alternatives were extended further north within the existing NC 12 easement. If in a future decision, the Phase IIa study alternatives were extended to Oregon Inlet, the following changes in NC 12 easements would occur:

- Bridge within Existing NC 12 Easement Alternative: 640 feet of new 100-foot-wide easement would be needed with Connector C and 1,650 feet with connector D. With Connector C, 7,400 feet (1.4 miles) of existing 100-foot-wide easement could be returned to the Refuge and restored. This would be 6,400 feet (1.2 miles) with Connector D.

- Bridge on New Location Alternative Alignment A: Approximately 2,480 feet (0.47 mile) of 100-foot-wide easement could be returned to the Refuge and restored. Depending on the status of the sand overwash behind the Pea Island breach at that time, additional new easement could be required along Connector E.

- Bridge on New Location Alternative Alignment B: Approximately 2,530 feet (0.48 mile) of 100-foot-wide easement would be returned to the Refuge and restored. Depending on the status of the sand overwash behind the Pea Island breach at that time, additional new easement could be required along Connector F. Because it is further into the sound, it less likely that such new easement would be needed along Connector F than Connector E.

5.3.2 Access

Aside from access to the New Inlet boat ramp/parking lot, the Phase IIa study alternatives would change paved road access to the Refuge as follows:

- Bridge within Existing NC 12 Easement Alternative: Paved road access to the Refuge within the expanded Phase IIa project area would be reduced from 4.1 miles to 2.9 miles. The access road from the southern terminus to the New Inlet boat ramp/parking lot included in the Bridge with Existing NC 12 Easement Alternative (see Section 2.2.1) is counted as paved road access in this change.

- Bridge on New Location Alternative: Paved road access would be eliminated in the expanded Phase IIa project area, unless a connection to the Refuge provided by the Phase IIb Selected Alternative is retained as described below. The elimination of paved road access in the expanded Phase IIa project area would eliminate the only section of NC 12 in the Refuge that is not affected by shoreline erosion through 2060

(4.1 miles), of which 1.9 miles also is not in an area susceptible to breaching. Thus, unless future phases north of the expanded Phase IIa project area were to involve moving NC 12 away from the shoreline as a surface road, there would be no paved road access to any part of the Refuge upon completion of all phases of the PBC/TMP Alternative.

The elimination of paved road access to the Refuge described for the Bridge on New Location Alternative assumes the connection to the Refuge from the sound with Phase IIb Selected Alternative is removed. To retain paved road access to the Refuge with a Bridge on New Location Alternative in the one area not threatened by shoreline erosion through 2060 or breaching, the Phase IIb bridge (where it connects with a Phase IIa Bridge on New Location Alternative) would have to be rebuilt as a "T" intersection with adequate sight distance for drivers. In addition, since this section of NC 12 would be a Refuge access road and not a public thoroughfare, the Refuge likely would need to agree to accept this section of NC 12 as a Refuge access road, maintain the road, and accept the liability for the road. If the pavement is retained all the way north to the New Inlet boat ramp/parking lot with the Bridge on New Location Alternative, NCDOT would remove NC 12 pavement and the interim bridge for 1.2 miles north of the New Inlet boat ramp/parking lot and restore the easement.

5.3.3 Recreation Use

Impact on recreation use in the Refuge would depend upon how much of existing NC 12 remains to provide paved road access. The differences in access between the Phase IIa study alternatives are described in the previous section. Paved road in the expanded Phase IIa project provides access to:

- A new parking lot at the northern terminus of Phase IIb.
- The New Inlet boat ramp/parking
- An opportunity to ultimately move and retain the Refuge Visitor Center, interpretive exhibits, and formal trails for visitors within the Refuge, if current access to these facilities north of Phase IIa were eliminated by a future phase involving a bridge within the existing NC 12 easement or a bridge within Pamlico Sound instead of a surface road.
- Fishing, surfing, use of the beach within the Refuge by visitors.

5.3.4 Facilities

With the Bridge within Existing NC 12 Easement Alternative, access to the New Inlet boat ramp/parking lot on the west side of NC 12 would be closed during construction and likely would be used as a staging area, as discussed in the 2013 Phase IIa ROD. It would be restored by NCDOT following construction. An access road with a

turnaround would be constructed from the southern terminus of the new bridge to the boat ramp parking lot, within the existing NC 12 easement to the greatest extent possible. The only part that would be outside the existing NC 12 easement would be part of the intersection of the access road and NC 12.

The Bridge on New Location Alternative would bypass the part of the Refuge containing the New Inlet boat ramp/parking lot, as well as the new parking lot at the northern terminus of Phase IIb. Access to these facilities could be retained only by the Phase IIb bridge (where it connects with a Phase IIa Bridge on New Location Alternative) being rebuilt as a "T" intersection with adequate sight distance, and the Refuge would likely need to agree to accept the section of NC 12 as a Refuge access road (including New Inlet boat ramp/parking lot access), maintain the road, and accept the liability for the road.

5.4 Coastal Process Impacts

This section describes the impacts of the Phase IIa study alternatives either to, or as a result of, the following: flooding during major storms, natural shoreline movement (including shoreline erosion and ocean overwash), accelerated sea level rise, and potential for an island breach. This section also summarizes the potential effects of a bridge in the ocean on offshore coastal processes.

5.4.1 Flooding During Major Storms

As discussed in Section 4.5, all of the Phase IIa study alternatives are within flood zones mapped by FEMA under the National Flood Insurance Program. In addition, all of the Phase IIa study alternatives are partially within coastal flood zones with a velocity hazard (VE zone) because of wave action. (See Figure 6.) `

The 2008 FEIS indicates that all of the proposed replacement bridge corridor alternatives, as well as existing NC 12 through the project area, meet the definition of "significant encroachment" in that they include a road at an elevation below the storm surge. This is the case for the Phase IIa study alternatives. However, like all of the proposed replacement bridge corridor alternatives assessed in the 2008 FEIS, all of the Phase IIa study alternatives would reduce the risk of overwash of NC 12 and temporary closure compared to the risk today because they all would involve the use of bridges in areas vulnerable to overwash through 2060 except at their northern end. With bridges, NC 12 would be raised above the storm surge and either bypass or bridge the potential breach location in the expanded Phase IIa project area. Thus, none of the alternatives would create a new significant risk. The Phase IIa study alternatives would not have a significant adverse impact on natural and beneficial floodplain values. The piles of the bridge substructure would not affect existing hydraulics, since the size of Pamlico Sound and the low water velocities would combine to create a situation where the small area blocked by the Phase IIa study alternatives would not create backwater or adverse

hydraulic conditions. From the perspective of the beneficial floodplain values associated with natural barrier island evolution, as well as the ecological change and habitat creation associated with barrier island evolution, the Phase IIa study alternatives all would restore natural shoreline overwash.

5.4.2 Erosion and Natural Overwash

Overwash is the natural landward transport of sand and water. The deposit is called a washover fan. Overwash is a storm generated process that serves a critical function in barrier island evolution, as it is the source of sand for the soundside of the island. In this way, sand is removed from the beach and dune system and builds up on the soundside.

None of the Phase IIa study alternatives would require the maintenance of a human-made dune system to protect NC 12 from overwash. Thus, all of the alternatives would allow for natural overwash and shoreline migration to occur.

Locations where the distance from the edge of pavement to the active ocean shoreline (mean high water [MHW]) is less than or equal to 230 feet are considered to be vulnerable sections of roadway (Overton, 2015). All the Phase IIa study alternatives would be west of the 230-foot critical buffer distance through at least 2019, according to the most recent shoreline forecasts. The vulnerability of NC 12 in the expanded Phase IIa project area is described in Section 4.6.4 under "Critical Buffer of 230 Feet from the Ocean Shoreline to the NC 12 Edge of Pavement." The Phase IIa study alternatives would bridge or bypass the vulnerable areas within the expanded Phase IIa project area, except for the approach fills at the northern end of the Phase IIa detailed study alternatives and their surface connection to existing NC 12. These approach fills and surface connections would be in an area vulnerable to repetitive overwash and sand deposits by 2030.

The above findings, and that of coastal monitoring in future years, will need to be addressed as part of the identification of future phases for the PBC/TMP Alternative and the timing and nature of future environmental impact documentation. For example, most of NC 12 in the expanded Phase IIa project area is not vulnerable to overwash at any time through 2060, but is still at risk for breaching. Because the Pea Island breach has closed, future assessment of coastal monitoring results could conclude the risk of it reopening is now low enough that the priority for future phases could shift to vulnerable areas further north.

5.4.3 Accelerated Sea Level Rise

The impact of accelerated sea level rise on the Parallel Bridge Corridor alternatives is addressed in Section 4.6.6 of the 2008 FEIS.

For the Bridge within Existing NC 12 Easement Alternative, it is possible with accelerated sea level rise that the portion of the alternative on the beach or in the ocean

would be longer in 2060 than described below in Section 5.4.6 under "Beach Erosion" assuming Gutierrez et al's (2007) sea level rise scenario 2 in Section 3.6.3.3 of the 2008 FEIS. The on-going coastal monitoring program, whose annual results reflect actual shoreline change whether from shoreline erosion or sea level rise, allows for sea level rise to be taken into account in planning future phases.

As noted in the 2008 FEIS, worst-case imagined scenarios (such as Gutierrez's scenario 3) suggest substantial island disintegration with substantial change in the hydrodynamics (the hydraulic exchange) between sound and ocean. Thus, it is important to keep in mind that this dramatic change in trends would affect not just the expanded Phase IIa project area but the entire barrier island system.

All three alternatives consider the most recent high erosion shoreline forecast. The southern terminus of the Bridge within Existing Easement alternative includes an additional buffer to accommodate any potential accelerated erosion because of sea level rise. The 2060 high-erosion shoreline does show the Phase IIa study alternatives in the ocean at their northern end, including their approach fills. Parts of NC 12 to the north of that point also would be in the ocean by as early as 2030. Thus, it can be assumed that based on the findings of on-going shoreline and vulnerability studies that are a part of the TMP, a future phase would be implemented prior to shoreline erosion becoming a threat to the approach to the north end of Phase IIa bridges.

