MID-CURRITUCK BRIDGE STUDY

NATURAL RESOURCES TECHNICAL REPORT

WBS ELEMENT: 34470.1.TA1
STIP NO. R-2576
CURRITUCK COUNTY
DARE COUNTY

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November 2009

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1.0 Introduction

The North Carolina Turnpike Authority (NCTA), in cooperation with the Federal Highway Administration (FHWA) and the North Carolina Department of Transportation (NCDOT), is preparing a Draft Environmental Impact Statement (DEIS) to evaluate proposed improvements in the Currituck Sound area. The proposed action is included in NCDOT's 2009-2015 *State Transportation Improvement Program* (STIP), the North Carolina Intrastate System, the North Carolina Strategic Highway Corridor Plan, and the Thoroughfare Plan for Currituck County. This report focuses on the potential direct impacts of the detailed study alternatives. An assessment of the potential indirect and cumulative effects of the detailed study alternatives is presented in the *Indirect and Cumulative Effects Technical Report (*Parsons Brinckerhoff, 2009).

The project area is in northeastern North Carolina and includes the Currituck County peninsula on the mainland and its Outer Banks, as well as the Dare County Outer Banks north of Kitty Hawk (see Figures 1 and 2 in Appendix A). The project area is south of the Virginia Beach-Norfolk, Virginia (Hampton Roads) metropolitan area. The project area encompasses two thoroughfares, US 158 from NC 168 to NC 12 (including the Wright Memorial Bridge) and NC 12 north of its intersection with US 158 to its terminus in Currituck County. US 158 is the primary north-south route on the mainland. NC 12 is the primary north-south route on the Outer Banks. The Wright Memorial Bridge connects the mainland with the Outer Banks.

The proposed action responds to three underlying needs in the project area. These needs are based on the following travel conditions:

- The project area's main thoroughfares (US 158 and NC 12) are becoming increasingly congested, and congestion will become even more severe in the future.
- Increasing congestion is causing travel time between the Currituck County mainland and the Currituck County Outer Banks to increase, especially during the summer.
- Evacuation times for residents and visitors who use US 158 and NC 168 as an evacuation route far exceed the State-designated standard of 18 hours.

An alternatives screening study was conducted for the project. Its findings were discussed with federal and state environmental resource and regulatory agencies in a series of Turnpike Environmental Agency Coordination (TEAC) meetings in 2006, 2007, 2008, and 2009. Based on discussions at TEAC meetings, and written comments received from the agencies and public, the *Alternatives Screening Report* (Parsons Brinckerhoff, 2009) for the proposed project identified three alternatives to be carried forward for detailed study in the DEIS along with the No-Build Alternative. The detailed study alternatives identified are ER2, MCB2, and MCB4. The detailed study alternatives are shown on Figure 3 in Appendix A and described below:

- ER2
  - Adding for evacuation use only, a third outbound evacuation lane on US 158 between NC 168 and the Wright Memorial Bridge as a hurricane evacuation improvement or using the existing center turn lane as a third outbound evacuation lane; in either case one inbound lane on the Wright Memorial Bridge and on the Knapp (Intracoastal Waterway) Bridge would be used as a third outbound evacuation lane;
  - Widening US 158 to a six-lane super-street between the Wright Memorial Bridge and Cypress Knee Trail that widens to eight lanes between Cypress Knee Trail and the Home Depot driveway;
  - Constructing an interchange at the current intersection of US 158, NC 12, and the Aycock Brown Welcome Center entrance, including six through lanes on US 158 starting at the Home Depot driveway and returning to four lanes just south of Grissom Street; and
  - Widening NC 12 to three lanes between US 158 and a point just north of Hunt Club Drive in Currituck County (except where NC 12 is already three lanes in Duck) and to four lanes with a median from just north of Hunt Club Drive to Albacore Street.
- MCB2
  - Constructing a two-lane toll bridge across Currituck Sound, as well as approach roads and/or bridges and an interchange at US 158;
  - Adding for evacuation use only, a third outbound evacuation lane on US 158 between NC 168 and the Mid-Currituck Bridge as a hurricane evacuation improvement or using the existing center turn lane as a third outbound evacuation lane; in either case one inbound lane on the Knapp (Intracoastal Waterway) Bridge would be used as a third outbound evacuation lane;
  - Widening US 158 to a six-lane super-street between the Wright Memorial Bridge and Cypress Knee Trail and an eight-lane super-street between Cypress Knee Trail and the Home Depot driveway;
  - Constructing an interchange at the intersection of US 158, NC 12, and the Aycock Brown Welcome Center entrance, including six through lanes on US 158 starting at the Home Depot driveway and returning to four lanes just south of Grissom Street; and
  - Widening NC 12 to three lanes between US 158 and a point just north of Hunt Club Drive in Currituck County (except where NC 12 is already three lanes in Duck) and to four lanes with a median from just north of Hunt Club Drive to NC 12's intersection with the Mid-Currituck Bridge.

- MCB4
  - Constructing a two-lane toll bridge across Currituck Sound, as well as approach roads and/or bridges and an interchange at US 158;
  - Adding for evacuation use only, a third outbound evacuation lane on US 158 between NC 168 and the Mid-Currituck Bridge as a hurricane evacuation improvement or using the existing center turn lane as a third outbound evacuation lane; in either case one inbound lane on the Knapp (Intracoastal Waterway) Bridge would be used as a third outbound evacuation lane;
  - Adding for evacuation use only, a third outbound evacuation lane on US 158 between the Wright Memorial Bridge and NC 12 as a hurricane evacuation improvement or using the existing center turn lane as a third outbound evacuation lane; in either case one inbound lane on the Wright Memorial Bridge would be used as a third outbound evacuation lane; and
  - Widening NC 12 in Currituck County to four lanes with a median from Seashell Lane to NC 12's intersection with the Mid-Currituck Bridge.

The unique characteristic of a super-street, included along US 158 east of the Wright Memorial Bridge with ER2 and MCB2, is the configuration of the intersections. Side-street traffic wishing to turn left or go straight must turn right onto the divided highway where it can make a U-turn through the median a short distance away from the intersection. After making the U-turn, drivers can then either go straight (having now accomplished the equivalent of an intended left turn) or make a right turn at their original intersection (having now accomplished the equivalent of an intention to drive straight through the intersection).

For MCB2 and MCB4, two design options are evaluated for the approach to the bridge over Currituck Sound, between US 158 and Currituck Sound. Option A would place a toll plaza within the US 158 interchange. The mainland approach road to the bridge over Currituck Sound would include a bridge over Maple Swamp. With Option B, the approach to the bridge over Currituck Sound would be a road placed on fill within Maple Swamp. Aydlett Road would be removed and the roadbed restored as a wetland. Traffic traveling between US 158 and Aydlett would use the new bridge approach road. A local connection would be provided between the bridge approach road and the local Aydlett street system. The toll plaza would be placed in Aydlett east of that local connection so that Aydlett traffic would not pass through the toll plaza when traveling between US 158 and Aydlett. No access to and from the Mid-Currituck Bridge would be provided at Aydlett.

Also for MCB2 and MCB4, there are two variations of the proposed bridge corridor (see Figure 3 in Appendix A) in terms of its terminus on the Outer Banks. Bridge corridor C1 would connect with NC 12 at an intersection approximately two miles north of the Albacore Street retail area, whereas bridge corridor C2 would connect with NC 12 approximately one-half mile south of this area. The length of the proposed

Mid-Currituck Bridge would be approximately 7.0 miles with bridge corridor C1, whereas it would be approximately 7.5 miles with bridge corridor C2.

When impacts differ for the three alternatives (ER2, MCB2, and MCB4) between the mainland approach road design options (Option A and Option B) and/or the two bridge corridors (C1 and C2), the names of the alternatives are augmented with suffixes for the mainland approach road design option and/or the bridge corridor. For example, MCB2 with mainland design Option B and the C1 corridor is referred to as MCB2/B/C1. In situations where impacts differ between the bridge corridors but the design option on the mainland is not relevant to the comparison, only the corridor suffix is used (e.g., MCB2/C1). When differences are confined to the mainland design options, only the design option suffix is used (e.g., MCB2/A). If no suffix is provided (e.g., MCB2), then the reader can assume that impacts would be identical irrespective of the mainland design option or corridor terminus alternative used.

2.0 Methodology and Qualifications

All work conducted towards the completion of this document was performed according to approved NCDOT protocols defined in the Natural Environment Unit (NEU) standard operating procedures dated July 24, 2006. These are the procedures that were in force at the time the natural resource assessment was initiated. On-site fieldwork was conducted in April 1994 and June 1995; during the period from September 2007 through January 2008; in May, July, and October 2008; and in January 2009. Jurisdictional areas identified in the project area were verified in the field by Bill Biddlecome of the US Army Corps of Engineers (USACE) on November 1, 2007, December 6, 2007, January 8, 2008, and October 22, 2008. David Wainwright of the North Carolina Department of Environment and Natural Resources (NCDENR), Division of Water Quality (DWQ) verified jurisdictional areas in the field on December 19, 2007 and October 22, 2008. Further details of the methodology and findings are reported in the respective sections of this report. The principal personnel contributing to this document were:

Investigator:	Steve Beck
Education:	B.S. Biology, Juniata College
Experience:	Biologist, CZR Incorporated, 2006-2009
Responsibilities:	Wetland and stream delineations and assessments, aquatic and terrestrial community assessment, threatened and endangered species assessment, document preparation.

Investigator:	T. Travis Brown
Education:	B.S. Wildlife Biology, Murray State University M.S. Biology, Murray State University
Experience:	Biologist, CZR Incorporated, 2007-2008
Responsibilities:	Aquatic and terrestrial community assessment, threatened and endangered species assessment, document preparation.

Investigator:	Samuel Cooper
Education:	B.S. Biology, Northland College M.S. Marine Biology, UNC-Wilmington
Experience:	Project Manager, Sr. Environmental Scientist, CZR Incorporated 1988-present
Responsibilities:	Project review and coordination.

Investigator:	Barbara Goad
Experience:	Graphics Manager/CADD Operator, CZR Incorporated, 1988-present
Responsibilities:	Computer and manual generated AutoCadd and ArcGIS.

Investigator:	Lorrie Laliberte
Education:	B.A. Conservation Biology, UNC-Wilmington M.S. Coastal Marine and Wetland Studies, Coastal Carolina University
Experience:	Biologist, CZR Incorporated, 2006-present
Responsibilities:	Document preparation, impact evaluations, wildlife assessments.

Additional CZR Incorporated personnel who contributed to portions of the field work and/or documentation for this project were Julia Berger, Mark Grippo, and Terry Jones. Appendix D lists the qualifications of these contributors.

3.0 Physical Resources

Currituck County and Dare County are in northeastern North Carolina within the Tidewater Region of the Atlantic Coastal Plain physiographic province. The project area is depicted on Figure 2 in Appendix A. Topography of the project area consists of nearly level and gently sloping land that drains primarily into Currituck Sound and the North River. Mainland portions of the project corridors traverse several distinctive landscapes. The eastern edge of Great Swamp occurs west of US 158 along the edge of the project area. Great Swamp is a low elevation wetland associated with the North River. US 158 follows a well drained ridge near the western edge of the project area. East of this ridge lies a broad, level, poorly drained, linear depression occupied by Maple Swamp. Another well drained ridge occurs between Maple Swamp and Currituck Sound. Mainland development is concentrated along these upland ridges. Elevations on the mainland range from near sea level to approximately 20 feet above sea level, and elevations along the Outer Banks range from sea level to approximately 40 feet above sea level on top of dunes.

3.1 Soils

US Natural Resources Conservation Service (NRCS) soil data for Currituck and Dare counties (NRCS, 2008) identify 29 soil types and areas occupied by water within the project area (see Table 1).

3.2 Water Resources

3.2.1 Surface Waters

The project region is in the Pasquotank River Basin (US Geologic Survey [USGS] Hydrologic Unit 03010205), a drainage basin covering approximately 3,750 square miles in the North Carolina Coastal Plain physiographic province. It encompasses numerous small watersheds that empty into the Albemarle, Currituck, Croatan, Roanoke, and Pamlico sounds, in addition to the sounds themselves. The Pasquotank River Basin forms part of the Albemarle-Pamlico Estuarine System, the second-largest estuarine system in the United States. The NCDENR-DWQ has divided North Carolina's major drainage basins into subbasins. The project area falls within Pasquotank subbasin 03-01-54 (NCDENR-DWQ, 2006).

Surface waters of the project area are found primarily in association with the open waters of Currituck Sound. The Atlantic Intracoastal Waterway (AIWW) and Jean Guite

Table 1. Soil Types Occurring within the Project Area

Mapping Unit	Soil Series	Drainage Class	Hydric Status
AaA	Altavista fine sandy loam	Moderately well drained	Hydric
At	Augusta fine sandy loam	Somewhat poorly drained	Hydric*
BnD	Beaches-Newhan complex	Excessively drained	Hydric
BoA	Bojac loamy sand	Well drained	Nonhydric
Ca/CaA	Cape Fear loam	Very poorly drained	Hydric
CnA	Conetoe loamy sand	Well drained	Nonhydric
CnA/Cb	Conaby muck	Very poorly drained	Hydric
CoB	Corolla fine sand	Moderately well or somewhat poorly drained	Hydric*
CrB	Corolla-Duckston complex	Moderately well or poorly drained	Hydric
Cu/CuA	Currituck mucky peat	Poorly drained	Hydric
Do	Dorovan mucky peat	Very poorly drained	Hydric
Ds	Dragston loamy fine sand	Somewhat poorly drained	Hydric*
Dt/DtA	Duckston fine sand	Poorly drained	Hydric
Du/DuE	Dune land	Excessively drained	Nonhydric
DwD/DwE	Dune land-Newhan complex	Excessively drained	Hydric*
FrD	Fripp fine sand	Excessively drained	Hydric*
Mu	Munden loamy sand	Moderately well drained	Hydric*
NeC	Newhan fine sand	Excessively drained	Hydric*
NhC	Newhan-Corolla complex	Excessively drained	Hydric*
No	Nimmo loamy sand	Poorly drained	Hydric
Os/OsA	Osier fine sand	Poorly drained	Hydric
OuB	Ousley fine sand	Moderately well drained	Hydric*
Po	Ponzer muck	Very poorly drained	Hydric
Pt	Portsmouth fine sandy loam	Very poorly drained	Hydric
Ro	Roanoke fine sandy loam	Poorly drained	Hydric
StA/StB	State fine sandy loam	Well drained	Nonhydric
To	Tomotley fine sandy loam	Poorly drained	Hydric
W	Water	N/A	N/A
WnB	Wando loamy fine sand	Excessively drained	Nonhydric
Ws	Wasda muck	Very poorly drained	Hydric

Source: Soil data obtained from NRCS, 2008; hydric status from NRCS, 2008a.
*Soil type is primarily nonhydric, but contains hydric inclusions.

Creek (east of the Wright Memorial Bridge) are the only major drainages present within the project area. There are five additional jurisdictional un-named drainages identified within the project area (see Table 2). These include two canals which connect to Maple Swamp and drain into Great Swamp and Deep Creek (North River) that are along the mainland portion of US 158 (S1 and S2). Two modified natural streams were identified along US 158 that drain into Currituck Sound (S3 and S4). The southern portion of the

Table 2. Jurisdictional Stream Features Found in the Project Area

Water Resource[1]	Map ID	NCDENR-DWQ Index Number	Best Usage Classification	Appendix A Figure Where Illustrated
UT[2] to Deep Creek[3]	S001	30-2-8	SC[5]	4(d)
UT to Goose Pond[3]	S002	30-2-9	SC	4(d)
UT to Dowdy's Bay 1[4]	S003	30-1-15	SC	4(e)
UT to Dowdy's Bay 2[4]	S004	30-1-15	SC	4(e)
Jean Guite Creek[4]	Jean Guite Creek	30-1-17	SC	4(h)
UT to Sander's Bay[4]	S005	30-1-11	SC	4(l)

[1]In counterclockwise order around the project area, starting in the northwest quadrant, south of the Aydlett Road/US 158 intersection.
[2]Unnamed tributary
[3]North River/Albemarle Sound tributary
[4]Currituck Sound tributary
[5]All tidal salt waters protected for: secondary recreation such as fishing, boating, and other activities involving minimal skin contact; fish and noncommercial shellfish consumption; aquatic life propagation and survival; and wildlife.

project area (east of the Wright Memorial Bridge) crosses Jean Guite Creek and there is also a small stream (S5) identified within the maritime swamp in the vicinity of the C2 bridge corridor landing area on the Outer Banks that also drains into Currituck Sound. The location of each feature is shown on Figure 4 in Appendix A. The physical characteristics of these streams are provided in Table 3.

Several small natural ponds and naturalized excavated ponds exist on both the mainland and the Outer Banks (see Figures 4 and 5 in Appendix A). There are a total of 20 jurisdictional ponds that occur within the project area, totaling approximately 9.99 acres. One of these ponds occurs within Maple Swamp on the mainland (P1), and the other nineteen ponds are found on the Outer Banks (P2-P20). Ten of these ponds (P1-P4, P7-P9, and P16-P18) have surface hydrologic connections (often through jurisdictional wetlands) to Currituck Sound, which is a traditional navigable waterway. The other ten ponds were determined to be jurisdictional via sub-surface hydrologic connections created by porous sandy soils. Ponds that are not naturalized or are excavated wholly in uplands, such as stormwater retention ponds, are not jurisdictional and thus not included in open water acreage.

Table 3. Physical Characteristics of Stream Features in the Project Area

Map ID	Bank Height in Feet	Bankful Width in Feet	Water Depth in Feet	Channel Substrate	Velocity	Clarity	Appendix A Figure Where Illustrated
S001	3.0	15.0	0.0	Organic debris, silt, sand	N/A	N/A	4(d)
S002	1.0	5.0-10.0	0.3	Silt, sand	Slow	Turbid	4(d)
S003	2.0	5.0-20.0	0.3-1.5	Silt, sand	Moderate	Slightly turbid	4(e)
S004	0.0-1.0	5.0-8.0	0.0	Organic debris, silt, sand	N/A	N/A	4(e)
Jean Guite Creek	6.0	75.0	4.0	Silt, sand	Slow	Slightly turbid	4(h)
S005	1.0-2.0	5.0-10.0	0.3	Organic debris, silt, sand	Slow	Slightly turbid	4(l)

Note: Streams S1 and S4 did not have water present at time of evaluation.

Additional water resources in the project area include Currituck Sound, Maple Swamp, Great Swamp, and the Intracoastal Waterway (sometimes referred to as Coinjock Canal). Approximately 3,897 acres of Currituck Sound open water occur within the project area. The total drainage area for Currituck Sound is approximately 280 square miles. Currituck Sound is an oligohaline (brackish) estuary extending from the North Carolina/Virginia state line approximately 29 miles south to its confluence with Albemarle Sound. Water is supplied to Currituck Sound from three primary sources: riverine, precipitation, and ocean water. The main sources of fresh water include the North Landing River, Northwest River, Tull Creek, and Jean Guite Creek. Jurisdictional stream features S003, S004, and S005 also drain into Currituck Sound. The AIWW provides a hydrologic corridor between North River (a tributary to Albemarle Sound) and Currituck Sound. Increased salinity in the northern portion of Currituck Sound has been attributed to northerly winds driving water south from the Chesapeake Bay. The same data also suggested that increased salinity in the southern portion of Currituck Sound may be a result of southerly winds driving water north from the Albemarle Sound (Caldwell, 2001).

Maple Swamp has an approximate area of 4,350 acres with elevations ranging from sea level to 6 feet. Approximately 494 acres of Maple Swamp that are considered jurisdictional wetland occur within the project area. Water is supplied to Maple Swamp by proximity to groundwater and precipitation. Drainage may be influenced by wind-driven water in Currituck Sound. During storm events, the storm surge enters the northern end of Maple Swamp through Coinjock Bay and Currituck Sound. Existing SR 1140 (Aydlett Road) bisects Maple Swamp, linking Aydlett with US 158. Ten drainage culverts under the road allow water exchange between the southern and northern sections of the swamp. Although no studies are available on Maple Swamp hydrology, topographic maps indicate water flow in the swamp to be primarily from south to north with field observations indicating that Aydlett Road may somewhat restrict this northward flow. There are also several man-made canals that may occasionally drain the southern portions of Maple Swamp to the Great Swamp and North River.

Great Swamp and the adjacent forests and marshes bordering North River and Deep Creek have an approximate area of 233.6 square miles. Great Swamp is one of the largest swamps remaining in North Carolina (Frost et al., 1990). Water is supplied to Great Swamp by groundwater and precipitation. Within the project area, there are approximately 203.7 acres of Great Swamp present that were determined to be jurisdictional wetlands. This area is found on the west side of US 158 throughout a substantial portion of project area. While Deep Creek, North River, and the associated marshes mainly occur outside the project area, they are contiguous with Great Swamp. Also contiguous with Great Swamp is the AIWW. Several non-jurisdictional ditches transport runoff from roads and agricultural fields to Maple Swamp and Great Swamp. Jurisdictional stream features S1 and S2 connect to Maple Swamp and appear to primarily drain into Great Swamp.

3.2.2 Water Use Classification

All waters found within the project area are designated as "SC" under North Carolina's water quality classifications by the NCDENR-DWQ (NCDENR-DWQ, 2008). This saltwater classification represents the minimum quality standards applicable to all saltwaters. Suitable activities for waters classified SC include "aquatic life propagation and survival, fishing, wildlife and secondary recreation" (NCDENR-DWQ, 2008a). Most of Currituck Sound and all waters of the project area are closed to harvesting shellfish for direct marketing purposes or human consumption. The waters of Currituck Sound are classified as joint fishing waters by agreement of the North Carolina Marine Fisheries Commission and the North Carolina Wildlife Resources Commission (NCWRC), and are subject to fishing regulations enforced by both agencies (North Carolina Register, 15A NCAC 03Q.0202). There are no water bodies classified as High Quality Waters (HQW), Outstanding Resource Waters (ORW), or Water Supply watersheds (WS-I, WS-II) within 1.0 mile downstream of the project area. There are no waters within 1.0 mile of the project area designated on the 303(d) list because of high sedimentation/turbidity levels or highway runoff causing degraded water quality (NCDENR-DWQ, 2006).

Primary Nursery Areas (PNAs) are low salinity state-designated waters in the upper reaches of streams which are used by marine and estuarine fishes and invertebrates during early development. Anadromous (fish that spawn) Fish Spawning Areas (AFSA) are low salinity, state-designated waters that contain the physical, chemical, and biological attributes necessary for anadromous fish to spawn successfully. No AFSA are crossed by the detailed study alternatives. The southern portion of the project area crosses Jean Guite Creek, which is a designated PNA. This is the only state-designated fish nursery/spawning area (primary, secondary, or anadromous spawning area) crossed by any alternative.

Point source pollution within the project area is limited. There are three facilities requiring a National Pollution Discharge Elimination System Permit (NPDES) in Currituck County: the Mainland Water Treatment Plant (WTP), the Currituck County WTP, and the Southern Outer Banks Water System WTP. All of these facilities are located within the same subbasin as the project area. Violations have only been reported in relation to the Currituck County WTP (personal communication, Gil Vinzani, NCDENR-DWQ, April 28, 2008). The facility has exceeded limits for daily Total Residual Chlorine (TRC) multiple times since 2005 (personal communication, Ron Berry, NCDENR-DWQ, April 28, 2008).

Local non-point source pollution is typical of developed areas and generally is in the form of stormwater runoff. Additional potential pollution sources are incidental spills of petroleum and exhaust emissions associated with the heavy boat traffic in the area. The project area is influenced by basin-wide land uses, including runoff from agricultural and livestock operations.

3.2.3 Impacts to Water Quality

3.2.3.1 Temporary Impacts

The most notable temporary impact to water quality in Currituck Sound would be the increased turbidity levels produced during the period of construction of the C1 and C2 bridge corridors for MCB2 and MCB4. The duration and severity of these impacts would vary based on the number of simultaneous construction sites for the bridge. For example, if bridge construction proceeded in one direction across Currituck Sound (one active work site), turbidity impacts would be less severe, but would occur for a longer period of time. If bridge construction proceeded in two directions across the sound (two active work sites working towards each other), turbidity levels would be more severe, but occur for a shorter period of time. If construction is done from low-draft barges, additional simultaneous construction sites could occur. Increases in turbidity and sedimentation can negatively affect aquatic flora and fauna by depressing light penetration, lowering dissolved oxygen levels, causing fluctuating nutrient levels, and limiting visibility. This could result in increased algal growth, which would be detrimental to aquatic life near the bridge. These impacts would likely be prolonged because of poor water circulation in the sound. Increased turbidity and sedimentation levels would also temporarily increase as a result of runoff from construction areas on land, until post-construction revegetation. Temporary impacts to water quality would be minimized through the use of NCDOT erosion and sedimentation control measures. This issue is discussed further in Section 4.2.3.

3.2.3.2 Permanent Impacts

Permanent impacts to water quality are primarily associated with increased levels of bridge and highway runoff, which is considered a non-point source discharge. The effects of runoff are highly site specific. The primary pollutants associated with bridge and highway runoff include particulates, organic compounds, nutrients, and heavy metals. These pollutants accumulate on impervious surfaces and derive from automobiles and materials used in construction and maintenance of roadways. These substances have the potential to negatively affect aquatic life by directly or indirectly interfering with various biological processes and cycles. It is difficult to predict the amounts and specific types of future pollutants that will occur on a roadway, as well as the frequency and severity of future rain events which determine level of exposure. The highest traffic volumes (highest pollutant production) in the project area currently occur on summer weekends and it is assumed that this will continue in the future given the tourism-based nature of the Outer Banks.

Pollutants discharged into Currituck Sound near the bridge would dissipate slowly because of poor water circulation, and could result in higher sediment pollutant levels and bioaccumulation when compared to bridges over high-flow areas with better water circulation. Thermal and turbidity differences in runoff could also affect water quality by depressing oxygen levels and light penetration. Based solely on the increased amount of impervious surface area, MCB2/C1 would result in the greatest increase in runoff, whereas MCB4/C2 would result in the smallest increase (see Table 4). The removal of Aydlett Road (2.8 acres) is factored into impervious surface calculations in Table 4. Use of mainland approach road Option A would result in approximately 0.4 acre more impervious surface area than Option B. A detailed analysis predicting future pollutant concentrations in runoff for each detailed study alternative is presented in the *Assessment of Alternatives for Treating Bridge Runoff* (Parsons Brinckerhoff, 2009).

For the proposed bridges over Maple Swamp and Currituck Sound with MCB2 and MCB4, the actual amount of runoff and associated impacts to water quality would be dependent upon the method implemented to manage bridge runoff. The preliminary designs used in this impact assessment assume that bridges over Currituck Sound and Maple Swamp would drain directly into the sound and swamp. Drainage would not be captured and treated to remove motor vehicle pollutants.

Water from the bridges could be captured and treated in one of three ways. All three would involve additional cost. Further consideration of capturing and treating runoff would be accomplished when finalizing mitigation measures should MCB2 or MCB4 be selected for implementation.

The first option would involve creating high points in the bridges over Maple Swamp and Currituck Sound. This would allow the bridges to drain to the bridge termini via a pipe system where runoff from the bridge deck could be directed to stormwater treatment Best Management Practices (BMPs), such as stormwater wetlands or wet detention basins. With a uniform minimum 0.3 percent slope, the Mid-Currituck Bridge

Table 4. Existing and Proposed Impervious Surface Areas by Detailed Study Alternative

	ER2 (acres)	MCB2/C1 (acres)	MCB2/C2 (acres)	MCB4/C1 (acres)	MCB4/C2 (acres)
Option A					
Existing Impervious Surface	290.4	290.4	290.4	290.4	290.4
Proposed Impervious Surface	379.4 (344.7)	417.2 (412.0)	410.8 (405.6)	377.0 (370.4)	371.4 (364.8)
Increase in Impervious Surface					
• Road	89.0 (54.3)	87.3 (82.1)	77.8 (72.6)	47.1 (40.5)	38.4 (31.8)
• Bridge	0.0	39.5	42.6	39.5	42.6
Total/Percent Increase	89.0/30.6 (54.3/18.7)	126.8/43.7 (121.6/41.9)	120.4/41.5 (115.2/39.7)	86.6/29.8 (80.0/27.5)	81.0/27.9 (74.4/25.6)
Option B					
Existing Impervious Surface (acres)	NA	290.4	290.4	290.4	290.4
Proposed Impervious Surface (acres)	NA	416.8 (411.6)	410.4 (405.2)	376.6 (370.0)	371.0 (364.4)
Increase in Impervious Surface					
Road (acres)	NA	96.8 (91.6)	87.3 (82.1)	56.6 (50.0)	47.9 (41.3)
Bridge (acres)	NA	29.6	32.7	29.6	32.7
Total (acres)/ Percent Increase	NA	126.4/43.5 (121.2/41.7)	120.0/41.3 (114.8/39.5)	86.2/29.7 (79.6/27.4)	80.6/27.8 (74.0/25.5)

The numbers in parentheses reflect the impact if reversing the center turn lane is used to reduce hurricane evacuation clearance times rather than constructing a third outbound lane. When there is no number in parentheses, the impact would be identical for either hurricane evacuation option. The removal of Aydlett Road is factored into impervious surface area calculations for Option B.

would be 71 to 79 feet high at its highest point, compared to the current 20 feet of elevation. Bridge runoff is transported through pipes to stormwater treatment BMPs such as stormwater wetlands or dry infiltration basins located on the mainland and the Outer Banks. This option would replicate natural physical, chemical, and biological methods of runoff treatment.

The second option would treat runoff from the bridge deck using filter devices on the bridge itself rather than conveying runoff to the ends of the bridges on the mainland and Outer Banks. The bridge design would need to be modified to allow a minimum longitudinal slope of 0.3 percent so that bridge deck runoff would find its way to the regularly spaced filter units. This would introduce periodic high and low points in the bridge profile, rather than creating a single high point as in the first option.

The third option would use the 0.5 percent slope of the bridge's Outer Banks approach span (i.e., the sloped bridge segment that brings the bridge down to grade) to allow bridge runoff over the sensitive coastal marsh on the Outer Banks (adjacent to the Currituck Sound shoreline) to be collected. It would then be transported to off-site treatment sites such as stormwater wetlands or wet detention basins. For the C1 corridor, the sensitive coastal wetlands crossed by the bridge corridor are completely under the bridge's approximately 590-foot-long Outer Banks approach span, so a runoff collection pipe matching the slope of the bridge approach span could be hung from the bridge to collect runoff. For the C2 corridor, the length of the Outer Banks approach span is approximately 773 feet, so a substantial portion of the sensitive coastal wetlands crossed by the bridge corridor is under the sloped segment of the bridge where a runoff collection pipe matching the slope of the bridge could be used to collect the runoff. However, there is an additional approximately 452 feet of coastal wetlands (between the shoreline and the start of the approach span) that would be under a flat segment of the bridge. In order to collect the runoff in this area, the runoff collection pipe could be hung from the bridge with a slight slope (i.e., the hangers on the western end of the pipe would be shorter than those on the eastern end) until the pipe ties into the sloped pipe within the approach span. For the balance of the bridge, bridge runoff would drop directly into Currituck Sound.