5.4.4 Island Breach within the Pea Island National Wildlife Refuge

All of the Phase IIa study alternatives would be on bridge in the part of the expanded Phase IIa project area at risk from breaching. Bridge foundation designs would take into account the potential formation of a breach anywhere considered geologically susceptible to breaching within the Phase IIa project area (see Figure 2). Thus, this risk is minimized with any of the alternatives.

5.4.5 Bridge in Ocean and its Effect on Off-Shore Coastal Processes

Section 4.6.8 of the 2008 FEIS addresses the effect of bridge piles of the Phased Approach Alternative, called the Bridge within Existing NC 12 Easement Alternative for Phase IIa. The sections that follow address this potential impact from the perspectives of scour in the ocean, wave climate, long-shore sediment transport, beach erosion, potential for scour around bridge piles on land during storm events, and potential for island breach during storm events.

Scour in the Ocean

The effect of bridge piles on scour in the ocean bottom was addressed in Section 4.6.8.1 of the 2008 FEIS. The Bridge on Existing NC 12 Easement Alternative would have piles in the ocean in 2060 assuming the high-erosion shoreline for approximately 1 mile of its 2.4-mile length. Bridge piles would be within the breaker area. As indicated in the 2008 FEIS, scour depth in breaking waves has been studied in the lab and observed in the

field at two research piers (USACE Field Research Facility at Duck, North Carolina and by Bayram and Laursen using data from a research pier in Japan). These studies found that, in the breaker area, scour occurred around piles, but that the high turbulence produced by breaking waves and the subsequent large volumes of sediment transport acted to fill in these holes landward of the breaking point. Thus, scour holes are expected to occur around bridge piles in the ocean only once they are seaward of the wave breaking point. Landward of the breaker, the piles could alter the development of a "barred" profile and contribute to the formation of rip currents, features that occur naturally along the coast but have been noted occurring in relationship to piers.

Wave Climate

The effect of bridge piles on wave climate is discussed in Section 3.6.8.2 of the FEIS. This discussion concludes that bridge piles:

- Are not expected to change the wave climate seaward of the bridge pile vicinity
- Would not substantially influence wave form other than in the immediate vicinity of a pile group
- When seaward of the breaking zone changes in the wave form because of scour could affect longshore currents
- Could interrupt the development of the offshore bar, which could fix the location of a rip current under and aligned seaward of the bridge pier, but not increase the frequency of rip currents.

Longshore Sediment Transport

Section 4.6.8.3 of the FEIS indicates the development of scour holes (as summarized above), as well as the subsequent effect on the local wave characteristic (summarized in the previous subsection), could potentially have an impact on the localized longshore sediment transport and resulting erosion and accretion patterns along the shoreline, depending on the size and orientation of the holes. As indicated in the scour discussion, this would result when bridge piles are outside the breaking zone, which would not be the case with Phase IIa.

Beach Erosion

Section 4.8.8.4 of the FEIS discusses the effect of bridge piles in the ocean on beach erosion. Several impacts are discussed in association with scour holes around bridge piles outside the breaking zone. Potential impacts when bridge piles are outside the breaker zone include a cuspate (scallop-like) beach erosional hot spots, rip currents, and breaks in the offshore sand bar. As stated in the 2008 FEIS, cusps, rips and breaks in the bar are all naturally occurring features along Hatteras Island today. Thus, the impacts on beach erosion noted are already part of the system. However, the formation of these features associated with fixed locations (e.g., the piles) could create persistent features

that would lead to focused erosional hot spots that are not currently present in the system. As stated in Appendix F of the Phase IIb ROD, focused erosional hot spots can be visualized as the beach taking on the shape of a series of cusps (in contrast to a relatively straight line) in relationship to the offshore bridge pilings. Natural cusps are typically around 80 to 100 feet in the alongshore direction and 30 to 40 feet in the cross shore direction (though both smaller and larger cusps have been identified on natural beaches). These impacts would not occur with the Phase IIa study alternatives because none of the Phase IIa study alternatives would be outside the breaker zone in 2060.

Potential for Scour around Bridge Piles on Land during Storm Events

Chapter 4.6.8.5 of the 2008 FEIS discusses the potential impact from scour around the bridge piles in the swash zone (within the foreshore), the backshore and the upland zones that would likely occur during a storm event. The impact is described as scour holes around the piles and potential scour between piles resulting from possible channeling of the flow. During non-storm periods, these piles are on land and no scour impact would occur.

In the response to the comments on the Phase IIa EA presented in the Phase IIa ROD (Appendix C), discussion was provided to describe why scour is expected to occur around bridge piles on land during storm events. Existing flood insurance rate maps were used to determine if the piles would be subjected to the 100 year storm surge and if so, if the piles were in the mapped VE zones. As shown in Figure 6, VE zones on land in the expanded Phase IIa project area are generally east of NC 12.

The Bridge on New Location Alternative alignments would be on land only for a short distance (2,430 feet for Alignment A and 2,535 feet for Alignment B) and not within a VE zone. The Bridge within Existing NC 12 Easement Alternative would be on land for 12,410 feet (2.4 miles) of which approximately 3,200 feet would be adjacent to the VE zone along the Atlantic Ocean.

VE zones are locations in which higher velocities and likely scour and erosion occur during the storm even without bridge pilings. Post-storm observations indicate that sand loss (erosion or scour) in one area and sand deposition in another is a common outcome of severe storms. Vegetation is likely removed as dunes erode and vegetation may be covered if washover fans develop. Habitat may change as a function of these naturally occurring storm effects.

The presence of bridge piles may affect normal patterns of storm-related erosion on land. The pattern change could involve scour holes developing around the piles and the possible channeling of flow between the piles when the piles are subjected to storm surge, while otherwise landward of the mean high water line and generally on dry beach or inland. The presence of buildings, above ground utilities, and other structures also act to channel flow during storm events and affect scour, erosion, and sand deposition patterns.

While the potential for local scour impact is acknowledged, the analysis of the magnitude of the depth of scour depends on site specific parameters, e.g., depth of flow, magnitude and direction of flow velocity, soil characteristics and piling (pier bents) geometry). Modeling studies can be used to determine the site specific magnitude and direction of the flow and the flow depth during storms. Given this information the depth of scour can be estimated. As a part of future environmental impact documentation, pier scour modeling studies will be conducted for Bridge within Existing NC 12 Easement Alternatives being assessed.

Potential for Island Breach during Storm Events

Chapter 4.6.8.5 of the 2008 FEIS also says that the combination of scour around the piles and the channeling of the flow in the cross shore direction would increase the erosion potential with a bridge on land. Since these events are associated with the creation of a breach in the island, it is possible that the presence of the structure could accelerate the development of a breach during storm events. The Phase IIa study alternatives would either bypass or bridge the area geologically susceptible to breaching in the expanded Phase IIa project area.

The 2008 FEIS also says that during non-storm conditions, the bridge elements on land could increase sediment accumulation because of the interruption of the windblown transport processes. In the backshore, the interruption of windblown sediments could cause a loss of transport from the beach to the dune.

5.5 Natural Resource Impacts

This section describes the impacts of the Phase IIa study alternatives on natural resources. Examined are impacts to surface waters and water quality, biotic communities, wetlands and open water, unique and rare habitats, essential fish habitat, birds, and protected species.

5.5.1 Surface Waters and Water Quality

With the Bridge within Existing NC 12 Easement Alternative, as discussed in Section 4.2.4 of the 2013 Phase IIa EA, impacts to surface waters would be dependent on whether the Pea Island breach reopens. If it reopens, waters associated with the Pea Island inlet would likely be classified as SA waters (Class A saltwaters) with a supplemental classification as High-Quality Waters (HWQ). Construction-related water quality impacts to the open water of the breach could result in temporary increases in turbidity; however, given the dynamic nature of the waters of an open breach, a temporary increase in turbidity likely would not be notable as the flux of water through the breach would reduce the potential for any permanent water quality problems. With the breach closed, the Bridge within Existing NC 12 Easement Alternative would be built over land; therefore, direct water quality impacts during construction would be minimal.

As discussed in Section 4.7.2 of the 2008 FEIS, waters associated with Pamlico Sound are classified as SA waters (Class A saltwaters) with a supplemental classification as High-Quality Waters (HQW). Like with an open Pea Island breach, construction-related water quality impacts to the open water of the sound could result in temporary increases in turbidity and a potential decrease in dissolved oxygen; however, given the dynamic nature of the waters in the sound, a temporary increase in turbidity likely would not be notable as the flux of water through the sound would reduce the potential for any permanent water quality problems. Most of the Bridge on New Location Alternative length would be built over water in Pamlico Sound; therefore, direct water quality impacts during construction would occur. Impacts would be minimized by not using dredging during bridge construction and by containing pile jetting spoil. (See Section 5.7.)

The 2060 high-erosion shoreline shows the Phase IIa study alternatives in the ocean at their northern end, including their approach fills. Parts of NC 12 to the north of that point also would be in the ocean by as early as 2030. Thus, it can be assumed that based on the findings of on-going shoreline and vulnerability studies that are a part of the TMP, a future phase would be implemented prior to shoreline erosion becoming a threat to the approach to the north end of Phase IIa bridges.

As with previous phases with any of the Phase IIa study alternatives, to minimize the potential impact of project pollutants, a Post-Construction Stormwater Program (PCSP) would be developed in association with NCDEQ Division of Water Resources (NCDEQ-DWR) and other state and federal environmental resource and regulatory agencies during final bridge design and in the process of obtaining related permits. Best Management Practices (BMPs) discussed in Section 4.7.2.2 of the 2008 FEIS would apply to all Phase IIa study alternatives.

5.5.2 Biotic Communities

Biotic communities in the expanded Phase IIa study area would be impacted permanently and temporarily. The impacts to biotic communities for the Phase IIa study alternatives are shown in Table 2.