Catching runoff over coastal wetlands is the most reasonable of the three options. The use of filtering devices appears to be the more reasonable of the remaining two options given the bridge height needed to implement the first, although additional design studies would be needed to determine their practicability. Catch basins would be required on approximately every other span. These basins would be made of fabricated thin steel plates and would remain partially full of water at all times. As a result, the self-weight of a single basin would be nearly 5,000 pounds. The basins would likely rest on an extension of the bent cap and be in full view of persons viewing the bridge. Water would be piped to the basins. The catch basins would require routine cleaning, and the filters would require replacement on a regular basis.

Details regarding the two bridge runoff treatment options can be found in the *Assessment of Alternatives for Treating Bridge Runoff* (Parsons Brinckerhoff, 2009).

For the road widening portions of the detailed study alternatives, infiltration strips and ditch transport to dry infiltration basins would be implemented to treat highway runoff.

Additional impacts to water quality could occur from single pollution events such as incidents resulting in hazardous spills on proposed bridge structures or widened roadways. Based on the predominantly residential land use of the area and lack of heavy industry, bulk cargo is likely to consist of household and petroleum products. If spilled, these products degrade over time, but would have short-term negative effects on water quality. The NCTA has a hazardous spill contingency plan should any spill occur. A hazardous spill contingency plan is also in place for Currituck and Dare counties and involves participants from local, state, and federal agencies.

Impacts to salinity, water supply, and wastewater treatment should not result from any of the detailed study alternatives. Salinity levels would not change because of the presence of a bridge across Currituck Sound since existing flow patterns would not be altered. It is not expected that the increased impervious surface area with the detailed study alternatives would have a measurable effect on well fields and groundwater tables on the mainland or the Outer Banks. If any of the proposed improvements associated with the detailed study alternatives would impact existing septic tanks, the tanks would be properly removed prior to construction.

4.0 Biotic Resources

4.1 Terrestrial Communities

4.1.1 Terrestrial Habitat

Plant communities are represented as distinct assemblages of dominant vegetation. The communities within the project area were identified and characterized based on the dominant vegetation found in the canopy, subcanopy, shrub, and herbaceous strata. Plant communities were identified through the interpretation of aerial imagery (1998 Color-Infrared Digital Ortho Mosaics and 2002, and 2006-2007 color aerial photography), as well as through field observations conducted in April 1994 and June 1995; during the period from September 2007 through January 2008; in May, July, and October 2008; and in January 2009.

Plant communities vary with respect to local geologic, hydrologic, and soil conditions. Some communities have been influenced at some time by such disturbances as logging, livestock grazing, suppression of natural fires, and modification of hydrologic regimes. As a consequence of disturbance and plant succession, some of the habitats in the project area represent intermediate stages or ecotones of the distinct plant communities described in this section. These areas have been included within the most characteristic or representative community. Because of human disturbance, many of the biotic communities described below do not correspond directly to communities described by Schafale and Weakley (1990). Where applicable, the community or communities from Schafale and Weakley (1990) that most closely correspond to those described in this report have been included in the descriptions. All Section 404 jurisdictional wetland community names begin with the word “wetland”. This results in some redundancy (e.g., “Wetland Freshwater Marsh”), but provides a method of rapidly identifying all of the wetland communities. Two Section 404 jurisdictional communities (ponds and open water) that are considered “waters” rather than “wetlands” by the USACE (1987) are described in Section 4.2.1.

Twenty-one (21) community types occur within the 6,622.85 acre project area. Of these 21 communities, seven communities are the result of direct human disturbance, including: man-dominated land, agricultural land, pine forest, shrub/scrub, wetland man-dominated land, wetland pine forest, and wetland shrub/scrub. Fourteen (14) communities can be considered to be relatively natural systems: mixed-pine/hardwood forest, hardwood forest, maritime shrub/grassland, maritime forest, wetland mixed-pine/hardwood forest, wetland hardwood forest, wetland bay forest, wetland swamp forest, wetland maritime shrub/grassland, wetland maritime forest, wetland maritime swamp, wetland freshwater marsh, ponds, and open water. Scientific and common names of plants referenced in this report are found in Appendix B. Ponds and open water areas exist naturally and as a result of human disturbance within the project area and are described in Section 4.2.1. Figure 5 in Appendix A depicts the distribution of these communities throughout the project area. Table 5 contains the acreages of each biotic community type present in the entire project area, along with the associated Cowardin et al. (1979) classification codes and NCDENR-DWQ wetland quality rating (if applicable).

Table 5. Coverage of Biotic Communities within the Project Area

Biotic Community	Cowardin Classification	NCDENR-DWQ Wetland Rating[1]	Acreage
Upland man-dominated land	N/A	N/A	1,030.14
Upland agricultural land	N/A	N/A	403.87
Upland pine forest	N/A	N/A	37.29
Upland shrub/scrub	N/A	N/A	21.74
Upland mixed-pine/hardwood forest	N/A	N/A	74.06
Upland hardwood forest	N/A	N/A	23.39
Upland maritime shrub/grassland	N/A	N/A	155.77
Upland maritime forest	N/A	N/A	96.61
Wetland man-dominated land	PEM1/2B, PSS1/3/4B	69.67	30.42
Wetland pine forest	PFO4B	49.00[2]	4.80
Wetland shrub/scrub	PSS1/3/4B	38.67	9.68
Wetland mixed-pine/hardwood forest	PFO1/3/4B	59.67	179.91
Wetland hardwood forest	PFO1/3E	74.33	120.64
Wetland bay forest	PFO1/3E	75.00[2]	27.43
Wetland swamp forest	PFO1/3F	78.00	334.88
Wetland maritime shrub/grassland	PEM1/2B, PSS1/3/4B	20.67	2.70
Wetland maritime forest	PFO1/3/4B	65.00	27.20
Wetland maritime swamp	E2SS/FO1/3/4P, PFO1/3/4F	74.33	27.39
Wetland freshwater marsh	E2EM1P	87.00	100.76
Pond	PUB2/3/4H/x, E1UB2/3/4Lx	N/A	9.87
Open water	E1UB2/3/4K/L/M/x, E1AB3L6	N/A	3,904.30
Total			6,622.85

[1]Wetland ratings are an average from three sites within each community.
[2]Only one example of this wetland community is found in the project area.

4.1.1.1 Upland Man-Dominated Land

Areas mapped within this category include residential and commercial structures, roadways, and maintained areas such as lawns, yards, road edges, power line corridors, and non-jurisdictional ponds dug out of upland (such as stormwater retention ponds). Vegetation in these communities has been altered or natural succession has been restricted by routine human use or management. Agricultural and silvicultural dominated landscapes (shrub/scrub) are distinct man-created communities, but are excluded from this category for the purposes of accounting acreages of different land use.

4.1.1.2 Upland Agricultural Land

Agricultural land is composed of primarily croplands and a few pasture lands. Major crops of the area include corn, soybeans, potatoes, peanuts, and small grains.

4.1.1.3 Upland Pine Forest

The pine forest community represents areas where loblolly pine plantations have been cut and natural regeneration of a pine-dominated forest has occurred. The resulting community consists of a nearly monospecific stand of loblolly pine with few additional species.

4.1.1.4 Upland Shrub/Scrub

The shrub/scrub community is comprised of previously cultivated and recently timbered lands that are in the early stages of regeneration. This community is defined more by disturbance history than by a distinct assemblage of plants. The vegetation of a shrub/scrub community is characterized by a dense shrub layer comprised of various combinations of sweetgum, red maple, tulip poplar, loblolly pine, wax myrtle, winged sumac, and eastern red cedar. These areas often have a dense growth of woody vines that include yellow jessamine, muscadine, greenbrier, Virginia creeper, Japanese honeysuckle, and poison ivy. Open areas within the shrub thickets contain weedy species such as blackberry, dog fennel, yarrow, Venus' looking-glass, cudweed, day flower, and pokeweed.

4.1.1.5 Upland Mixed-Pine/Hardwood Forest

The mixed-pine/hardwood forest represents a transitional community between pine forest and hardwood forest. This community is often indicative of an area that has been logged or used in agriculture, and is dominated by loblolly pine in combination with various species of hardwood. As the pines age and die out they are replaced by hardwoods, eventually resulting in a stable hardwood forest community.

Loblolly pine makes up a substantial portion of the canopy (50 percent or greater) along with numerous hardwood species that include tulip poplar, sweetgum, red maple, water oak, and laurel oak. The open shrub layer includes swamp red bay, horse sugar, giant cane, highbush blueberry, American holly, and sourwood. The sparse herbaceous layer includes netted chainfern in shaded, depressional areas.

4.1.1.6 Upland Hardwood Forest

The hardwood forest community most closely resembles the mesic mixed hardwood forest described by Schafale and Weakley (1990). This community occurs on moist upland soils adjacent to the wet hardwood forest and swamp forest communities. This community is dominated by species characteristic of both dry and mesic communities.

The closed canopy is dominated by a combination of upland trees that include white oak, southern red oak, and black oak, as well as more mesic species that include tulip poplar, sweetgum, water oak, and red maple. The sparse to moderately dense shrub layer also contains a mixture of dry upland and more mesic species that includes flowering dogwood, sourwood, ironwood, horse sugar, and giant cane. Common woody vines include poison ivy and greenbrier. The sparse herbaceous layer is comprised of ferns that include netted chainfern and southern lady fern in shaded, depressional areas.

4.1.1.7 Upland Maritime Shrub/Grassland

The maritime dry shrub/grassland community occupies sand deposits behind and between low dunes on barrier islands. This community includes areas that are similar to the maritime dry grassland and maritime shrub communities described by Schafale and Weakley (1990). Prior to artificial dune stabilization and man-induced alteration of hydrology, periodic sea water flooding would have eliminated all but the most salt tolerant species resulting in a distinct assemblage of herbaceous species interspersed with scattered clumps of shrubs. Increased protection from flooding has resulted in a community dominated by numerous weedy herbaceous and woody species that are characteristic of disturbed areas.

Areas dominated by trees and shrubs contain live oak, loblolly pine, eastern red cedar, persimmon, northern bayberry, and black cherry. Open areas dominated by herbaceous species contain switchcane, crabgrass, thoroughwort, broomsedge, toad flax, goldenrod, cudweed, rush, plantain, blackberry, and pineweed. Woody vines are also prevalent and include muscadine and greenbrier.

4.1.1.8 Upland Maritime Forest

The maritime forest community includes a mixture of forest communities described as maritime evergreen forest and maritime deciduous forest by Schafale and Weakley (1990). This community is located on the sound side of the Outer Banks where vegetation is protected from much of the ocean salt spray and overwash. This community may be composed almost entirely of live oaks and yaupon in the most ocean-exposed areas (eastern side of the forest). However, the more-protected, western portions of this community can consist of a more diverse canopy of hardwoods (e.g., red maple, sweetgum, water oak, and ironwood) and loblolly pines with an understory of relatively salt intolerant species such as flowering dogwood and giant cane.

4.1.1.9 Wetland Man-Dominated Land

Areas mapped within this category include residential and commercial maintained areas such as lawns, yards, road edges, and power line corridors. Vegetation in these communities has been altered or succession has been restricted by routine human use or management. Unlike the upland version of this community, habitats categorized within the wetland man-dominated lands have the vegetation, soil characteristics, and hydrologic regime necessary to be regulated as a Section 404 jurisdictional wetland by the USACE (1987). In the Cowardin et al. (1979) system of wetland classification these communities can be classified as "Palustrine Scrub-Shrub Wetlands" (codes PSS1/3/4B) or "Palustrine Emergent Wetlands" (codes PEM1/2B) that are maintained in a constant state of early succession by human activity.

4.1.1.10 Wetland Pine Forest

The wetland pine forest community represents areas where loblolly pine plantations have been cut and natural regeneration of a pine-dominated forest has occurred. The resulting community consists of a nearly monospecific stand of loblolly pine with few additional species. Unlike the upland version of this community, these areas possess the soil characteristics and hydrologic regime necessary to be regulated as a Section 404 jurisdictional wetland by the USACE (1987). In the Cowardin et al. (1979) system of wetland classification these communities can be classified as a "Palustrine Forested Wetlands" (code PFO4B).

4.1.1.11 Wetland Shrub/Scrub

The wetland shrub/scrub community is comprised of previously cultivated and recently timbered lands that are in the early stages of regeneration. This community is defined more by disturbance history than by a distinct assemblage of plants. The vegetation of a shrub/scrub community is characterized by a dense shrub layer comprised of various combinations of sweetgum, red maple, tulip poplar, loblolly pine, wax myrtle, winged sumac, and red cedar. These areas often have a dense growth of woody vines that include yellow jessamine, muscadine, greenbrier, Virginia creeper, Japanese honeysuckle, and poison ivy. Open areas within the shrub thickets contain weedy species such as blackberry, dog fennel, yarrow, Venus' looking-glass, cudweed, day flower, and pokeweed. Unlike the upland version of this community, habitats categorized within the wetland shrub/scrub community have the vegetation, soil characteristics, and hydrologic regime necessary to be regulated as a Section 404 jurisdictional wetland by the USACE (1987). In the Cowardin et al. (1979) system of wetland classification these communities can be classified as a "Palustrine Scrub-Shrub Wetlands" (codes PSS1/3/4B).

4.1.1.12 Wetland Mixed-Pine/Hardwood Forest

The wetland mixed-pine/hardwood forest represents a transitional community between pine forest and hardwood forest. This community is often indicative of an area that has been logged or used in agriculture and is dominated by loblolly pine in combination with various species of hardwoods. As the pines age and die out they are replaced by hardwoods, eventually resulting in a stable hardwood forest community.

Loblolly pine makes up a substantial portion of the canopy (50 percent or greater) along with numerous hardwood species that include tulip tree, sweetgum, red maple, water oak, and laurel oak. The open shrub layer includes swamp red bay, horse sugar, giant cane, highbush blueberry, American holly, and sourwood. The sparse herbaceous layer is comprised of netted chainfern. Unlike the upland version of this community, habitats categorized within the wetland mixed-pine/hardwood forest category have the vegetation, soil characteristics, and hydrologic regime necessary to be regulated as a Section 404 jurisdictional wetland by the USACE (1987). In the Cowardin et al. (1979) system of wetland classification these communities can be classified as "Palustrine Forested Wetlands" (codes PFO1/3/4B).

4.1.1.13 Wetland Hardwood Forest

The wetland hardwood forest community type occurs on areas of interstream flats with poorly drained mineral soils or shallow organic soils. Areas mapped as this community within the project area correspond to the non-riverine wet hardwood forest described by Schafale and Weakley (1990). The occurrence of this community is dependent on seasonal flooding or saturation, substantial mineral inputs, and the absence of fire. These areas grade into swamp forest as mineral content of the soil decreases and flooding frequency increases.

The vegetation of this community is characterized by a closed canopy dominated by laurel oak, water oak, swamp chestnut oak, tulip poplar, red maple, sweetgum, and swamp tupelo. The canopy composition differs substantially from that of the swamp forest in that oaks are a major component and the overall diversity of hardwoods is greater. The sparse shrub layer contains horse sugar, swamp red bay, American holly, giant cane, fetterbush, paw paw, ironwood, highbush blueberry, and sweet pepperbush. The sparse herbaceous layer contains netted chainfern, royal fern, and false nettle. Unlike the upland version of this community, habitats categorized within the wetland hardwood forest category have the vegetation, soil characteristics, and hydrologic regime necessary to be regulated as a Section 404 jurisdictional wetland by the USACE (1987). In the Cowardin et al. (1979) system of wetland classification these communities can be classified as "Palustrine Forested Wetlands" (codes PFO1/3E).

4.1.1.14 Wetland Bay Forest

The community type classified as bay forest (Schafale and Weakley, 1990) occurs on areas of interstream flats that have very poorly drained organic soils. Within the project area, this community occurs on the Ponzer muck soil series. The occurrence of bay forest is dependent on a combination of factors that include seasonal flooding or saturation, the absence of substantial mineral inputs, the presence of very nutrient-poor organic soils, and the absence of fire for extended periods. Areas with greater mineral inputs and better nutrient availability support a greater diversity of hardwood trees, and areas with more frequent fires support various pocosin communities.