Table 2 indicates that permanent fill and pile impacts to biotic communities would be greatest with the Bridge within Existing NC 12 Easement Alternative. This would be the case because this alternative has two end points on land and the Bridge on New Location Alternative alignments have only one. Fill would only occur at the bridge approaches on land. With all of the alternatives, over 60 percent of the impact would be within the upland man-dominated biological community. The bulk of the remainder of the impact for the Bridge within Existing NC 12 Easement Alternative would be upland maritime shrub-thicket. For the Bridge on New Location Alternative, the bulk of the remaining impact is upland maritime shrub-thicket and Pamlico Sound.

Table 2. Impacts to Biotic Communities in the Expanded Phase IIa Project Area

Biotic Community	Subject to Section 404 Jurisdictions?	Bridge within Existing NC 12 Easement Alternative			Bridge on New Location Alternative					
					Alignment A			Alignment B		
		Permanent Fill and Pile (acres)	Permanent Shading (acres)	Temporary Easement (acres)	Permanent Fill and Pile (acres)	Permanent Shading (acres)	Temporary Easement (acres)	Permanent Fill and Pile (acres)	Permanent Shading (acres)	Temporary Easement (acres)
Estuarine waters - Pamlico Sound	Yes	--	--	--	0.23	22.89	--	0.25	24.85	--
Open water – pool and impoundment	Yes	--	--	--	<0.01	0.12	--	<0.01	0.12	--
Open water - culvert	Yes	--	--	--	--	--	--	--	--	--
Open water - ditch	Yes	0.08	0.60	<0.01	--	--	--	--	--	--
Upland beach	No	<0.01	0.02	--	<0.01	0.40	--	<0.01	0.48	--
Upland dune	No	<0.01	0.07	--	--	--	--	--	--	--
Upland man-dominated	No	1.91	8.48	0.02	0.85	0.53	--	0.84	0.54	--
Wetland maritime grassland	Yes	0.05	0.14	<0.01	--	--	--	--	--	--
Upland maritime grassland	No	0.01	0.23	0.02	0.17	0.48	0.13	0.14	0.54	0.13
Upland overwash	No	--	<0.01	--	--	--	0.03	--	--	0.03
Wetland maritime shrub thicket	Yes	--	--	0.08	<0.01	0.11	--	<0.01	0.17	--
Upland maritime shrub thicket	No	0.93	0.80	0.20	0.10	--	0.09	0.14	0.19	0.09
Wetland maritime shrub	Yes	<0.01	0.02	--	--	--	--	--	--	--
Upland maritime shrub		--	--	--	--	--	--	--	--	--
Wetland salt shrub	Yes	--	--	--	--	--	--	--	--	--
Non-tidal marsh	Yes	--	--	--	--	--	--	--	--	--
Wetland maritime shrub/grassland	Yes	0.01	--	0.03	0.04	0.13	--	0.04	0.12	--
Upland maritime shrub/grassland	No	0.04	0.39	0.39	<0.01	0.09	--	<0.01	0.10	--

Table 2 (concluded). Impacts to Biotic Communities in the Expanded Phase IIa Project Area

Biotic Community	Subject to Section 404 Jurisdictions?	Bridge within Existing NC 12 Easement Alternative			Bridge on New Location Alternative					
					Alignment A			Alignment B		
		Permanent Fill and Pile (acres)	Permanent Shading (acres)	Temporary Easement (acres)[1]	Permanent Fill and Pile (acres)	Permanent Shading (acres)	Temporary Easement (acres)[1]	Permanent Fill and Pile (acres)	Permanent Shading (acres)	Temporary Easement (acres)[1]
CAMA marsh	Yes	--	--	0.07	0.01	0.95	--	<0.01	0.37	--
CAMA wetland maritime grassland	Yes	--	--	--	--	--	--	--	--	--
CAMA wetland salt shrub/grassland	Yes	--	--	0.03	--	--	--	--	0.04	--
CAMA wetland maritime shrub/grassland	Yes	--	--	<0.01	--	--	--	--	--	--
CAMA wetland salt shrub	Yes	--	--	--	--	--	--	--	--	--
TOTAL BIOTIC COMMUNITY IMPACTS		**3.03**	**10.74**	**0.84**	**1.40**	**25.70**	**0.26**	**1.42**	**27.52**	**0.26**

Because they involve bridges more than twice as long as the Bridge within Existing NC 12 Easement Alternative, the Bridge on New Location Alternative alignments would have the greatest shading impacts. In the case of the Bridge within Existing NC 12 Easement Alternative, the bulk of what is shaded would be upland man-dominated. In this case of the Bridge on New Location Alternative alignments, the bulk of the shading would be over Pamlico Sound (see Section 5.5.5).

The temporary construction easement of the Bridge on New Location Alternative alignments would affect three upland biotic communities. The temporary construction easement of the Bridge within Existing NC 12 Easement Alternative would affect several habitat types, including 0.07 acre of CAMA wetland and 0.03 acre of wetland maritime shrub/grassland.

5.5.3 Wetlands and Open Water

Table 3 presents the wetlands and open water impact for each alternative. They assume the Pea Island breach is closed, as it is today. The alternatives have similar small wetland fill impacts of 0.06 acre with the Bridge within Existing NC 12 Easement Alternative and 0.04 acre with the Bridge on New Location Alternative alignments. The Bridge within Existing NC 12 Easement Alternative would have no other impact to wetlands or open water assuming Pea Island breach remains closed. Shading and pile impacts would occur if it were to re-open. Additional shading and pile impacts also would occur with the Bridge on New Location alignments if the breach were to reopen.

The two Bridge on New Location Alternative alignments would have similar pile impacts, with Alignment B having a slightly greater impact (0.02 acre) because of its longer length over Pamlico Sound.

The overall shading impact of the Bridge on New Location Alternative alignments would be similar (24.08 acres for Alignment A and 25.56 acres for Alignment B). The primary differences in shading impacts between the two alignments would be:

- Alignment A would cross CAMA marsh in the sound resulting in a total CAMA wetland shading impact of 0.95 acres versus 0.41 acre with Alignment B, a 0.54 acre difference.

- Alignment B would shade more potential SAV beds at 4.37 acres than Alignment A at 2.61 acres, a 1.76-acre difference.

The two Bridge on New Location Alternative alignments would have similar pile impacts, with Alignment B having a slightly greater impact (0.02 acre) because of its longer length over Pamlico Sound.

Table 3. Permanent Wetlands and Open Water Impact

Community	Bridge within Existing NC 12 Easement Alternative			Bridge on New Location Alternative					
				Alignment A			Alignment B		
	Fill (acres)	Pile (acres)	Shading (acres)	Fill (acres)	Pile (acres)	Shading (acres)	Fill (acres)	Pile (acres)	Shading (acres)
Open Water/EFH									
Aquatic bottom	--	--	--	--	0.20	20.28	--	0.20	20.47
Estuarine waters	--	--	--	--	--	--	--	--	--
SAV beds	--	--	--	--	0.03	2.61	--	0.04	4.37
TOTAL OPEN WATER/EFH IMPACT	--	--	--	--	**0.23**	**22.89**	--	**0.25**	**24.85**
Wetland									
Wetland maritime grassland	0.05	<0.01	-0.14	--	--	--	--	--	--
Wetland maritime shrub thicket	--	--	--	--	<0.01	0.11	--	<0.01	0.17
Wetland maritime shrub	--	<0.01	0.02	--	--	--	--	--	--
Wetland salt shrub	--	--	--	--	--	--	--	--	--
Non-tidal marsh									
Wetland maritime shrub/grassland	0.01	--	--	0.04	<0.01	0.13	0.04	<0.01	0.12
CAMA marsh	--	--	--	--	0.01	0.95	--	<0.01	0.37
CAMA wetland maritime grassland	--	--	--	--	--	--	--	--	--
CAMA wetland salt shrub/grassland	--	--	--	--	--	--	--	--	0.04
CAMA wetland maritime shrub/grasslands	--	--	<0.01	--	--	--	--	--	--
CAMA wetland salt shrub	--	--	--	--	--	--	--	--	--
TOTAL WETLAND IMPACT	**0.06**	<0.01	**0.16**	**0.04**	**0.01**	**1.19**	**0.04**	**0.01**	**0.71**

5.5.4 Unique and Rare Habitat

The Refuge is a NHNA identified by the North Carolina NHP. Use of Refuge lands by the Phase IIa study alternatives is discussed in Section 5.3.1. The marsh islands immediately west of Hatteras Island are within the Refuge and managed as Wilderness areas. Bridge on New Location Alternative Alignment A would include 0.4 acre of

marsh island within its new NC 12 easement. The other alternatives would not cross marsh islands.

5.5.5 Essential Fish Habitat

All of Pamlico Sound is EFH. If the Pea Island breach were to reopen, it also would be EFH. Impacts to EFH for each Phase IIa study alternative (assuming the breach remains closed), are shown in Table 3, including the portion of the EFH impact where dense SAV beds occur. Pamlico Sound in the expanded Phase IIa project area appears, from available mapping and photography, to have few SAV beds close to the shoreline, and the Bridge on New Location Alternative alignments were placed so that impacts to such beds were minimized.

The bridge deck and pile presence would result in some loss of EFH (under the piles) and in changes in light levels (shading) of the area underneath the bridge and for some distance surrounding the bridge. Shading is defined, as it has been in previous environmental impact documentation, as the area under the bridge. The Bridge on New Location Alternatives would have similar pile impacts in EFH, with Alignment B having a slightly greater impact (0.02 acre) because of its longer length over Pamlico Sound. Shading of EFH also would be similar at 22.89 acres for Alignment A and 24.85 for Alignment B, a 1.96 acre difference. The primary difference is Alignment B would shade more potential SAV beds at 4.37 acres than Alignment A at 2.61 acres, a 1.76-acre difference. As indicated above, the trade-off is that Alignment B would avoid crossing CAMA marsh, and Alignment A would cross CAMA marsh in the sound resulting in a total CAMA wetland shading impact of 0.95 acres versus 0.41 acre with Alignment B, a 0.54 acre difference. The CAMA marsh crossed with Alignment A is managed by the Refuge as a Wilderness area.

With the Bridge on New Location Alternative alignments, temporary construction-related impacts on marine and estuarine waters could result from noise and turbidity, sediment removal, and burial of organisms. The impacts would be temporary and are not expected to result in significant short-term or long-term adverse effects on managed species. Like the Phase IIb Selected Alternative, a primary potential for construction impact within EFH for a Bridge on New Location Alternative is expected to be the pile jetting process, including increased turbidity and burial of organisms by jetting spoil surrounding the pile being jetted into place.

As mitigation for jetting in open water with the Bridge on New Location Alternative, mitigation could be to require the contractor to minimize turbidity and water quality degradation by containing the jetting spoil. Primary and secondary containment systems could capture as much of the jetting water as possible and re-use it within the jetting operation in SAV and wetland areas. Spoil would be disposed of in an approved waste area. When jetting piles on land for any of the Phase IIa study alternatives, jetting water would be taken from the sound and be transported through pipes for jetting use.

The 2060 high-erosion shoreline shows the Phase IIa study alternatives in the ocean at their northern end, including their approach fills. Parts of NC 12 to the north of that point also would be in the ocean by as early as 2030. Thus, it can be assumed that based on the findings of on-going shoreline and vulnerability studies that are a part of the TMP, a future phase would be implemented prior to shoreline erosion becoming a threat to the approach to the north end of Phase IIa bridges.

5.5.6 Birds

In the expanded Phase IIa project area there are three key areas of high bird use described in Section 4.7.6: Pea island breach, South Pond, and Pamlico Sound and its associated marshes and submerged aquatic vegetation.

Pea Island Breach Area

In the Pea Island breach area, the Bridge within Existing NC 12 Easement Alternative would leave traffic and associated disturbance in the existing NC 12 easement. For 2,500 feet, it would pass by and cross the overwash flats/open sandy areas associated with the now closed Pea Island breach.

Alignments A and B of the Bridge on New Location Alternative would cross the overwash flats/open sandy areas associated with the now closed Pea Island breach for 850 feet and 1,000 feet, respectively, in a new easement.

South Pond

All of the Phase IIa study alternatives terminate in the existing NC 12 easement at the southern end of South Pond.

Pamlico Sound

The Bridge within Existing NC 12 Easement Alternative would not affect Pamlico Sound. The Bridge on New Location Alternative would be within the sound over open water for almost all of their length. The primary difference between the two alignments is Alignment A would bridge marsh islands for approximately 280 feet.

Overall, Alignment A would affect the greatest variety of habitat types including, marsh islands and overwash flats/sandy areas on new easement.

5.5.7 Protected Species

Biological conclusions to date for the Bonner Bridge Replacement Project, including the Bridge within Existing NC 12 Easement and Bridge on New Location alternatives are:

- Red-cockaded woodpecker: USFWS Biological Conclusion – No Effect
- Roseate tern: USFWS Biological Conclusion – May Affect, Not Likely to Adversely Affect

- West Indian manatee: USFWS Biological Conclusion – May Affect, Not Likely to Adversely Affect

- Piping plover and critical habitat (wintering): USFWS Biological Conclusion – May Affect, Likely to Adversely Affect

- Rufa red knot: USFWS Biological Conclusion – May Affect, Likely to Adversely Affect

- Leatherback sea turtle: USFWS Biological Conclusion – May Affect, Likely to Adversely Affect; NMFS Biological Conclusion-May Affect, Not Likely to Adversely Affect

- Green sea turtle: USFWS Biological Conclusion – May Affect, Likely to Adversely Affect; NMFS Biological Conclusion – May Affect, Not Likely to Adversely Affect

- Loggerhead sea turtle: USFWS Biological Conclusion – May Affect, Likely to Adversely Affect; NMFS Biological Conclusion-May Affect, Not Likely to Adversely Affect

- Kemp's ridley sea turtle: NMFS Biological Conclusion – May Affect, Not Likely to Adversely Affect

- Hawksbill sea turtle: NMFS Biological Conclusion – May Affect, Not Likely to Adversely Affect

- Atlantic sturgeon*:* NMFS Biological Conclusion – May Affect, Not Likely to Adversely Affect (updated from 2012 technical memorandum based on consultation with NMFS in September 2013).

- Shortnose sturgeon: NMFS Biological Conclusion – May Affect, Not Likely to Adversely Affect

- Seabeach amaranth: USFWS Biological Conclusion – May Affect, Not Likely to Adversely Affect

- Northern long-eared bat: USFWS Biological Conclusion – May Affect, Likely to Adversely Affect

- Red wolf: USFWS Biological Conclusion – No Effect

Protected Shorebirds Potentially Using Habitats within the Expanded Phase IIa Project Area

Roseate Tern. The roseate tern prefers sandy, open beach and interdunal habitat. The 2008 FEIS concluded that the construction, operation, and existence of a bridge in Pamlico Sound or the existing NC 12 easement would not affect any nesting areas of the

roseate tern. The detailed description of the life history and background information relative to the roseate tern remain unchanged from that described in Section 4.7.9 of the 2008 FEIS.

Rufa Red Knot. The rufa red knot was listed as threatened by the USFWS in 2014 and addressed for all Bonner phases in a 2014 technical memorandum (FHWA and NCDOT, December 2014). The detailed description of the life history and background information relative to the rufa red knot remain unchanged from those described in Section 4 of the 2014 technical memorandum.

Monthly bird surveys conducted by NCDOT in 2012, 2013, 2014, and 2015 documented 178 rufa red knot sightings within the Bonner Bridge Replacement Project (B-2500) project area. Total birds documented were 34 in 2012, 33 in 2013, 72 in 2014, and 39 in 2015. The 178 sightings were geographically distributed as follows: 21 in the vicinity of Oregon Inlet, 89 between Oregon Inlet and the Pea Island breach, 62 in the vicinity of the Pea Island breach, and six between Pea Island breach and Rodanthe (unpublished NCDOT data; Personal Communication, October 21, 2016, Kathy Herring, biologist, NCDOT and a February 5, 2015 NCDOT memorandum summarizing 2012-2014 bird survey data).

The USFWS conducts refuge-wide bird surveys approximately every ten days, but these data are not currently available by specific locations, so NCDOT data are the best source for describing bird use in the expanded Phase IIa project area. USFWS refuge-wide bird survey data from 2005 through 2015 documented an annual average of 197 sightings per year of rufa red knot and a range of 21 to 440 sightings per year for this period (unpublished USFWS data; Personal Communication, October 26, 2016, Becky Harrison, Supervisory Wildlife Biologist, USFWS).

Potential areas within the expanded Phase IIa project area used by rufa red knot for foraging and/or roosting are found primarily around the Pea Island breach, specifically open shorelines, intertidal areas, shallow pools and mudflats, and open sandy beach areas. Suitable rufa red knot habitat occurs in the vicinity of the Pea Island breach and has increased in recent years because of the presence of sandy and shallow water flats associated with the flood tidal delta.

All of the Phase IIa study alternatives would cross rufa red knot habitat in the Pea Island breach area.

Piping Plover. Piping plover characteristics presented in Section 4.7.9 of the 2008 FEIS and 4.2.5.4 of the 2016 Revised Phase IIb EA remain unchanged; however, there has been an increase in suitable habitat in the vicinity of the Pea Island breach. Beaches, pools, and intertidal areas, especially in the vicinity of inlets, are the primary habitats used by piping plovers in the expanded Phase IIa project area. Piping plovers have been documented throughout the Bonner Bridge Replacement Project (B-2500) project area,

with the most sightings in the vicinity of Oregon Inlet (NCDOT surveys between 2012 and 2015). Most nesting has occurred in the vicinity of Oregon Inlet and Pea Island breach, but the species likely nested near the Refuge's North Pond in 2014.

Monthly bird surveys conducted by NCDOT in 2012, 2013, 2014, and 2015 documented 151 piping plover sightings within the Bonner Bridge Replacement Project (B-2500) project area. Total birds documented were 35 in 2012, 51 in 2013, 45 in 2014, and 20 in 2015. The 151 sightings were geographically distributed as follows: 57 in the vicinity of Oregon Inlet, 65 between Oregon Inlet and the Pea Island breach, 21 in the vicinity of the Pea Island breach, and eight between Pea Island breach and Rodanthe (unpublished NCDOT data; Personal Communication, October 21, 2016, Kathy Herring, biologist, NCDOT and February 5, 2015 NCDOT memorandum summarizing 2012-2014 bird survey data).

USFWS refuge-wide bird survey data from 2005 through 2015 documented an annual average of 54 sightings per year and a range of 20 to 107 sightings per year for this period (unpublished USFWS data; Personal Communication, October 26, 2016, Becky Harrison, Supervisory Wildlife Biologist, USFWS).

Potential areas within the Phase IIa project area used by piping plovers for foraging, roosting, and/or nesting are found primarily around the Pea Island breach, specifically open shorelines, intertidal areas, shallow pools and mudflats, and open sandy beach/overwash areas. Nesting is associated with open sandy areas, and piping plovers have been documented nesting at the Pea Island breach. Suitable piping plover habitat occurs in the vicinity of the Pea Island breach and has increased in recent years because of the presence of sandy and shallow water flats associated with the flood tidal delta.

All the Phase IIa study alternatives would cross piping plover habitat in the Pea Island breach area.

Protected Aquatic Species Potentially Using Waters of the Phase IIa Project Area

The aquatic species listed below were addressed in previous documentation because the project area for assessing and addressing protected species included the waters of the Pamlico Sound; however, the new Bridge on New Location Alternative alignments include additional impacts to Pamlico Sound. Thus, in future environmental documentation the previous biological conclusions would be subject to reevaluation for the following species:

- West Indian manatee
- Leatherback sea turtle
- Green sea turtle
- Loggerhead sea turtle
- Kemp's ridley sea turtle
- Hawksbill sea turtle

- Atlantic sturgeon
- Shortnose sturgeon

There is no available information related to the presence of protected aquatic species in Pamlico Sound that is specific to the expanded Phase IIa project area, just as there was not in the Phase IIb project area. It is known that all of these species can occur in the waters of the Pamlico Sound. Detailed available background information on these aquatic species can be found in Section 4.7.9 of the 2008 FEIS. A Bridge on New Location Alternative would include more bridging over the Pamlico Sound, which would affect more suitable habitat (open waters and submerged aquatic vegetation [SAV] areas) for protected aquatic species during construction and bridge operation. A Phase IIa Bridge on New Location Alternative would not affect any additional potential sea turtle nesting habitat (beaches).