Vegetation of the bay forests within the project area is comprised of a closed canopy dominated primarily by loblolly bay and red maple with lesser amounts of swamp red bay, sweetgum, swamp tupelo, and sweetbay. The moderately dense to sparse shrub layer is dominated by swamp red bay, sweetbay, sweet pepper bush, highbush blueberry, and Virginia willow. The sparse herbaceous layer contains netted chainfern and Virginia chainfern. This community grades into swamp forest with a shift from nutrient-poor organic soils to mineral soils with greater nutrient availability. This community possesses the vegetation, soil characteristics, and hydrologic regime necessary to be regulated as a Section 404 jurisdictional wetland by the USACE (1987). In the Cowardin et al. (1979) system of wetland classification these communities can be classified as “Palustrine Forested Wetlands” (codes PFO1/3E).

4.1.1.15 Wetland Swamp Forest

Swamp forests of the project area most closely resemble the non-riverine swamp forest described by Schafale and Weakley (1990). This community occurs on very poorly drained interstream flats on both organic and mineral soils. Swamp forests of the project area occur on Ponzer muck, Wasda muck, Dorovan muck peat, Tomotley fine sandy loam, and Munden loamy sand. The occurrence of swamp forest is dependent on seasonal to frequent saturation or flooding and occasional mineral inputs that lead to improved nutrient availability relative to bay forest and pocosin communities. As mineral inputs decrease and fire frequency increases, these areas grade into bay forest.

Vegetation of the swamp forest is comprised of a closed canopy dominated primarily by red maple, swamp tupelo, and sweetgum with lesser amounts of swamp chestnut oak, water oak, and laurel oak. The moderately dense to sparse shrub layer is dominated by red bay, sweetbay, Virginia willow, highbush blueberry, and American holly. Woody vines include greenbrier, muscadine, and poison ivy. The sparse herbaceous layer contains netted chainfern, Virginia chainfern, royal fern, and lizard's tail. This community has the vegetation, soil characteristics, and hydrologic regime necessary to be regulated as a Section 404 jurisdictional wetland by the USACE (1987). In the Cowardin et al. (1979) system of wetland classification these communities can be classified as “Palustrine Forested Wetlands” (codes PFO1/3F).

4.1.1.16 Wetland Maritime Shrub/Grassland

The wetland maritime shrub/grassland community primarily occupies interdunal swales and other low areas on barrier islands. This community includes areas that are similar to the maritime wet grassland and maritime shrub communities described by Schafale and Weakley (1990). Prior to artificial dune stabilization and man-induced alteration of hydrology, periodic sea water flooding would have eliminated all but the most salt tolerant species resulting in a distinct assemblage of herbaceous species interspersed with scattered clumps of shrubs. Increased protection from flooding has resulted in a community dominated by numerous weedy herbaceous and woody species that are characteristic of disturbed areas.

Areas dominated by trees and shrubs contain loblolly pine, eastern red cedar, persimmon, wax myrtle, northern bayberry, and black cherry. Open areas dominated by herbaceous species contain switchcane, crabgrass, thoroughwort, broomsedge, toad flax, goldenrod, cudweed, rush, plantain, blackberry, and pineweed. Woody vines are also prevalent and include muscadine and greenbrier. Unlike the upland version of this community, habitats categorized within the wetland maritime shrub/grassland community have the vegetation, soil characteristics, and hydrologic regime necessary to be regulated as a Section 404 jurisdictional wetland by the USACE (1987). In the Cowardin et al. (1979) system of wetland classification these communities can be classified as “Palustrine Scrub-Shrub Wetlands” (codes PSS1/3/4B) or “Palustrine Emergent Wetlands” (codes PEM1/2B).

4.1.1.17 Wetland Maritime Forest

The wetland maritime forest community includes a mixture of forest communities described as maritime evergreen forest and maritime deciduous forest by Schafale and Weakley (1990). This community is located closer to the sound side of the Outer Banks where vegetation is protected from much of the ocean salt spray and overwash. This community may consist of a diverse canopy of hardwoods (e.g., red maple, sweetgum, water oak, ironwood, etc.) and loblolly pines with an understory of relatively salt intolerant species such as flowering dogwood, giant cane, and netted chain fern. Unlike the upland version of this community, habitats categorized within the wetland maritime forest community have the vegetation, soil characteristics, and hydrologic regime necessary to be regulated as a Section 404 jurisdictional wetland by the USACE (1987). In the Cowardin et al. (1979) system of wetland classification these communities can be classified as “Palustrine Forested Wetlands” (codes PFO1/3/4B).

4.1.1.18 Wetland Maritime Swamp

Equivalent to the maritime shrub swamp of Schafale and Weakley (1990), this community occurs on sandy soils adjacent to the freshwater marshes of Currituck Sound. These areas are frequently inundated but receive less flooding than the marshes.

The vegetation is characterized by a closed canopy dominated by red maple, swamp tupelo, sweetgum, and loblolly pine. The dense to open shrub layer contains swamp red bay, wax myrtle, highbush blueberry, red maple, and sweetgum. The herbaceous layer varies from moderately dense at the edge of the freshwater marsh to sparse further into the forest. Species include marsh fern, netted chainfern, Virginia chainfern, royal fern, false nettle, pennywort, spadeleaf, mock bishop's weed, water hemlock, cut grass, slender spikegrass, sedges, rushes, and marsh seedbox. This community grades landward into maritime forest as flooding frequency decreases. These communities have the vegetation, soil characteristics, and hydrologic regime necessary to be regulated as a Section 404 jurisdictional wetland by the USACE (1987). In the Cowardin et al. (1979) system of wetland classification these communities can be classified as “Palustrine Forested Wetlands” (codes PFO1/3/4F) or “Estuarine Intertidal Shrub-Scrub Forested Wetlands” (codes E2SS/FO1/3/4P).

4.1.1.19 Wetland Freshwater Marsh

Extensive areas of wetland freshwater marsh (Schafale and Weakley, 1990) occur along the margins of Currituck Sound on Currituck mucky peat soil. These areas are irregularly flooded by wind tides that bring in nutrients and sediments. A diverse assemblage of emergent herbaceous species dominates this community with scattered shrubs occurring on small isolated hummocks.

The freshwater marshes of the project area resemble the oligohaline variant described by Schafale and Weakley where cattail and big cordgrass are two of the dominant species. The oligohaline variant is slightly influenced by salt but retains high plant diversity. Additional herbaceous species include mock bishop's weed, creeping spikerush, arrow-head, duck potato, arrow arum, false nettle, pennywort, spadeleaf, water hemlock, bedstraw, cut grass, numerous sedges, rushes, three-square, bulrush, and marsh fern. Scattered shrubs on small hummocks include groundsel-tree, red maple, and swamp willow. This community grades shoreward into maritime swamp and seaward into the open water of Currituck Sound. This community has the vegetation, soil characteristics, and hydrologic regime necessary to be delineated as a Section 404 jurisdictional wetland by the USACE (1987). In the Cowardin et al. (1979) system of wetland classification these communities can be classified as "Estuarine Intertidal Emergent Wetlands" (code E2EM1P).

4.1.1.20 Parcels in Maple Swamp Potentially Separated from Public Access (Landlocked)

Nine parcels that would be landlocked by MCB2/B and MCB4/B are depicted in Figures 5b and 5c in Appendix A. MCB2/A and MCB4/A would only landlock portions of several of the northernmost of these nine parcels where they occur north of the corridor through Maple Swamp (see Figures 5b and 5c in Appendix A). These parcels are identified here because landlocked parcels in Maple Swamp would be purchased and preserved with the bridge alternatives. The nine parcels comprise approximately 613 acres, of which approximately 264 acres were clear-cut for timber sometime between late 2007 and early 2009. Acreages of each biotic community within the parcels relative to pre- and post-timbering as well as projected biotic community, if allowed to naturally re-vegetate, are found in Table 6. The vegetation of the timbered areas during 2009 was representative of a wetland depression meadow/freshwater marsh-like community. Portions of the timbered areas also were being invaded by early successional tree species such as red maple and sweet gum. Through natural succession over time (decades), most of the timbered areas will return to forested wetland communities.

Clear cut timbering alters some wetland functions and values. Comparison of NCDWQ rating values for wetland hardwood forest and swamp forest, the two most prevalent biotic communities in these parcels, shows scores from 75 to 84 out of a possible 100, which represents the highest score. The power line crossing of Maple Swamp represents conditions similar to recently timbered areas, and scored 69. The NCDWQ rating system incorporates weighted values in the following categories: water storage, stream

Table 6. Acreage of Potential Landlocked Areas in Maple Swamp

Biotic Community	Baseline[1] and Preserved		Post-Timbering 2009 Conditions	
	Option A	Option B	Option A	Option B
Upland man-dominated	0.0	1.3	0.0	1.3
Upland mixed pine/hardwood forest	0.0	0.1	0.0	0.0
Wetland bay forest	0.0	105.1	0.0	105.1
Wetland hardwood forest	11.7	16.4	11.7	15.0
Wetland man-dominated land	0.0	13.4	0.0	2.4
Wetland mixed pine/hardwood forest	101.9	158.9	49.1	84.9
Wetland swamp forest	149.6	317.6	31.2	140.4
Pond	0.0	0.2	0.0	0.2
Timbered (clear cut)[2]	0.0	0.0	171.2	263.7
Total forest	263.2	611.5	92.0	347.8
Total	263.2	613.0	263.2	613.0

[1]Acreage estimated through the interpretation of aerial imagery (1998 Color-Infrared Digital Ortho Mosaics and 2002, and 2006-2007 color aerial photography), as well as through field observations conducted in April 1994 and June 1995; during the period from September 2007 through January 2008; in May, July, and October 2008; and in January 2009. Community preserved is based on the assumption that timbered areas will be allowed to re-vegetate to similar pre-timbering community.
[2]Community in 2009 was dominated by primarily wetland mixed herbaceous species and young invading tree species. Acreage estimated through a field visit 4-5 August, 2009 aided by a GPS unit to identify timbered boundaries. Timbering occurred sometime between late 2007 and early 2009.

bank/shore stabilization, pollution removal, wildlife habitat, aquatic life, and recreation and education. Because the NCDWQ rating system is weighted toward water quality functions, the scores may not accurately represent the difference in wildlife usage and diversity. Species preferring canopy strata and large areas of mature forests may not become established for decades after timber removal. Because these parcels are within the boundaries of a system identified by the North Carolina Natural Heritage Program (NCNHP) as a Significant Natural Heritage Area (SNHA), the parcels did and do continue to have the potential to provide important and valuable habitat to the region.

4.1.1.21 Significant Natural Heritage Areas

There are several SNHAs designated by the NCNHP present in the project area (see Figure 6 in Appendix A). Portions of the Pine Island/Currituck Club Natural Area are within Currituck Sound in the project area. The Pine Island/Currituck Club Natural Area contains an extensive tidal freshwater marsh system along the eastern side Currituck Sound. This area is given a "C" status, which indicates that this is an outstanding example of this community, though this community may be represented by better examples in the state (NCNHP, 2005). Diverse marsh and shrub species can be found in this area, and this community is described in further detail in Section 4.1.1.19.

Figure 6 in Appendix A shows the SNHAs and other natural resource-related features in the vicinity of the project area.

Maple Swamp is recognized by the NCNHP as a SNHA. The area is a Natural Heritage Priority Area and is assigned a "B" status, which represents a statewide significant site that is among the highest quality occurrences in North Carolina. The significant features associated with this site include an unusually extensive stand of loblolly bay forest, which may represent the largest stand in the state and the most northern range of this community. Predominant communities associated with Maple Swamp and found within the project area also include non-riverine swamp forest and non-riverine wet hardwood forest. These communities are discussed in further detail in Section 4.1.1.

Large portions of the forests and marshes surrounding North River and Deep Creek, including Great Swamp, are recognized by the NCNHP as SNHAs. These areas are rated as having county significance, which indicates that they are significant, high quality sites, although there are better examples in the region as well as in the state as a whole. Significant features of these areas include good examples of tidal cypress/gum swamp and areas of tidal freshwater marsh. These areas are also assigned a "B" status (see above) because of the extensive tidal freshwater marsh areas and what are thought to be natural and/or virgin stands of tidal cypress/gum swamp.

4.1.1.22 Rare and Threatened Communities

Rare and threatened natural community types within the state are identified by the NCNHP and ranked based on rarity or because of factors making a particular community especially vulnerable to degradation. Table 7 lists the rare and threatened natural communities that have been identified within the project area by the NCNHP (2008a).

<u>*Maritime Communities*</u>

These areas include maritime dry and wet grassland, maritime shrub, and maritime swamp and evergreen forests. Upland communities along barrier islands receive little protection from development pressures, and consequently have undergone extreme degradation. For these reasons, maritime communities include some of the most endangered communities in North Carolina (NCNHP, 2008a). Maritime communities, comprising upland and wetland habitats, are particularly susceptible to the effects of fragmentation. Maritime forests and swamps serve as relatively stable sources of refuge for many species of wildlife, contribute to the biodiversity of barrier islands, and often occur as "islands" of habitat along the Outer Banks. The maritime forests along the Currituck Outer Banks were given high priority status and were considered deserving of protection (Lopazanski et al., 1988). Most of the maritime forest along the sound side of the Outer Banks is under private ownership and subject to degradation. In order to help minimize the impacts of development on maritime forest, the Currituck County Unified Development Ordinance provides guidelines for both minimizing maritime forest impacts during site development and rehabilitating maritime forest. Since the 1980s, the County has worked proactively with property owners and developers to foster awareness of the importance of maritime forests. SNHAs such as Currituck Banks,

Table 7. Rare and Threatened Natural Communities Found within the Project Area

NCNHP Rare or Threatened Community Type	Contains Section 404 Areas	State Rank[1]	Global Rank[2]	Equivalent Mapped Communities
Maritime dry grassland	No	S2	G3	Upland maritime shrub/grassland
Maritime wet grassland	Yes	S2	G3	Wetland maritime shrub/grassland
Maritime shrub	Yes	S3	G4	Wetland maritime shrub/grassland, upland maritime shrub/grassland
Maritime swamp forest	Yes	S2S3	G2G3	Wetland maritime forest, wetland maritime swamp
Maritime evergreen forest	No	S1	G2G3	Maritime forest
Non-riverine wet hardwood forest	Yes	S1	G1	Wetland hardwood forest
Non-riverine swamp forest	Yes	S2S3	G2G3	Wetland swamp forest
Bay forest	Yes	S2	G3G4	Wetland bay forest
Tidal cypress/gum swamp	Yes	S3	G4	Wetland swamp forest[3]
Tidal freshwater marsh	Yes	S2S3	G4	Wetland freshwater marsh

Source: NCNHP, 2008a

[1] S1 = Critically imperiled in North Carolina because of extreme rarity or otherwise very vulnerable to extirpation in the state. S2 = Imperiled in North Carolina because of rarity or otherwise vulnerable to extirpation in the state. S3 = Rare or uncommon in North Carolina.

[2] G1 = Critically imperiled globally because of extreme rarity or otherwise very vulnerable to extinction throughout its range. G2 = Imperiled globally because of rarity or otherwise vulnerable to extinction throughout its range. G3 = Either very rare and local throughout its range, or found locally in a restricted area. G4 = Apparently secure globally, although it may be quite rare in parts of its range (especially at the periphery).

[3] There are no tidal cypress/gum swamps that occur within the project area. However, this community is contiguous with wetland swamp forest communities within the project area in Great Swamp and Maple Swamp.