Seabeach Amaranth

According to the 2008 FEIS, the sand flats and the foredune in the expanded Phase IIa project area offer suitable habitat for the seabeach amaranth. The Phase IIa study alternatives would not affect this habitat. The detailed description of the life history and background information relative to the seabeach amaranth remain unchanged from that described in Section 4.7.9 of the 2008 FEIS.

Northern Long-Eared Bat

Because of a lack of suitable habitat (mainland forest), the northern long-eared bat is not expected to occur in the Bonner Bridge (B-2500) project area, including the expanded Phase IIa project area. USFWS has developed a programmatic biological opinion (PBO) in conjunction with the FHWA, USACE, and NCDOT for the northern long-eared bat in eastern North Carolina. The PBO covers the entire NCDOT program in Divisions 1-8, including all NCDOT projects and activities. The programmatic determination for the northern long-eared bat for the NCDOT program is May Affect, Likely to Adversely Affect. The PBO provides incidental take coverage for the northern long-eared bat and will ensure compliance with Section 7 of the Endangered Species Act for five years for all NCDOT projects with a federal nexus in Divisions 1-8, which includes Dare County, where the Phase IIa study alternatives are located. This level of incidental take is authorized from the effective date of a final listing determination through April 30, 2020.

5.6 Utilities Considerations

The Bridge within Existing NC 12 Easement alternative would not disturb utilities passing through the expanded Phase IIa project area. Paved road access just to the east of and parallel to the utility easement would continue for 2.9 miles from the southern end of the expanded Phase IIa project area to the Refuge's boat ramp. For 1.2 miles to the northern end of project, NC 12 would be raised and access to the utility easement could not be obtained from the NC 12 easement. If the utility providers chose to expend

the funds to mount their lines to the bridge, it would be for a distance of approximately 2.1 miles (the length of the bridge).

The Bridge on New Location Alternative also would not disturb utilities passing through the expanded Phase IIa project area. There would no longer be a paved road parallel to the utility easement for the length of the expanded Phase IIa project area (4.1 miles). If the utility providers chose to expend the funds to mount their lines to the bridge, it would be for a distance of approximately 5.1 miles with Alignment A or approximately 5.5 miles with Alignment B.

With all of the Phase IIa study alternatives, as the shoreline recedes, utilities could choose to continue to obtain permits needed to move lines west away from the eroding shoreline.

5.7 Construction Considerations

All of the Phase IIa study alternatives would require a temporary easement in the Refuge for maintenance of traffic, primarily where the bridges end in the Refuge and must be connected into existing NC 12. The area required would be:

- Bridge within Existing NC 12 Easement Alternative: approximately 0.8 acre
- Bridge on New Location Alternative (either alignment): approximately 0.3 acre

When constructing in Pamlico Sound with the Bridge on New Location Alternatives to minimize construction impacts to EFH, SAV, and water quality:

- Work bridges would be used for movement of construction equipment in shallow areas and over intertidal marsh.
- Sedimentation and erosion control measures will adhere to the Design Standards in Sensitive Watersheds [15A NCAC 04B.0124 (b)-(e)].
- Bridge piles in open water would be jetted to the tip elevation (depth of the tip of the pile). Potential damage to SAV would minimized to the extent practicable.
- USFWS guidance on manatee protection and NMFS guidance on protecting sea turtles would be followed.
- Other minimization and mitigation strategies contained in open water construction agreements with the NMFS for the Phase IIb Bridge on New Location Alternative would be used as applicable to a Phase IIa Bridge on New Location Alternative.

On land with any of the Phase IIa study alternatives:

- USFWS conservation measures related to protection of threatened and endangered species, including construction lighting requirements during nesting season for sea turtles would be followed.

- Bridge piles over land would be jetted or driven. Potential damage to wetlands, from jetting spoils will be minimized. Jetting spoils would be contained within the existing or, with the Bridge on New Location Alternative, the approved new easements.

5.8 Section 4(f)

The only Section 4(f) resource used by the Phase IIa study alternatives is the Refuge. The Phase IIa study alternatives all use Refuge lands but vary in their use of the Refuge as shown in Table 4. The primary difference in use between the Bridge within Existing NC 12 Easement Alternative and the Bridge on New Location Alternative would be that with the latter, approximately 52 acres of NC 12 easement would be returned to the Refuge. However as discussed in Section 5.3.2, the elimination of the easement and thus paved road access in the expanded Phase IIa project area would eliminate the only section of NC 12 in the Refuge that is not forecasted to be affected by shoreline erosion through 2060 (4.1 miles), of which 1.9 miles also is not in an area susceptible to breaching. Thus, unless future phases north of the expanded Phase IIa project area were to involve moving NC 12 away from the shoreline as a surface road, there would be no paved road access to any part of the Refuge upon completion of all phases of the PBC/TMP Alternative.

Table 4. Section 4(f) Use

	Permanent New NC 12 Easement (acres)	Existing NC 12 Easement Returned to the Refuge (acres)	Change in NC 12 Easement in the Refuge (acres)	Temporary Construction Easement (acres)
Bridge within Existing NC 12 Easement Alternative	--	--	--	0.84
Bridge On New Location Alternative				
• Alignment A	5.99	52.07	-46.08	0.26
• Alignment B	5.84	52.18	-46.34	0.26

As noted in Section 5.3.3, paved roadway in the expanded Phase IIa project provides access to:

- A new parking lot at the northern terminus of Phase IIb.
- The New Inlet boat ramp/parking
- An opportunity to ultimately move and retain within the Refuge the Refuge Visitor Center, interpretive exhibits, and formal trails for visitors now north of Phase IIa.
- Fishing, surfing, use of the beach within the Refuge by visitors.

All of this recreational access would be eliminated with the return of the NC 12 easement to the Refuge with the Bridge on New Location Alternative.

As stated in Section 5.3.1, Alignment A would require 0.4 acres of new NC 12 easement on marsh islands. As described in Section 4.7.4, the Refuge manages the marsh islands as Wilderness areas, although they are not officially designated part of the National Wilderness and Preservation System. This impact would not occur with Alignment B or the Bridge within Existing NC 12 Easement Alternative.

As discussed in 5.4.5 under "Potential for Scour around Bridge Piles on Land during Storm Events," the presence of bridge piles may affect normal patterns of storm-related erosion on land. The pattern change could involve scour holes developing around the piles and the possible channeling of flow between the piles when the piles are subjected to storm surge, while otherwise landward of the mean high water line and generally on dry beach or inland. When built, the Bridge within Existing NC 12 Easement Alternative would be on land for its entire 2.4-mile length. As a part of future environmental impact documentation, pier scour modeling studies will be conducted for any Bridge within Existing NC 12 Easement Alternative being assessed.

Finally, the extent of the visual impact to the Refuge as an historic resource would differ between the alternatives, in that the Bridge within Existing NC 12 Easement Alternative would be within the Refuge for its full length of approximately 2.4 miles. The Bridge on New Location Alternative alignments would be within the Refuge for approximately 0.5 mile.

None of the Phase IIa study alternatives are Section 4(f) avoidance alternatives. The only Section 4(f) avoidance opportunity would come with a future phase that would place NC 12 in Pamlico Sound for its full length from Rodanthe to Oregon Inlet. At this time such an option appears to be feasible; its prudence would need to be considered in future environmental impact documentation from two perspectives:

- Completing the PBC/TMP Alternative in a single phase from the northern end of the Phase IIb Selected Alternative to Oregon Inlet.

- Completing the PBC/TMP Alternative in more than one additional phase that would involve placing each phase prior to the final phase in the sound, but re-entering the Refuge to connect back into existing NC 12 at each phase's terminus, such as occurs with the Phase IIb Selected Alternative and the Phase IIa Bridge on New Location Alternatives. This approach, however, would involve interim Section 4(f) uses.

The prudence of these alternatives likely would need to take into consideration:

- Cost and financial resources available, particularly for an alternative that would build the balance of the PBC/TMP Alternative in a single phase

- The impacts of a continuous bridge in the sound to EFH, SAV, and within the Proclamation Boundary adjacent to the Refuge

- The desirability on the part of Refuge and Seashore officials of eliminating all public road access to the Refuge, including the one section of the Refuge where NC 12 is not threatened by shoreline erosion in the 2060 high erosion forecasts, and regular storm-related repairs of maintenance would not be expected to occur in the foreseeable future.

Other considerations also could reveal themselves during scoping for future phase environmental impact assessment and documentation.

6.0 Conclusions

The cost of the Phase IIa detailed study alternatives and a summary of the impact findings above is presented in Table 5. The following conclusions can be reached:

- The Bridge on New Location Alternative would be substantially more expensive to build than the Bridge within Existing NC 12 Easement Alternative, primarily because of the longer bridge length and the need to erect a work bridge to build it.

- Under the STI, Phase IIa is eligible to compete for highway program funding in the Regional and Division categories. When a long-term Phase IIa project is listed in the STIP during a future prioritization process, NCDOT would explore financing such as GARVEE Bonds to allow NCDOT to spread highway program funding for the project over a long period to ensure that NCDOT can afford the project.

- All the Phase IIa study alternatives could be extended north to Oregon Inlet in a future phase or phases as a Bridge on New Location Alternative in Pamlico Sound or a Bridge within Existing NC 12 Easement Alternative, as well as a surface road on new NC 12 easement, a bridge on new NC 12 easement, and retaining the existing surface road through beach nourishment and dune maintenance.