Corolla Natural Area, Swan Island Natural Area, Currituck National Wildlife Refuge, Pine Island/Currituck Club Natural Area, and Kitty Hawk Woods contain these maritime communities and are in the vicinity of the project area (see Figure 6 in Appendix A). Another SNHA in the vicinity of the project area is the Southern Shores Cypress Swamp. This small area is one of the few cypress swamps found on the Outer Banks.

Non-Riverine Wetland Forests

Non-riverine wet hardwood and swamp forests most commonly occur on very poorly drained flats in northeastern North Carolina. Within the project area, they occur in Maple Swamp. Loss of these communities can be attributed to logging, development, and conversion to agriculture and silviculture, since these areas are largely privately owned. Once impacted these areas are unlikely to return to their original state. These communities are heavily fragmented and only a few small stands containing large trees still exist. Smaller gum and maple trees with dense shrub layers now dominate most of these communities. The primary difference between non-riverine wet hardwood/ swamp forest and tidal cypress-gum swamp is topographic position and the source of flooding, with non-riverine swamp forests being flooded with high groundwater, as opposed to flowing or tidal sources (Schafale and Weakley, 1990). These are stable communities that provide refuge for a large diversity of neotropical migrants, local avian populations, reptiles, amphibians, and mammals (Schafale, 1999).

Tidal Communities

Tidal cypress/gum swamp and tidal freshwater marsh typically surround freshwater/ oligohaline water bodies in the coastal plain that are influenced by lunar and/or wind tides. Great Swamp and Currituck Sound are areas that contain estuarine and tidal communities within the project area. These communities are also found in SNHAs such as the North River/Deep Creek Marshes and Forest, Mamie Marshes and Ponds, Harbinger Marshes, Church Island Marsh, Bell Point Marsh, Currituck Banks, Corolla Natural Area, Swan Island Natural Area, Currituck National Wildlife Refuge, and the Pine Island/Currituck Club Natural Area which are all present in the vicinity of the project area (see Figure 6 in Appendix A). Primary threats to these communities include Common reed encroachment and the resulting reduction of plant and animal diversity, reduced fire regime allowing succession to other communities, and swamp drainage for development and mosquito control; all of which have reduced the size of these areas. Salt intrusion from storm surge events can also negatively affect these communities. Few old growth cypress-gum swamps remain. This community provides refuge for a diversity of avian, reptile, and amphibian species. Current protection efforts include a large area of tidal freshwater marsh that is partly owned by the National Audubon Society-Pine Island Audubon Sanctuary, but the remainder is privately owned (NCNHP, 1990).

4.1.2 Impacts to Terrestrial Habitat

Permanent impacts to biotic communities include losses because of fill, bridge pilings, drainage easements, and cleared maintenance corridors. Shading from proposed bridge decks would primarily affect open water habitats (see Section 4.2.3). Temporary impacts would result from fill and clearing during construction but would likely return to natural conditions over time. The estimated amounts of temporary impacts to biotic communities for each detailed study alternative are shown in Table 8 and Table 9. The estimated amounts of permanent impacts to biotic communities for each detailed study alternative are shown in Table 10 and Table 11. Openings in forested communities created by vegetation removal and/or filling would lead to adverse effects including community fragmentation, introduction of shade intolerant weedy species, and alteration of other environmental factors that affect biotic community dynamics. These "edge effects" would be most prominent in forest and swamp communities of Maple Swamp and the Outer Banks with MCB2 and MCB4. Impacts to Great Swamp and roadside communities associated with ER2 and the road-widening portions of MCB2 and MCB4 would be less severe since these areas are near existing road corridors.

Table 8. Temporary Impacts to Biotic Communities by Detailed Study Alternative for ER2, MCB2/A, and MCB4/A

Biotic Community	ER2 (acres)	MCB2/A/C1 (acres)	MCB2/A/C2 (acres)	MCB4/A/C1 (acres)	MCB4/A/C2 (acres)
Upland man-dominated land	75.0 (1.7)	7.4 (1.5)	7.9 (2.0)	8.2 (0.0)	8.2 (0.0)
Upland agricultural land	29.9 (0.0)	1.7 (0.0)	1.7 (0.0)	1.7 (0.0)	1.7 (0.0)
Upland pine forest	1.1	0.0	0.0	0.0	0.0
Upland shrub/scrub	1.3	0.0	0.0	0.0	0.0
Upland mixed-pine/ hardwood forest	4.5 (0.0)	0.1 (0.0)	0.1 (0.0)	0.1 (0.0)	0.1 (0.0)
Upland hardwood forest	1.3 (0.0)	0.0	0.0	0.0	0.0
Upland maritime shrub/grassland	0.1	0.1	0.1	0.0	0.0
Upland maritime forest	0.0	0.0	0.0	0.0	0.0
Wetland man-dominated land	0.5 (0.0)	0.3 (0.0)	0.3 (0.0)	0.7 (0.0)	0.7 (0.0)
Wetland pine forest	0.0	0.0	0.0	0.0	0.0
Wetland shrub/scrub	0.0	0.0	0.0	0.0	0.0
Wetland mixed-pine/ hardwood forest	0.0	0.0	0.0	0.0	0.0
Wetland hardwood forest	0.6 (0.0)	0.3 (0.0)	0.3 (0.0)	0.3 (0.0)	0.3 (0.0)
Wetland bay forest	0.0	0.0	0.0	0.0	0.0
Wetland swamp forest	1.1 (0.0)	1.1 (0.0)	1.1 (0.0)	1.1 (0.0)	1.1 (0.0)
Wetland maritime shrub/grassland	0.0	0.0	0.0	0.0	0.0
Wetland maritime forest	0.0	0.0	0.0	0.0	0.0
Wetland maritime swamp	0.0	0.0	0.0	0.0	0.0
Wetland freshwater marsh	0.0	0.0	0.0	0.0	0.0

Table 8 (concluded). Temporary Impacts to Biotic Communities by Detailed Study Alternative for ER2, MCB2/A, and MCB4/A

Biotic Community	ER2 (acres)	MCB2/A/C1 (acres)	MCB2/A/C2 (acres)	MCB4/A/C1 (acres)	MCB4/A/C2 (acres)
Pond	0.0	0.0	0.0	0.0	0.0
Open water (total)	0.1 (0.0)	0.0	0.0	0.0	0.0
• SAV	0.0	0.0	0.0	0.0	0.0
• Aquatic bottom	0.0	0.0	0.0	0.0	0.0
• Stream (acreage)	0.0	0.0	0.0	0.0	0.0
• Stream (linear feet)	171.7 (clearing)	0.0	0.0	0.0	0.0
Total	115.5 (4.2)	11.1 (1.6)	11.6 (2.1)	12.2 (0.0)	12.2 (0.0)

Note: Temporary impact calculations only include areas contained within temporary construction easements and do not include temporary impacts to the waters of Currituck Sound. The numbers in parentheses reflect the impact if reversing the center turn lane is used to reduce hurricane evacuation clearance times rather than constructing a third outbound lane. When there is no number in parentheses, the impact would be identical for either hurricane evacuation option.

Table 9. Temporary Impacts to Biotic Communities by Detailed Study Alternative for MCB2/B and MCB4/B

Biotic Community	MCB2/B/C1 (acres)	MCB2/B/C2 (acres)	MCB4/B/C1 (acres)	MCB4/B/C2 (acres)
Upland man-dominated land	7.9 (1.5)	7.9 (1.5)	8.7 (0.0)	8.7 (0.0)
Upland agricultural land	1.8 (0.1)	1.8 (0.1)	1.8 (0.1)	1.8 (0.1)
Upland pine forest	0.0	0.0	0.0	0.0
Upland shrub/scrub	0.0	0.0	0.0 (0.0)	0.0 (0.0)
Upland mixed-pine/ hardwood forest	0.1 (0.0)	0.1 (0.0)	0.1 (0.0)	0.1 (0.0)
Upland hardwood forest	0.0	0.0	0.0	0.0
Upland maritime shrub/grassland	0.1	0.1	0.0	0.0
Upland maritime forest	0.0	0.0	0.0	0.0
Wetland man-dominated land	0.3 (0.0)	0.3 (0.0)	0.7 (0.0)	0.7 (0.0)
Wetland pine forest	0.0	0.0	0.0	0.0
Wetland shrub/scrub	0.0	0.0	0.0	0.0
Wetland mixed-pine/ hardwood forest	0.0	0.0	0.0	0.0
Wetland hardwood forest	0.3 (0.0)	0.3 (0.0)	0.3 (0.0)	0.3 (0.0)
Wetland bay forest	0.0	0.0	0.0	0.0
Wetland swamp forest	1.1 (0.0)	1.1 (0.0)	1.1 (0.0)	1.1 (0.0)
Wetland maritime shrub/grassland	0.0	0.0	0.0	0.0
Wetland maritime forest	0.0	0.0	0.0	0.0
Wetland maritime swamp	0.0	0.0	0.0	0.0
Wetland freshwater marsh	0.0	0.0	0.0	0.0

Table 9 (concluded). Temporary Impacts to Biotic Communities by Detailed Study Alternative for MCB2/B and MCB4/B

Biotic Community	MCB2/B/C1 (acres)	MCB2/B/C2 (acres)	MCB4/B/C1 (acres)	MCB4/B/C2 (acres)
Pond	0.0	0.0	0.0	0.0
Open water (total)	0.0	0.0	0.0	0.0
• SAV (known)	0.0	0.0	0.0	0.0
• Aquatic bottom	0.0	0.0	0.0	0.0
• Stream (acreage)	0.0	0.0	0.0	0.0
• Stream (linear feet)	0.0	0.0	0.0	0.0
Total	11.7 (1.7)	11.7 (1.7)	12.9 (0.1)	12.9 (0.1)

Note: Temporary impact calculations only include areas contained within temporary construction easements and do not include temporary impacts to the waters of Currituck Sound. The numbers in parentheses reflect the impact if reversing the center turn lane is used to reduce hurricane evacuation clearance times rather than constructing a third outbound lane. When there is no number in parentheses, the impact would be identical for either hurricane evacuation option.

Table 10. Permanent Impacts to Biotic Communities by Detailed Study Alternative for ER2, MCB2/A, and MCB4/A

Biotic Community	ER2 (acres)				MCB2/A/C1 (acres)				MCB2/A/C2 (acres)				MCB4/A/C1 (acres)				MCB4/A/C2 (acres)			
	Fill	Pilings	Shading	Clearing	Fill	Pilings	Shading	Clearing	Fill	Pilings	Shading	Clearing	Fill	Pilings	Shading	Clearing	Fill	Pilings	Shading	Clearing
Upland man-dominated land	35.7 (33.9)	0.0	0.0	0.0	78.0 (76.3)	0.0	0.1	0.1	74.5 (72.8)	0.0	0.2	0.3	49.0 (47.3)	0.0	0.1	0.1	45.5 (43.8)	0.0	0.2	0.3
Upland agricultural land	0.2 (0.0)	0.0	0.0	0.0	16.3 (16.1)	0.0	0.0	0.0	16.3 (16.1)	0.0	0.0	0.0	16.3 (16.1)	0.0	0.0	0.0	16.3 (16.1)	0.0	0.0	0.0
Upland pine forest	0.0	0.0	0.0	0.0	9.5	0.0	0.6	2.1	9.5	0.0	0.6	2.1	9.5	0.0	0.6	2.1	9.5	0.0	0.6	2.1
Upland shrub/scrub	0.0	0.0	0.0	0.0	2.9	0.0	0.0	0.0	2.9	0.0	0.0	0.0	2.9	0.0	0.0	0.0	2.9	0.0	0.0	0.0
Upland mixed-pine/hardwood forest	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.1	2.0	0.0	0.0	0.1	2.0	0.0	0.0	0.1	2.0	0.0	0.0	0.1
Upland hardwood forest	0.0	0.0	0.0	0.0	4.8	0.0	0.0	0.0	4.8	0.0	0.0	0.0	4.8	0.0	0.0	0.0	4.8	0.0	0.0	0.0
Upland maritime shrub/grassland	54.2	0.0	0.0	0.0	61.8	0.0	0.3	0.4	54.1	0.0	0.0	0.1	22.5	0.0	0.3	0.4	14.8	0.0	0.0	0.1
Upland maritime forest	31.1	0.0	0.0	0.0	32.5	0.0	0.0	0.1	36.8	0.0	0.8	0.3	2.5	0.0	0.0	0.1	6.8	0.0	0.8	0.3
Wetland man-dominated land	0.2	0.0	0.0	0.0	1.2	0.0	0.0	0.1	1.2	0.0	0.0	0.1	1.0	0.0	0.0	0.1	1.0	0.0	0.0	0.1
Wetland pine forest	0.0	0.0	0.0	0.0	0.0	0.0	0.4	1.3	0.0	0.0	0.4	1.3	0.0	0.0	0.4	1.3	0.0	0.0	0.4	1.3
Wetland shrub/scrub	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wetland mixed-pine/hardwood forest	0.2 (0.0)	0.0	0.0	0.0	0.6 (0.4)	0.0	2.1	6.4	0.6 (0.4)	0.0	2.1	6.4	0.6 (0.4)	0.0	2.1	6.4	0.6 (0.4)	0.0	2.1	6.4
Wetland hardwood forest	0.0	0.0	0.0	0.0	2.7	0.0	3.4	6.8	2.7	0.0	3.4	6.8	2.7	0.0	3.4	6.8	2.7	0.0	3.4	6.8

Table 10 (continued). Permanent Impacts to Biotic Communities by Detailed Study Alternative for ER2, MCB2/A, and MCB4/A

Biotic Community	ER2 (acres)				MCB2/A/C1 (acres)				MCB2/A/C2 (acres)				MCB4/A/C1 (acres)				MCB4/A/C2 (acres)			
	Fill	Pilings	Shading	Clearing	Fill	Pilings	Shading	Clearing	Fill	Pilings	Shading	Clearing	Fill	Pilings	Shading	Clearing	Fill	Pilings	Shading	Clearing
Wetland bay forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wetland swamp	0.2 (0.0)	0.0	0.0	0.0	0.7 (0.5)	0.0	4.1	10.9	0.7 (0.5)	0.0	4.1	10.9	0.7 (0.5)	0.0	4.1	10.9	0.7 (0.5)	0.0	4.1	10.9
Wetland maritime shrub/grassland	0.2	0.0	0.0	0.0	1.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wetland maritime forest	1.7	0.0	0.0	0.0	4.2	0.0	0.1	0.3	2.3	0.0	0.9	1.9	2.8	0.0	0.1	0.3	0.9	0.0	0.9	1.9
Wetland maritime swamp	1.8	0.0	0.0	0.0	1.8	0.0	0.0	0.0	1.8	0.0	0.9	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.9	1.8
Wetland freshwater marsh	0.7	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.7	0.0	0.6	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.6	1.4
Pond	0.3	0.0	0.0	0.0	1.2	0.0	0.0	0.0	0.2	0.0	0.0	0.0	1.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0

Table 10 (concluded). Permanent Impacts to Biotic Communities by Detailed Study Alternative for ER2, MCB2/A, and MCB4/A

Biotic Community	ER2 (acres)				MCB2/A/C1 (acres)				MCB2/A/C2 (acres)				MCB4/A/C1 (acres)				MCB4/A/C2 (acres)			
	Fill	Pilings	Shading	Clearing	Fill	Pilings	Shading	Clearing	Fill	Pilings	Shading	Clearing	Fill	Pilings	Shading	Clearing	Fill	Pilings	Shading	Clearing
Open water (total)*	0.1	0.0	0.1	0.0	0.1	0.2	14.5	0.0	0.1	0.2	17.8	0.0	0.0	0.2	14.5	0.0	0.0	0.2	17.8	0.0
• SAV (known)	0.0	0.0	0.0	0.0	0.0	0.0	4.3	0.0	0.0	0.0	5.5	0.0	0.0	0.0	4.3	0.0	0.0	0.0	5.5	0.0
• Aquatic bottom Total/ depths < 6ft	0.1/ 0.1	0.0/ 0.0	0.1/ 0.1	0.0/ 0.0	0.1/ 0.1	0.2/ 0.1	28.2/ 14.5	0.0/ 0.0	0.1/ 0.1	0.2/ 0.1	28.2/ 17.8	0.0/ 0.0	0.1/ 0.0	0.1/ 0.1	28.1/ 14.5	0.0/ 0.0	0.0/ 0.0	0.2/ 0.1	29.1/ 17.8	0.0/ 0.0
• Stream (acreage)	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
• Stream (linear feet)	0.0	0.0	36.0	0.0	0.0	0.0	36.0	0.0	0.0	0.0	136.0	0.0	0.0	0.0	18.0	0.0	0.0	0.0	118.0	0.0
Total	126.6 (124.2)	0.0	0.1	0.0	221.8 (219.5)	0.2	39.3	28.5	211.4 (209.1)	0.2	43.1	33.5	119.0 (116.7)	0.2	39.3	28.6	108.6 (106.2)	0.2	43.0	33.5

*Open water subcategory (i.e., SAV, aquatic bottom, and stream) amounts are included in total open water, but subcategory amounts do not add up to total because of the overlapping nature of these communities.
The numbers in parentheses reflect the impact if reversing the center turn lane is used to reduce hurricane evacuation clearance times rather than constructing a third outbound lane. When there is no number in parentheses, the impact would be identical for either hurricane evacuation option. Also, the numbers in this table were rounded to the nearest tenth, so minor rounding error exists when adding the individual numbers to get the totals.