Table 5. Summary of Cost and Impact Findings

Impact	Bridge within Existing NC 12 Easement Alternative	Bridge on New Location Alternative	
		Alignment A	Alignment B
Cost (millions)	$99,300,000	$250,100,000	$267,300,000
Options for Extending to Oregon Inlet			
• On Hatters Island	Yes		
• In Pamlico Sound	Yes		
Visual Impacts	Bridge a notable new feature in Refuge	In Refuge a short distance; present in sound views from the Refuge	
Cultural Resource Impacts			
• Refuge Historic Landscape	Adverse visual effect		
• Archaeology	No known archaeological resources in expanded Phase IIa project area		
Refuge Impacts			
• New NC 12 Easement (acres)	0.0	6.0	5.8
• NC 12 Easement Returned to Refuge (acres)	0.0	52.1	52.2
• Temporary construction easement (acres)	0.8	0.3	0.3
• Paved road access for recreation use	Access retained to Refuge facilities retained for 2.9 miles	Access to Refuge facilities not retained	
Coastal Process Impacts			
• Allow natural shoreline migration	Yes		
• Flooding During Major Storms	With bridges, there is no significant risk beyond current risk; no significant adverse impact on natural and beneficial floodplain values		
• Erosion and Natural Overwash	Northern terminus approach road vulnerable to shoreline erosion by 2030		
• Accelerated Sea Level Rise	Accounted for in use of bridges, shoreline forecasts, and shoreline monitoring program		
• Island Breach	Bridge area geologically susceptible to breaching	Bypass area geologically susceptible to breaching	

Table 5 (continued). Summary of Cost and Impact Findings

Impact	Bridge within Existing NC 12 Easement Alternative	Bridge on New Location Alternative	
		Alignment A	Alignment B
• Offshore coastal processes	Piles when in ocean within breaker area in 2060, so would not result in scour around piles, effect off shore sediment transport, or effect beach erosion.		
• Scour Around Bridge Piers on Land During Storm Events (length of bridge on land in feet)	Potential for scour could occur around bridge piles on land as a result of storm events. As a part of future environmental impact documentation, pier scour modeling studies will be conducted. The length of bridge on land is:		
	12,410	2,430	2,535
Natural Resource Impacts			
• Surface Waters and Water Quality	On land unless Pea Island breach open	Almost all over Pamlico Sound, an SA water (Class A saltwaters) with a supplemental classification as High-Quality Water (HQW)	
• Upland communities Affected (acres)			
– Permanent Fill and Pile[1]	2.89	1.12	1.13
– Permanent Shading[1]	9.99	1.51	1.84
– Temporary[1]	0.62	0.26	0.26
• Open Water/EFH Affected (acres)			
– Permanent Fill	0.00	0.00	0.00
– Permanent Pile	0.00	0.23	0.25
– Permanent Shading	0.00	22.89	24.85
– Temporary	<0.01	0.00	0.00
• SAV Affected			
– Permanent Fill	0.00	0.00	0.00
– Permanent Pile	0.00	0.03	0.04
– Permanent Shading	0.00	2.61	4.37
– Temporary	0.00	0.00	0.00
• Wetlands Affected (acres)			
– Permanent Fill	0.06	0.04	0.04
– Permanent Pile	<0.01	0.01	0.01
– Permanent Shading	0.16	1.19	0.71

Table 5 (concluded). Summary of Cost and Impact Findings

Impact	Bridge within Existing NC 12 Easement Alternative	Bridge on New Location Alternative	
		Alignment A	Alignment B
– Temporary	0.22	0.00	0.00
• CAMA Wetlands Affected (acres)			
– Permanent Fill	0.00	0.00	0.00
– Permanent Pile	0.00	0.01	<0.01
– Permanent Shading	<0.01	0.95	0.41
– Temporary[1]	0.11	0.00	0.00
• Birds	Affects Pea Island breach area bird habitat	Affects Pea Island breach area and Pamlico Sound (including marsh islands) bird habitat	Affects Pea Island breach area and Pamlico Sound bird habitat
• Protected species	May Affect, Likely to Adversely Affect piping plover, rufa red knot, and sea turtles on land	May Affect, Likely to Adversely Affect piping plover, rufa red knot, sea turtles on land, and aquatic species	

[1] Minor differences between these totals and totaling the individual biotic community numbers in Table 2 reflect rounding error.

- Impacts to the appearance of the Refuge as an historic landscape would be greatest with the Bridge within Existing NC 12 Easement Alternative.

- The Bridge within Existing NC 12 Easement Alternative would have the greatest potential impact on resources within the Refuge. A storm surge potentially could create scour holes around bridge piles on land. This alternative would, however, allow the retention of paved road access to the Refuge and some Refuge facilities for 2.9 miles. This is potentially the only opportunity from Rodanthe to Oregon Inlet to retain paved road access in the Refuge unless future phases north of Phase IIa retain all or part of a surface road.

- The Bridge on New Location Alternative (both alignments) would have the greatest impact on essential fish habitat, aquatic protected species habitat, and submerged aquatic vegetation by bridging over Pamlico Sound for 5.1 miles with Alignment A and 5.4 miles with Alignment B.

- Wetland fill impacts would range from 0.04 acre to 0.06 acre.

- The Bridge on New Location Alternative Alignment A would have 0.95 acre of shading impact on CAMA resources versus 0.41 with Alignment B and less than 0.01 acre with the Bridge within Existing NC 12 Easement Alternative. The larger impact with Alignment A would result from bridging part of a marsh island.

- All of the Phase IIa study alternatives would affect key areas of bird habitat in the Pea Island breach area. The Bridge on New Location Alternative alignments also would affect the bird habitat offered by Pamlico Sound. Alignment A also would bridge marsh island bird habitat, which is managed as Wilderness by the Refuge.

For a detailed study alternative decision as a part of a future revisit of merger process Concurrence Point 2, the findings of the alternatives study report indicate that the Bridge within Existing NC 12 Easement and Bridge on New Location alternatives offer differing pros and cons. They both warrant both be considered in detail in future environmental impact documentation. A key difference between Bridge on New Location Alternative alignments A and B is that Alignment A would bridge marsh islands managed by the Refuge as Wilderness and Alignment B would not. Merger Team representatives could conclude that that factor would warrant a decision not to carry alignment A forward as a detailed study alternative in future environmental impact documentation.

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Appendix

Merger Team Meeting Handout and Summary

Phase IIa Bridge on New Location Alternative Conceptual Alignment Assessment

October 19, 2016 Merger Team Informational Meeting

prepared by Parsons Brinckerhoff

October 7, 2016

Introduction

The April 2015 agreement that settled the Bonner Bridge Replacement Project lawsuits brought forth by the Defenders of Wildlife and the National Wildlife Refuge Association states:

> NCDOT shall prepare a report on the Phase II Extension Alternative within one and one-half years of the [lawsuit] dismissals referred to in paragraph l.h. The report shall contain information and evaluation sufficient to support Concurrence Points 2 and 2A for the Phase II Extension, and shall inform the analysis necessary for Concurrence Point 3 and for the Section 4(f) evaluation. The report shall, without limitation:
>
> 1. Describe the environmental features of the Phase II Extension study area, including performing new studies or updating existing studies of the topography, coastal condition, wetland and open water habitat, protected species, essential fish habitat, historic properties, and utilities.
>
> 2. Identify preliminary corridors that address the Purpose and Need for the project and consider the environmental constraints within the study area, including preparing conceptual/functional designs with horizontal and vertical alignments, edge of pavements, slope stakes, and right of way limits on digital orthophotography, as needed.
>
> 3. Include meeting summaries describing recommendations from members of the Merger Team, stating the rationale for retaining or dropping conceptual alternatives. Based on the input from the Merger Team, NCDOT shall identify the alternatives to be carried forward for more detailed design (preliminary level design).
>
> 4. Describe the development of the preliminary designs and, after coordination with key federal and State agencies, identify environmental impacts and possible measures to minimize such impacts.
>
> 5. Provide cost estimates and identify funding alternatives based on the preliminary design.

The Phase II Extension Alternative refers to an option that extends the Phase IIb Bridge on New Location Alternative (selected as the B-2500B LEDPA) to the north end of the Phase IIa study area. The Phase II Extension Alternative concept was first presented to the Merger Team in a meeting on September 11, 2014. For the purpose of today's meeting and this study, the Phase II Extension Alternative has been renamed as the **Phase IIa Bridge on New Location Alternative**.

The purpose of this report is to document the information used in evaluating the referenced "preliminary corridors" examined to date for discussion with the Merger Team. Based on Merger Team comments today, NCDOT will:

- Select conceptual alignments for preliminary design
- Prepare preliminary designs, cost estimates, and a discussion of funding options
- Prepare an Alternatives Study Report, which could later be used in the context of revisiting Phase IIa Concurrent Points 2 and 2A

The NCDOT study team is updating its biotic community information in the Phase IIa area, delineating wetlands where they have not been previously delineated, and completing additional research on protected species, essential fish habitat, and migratory and other waterfowl characteristics in Pamlico Sound.

The completed Alternatives Study Report will be discussed with the Merger Team at a future informational meeting.

The overall Bonner Bridge Project area is shown in Figure 1. This report presents and examines three conceptual Bridge on New Location Alternative alignments for Phase IIa. They are labeled Alignments A, B and AB. Alignments A and B are separate alignments. Alignment AB begins on the south with Alignment A and switches to the B alignment. These three alignments and the Bridge within Existing NC 12 Easement Alternative (Selected Alternative in the October 2013 *Record of Decision for NC 12 – Pea Island Long-Term Improvements Bonner Bridge Replacement Project Phase IIa*) are shown on Figure 2. The Figure 2 map coverage is noted in Figure 1.

The settlement agreement also states:

> NCDOT and FHWA shall not design Phase IIa and Phase IIb of the Project so as to preclude the construction of subsequent phases within Pamlico Sound.

In order to address this requirement, this assessment also presents the opportunities available to extend both the conceptual Phase IIa Bridge on New Location Alternative alignments discussed in this report and the Bridge within Existing NC 12 Easement

Alternative. Figure 2 also shows the following possible "connectors" from the north end of Phase IIa to the new bridge over Oregon Inlet.