Table 11. Permanent Impacts to Biotic Communities by Detailed Study Alternative for MCB2/B and MCB4/B

Biotic Community	MCB2/B/C1 (acres)				MCB2/B/C2 (acres)				MCB4/B/C1 (acres)				MCB4/B/C2 (acres)			
	Fill	Pilings	Shading	Clearing	Fill	Pilings	Shading	Clearing	Fill	Pilings	Shading	Clearing	Fill	Pilings	Shading	Clearing
Upland man-dominated land	79.2 (77.4)	0.0	0.7	0.0	75.7 (74.0)	0.0	0.7	0.3	50.1 (48.3)	0.0	0.7	0.0	46.6 (44.8)	0.0	0.0	0.3
Upland agricultural land	35.7 (35.5)	0.0	0.0	0.0	35.7 (35.5)	0.0	0.0	0.0	35.7 (35.5)	0.0	0.0	0.0	35.7 (35.5)	0.0	0.0	0.0
Upland pine forest	16.5	0.0	0.3	0.0	16.5	0.0	0.3	0.0	16.5	0.0	0.3	0.0	16.5	0.0	0.0	0.0
Upland shrub/scrub	2.8	0.0	0.0	0.0	2.8	0.0	0.0	0.0	2.8	0.0	0.0	0.0	2.8	0.0	0.0	0.0
Upland mixed-pine/hardwood forest	4.8	0.0	0.0	0.0	4.8	0.0	0.0	0.0	4.8	0.0	0.0	0.0	4.8	0.0	0.2	0.0
Upland hardwood forest	3.4	0.0	0.0	0.0	3.4	0.0	0.0	0.0	3.4	0.0	0.0	0.0	3.4	0.0	0.0	0.0
Upland maritime shrub/grassland	61.8	0.0	0.3	0.4	54.1	0.0	0.0	0.1	22.5	0.0	0.3	0.4	14.8	0.0	0.2	0.1
Upland maritime forest	32.5	0.0	0.0	0.1	36.8	0.0	0.1	0.3	2.5	0.0	0.0	0.1	6.8	0.0	0.0	0.3
Wetland man-dominated land	2.4	0.0	0.0	0.0	2.4	0.0	0.0	0.0	2.2	0.0	0.0	0.0	2.2	0.0	0.0	0.0
Wetland pine forest	1.6	0.0	0.0	0.0	1.6	0.0	0.0	0.0	1.6	0.0	0.0	0.0	1.6	0.0	0.0	0.0
Wetland shrub/scrub	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wetland mixed-pine/hardwood forest	9.2 (9.0)	0.0	0.0	0.0	9.2 (9.0)	0.0	0.0	0.0	9.2 (9.0)	0.0	0.0	0.0	9.2 (9.0)	0.0	0.0	0.0

Table 11 (continued). Permanent Impacts to Biotic Communities by Detailed Study Alternative for MCB2/B and MCB4/B

Biotic Community	MCB2/B/C1 (acres)				MCB2/B/C2 (acres)				MCB4/B/C1 (acres)				MCB4/B/C2 (acres)			
	Fill	Pilings	Shading	Clearing	Fill	Pilings	Shading	Clearing	Fill	Pilings	Shading	Clearing	Fill	Pilings	Shading	Clearing
Wetland hardwood forest	9.0	0.0	0.2	0.0	9.0	0.0	0.2	0.0	9.0	0.0	0.2	0.0	9.0	0.0	0.2	0.0
Wetland bay forest	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wetland swamp	13.1 (12.9)	0.0	0.2	0.0	13.1 (12.9)	0.0	0.2	0.0	13.1 (12.9)	0.0	0.2	0.0	13.1 (12.9)	0.0	0.2	0.0
Wetland maritime shrub/grassland	1.0	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wetland maritime forest	4.2	0.0	0.1	0.3	2.3	0.0	0.8	1.9	2.8	0.0	0.1	0.3	0.9	0.0	0.8	1.9
Wetland maritime swamp	1.8	0.0	0.0	0.0	1.8	0.0	0.9	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.9	1.8
Wetland freshwater marsh	0.7	0.0	0.0	0.0	0.7	0.0	0.6	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.6	1.4

Table 11 (concluded). Permanent Impacts to Biotic Communities by Detailed Study Alternative for MCB2/B and MCB4/B

Biotic Community	MCB2/B/C1 (acres)				MCB2/B/C2 (acres)				MCB4/B/C1 (acres)				MCB4/B/C2 (acres)			
	Fill	Pilings	Shading	Clearing	Fill	Pilings	Shading	Clearing	Fill	Pilings	Shading	Clearing	Fill	Pilings	Shading	Clearing
Pond	1.2	0.0	0.0	0.0	0.2	0.0	0.0	0.0	1.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0
Open water (total)*	0.1	0.2	14.5	0.0	0.1	0.2	17.8	0.0	0.0	0.2	14.5	0.0	0.0	0.2	17.8	0.0
• SAV (known)	0.0	0.0	4.3	0.0	0.0	0.0	5.5	0.0	0.0	0.0	4.3	0.0	0.0	0.0	5.5	0.0
• -Aquatic bottom Total/ depths <6ft	0.1/0.1	0.1/0.1	28.2/14.5	0.0/0.0	0.1/0.1	0.1/0.1	28.2/17.8	0.0/0.0	0.1/0.1	0.1/0.1	28.1/14.5	0.0/0.0	0.0/0.0	0.2/0.1	29.1/17.8	0.0/0.0
• -Stream (acreage)	0.0	0.0	0.1	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
• -Stream (linear feet)	0.0	0.0	36.0	0.0	0.0	0.0	136.0	0.0	0.0	0.0	18.0	0.0	0.0	0.0	118.0	0.0
Total	280.9 (278.4)	0.2	30.5	0.9	270.5 (268.0)	0.2	33.5	5.7	178.1 (175.6)	0.1	30.4	0.9	167.5 (165.0)	0.2	32.8	5.7

*Open water subcategory (i.e., SAV, aquatic bottom, and stream) amounts are included in total open water, but subcategory amounts do not add up to total because of the overlapping nature of these communities.

The numbers in parentheses reflect the impact if reversing the center turn lane is used to reduce hurricane evacuation clearance times rather than constructing a third outbound lane. When there is no number in parentheses, the impact would be identical for either hurricane evacuation option. Also, the numbers in this table were rounded to the nearest tenth, so minor rounding error exists when adding the individual numbers to get the totals.

4.1.2.1 Temporary Impacts

For all of the detailed study alternatives, the use of temporary construction easements would involve impacts to terrestrial habitat through the removal of vegetation and ground disturbance; however, conditions would be returned to their original state after construction and natural revegetation would occur. Most impacts associated with temporary construction easements would occur in man-dominated and agricultural areas for all of the detailed study alternatives. Table 8 and Table 9 indicate that, in general, temporary impacts to biotic communities would be greatest with ER2 (115.5 acres) with construction of a third outbound lane for hurricane evacuation. These impacts are primarily associated with the third outbound hurricane evacuation lane and for any detailed study alternative are minor without the lane. Temporary impacts to biotic communities with MCB2 and MCB4 would range from 11.1 to 12.9 acres with construction of a third outbound lane for hurricane evacuation. Temporary impacts to upland maritime communities are less than 1.0 acre for all of the detailed study alternatives (with or without the hurricane evacuation lane), with no easements proposed for MCB4 in these areas. The detailed study alternatives using Option B would have slightly more temporary impacts to upland man-dominated and agricultural lands than their Option A equivalents, except for MCB2/C2 which is the same for both for upland man-dominated land.

Temporary impacts to forested wetland habitats would be slightly greater for ER2, with easements proposed in several wetland communities. Without a third outbound lane on US 158 for improving hurricane evacuation times, no temporary impacts to wetland habitats would occur with any of the detailed study alternatives. Overall differences in temporary wetland impacts with a third outbound lane would be minimal (1.7 to 2.2 acres). None of the detailed study alternatives would involve the use of temporary construction easements in wetland bay forest or wetland maritime and marsh communities. ER2 would have the most substantial temporary impacts to terrestrial habitat because ER2 construction activities would be entirely on land, and also would involve the greatest distance of road widening along US 158 and NC 12 of the detailed study alternatives. Without the hurricane evacuation lane, temporary impacts to terrestrial habitat with ER2 would be substantially less, but still would be greater than the other detailed study alternatives. MCB2 and MCB4 would have more substantial temporary impacts to aquatic habitat because of the associated bridge construction across Currituck Sound (see Section 4.2.3).

If dredging were used as a part of construction, temporary impacts to the Currituck Sound bottom would occur. If used, dredging would occur in areas of shallow water less than 6 feet deep where there is no SAV. Given the assumptions described in Section 4.2.3.1, C1 would disturb by dredging approximately 25 acres of bottom area and C2 would disturb approximately 17 acres. Additionally, dredging may be necessary to construct and operate a temporary materials delivery dock which would affect approximately 4 additional acres of bottom area. These impacts are not quantified in Table 8 and Table 9, which only include areas contained within temporary construction easements.

4.1.2.2 Permanent Impacts

As shown in Table 10 and Table 11, for ER2, MCB2/A, and MCB4/A, permanent impacts would be primarily associated with alteration of upland communities, particularly unnatural, man-dominated land. Most of the remaining impacts would occur in upland maritime communities, followed by upland agricultural land. Without the hurricane evacuation lane on mainland US 158, impacts would be reduced by approximately 2 to 3 acres, depending upon the alternative.

For MCB2/B and MCB4/B, the most permanent impacts would occur in upland communities, primarily man-dominated land and maritime shrub/grassland followed by agricultural land and maritime forest. Unlike with MCB2/A and MCB4/A, three wetland communities are notably affected (mixed pine/hardwood forest, hardwood forest, and swamp). Without the hurricane evacuation lane on mainland US 158, impacts would be reduced by 3 or less acres, depending on the alternative, for only a few of the communities.

The most substantial alteration of natural upland habitat would be associated with ER2 and MCB2 (with either bridge option or approach road option), which would involve removal of large amounts of maritime shrub/grassland and maritime forest communities. MCB4 would also involve removal of these areas, but to a lesser extent. MCB2 and MCB4 would remove equal amounts of upland hardwood and upland mixed-pine/hardwood forest communities, whereas ER2 would essentially not affect these areas.

Terrestrial wetland habitat would be most substantially altered with MCB2 and MCB4, which would involve permanent clearing, shading, and fill (primarily with MCB2/B and MCB4/B) of wetland swamp and forest communities associated with Maple Swamp and the eastern banks of Currituck Sound. There would be no permanent loss or alteration of the wetland bay forest found within Maple Swamp.

Wetland communities on the mainland would be least affected by ER2. Mainland wetland impacts would differ between Option A and Option B for MCB2 and MCB4, with Maple Swamp being bridged by MCB2/A and MCB4/A, and MCB2/B and MCB4/B crossing Maple Swamp primarily on fill. Thus, MCB2/B and MCB4/B would result in substantially more fill impacts to wetland communities.

Currently, Maple Swamp is fragmented by a maintained power line corridor and Aydlett Road. The integrity of Maple Swamp's forest trees/canopy was substantially altered by timbering activity between 2007 and 2009. During this time over 264 acres of forest were removed north of Aydlett Road, and additional timbering of an unknown acreage occurred south of Aydlett Road. These timbering activities created a large break in the forest canopy that extends across most of the east-west orientation of the swamp. The opening in the forest canopy from timbering has created an edge/fragmentation effect that will be temporarily much greater than the effect from a power line and road corridor. With time (many decades) these timbered areas are expected to re-vegetate with similar forest communities and provide habitat for species that prefer large tracts of unbroken forest. The proposed bridge/road corridor through Maple Swamp is adjacent to the existing power line corridor for a large portion of its length and would not create an additional fragmentation or break in the forest, but would increase the width of the current break between the two sides of the swamp. With MCB2/B and MCB4/B, Aydlett Road would be removed and the footprint restored as wetland, reducing the future, long-term effects of fragmentation by reducing the number of potential non-forested corridors across the swamp from two to one. With MCB2/A and MCB4/A, Aydlett Road and its non-forested corridor would remain.

The C1 and C2 bridge corridors would affect maritime wetland communities differently. The C1 bridge corridor landing on the Outer Banks would not shade or clear as much freshwater marsh, wetland maritime swamp, or wetland maritime forest (if any) as the C2 bridge corridor landing. Additionally, construction of permanent drainage easements along NC 12 and widening of US 158 east of the Wright Memorial Bridge would also alter maritime wetland communities. The permanent loss and alteration of these communities would be similar for ER2 and MCB2, but both would have greater impacts on these communities than MCB4 because they would have larger areas of road widening on the Outer Banks and would widen the bridge over Jean Guite Creek.

It is difficult to determine which specific detailed study alternative would most substantially affect the Outer Banks wetland communities. Unless specified, conclusions are the same for Option A and Option B. The amount of fill in wetland maritime shrub/grassland communities would be least for MCB4/C2 and greatest for MCB2/C1. MCB4/C2 would create the least amount of fill (0.9 acre compared to the highest amount of 4.2 acres) in wetland maritime forest and would not fill any other wetland maritime community or freshwater marsh, but as with MCB2/C2 would involve permanent clearing and shading in the wetland maritime swamp and freshwater marsh communities. MCB2/C1 would result in the most permanent loss to wetland maritime forest, but would avoid permanent clearing and shading of the wetland maritime swamp and freshwater marsh communities. Compared to MCB2 and MCB4/C1, ER2 would have moderate impacts to maritime wetland communities. The impacts with ER2 would result from fill for widening US 158 west of the Wright Memorial Bridge and the construction of several permanent drainage easements along NC 12.

4.1.3 Terrestrial Wildlife

The project area encompasses a wide diversity of natural habitat types that support a great diversity of wildlife. The Pasquotank River Basin contains more wildlife refuges than any other drainage basin in North Carolina; however, none of these areas occur within the project area. The closest refuge to the project area is Currituck National Wildlife Refuge, which is north of Corolla on the Outer Banks. There are also several SNHAs in the region that are recognized for high animal diversity (see Section 3.2.1). Scientific and common names of animals referenced in this report and documented from the project area are found in Appendix B.

4.1.3.1 Waterfowl

The Mid-Atlantic region of the United States is an extremely important wintering habitat for waterfowl and Currituck Sound has a long history of attracting large concentrations of wintering waterfowl (North American Waterfowl Management Plan, Plan Committee, 2004). However, there have been substantial declines in waterfowl numbers since the 1980s. The wintering population of ducks and geese in the sound has historically represented up to 15 percent of the entire Atlantic flyway population; however, numbers decreased in the early 1990s, with only approximately 0.4 percent of the total Atlantic flyway population wintering in Currituck Sound (Earley, 1993). Up to 50 percent of the state's wintering waterfowl could be found in Currituck Sound during the 1970s; however, only 4 percent wintered there in 1993 (Earley, 1993). Many factors appear to be important in affecting waterfowl populations nationwide. Some waterfowl species also appear to be wintering further north than traditionally. Human disturbance, fluctuating sea grass abundances, and rising salinity levels have been suggested as important factors affecting wintering waterfowl in Currituck Sound (Rideout, 1990).

A review of annual midwinter waterfowl surveys conducted by the US Fish and Wildlife Service (USFWS) found American black ducks, mallards, northern pintails, American wigeon, green-winged teals, ring-necked ducks, and American coot to be more abundant in Currituck Sound during the period of infestation by Eurasian water-milfoil in the 1960s (Wicker and Endres, 1995). Numbers of wintering snow geese, Canada geese, and canvasbacks in the sound have declined throughout the period between 1968 and 1990 (Wicker and Endres, 1995). General trends of wintering waterfowl from recent USFWS aerial flights of the Currituck National Wildlife Refuge (CNWR) are found in Table 12. These data show that the three most abundant species typically comprise at least 70 percent of the total number of waterfowl present. The tundra swan has frequently been the most abundant species during these surveys and the American black duck is also frequently one of the more common species. Since 1999, snow geese have infrequently been very abundant, but did appear in larger numbers during surveys with lower total abundance (e.g., 2,000 individuals, or 65 percent of 3,072 total, on March 10, 2000). Numbers of Canada geese have fluctuated, but have typically been less than 1,000 individuals per survey. Canvasbacks have not been observed by aerial survey since 1999 (USFWS, 2008).

4.1.3.2 Important Bird Nesting Areas

The project area includes habitats used for nesting by a variety of birds. Bald eagle nesting sites are discussed in Section 5.8. According to the NCNHP (1990), the closest known location of a waterbird nesting colony to the project area is the rookery at Monkey Island (an SNHA and a portion of the CNWR) approximately four miles north of the project area (see Figure 6 in Appendix A). A variety of waterbirds, including glossy ibis, egrets, and herons (Ardeidae), use this island for nesting and roosting. Least terns also nest at the Currituck Banks and Corolla Natural Area SNHAs (personal communication, Sue Cameron, NCWRC, October 30, 2007), which are portions of the CNWR. Maritime habitats that normally support nesting of colonial waterbirds are only present on the Outer Banks side of the project area, and no evidence of waterbird

Table 12. Summary of USFWS Aerial Waterfowl Surveys of CNWR from 1999-2007

Winter	Survey Date of Greatest Abundance	Total Number of Waterfowl Observed	Three Most Abundant Species (percent of total)	Total Percentage of Three Most Abundant Species
1999-2000	12-4-1999	16,853	Gadwall (43) American coot (31) American black duck (10)	84
2000-2001	2-27-2001	2,014	Tundra swan (19) Mallard (17) American black duck (16)	52
2001-2002	12-6-2001	2,976	Northern pintail (34) Tundra swan (29) American black duck (11)	73
2002-2003	2-5-2003	2,034	Tundra swan (35) Gadwall (29) Northern pintail (15)	79
2003-2004	2-9-2004	6,472	Tundra swan (36) Green-winged teal (30) American black duck (13)	79
2004-2005	2-2-2005	15,796	Tundra swan (39) Snow goose (22) Northern pintail (9)	71
2005-2006	3-8-2006	8,733	Tundra swan (45) Green-winged teal (27) American black duck (7)	78
2006-2007	12-6-2006	2,466	American coot (59) Tundra swan (22) Gadwall (8)	89

Source: USFWS, 2008

colonies was found in this area during community mapping or wetland delineation work.

Some colonial nesting waterbirds, such as great blue herons, are known to nest at inland locations. Maple Swamp, Deep Creek Swamp, and Great Swamp are areas of swamp near foraging habitat (shallow water) that could accommodate inland waterbird rookeries. Although potential habitat exists in Maple Swamp, no signs of inland-nesting, colonial waterbirds were seen in the project area while conducting wetland delineations or during an extensive tree survey in Maple Swamp

Although not included on the USFWS or NCWRC threatened and endangered species lists, black rails and yellow rails are rare species documented from Currituck County (NCNHP, 2006). Yellow rails are primarily winter residents, and black rails are rare residents that nest primarily in brackish marshes (NCNHP, 2006). Black rails are known to occur at the Pine Island/Currituck Club Natural Area (NCNHP, 1990). Waterfowl known to breed in this area include Canada geese, mallard, black duck, and wood duck.

Several areas of large trees are present in the project area. The proposed widening of US 158 for the hurricane evacuation lane on the mainland of Currituck County could impact the edges, at most, of Great Swamp and the North River/Deep Creek Marshes and Forest SNHA. However, the project area includes a substantial amount of area in Maple Swamp, another SNHA that is noted for its large loblolly bays, swamp tupelo, and bald cypress (NCNHP, 1990).

The only cavity nesting bird on the NCNHP list of rare animals that is known to occur in Currituck County is the red-cockaded woodpecker. Although red-cockaded woodpecker nesting colonies exist in other types of pine communities, red-cockaded woodpeckers prefer longleaf pine savannahs with a sparse to non-existent hardwood understory (USFWS, 2003). No longleaf pine savannahs occur in the project area. There are some areas of mixed-pine/hardwood forest, but these are mainly wetland communities consisting of hardwoods with scattered loblolly pines. This type of habitat is not typically used for nesting by red-cockaded woodpeckers (USFWS, 2003).

Although not listed by the NCNHP, USFWS, or NCWRC, other cavity-nesting species potentially occurring in bottomland habitats such as Maple Swamp include prothonotary warblers, wood ducks, barred owls, and several species of woodpeckers (Picidae) (Scott et al., 1977).

Neotropical migrants are avian species that winter in tropical areas and breed in the United States and Canada. This group includes many passerine families, several species of waterfowl, many shorebirds, and some raptor species. Many neotropical migrants are declining because of fragmentation of forests in their breeding range. Many of the passerine neotropical migrants require large blocks of unbroken habitat in order to breed successfully (Terborgh, 1989; Martin and Finch, 1995). These neotropical species are negatively affected by forest-dividing corridors as narrow as eight meters in width, but are more adversely affected by wider corridors (Rich et al., 1994).

No species of passerine neotropical migrants are listed on the NCNHP list of rare animal occurrences for Currituck County. However, appropriate breeding habitat for rare species such as black-throated green warbler is present in the project area. Avoiding fragmentation of large blocks of forest in the project area by building along existing, cleared corridors would reduce impacts to neotropical migrant species.

4.1.3.3 Terrestrial Wildlife

The diversity of plant communities in the project area supports a wide variety of wildlife. The geographic setting of the area supports some species at the southern end of their range and other species near the northern edge of their range. Many amphibian and reptile species are found in association with the variety of wetland communities. Mammalian diversity is generally higher on the mainland compared to the Outer Banks. The Outer Banks are an important corridor that is heavily used by migrating birds along the Atlantic flyway. The extensive, relatively undisturbed areas of natural communities found in association with Maple Swamp and Great Swamp support many species that are sensitive to "edge" effects, and require large, unfragmented blocks of habitat (e.g., black bears). The majority of wildlife species in the area are not restricted to one habitat type and are known to range through a variety of plant communities. The ecotones between terrestrial and aquatic communities provide complex habitats that are used by many species for foraging, breeding, and refuge.

A variety of factors affect the distribution and diversity of wildlife along the Outer Banks. The fragmented nature of the limited natural communities on the Outer Banks creates islands of favorable habitat for some terrestrial animals. Increased human development and the presence of some introduced species have created additional pressures on the native fauna along the Outer Banks. Grazing of plant communities by feral hogs and horses has altered the vegetation and species composition in some areas. Predation on wildlife by feral cats creates additional pressure on native species.

Characteristic reptiles and amphibians of the project area vary with respect to plant communities. A review of selected literature revealed at least 85 species documented from the area that could occur in the project area (see Appendix B). A herpetological study of the Coinjock vicinity by Platania and Lee (1978a) found the most common frogs to be the spring peeper, green frog, and bullfrog; the most common turtles to be the stinkpot and eastern mud turtle; the most common lizards to be the fence lizard, ground skink, and broad-headed skink; and the most common snakes to be the black racer, red-bellied watersnake, and brown watersnake. These species represent characteristic species of the mainland communities. Along the Outer Banks, Parnell et al. (1987) found the most common reptiles and amphibians to include the green treefrog, squirrel treefrog, Fowler's toad, snapping turtle, eastern mud turtle, southeastern five-lined skink, six-lined racerunner, and cottonmouth.

The variety of natural habitats along a coastal setting within the Atlantic flyway supports and attracts a diverse and abundant avian population. The extensive natural forested communities found in association with Maple Swamp support such resident species as red-shouldered hawk, barred owl, red-bellied woodpecker, American crow, Carolina chickadee, tufted titmouse, Carolina wren, and northern cardinal. Other neotropical migrants that breed in the area include yellow-billed cuckoo, red-eyed vireo, prothonotary warbler, northern parula, ovenbird, and hooded warbler. The most common breeding birds in woody communities along the northern Outer Banks include the Carolina wren, gray catbird, white-eyed vireo, prairie warbler, field sparrow, northern cardinal, and red-winged blackbird. Common species associated with the marshes include herons and egrets, osprey, rails, and common yellowthroat. A list of the known and potentially occurring birds in the project area is included in Appendix B.

As mentioned earlier, mammalian diversity is generally higher on the mainland compared to the Outer Banks. Several species and subspecies of mammals that occur in the project area are at the edge of their range (southern or northernmost limit) in northeastern North Carolina. Many mammals also have been recognized as endemic to the Dismal Swamp area. At least 29 mammal species have been documented from the project area, including three introduced species: nutria, Norway rat, and house mouse. Species of socioeconomic value include game and fur-bearing species such as white-tailed deer, black bear, beaver, mink, raccoon, gray fox, gray squirrel, muskrat, and nutria. Many of these mammals are associated with forested wetlands and marshes near the sound. Common small animals on the mainland include marsh rice rat and the white-footed mouse (Platania and Lee, 1978b). A list of the known and potentially occurring mammals in the project area is included in Appendix B.

4.1.4 Impacts to Terrestrial Wildlife

4.1.4.1 Habitat Loss and Alteration

Each of the detailed study alternatives would result in the removal of existing vegetative habitats and the displacement of wildlife within the project construction limits. Wildlife species are dependent upon the available resources in the habitats used. Wildlife inhabiting the construction area would either be temporarily displaced, permanently displaced, or lost. ER2 would be the least invasive on wildlife habitat, since construction would occur in primarily man-dominated areas. Road widening would increase the role of existing roads as impassable barriers that restrict wildlife movement. Removal and alteration of wildlife habitat would be greatest for MCB2 and MCB4. These alternatives could permanently alter the wildlife species composition of the impacted forest and swamp communities of Maple Swamp and the Outer Banks. Species requiring large areas of undisturbed habitat would likely disappear from areas near these corridors, whereas species attracted to edge communities would likely become more common. By bridging Maple Swamp for MCB2/A and MCB4/A, the movement of terrestrial wildlife should not be restricted; however, movement of species away from and toward the edge communities of the project corridor could increase competition pressures for limited resources. However, the road on fill through Maple Swamp with MCB2/B and MCB4/B would substantially affect wildlife use of the habitat. Habitat fragmentation can reduce species preferring interior forest and change species composition. Many neotropical bird species have been shown to be negatively affected by increased fragmentation and reduction of habitat. As previously discussed, the type of habitat (large, undisturbed areas versus edge habitat) available would change with both Option A and B, but wildlife movement would be more inhibited and habitat would be less available with Option B. Many terrestrial species would be more likely to attempt, and be successful, crossing under a bridge compared to crossing a road on fill. Additional discussion on wildlife passage is found in Section 4.1.4.2.

While all of the detailed study alternatives are in the vicinity of existing road corridors and are under the influence of associated edge effects, these alternatives would amplify those effects. This would be especially detrimental to maritime wildlife habitat on the

Outer Banks, where existing habitat is already extremely sparse and fragmented. A description of the temporary and permanent impacts to terrestrial wildlife habitat with the detailed study alternatives is found in Section 4.1.2.

4.1.4.2 Roadkill

With ER2 and the road widening portions of MCB2 and MCB4, mammals, reptiles, amphibians, and avian species would be subjected to an increase in the distance required to cross the road corridor. Safe passage of wildlife across roadways increases vehicular safety and reduces animal roadkills. However, except for some rare species, road mortality has a minimal effect on most bird and mammal populations despite it being a leading cause of mortality for some species in some areas (Forman and Alexander, 1998). Some species seem to be capable of learning to avoid road mortality; however, in many instances the wildlife populations gradually decline after road construction and the full effect may not be evident for several years after construction (Brandenburg, 1996; Mumme et al., 2000; Coffin, 2007; Findlay and Bourdages, 2000). The road widening associated with all of the detailed study alternatives may not result in changes to traffic volumes, but the reduced congestion and resulting increased speeds could contribute to increased road mortality.

MCB2/B and MCB4/B would likely result in increased mammal, reptile, and amphibian mortality and potential wildlife-vehicle collisions because this corridor passes through higher quality wildlife habitat. Potential effects of roadways on wildlife include: population reduction, reduction of habitat and genetic diversity, and impediments to wildlife migrations and daily travel (Jones, 2008 [includes a review of several studies that support this statement]; Cramer and Bissonette, 2009). In addition to concerns on wildlife populations, there is increasing concern with public safety. Over one million wildlife-vehicle collisions occur each year within the United States (Cramer and Bissonette, 2009). In 2007, there were 223 human deaths from wildlife-vehicle collisions in the United States, including nine in North Carolina, and millions of dollars worth of property damage (Cramer and Bissonette, 2009; Insurance Institute for Highway Safety, 2009). One insurance company estimated that there were 1.2 million claims for property damage from wildlife-vehicle collisions in fiscal year 2008 (Insurance Institute for Highway Safety, 2009).

Highways with fencing and wildlife under/overpasses are highly effective at reducing wildlife-vehicle collisions (Huijser et al., 2008) and cost analyses indicate the benefits outweigh the costs (Donaldson, 2005; Huijser et al., 2008). One study estimated that if a minimum of 2.6 to 10.2 (depending on the type of structure that was built) deer-vehicle collisions were prevented each year, the savings in damages associated with collisions would far exceed the cost of building the structure (including fencing) (Donaldson, 2005). Clevenger and Waltho (2005) recommend using several types of wildlife crossings to maximize the ability of wildlife to cross the road safely. Wildlife species affected by roads include a broad range of sizes and behaviors, so one type of non-bridge passageway would not be adequate for all species.

Wildlife crossings targeting a wide size range of wildlife would be incorporated in Maple Swamp if MCB2/B or MCB4/B is selected. The preliminary design developed to assess impacts and estimate project cost for MCB2/B or MCB4/B includes the following for wildlife passage: two bridges with 180-foot spans (120-foot by 10-foot clear opening) at the east and west sides of the swamp; a 12-foot by 8-foot box culvert at the center of the swamp; and two 43-inch by 68-inch pipes for passage of reptiles and amphibians. Exclusionary fencing along the road also is assumed. The majority of literature on wildlife crossing structures has found that fencing substantially increases the effectiveness of crossing structures and further reduces the amount of wildlife-vehicle collisions. Wildlife need to be funneled to the crossing structures; otherwise, it will be more difficult for them to find the bridge spans or culverts.