- Connectors C and D are two options for connecting the Phase IIa Bridge within Existing NC 12 Easement Alternative to a bridge continuing north in Pamlico Sound
- Connector E illustrates how Alignment A could be extended to a bridge continuing north in Pamlico Sound
- Connector F illustrates how Alignments B and AB could be extended to a bridge continuing north in Pamlico Sound
- Connectors G and H illustrate two possible alignments for extending the other connectors to the new Oregon Inlet bridge

The connectors illustrate the feasibility of extending either the Phase IIa Bridge on New Location conceptual alignments or the Bridge within Existing NC 12 Easement Alternative to Oregon Inlet. Connectors E and F also are considered a factor in the selection alignments to pursue further in this alternatives study because they illustrate how much new bridge would be needed and how much bridge might need to be removed with the extension of each Phase IIa Bridge on New Location Alternative conceptual alignment.

Alignment and Connector Descriptions

Phase IIa Bridge on New Location Alternative Conceptual Alignments

All of the Phase IIa Bridge on New Location Alternative conceptual alignments assume the following:

- They are more than 300 feet from the estuarine shoreline and (for the most part) no closer than 200 feet from existing marsh islands.
- They have a design speed of 60 mph and a minimum horizontal curve radius of 2,250 feet, per the design criteria of other Bonner Bridge Replacement Project phases.
- Bridging over wetlands, Coastal Area Management Act (CAMA) resources, and the Refuge outside the existing NC 12 easement. The northern bridge approach fill is within the existing NC 12 easement, as was done with Phase IIb Bridge on New Location Alternative (B-2500B LEDPA) and the Phase IIa Bridge within Existing NC 12 Easement Alternative.
- Minimize (to the extent possible) bridging over submerged aquatic vegetation (SAV) beds as depicted on current infrared photography and North Carolina Department of Environmental Quality (NCDEQ) SAV mapping from 2013.

- Avoid Refuge historic features.

As shown on the Figure 2:

- Alignment A (5.04 miles of bridge) parallels the shoreline in the southern portion of the project area before turning back to the shore. It is farther from the estuarine shoreline that Alignment B. This alignment would bridge a marsh island complex as it approaches Pea Island.

- Alignment B (5.38 miles of bridge) parallels the estuarine shoreline closer than Alignment A before moving further into the sound to circumvent the marsh island complex that Alignment A bridges.

- Alignment AB (5.39 miles of bridge) follows the route of Alignment A in the southern portion of the bridge, paralleling the shore further out than Alignment B. As Alignment A turns to go back into the Island, Alignment AB begins to follow the route of Alignment B and circumvent the marsh islands.

There are five horizontal curves with Alignments B and AB and four with Alignment A.

Connectors to Oregon Inlet

Connector E brings Alignment A back out into the sound in a potential future phase. The connector is 1.45 miles long. If at the time of such an extension, the connection to the Refuge were removed, 0.86 miles of bridge would be removed. The total bridge added or removed is 2.31 miles.

Connector F brings Alignments B and AB back out into the sound in a potential future phase. The connector is 1.27 miles long. If at the time of such an extension, the connection to the Refuge were removed, 1.29 miles of bridge would be removed. The total bridge added or removed is 2.56 miles.

Connectors C and D (associated with the Bridge within Existing NC 12 Easement Alternative) differ in that Alignment C creates as little new easement in the Refuge as possible, but bridges a part of the remains of the historic bridge over New Inlet, while Alignment D requires more new NC 12 easement in the Refuge but avoids bridging New Inlet bridge remains. These alignments illustrate that the opportunity exists to extend the Bridge within Existing NC 12 Easement Alternative north to Oregon Inlet. Evaluation of such an alignment will not occur until a future alternatives study.

Connectors G and H illustrate two ways of connecting to the Oregon Inlet bridge while seeking to avoid SAV beds as much as possible. Evaluation of such alignments will not occur until a future alternatives study.

Assessment of Phase IIa Bridge on New Location Alternative Conceptual Alignments

The attached table compares conceptual alignments A, B, and AB in terms of their potential environmental impacts based on the following parameters:

- Bridge over Pamlico Sound and the Refuge
- Bridge over SAV and CAMA wetlands
- Proximity to estuarine shoreline
- Proximity to marsh islands
- Proximity to pond dikes (the closest historic feature)
- Wetlands filled

The alignments have the following key differences:

- Alignment A is over Pamlico Sound for a shorter distance (4.53 miles) than Alignments B and AB (4.84 and 4.85 miles).
- Alignments B and AB include a smaller amount of new NC 12 easement within the Refuge, based on both distance and total area: 0.34 miles/4.4 acres with Alignments B and AB versus 0.46 miles/5.67 acres with Alignment A.
- Alignment A would affect fewer SAV beds, bridging 1.52 acres versus 2.85 acres with Alignments B and AB. Alignments B and AB would bridge fewer CAMA wetlands (0.11 miles) than Alignment A (0.07 miles). With a composite of both SAV and CAMA wetlands, Alignment A would bridge 0.43 miles of and shade 2.1 acres of these sensitive biotic communities. Alignments B and AB would have a larger composite impact, bridging 0.67 miles and shading 3.2 acres of these communities.
- Alignments B and AB do not bridge marsh islands. Alignment A bridges a marsh island complex and would present a barrier between the islands. This could fragment the habitat of wading birds in the marsh islands. Alignments A and AB by circumventing the marsh island complex would not have the adverse effect of bifurcating the complex. There are no known feeding grounds on these marsh islands.
- All three alignments traverse the overwash area of the Pea Island breach (0.13 to 0.14 miles bridged), which could affect shorebirds nesting and foraging in the sand. These shorebirds include the protected species piping piper and rufa red knot. However, many of these species have the ability to fly in and out of the wash-over area and would still have access to the sand fan.

- The Alignment A bridge gets closer to the pond dike (85 feet) than Alignments B and AB (730 feet); however, Alignments B and AB stay within views of the sound from the dike for a longer distance than Alignment A before turning south.

- Alignment AB stays more than 200 feet from marsh islands for all but 0.35 mile; this length is 0.53 miles with Alignment A and 0.60 miles with Alignment B. Alignment A bridges marsh island for 544 feet.

- None of the alignments place fill in wetlands.

Request for Comments

All three Phase IIa Bridge on New Location Alternative conceptual alignments are feasible. The feedback needed from the Merger Team is as follows:

- Do you have any notable concerns with any of the alignments, and what are those concerns?

- What refinements to the alignments do you suggest be examined?

- Are there other alignments you suggest and why?

- What other important environmental issues need to be considered in the alternatives screening?

- Do you have results of studies you have done in this area that would be useful to the alternatives analysis? Are there persons you think the NCDOT study team should talk to learn more about the study area?

- Other observations and comments?

Comparison of Conceptual Phase IIa Bridge on New Location Alternative Alignments

	Alignments		
	A	**B**	**AB**
Total Bridge Length (miles)	5.04	5.38	5.39
Bridge Over Pamlico Sound (miles)	4.53	4.84	4.85
Bridge Over Refuge (miles)	0.46	0.34	0.34
Total Bridge Deck Area	24.45	26.07	26.16
Additional 100-Foot NC 12 Easement in Refuge (acres)	5.67	4.40	4.40
Bridge Over SAV Beds (miles)	0.32	0.60	0.60
Bridge Deck Over SAV beds (acres)	1.52	2.85	2.85
Bridge Over Breach Overwash (miles)	0.14	0.13	0.13
Fill In Wetlands (acres)	0.00	0.00	0.00
Bridge Over CAMA Wetlands (miles)	0.11	0.07	0.07
Bridge Deck Over CAMA Wetlands (acres)	0.58	0.38	0.38
Closest Distance to Shoreline (excluding marsh islands) (feet)	365	303	365
Bridge within 400 Feet of Shoreline (miles)	0.44	0.30	0.30
Bridge within 200 Feet of Marsh Islands (miles)	0.53 (bridges marsh island for 544 feet)	0.60	0.35
Distance to Closest Refuge Historic Feature (pond dike) (feet)	85	730 (however, in views from the dike longer than Alignment A)	730 (however, in views from the dike longer than Alignment A)
Design Speed (mph)	60	60	60
Minimum Horizontal Curve Radius (feet)	2,250	2,250	2,250
Number of Horizontal Curves	4	5	5

Figure 1 of this Merger Team handout is presented as Figure 2 in the main body of this Phase IIa Alternatives Study Report

Figure 2 of this Merger Team handout is presented as Figure 3 in the main body of this Phase IIa Alternatives Study Report

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MEMORANDUM

To: Merger Team Members
From: John Page
Date: November 21, 2016
Project Name: Bonner Bridge Replacement Project, Additional Phase IIa Studies
Project Number: B-2500A
Subject: October 19, 2016 Informational Merger Meeting Summary **DRAFT**

Attendees:

David Hering	NCDOT- Design Build
Byron Kyle	NCDOT- Design Build
Jerry Jennings	NCDOT- Division 1
Shawn Mebane	NCDOT- Division 1
Drew Joyner	NCDOT- HES
Paul Atkinson	NCDOT- Hydraulics
LeiLani Paugh	NCDOT- NES
Chris Rivenbark	NCDOT- NES
Michael Turchy	NCDOT- NES
Morgan Weatherford	NCDOT- NES
Nora McCann	NCDOT- PDEA
Brian Yamamoto	NCDOT- PDEA
Gary Lovering	NCDOT- Roadway Design
Kevin Fischer	NCDOT- SMU
Hardee Cox	NCDOT- STIP
Pareshkumar Patel	NCDOT- STIP
Dock Rosenthal	NCDOT- TPB
Garcy Ward	NCDEQ-DWR
Travis Wilson	NCWRC
Cathy Brittingham	NCDEQ-DCM
Clarence Coleman	FHWA
Ron Lucas	FHWA
Art Beyer	USFWS-Refuge
Gary Jordan	USFWS-Raleigh
Scott Lanier	USFWS-Refuge
Keith Hanson	NMFS
Steve Thompson	NPS
Kyle Barnes	USACE
Tracey Wheeler	USACE
Cynthia Van Der Wiele	USEPA
Beth Smyre	Dewberry
John Page	WSP | PB
Eric Misak	WSP | PB
Tim Brock	WSP | PB
Kathy Herring*	NCDOT- NES
Amy Chapman*	NCDEQ-DWR

DRAFT

Greg Daisey*	NCDEQ-DCM
Doug Huggett*	NCDEQ–DCM
Mark Staley*	NCDOT Roadside Environmental

*Attended via Conference Call

The meeting began with a brief update on coastal conditions resulting from Hurricane Matthew. Jerry Jennings said there was sand and water on NC12 but no dune breaches or pavement loss. Shawn Mebane noted that the Bonner Phase IIa new interim bridge has 14 of 42 spans set. During the hurricane, two construction barges got loose and floated about 25 miles down the coast on the Atlantic Ocean side near Avon and Buxton.. The contractor is in the process of recovering those two barges.

Conceptual Phase IIa Bridge on New Location Alternative alignments for the new Phase IIa alternatives study were presented for discussion. Nora McCann introduced and reviewed the merger meeting informational packet and explained the purpose of the alternative analysis.

USACE asked where this meeting was situated in the Merger Team process. Nora McCann and Brian Yamamoto said the meeting was an informational meeting to inform the Merger Team of the new Phase IIa alternatives study and receive comments on proposed Phase IIa Bridge on New Location Alternative alignments and connectors to the new Oregon Inlet bridge. A decision could be made after the completion of the alternatives study to take the Merger Team Process for Phase IIa back to Concurrence Point 2. John Page noted that previous Record of Decision was still in place with FHWA and the Merger Process currently stands completed and all permits issued. USACE asked that if the project returns to Concurrence Point 2 would additional information be provided to the Merger Team on the alternatives. Brian Yamamoto said yes..

Beth Smyre reviewed the criteria used in developing the proposed Phase IIa Bridge on New Location Alternative alignments and the connectors to the new Oregon Inlet bridge.

Regarding Cape Hatteras National Seashore and Pea Island National Wildlife Refuge property boundaries, NPS confirmed that their boundaries extend to 150 feet from the estuarine shoreline but that they have not considered marsh islands as NPS property nor have claimed a 150 foot extent off marsh islands in the past. The US Fish and Wildlife Service (USFWS)-Refuge noted that the marsh islands are considered Refuge lands and would need to be included in any analysis as Refuge property. They also indicated that they preferred that marsh islands be avoided. The NPS then said that if the Refuge claimed the marsh islands that the NPS 150-foot from the shoreline boundary also would apply to the marsh islands. Parsons Brinkerhoff indicated that the current analysis in the informational handout had not assumed the marsh islands were part of the Refuge. It was agreed that going forward, the analysis will reflect the marsh islands as part of the Refuge and the NPS property boundary extending 150 feet from the marsh islands. NPS provided NCDOT a copy of the deed that defined the 150-foot boundary within Pamlico Sound.

There was discussion initiated by NMFS about the ephemeral nature of the estuarine shoreline, marsh islands, and SAV beds. It was noted that the data for this alternatives study used infrared aerial photos and SAV boundaries obtained from NCDEQ and NC Division of Marine Fisheries to identify potential SAV beds. NCDCM reminded NCDOT that SAV mitigation is expensive. All of Pamlico Sound is considered essential fish habitat. It was also noted that comparing the aerial photo series between years could, in the future, aid in the identification of more stable SAV areas versus more dynamic SAV areas that change more frequently.

NCDCM asked if the north bridge approaches of the new alignments were 230 feet behind the 2060 shoreline. NCDCM noted that the northern terminus would have to meet the NCDCM setback requirements to obtain a permit. The project team said that the approaches are on the same location that was previously approved for the current Bridge within Existing NC 12 Easement Alternative. [This terminus is in the ocean using the 2060 high erosion shoreline, and any alternative likely would need to be extended before 2060. The bridge would need to terminate at the Refuge middle impoundment area for the approach to be more than 230 feet from the 2060 high erosion shoreline.]

Connector C, one two potential alignments shown to extend the Bridge within Existing NC 12 Easement Alternative to Oregon Inlet via Pamlico Sound, crosses the remnants of a wooden bridge structure built to cross the New Inlet that opened in the 1930s. The bridge is outside the Area of Potential Effects of alternatives considered in the past in the Phase IIa area. Consultation with the State Historic Preservation Office (HPO) is needed. Cathy Brittingham suggested if the HPO did not consider the bridge to be a contributing element to the Refuge as a historic landscape that Connector D be dropped from further consideration. Ron Lucas agreed and noted that Connector C leaves the island more directly and has fewer curves. Connector C also would require less new NC 12 easement in the Refuge than Connector D.

NCWRC asked the representatives from USFWS if they had bird survey data related to the marsh islands near the impoundments. USFWS-Refuge said they do have data on waterfowl use. USFWS-Raleigh indicated that the Programmatic Biological Opinion of 2008 states that each new phase will be reevaluated in terms of protected species. The wash-over at the Pea Island breach has become new piping plover habitat that needs to be considered. As a result, there may be a new Adverse Effect to the piping plover that had not been previously considered. John Page noted that CZR would contacting USFWS-Refuge for their bird data soon.

Cathy Brittingham inquired about merits of the Pamlico Sound Bridge Alternative that was previously considered. Cathy noted that it would avoid natural resources but had been eliminated because of cost concerns. Beth Smyre said the cost problem was that the alternative could not be phased in such a way that it could be open to traffic without completion of the entire alternative. NCDOT-Division 1 noted that the budget constraints facing the division remain true today.

Doug Huggett asked if the construction of a Bridge on New Location Alternative would require dredging in Pamlico Sound. Brian Yamamoto said that it is assumed that these alternatives would be built without dredging, for example with the use of work bridges where the water is too shallow to float a barge.

Beth Smyre and Nora McCann asked that Merger Team members submit any additional comments and questions by October 31st.

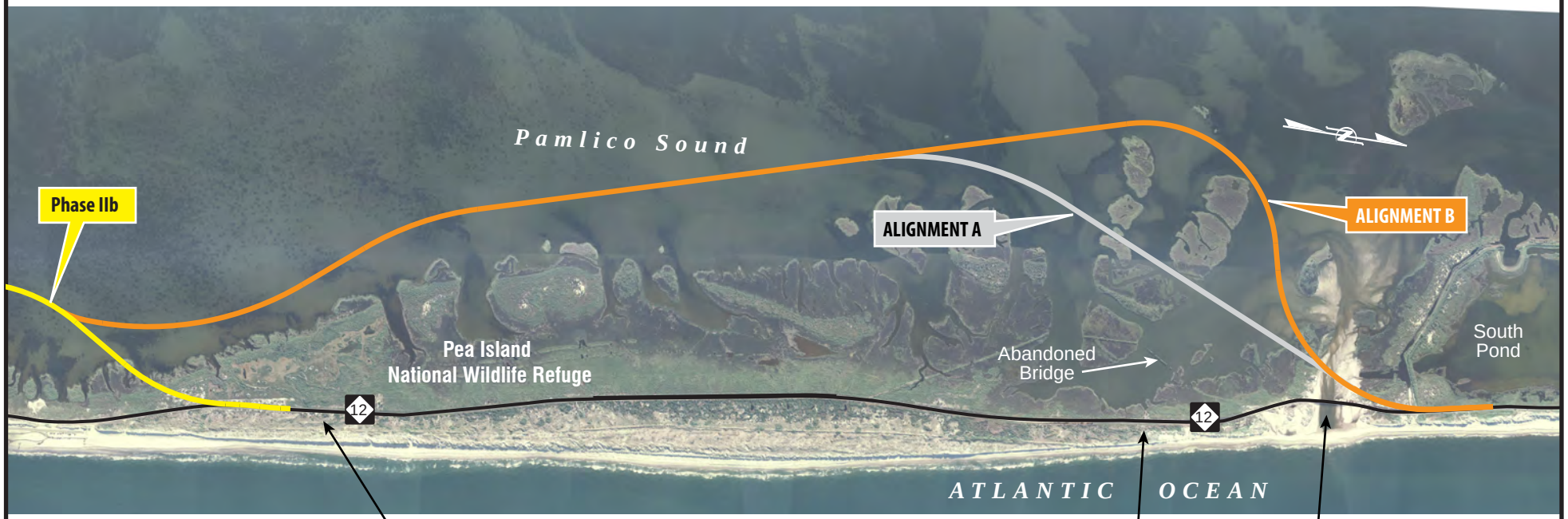
Next steps in the Merger Process were discussed. There will be one more Merger Team informational meeting before this alternatives study is completed. It is expected that when the NEPA process for Phase IIa begins again, the first step will be to revisit Concurrence Point 2, the selection of detailed study alternatives. It was noted that Phase IIa is not funded in the current State Transportation Improvement Program.

After the formal portion of the meeting concluded, LeiLani Paugh presented an update on the Phase I SAV mitigation site. Construction of the site is scheduled to begin in November; it is expected to be completed by the end of the year. The SAV within the breakwater footprint were transplanted last May, and the ReefMaker units that will form the site's breakwater are currently under construction. This presentation included photos from the casting yard of the breakwater units, each a four-tiered concrete form with stone insets set on a pilings. The first monitoring report for the project will be submitted in Spring 2017.

Following the meeting, the study team discussed and made the following revisions to the alignments presented at the meeting:

- Eliminated Alignment B up to its junction with Alignment A because the bridge centerline would be closer than 200 feet from marsh islands.
- At the later suggestion of NCDOT, increased the radius of the curve at Alignment A's connection with the Phase IIb bridge and adjusted the alignments of Connectors G and H so they join the new Oregon Inlet bridge where the superstructure changes from concrete box girders to beams, improving constructability while remaining more than 200 feet from the shoreline.

The revised drawing is attached.



Aerial date: 2014

Alignment A

Alignment B

PHASE IIa BRIDGE ON NEW LOCATION ALTERNATIVE ALIGNMENTS