There is a potential for increased avian roadkills on a new bridge structure across Currituck Sound. Avian species potentially affected include those that commonly perch on bridges such as gulls, terns, wading birds, pelicans, and possibly some raptors. Substantial bridge mortality has been documented in royal terns (Bard et al., 2001) and brown pelicans (Owens and James, 1991). Several species of gulls were commonly observed dead on the Wright Memorial Bridge while conducting field work.

4.1.4.3 Noise Disturbance

Although evidence of wildlife population declines as a result of roadway mortality has persisted for years, the long-term effects of road avoidance resulting from traffic noise have only recently been studied. Traffic noise is a potential threat to an animal's health, reproductive success, physiology, and behavior (Forman and Alexander, 1998; Radle, 2006). Road avoidance because of noise/human activity has been extensively documented for wildlife species such as black bears (Brody and Pelton, 1989), bobcats (Lovallo and Anderson, 1996), wolves (Thurber et al., 1994), and songbirds (Reijnen et al., 1995; Reijnen et al., 1996; Forman and Alexander, 1998). Some species may become habituated to noise disturbances, but many species display reduced nesting and activity near areas of traffic noise (Fenandez-Juricic, 2001). Even though road noise has a varying effect on wildlife, it seems to substantially affect avian communities that utilize sound in their basic behaviors (Coffin, 2007). Noise levels as low as those found in a library reading room (42 to 48 decibels) have been found to negatively affect avian species (reviewed in Forman and Alexander, 1998).

4.1.4.4 Bridge Lighting

The current design does not include the placement of lights on the bridge structure across Currituck Sound. However, there would be a possibility that a bike path on the bridge would be considered in the final design that could include low (i.e., close to the bridge deck) lighting. A potential option for lighting the bridge and its approaches appears to be the use of LED sources mounted at low level on the bridge structure (integrated or adjacent to the handrail or guardrail for lighting the pedestrian walkway) and on low height poles (approximately 12 feet to 14 feet) for walkways adjacent to bridge approach roads (on land). Lighting of this type offers source variability, including spectral selection, dimming capabilities, and optical control. Low level lighting is desirable because it would not include lighting structures on the bridge, would minimize potential light spill (e.g., lighting trespass, sky glow, and glare) and would minimize associated environmental impacts.

A low level lighting system such as the one described above would not likely adversely affect wildlife over Maple Swamp or Currituck Sound. The most substantial effect of this type of bridge lighting would likely involve the attraction of insects into a traffic area. At night, lights are known to attract insects in large concentrations that could also attract flying insectivorous predators (small birds and bats) into the vicinity of bridge traffic. This could increase the possibility of vehicle collisions for these species. Most concern with lighted structures in the vicinity of coastal areas is the potential to disrupt nesting sea turtles, hatchlings, and migratory shorebirds. However, this would not be a concern with the proposed project since appropriate sea turtle nesting habitat is not present in the project area and lighting systems would be low level and low-voltage. The urban glow currently produced by the nearby communities of Duck and Coinjock is substantially greater than what would be produced by the proposed lighting system. In addition, adverse impacts from lighting are usually associated with high-voltage lighting systems on high-mast bridges, both of which are not being considered for the detailed study alternatives.

4.2 Aquatic Communities and Wildlife

4.2.1 Aquatic Communities

Aquatic communities found in the project area include ponds and open water. These communities are shown on Figure 5 in Appendix A and discussed in the following sections.

4.2.1.1 Ponds

Several freshwater ponds occur within the project area. Some of these are naturally-occurring open waters located on the Outer Banks. These ponds may be subject to flooding from the waters of Currituck Sound. Other ponds have been excavated wholly or partially in wetlands and are surrounded by naturalized riparian zones. Ponds are not considered to be "wetlands" by the USACE (1987); however, these communities are Section 404 jurisdictional waters. In the Cowardin et al. (1979) system of classification these communities can be identified as "Palustrine Unconsolidated Bottom Deepwater Habitats" (codes PUB2/3/4H/x). Ponds that have been excavated wholly in uplands and are not naturalized, such as stormwater retention ponds, are included in the man-dominated lands category and are not mapped as ponds.

4.2.1.2 Open Water

Open water of the project area is found primarily in association with the surface water of Currituck Sound. In addition, a canal (which acts as a portion of the AIWW) crosses the project area on the mainland and connects Coinjock Bay to the North River. Using the

Cowardin et al. (1979) system of wetland classification, there are several types of deepwater habitats that occur in these water bodies. "Estuarine Subtidal Unconsolidated Bottom Deepwater Habitats" (codes E1UB2/3/4L/M6/x) include the following subtypes: estuarine water column, aquatic bed (tidal freshwater), and intertidal flats. "Estuarine Subtidal Rooted Vascular Aquatic Bed Deepwater Habitats" (code E1AB3L6) are also found within this community and are more commonly referred to as submerged aquatic vegetation (SAV). These open water subtypes are considered to be essential fish habitat (EFH) for certain fish species managed by the Mid-Atlantic Fisheries Management Council (MAFMC) and the South Atlantic Fisheries Management Council (SAFMC).

The shallow waters (less than 6 feet deep) of Currituck Sound provide habitat for extensive beds of SAV. These SAV communities are included within the open water areas of the Currituck Sound. For many juvenile and adult fish, the structural complexity of SAV habitat provides refuge from predators. These habitats are also rich in invertebrates and, therefore, serve as important foraging areas. Other roles include stabilizing sediment, nutrient cycling, reducing wave energy, and providing organic matter that supports complex food webs (NCWRC, 2005). For these reasons, SAV communities are considered Habitat Areas of Particular Concern (HAPC) for several managed fish species. The distribution and composition of SAV communities are influenced by several factors; among the most important factors are light, salinity, wave action, and nutrient levels. Recent studies have referenced these systems as submersed rooted vascular beds (SRV), which distinguishes rooted vegetation from primarily algae (Ferguson and Wood, 1994). Species composition and biomass of SAV in the Currituck Sound have varied greatly over the past 70 years (Davis and Carey, 1981; Davis and Brinson, 1983).

The abundance of many native SAV species declined in the 1960s with the invasion of Eurasian water milfoil. Recent trends indicate a decrease in Eurasian water milfoil and an increase in formerly more common, native species such as widgeon grass and wild celery (Ferguson and Wood, 1994; Davis and Brinson, 1989). Other submersed rooted vascular species occurring in the sound include sago pondweed, redhead grass, and bushy pondweed. Stoneworts, a type of macroscopic algae, have also been important components of SAV communities. Based on a recent survey conducted by the USACE (2007), there are approximately 711 acres of confirmed SAV within the project area in Currituck Sound.

In addition to the open waters of Currituck Sound, several jurisdictional drainages are found in the project area. On the mainland two minor, unnamed drainages are found along US 158 in association with Maple Swamp and Great Swamp (S1 and S2), and two more minor drainages are found in association with Currituck Sound (S3 and S4). On the Outer Banks, the project area crosses Jean Guite Creek in the southern portion of the project area and another stream (S5) in the vicinity of the C2 bridge corridor landing. These features are classified by Cowardin et al. (1979) as "Estuarine Subtidal Unconsolidated Bottom Deepwater Habitats." Open water habitats are not considered to be "wetlands" by the USACE (1987); however, these communities are Section 404 jurisdictional waters. The types of aquatic habitat present in open water areas of the project area (including EFH areas and SAV) are discussed in greater detail in the *Essential Fish Habitat Technical Report* (CZR Incorporated, 2009).

4.2.2 Aquatic Wildlife

4.2.2.1 Invertebrates

Macroinvertebrate populations of Currituck Sound are composed primarily of burrowing amphipods near the shore, but there is a more diverse population in deeper areas. Oligochaetes, chironomids, and brackish water clams were the most commonly sampled species (Matta, 1977). A more recent study by the NCDEHNR-Division of Environmental Management (DEM) in July 1993 found primarily freshwater taxa in the northern portions of the sound and more crustaceans in the more saline, southern areas of the sound. Insects were predominant in the northern portions of the sound and contributed to the higher diversity of invertebrates found in association with SAV beds. Commercially important invertebrates of the sound consist primarily of blue crab and some shrimp. These two species were documented from only the southern portions of the sound during invertebrate sampling in July 1993 (NCDEHNR-DEM, 1993). The lack of saline waters and suitable substrate limit the growth of most commercially important shellfish (i.e., oysters and clams). Currently, commercial shellfish harvesting is prohibited in the northern portion of the sound (including the project area) and Jean Guite Creek. A list of the known and potentially occurring macroinvertebrates in the Currituck Sound area is included in Appendix B.

4.2.2.2 Fish

Currituck Sound provides habitat for a variety of fish and shellfish. It is used by freshwater species, estuarine species, and juvenile marine fishes. Although shellfish harvesting is prohibited in Currituck Sound because of high levels of fecal coliform bacteria, this area provides an important fishery for many other species. Appendix B includes a list of the fish species that have been caught in Currituck Sound during sampling by the NCDENR-DMF (personal communication, Sara Winslow, NCDENR-DMF, May 15, 2008), the NCWRC, and commercial fishing vessels (NCDENR-DMF and NCWRC, unpublished data).

Sport and commercial fishing has been an important part of Currituck County's economy and history. The Currituck Sound is an important nursery area for migratory and resident fish. Migratory fish that use the sound include saltwater species that use the sound for spawning and juvenile stages of life, such as red drum, spot, Atlantic croaker, summer flounder, and southern flounder; saltwater species that pass through the sound to spawn in freshwater areas, such as American shad, blueback herring, alewife, and striped bass; and freshwater species that migrate to the sound as adults, such as white perch and catfishes. The total annual economic value of fisheries in Currituck Sound has ranged between \$0.9 and \$3.2 million during the past 14 years. Crab (primarily blue crab) is the most economically important fishery in the sound.

Flounder is a relatively close second, but most other species fall far behind in terms of economic value (NCDENR-DMF, unpublished data).

In the past, nursery areas for two anadromous fish species, the blueback herring and alewife, were known to occur within Currituck Sound. Nursery areas for these species, including Whale Head Bay and Sanders Bay, were identified in the sound from 1980 to 1983. Catch per unit of effort was highest for these two species during the months of June through August (Winslow et al., 1983). However, the status of the populations of these two species was identified as declining in the sound during 1980 (Copeland and Gray, 1989), and these areas (Whale Head Bay and Sanders Bay) are no longer officially recognized as anadromous fish spawning areas or PNAs. Section 3.2.2 contains current descriptions of these areas.

A 1977 fish survey in the sound found the most numerous species per hectare were yellow perch, tidewater silverside, pumpkinseed, and bluespotted sunfish (Borawa et al., 1978). This same study found the most important species, in terms of weight per hectare, to be carp, pumpkinseed, yellow perch, largemouth bass, and golden shiner. A 1989 fish survey of the same areas sampled in 1977 found the most important species, in terms of weight per hectare, to be carp, white perch, striped mullet, and pumpkinseed. This study also estimated the mean standing crop for Currituck Sound at 101.1 kilograms per hectare (89.4 pounds per acre) (Kornegay, 1989).

Current fish community structure within Currituck Sound was determined during a survey by the NCWRC in 1994 (personal communication, Kevin Dockendorf, NCWRC, June 13, 2008). This survey found the most abundant species to be spot, with estuarine species comprising slightly less than half of the total species observed. Common estuarine species also included killifish, bay anchovy, and white perch. Freshwater species observed during this survey included pumpkinseed, bluegill, largemouth bass, and yellow perch. Freshwater taxa were more abundant at sampling stations towards the northern half of the sound, with estuarine taxa becoming more common towards the southern half of the sound, corresponding with the higher salinity levels to the south (NCWRC, unpublished data).

4.2.3 Impacts to Aquatic Communities and Aquatic Wildlife

Construction of a new bridge structure over Currituck Sound would produce some short-term noise, turbidity, and siltation, thereby creating localized, short-term impacts to aquatic habitat and wildlife. Noise from open water construction activities would be a temporary, localized disturbance to fish. Historic and present stresses to aquatic flora and fauna in Currituck Sound have occurred because of fluctuations in turbidity and salinity (NCDEHNR, 1994; Caldwell, 2001). The proposed construction of the Mid-Currituck Bridge is not anticipated to affect the salinity of Currituck Sound. Turbidity is an important factor affecting the distribution and abundance of SAV (Davis and Carey, 1981; Davis and Brinson, 1983; Ferguson and Wood, 1994). Increased turbidity from shoreline erosion, dredging, boating, sedimentation, and runoff can all increase turbidity creating unfavorable conditions for SAV survival (Sincock, 1966; Davis and Brinson, 1983; Riggs et al., 1993), which would then affect those species that are dependent upon, or utilize, SAV. Runoff during and after construction could contain varying amounts of particulates, organic compounds, nutrients, and heavy metals, all of which could temporarily degrade water quality and impact aquatic organisms.

Fill, pile placement, shading, and clearing would result directly in the permanent loss or alteration of aquatic habitat within the project area, as summarized in the following sections. In addition to permanent loss of habitat resulting from pile placement, the C1 and C2 bridge corridors for MCB2 and MCB4 could generate several other impacts, including changes in water quality, water flow, and light levels of the areas both underneath the bridge and for some distance surrounding the bridge.

4.2.3.1 Temporary Impacts

Bridge construction associated with the C1 and C2 bridge corridors for MCB2 and MCB4 would take place over Currituck Sound. The over water construction activities associated with these alternatives would produce noise, turbidity, and siltation, thereby creating localized, short-term impacts to aquatic habitat. Because the C2 bridge corridor would be longer (7.5 miles) than the C1 corridor (7.0 miles), these impacts would likely be more substantial for MCB2/C2 and MCB4/C2. Another important factor in the level of temporary construction impacts would be the number of active bridge construction sites.

Several temporary construction easements would be located along the sections of NC 12 and US 158 that would be widened with all of the detailed study alternatives. In addition, the detailed study alternatives would involve temporary ground disturbance associated with actual road widening and construction of drainage easements. Increased turbidity and sedimentation could occur within Currituck Sound as a result of runoff from these areas. Runoff may contain varying amounts of particulates, organic compounds, nutrients, and heavy metals, all of which could degrade water quality and impact aquatic organisms. However, these effects would cease after revegetation and these areas would be expected to return to previous conditions. BMPs would be used to minimize sedimentation. A minor bridge replacement over Jean Guite Creek also is proposed for all of the detailed study alternatives. In summary, although some small adverse impacts to aquatic habitat would occur during the construction phases, the impacts would be temporary and are not expected to result in substantial short-term or long-term adverse effects.

The temporary effects of pile placement would include short-term increases in noise, turbidity, and siltation. Noise from open water construction activity would be a temporary, localized disturbance to fish. Construction related noise generated during pile driving can be of sufficient intensity to kill or injure marine organisms (reviewed in Hanson et al., 2004). At the ecosystem level, turbidity would result in a reduction in ecosystem productivity (i.e., ability of the system to produce and export energy) and nursery value by eliminating organisms that cannot readily move, and displacing mobile organisms. For individual organisms, turbidity can impair visual predation success, impair predator avoidance, and impair oxygen uptake by clogging respiratory structures. Siltation could generate increased water column turbidity, as well as smother or alter benthic vegetative and animal communities. These impacts are likely to be prolonged because of poor water circulation in the sound. Because of the degraded habitat value, most mobile animals would avoid the area of construction for the duration of the construction phase, while non-mobile shellfish, such as clams, could suffer long-term impacts from construction-related siltation. Benthic organisms are expected to rapidly recover after construction ceases, as most soft bottom benthic communities are resilient and likely to recolonize quickly. The NCDOT would take practicable measures to minimize turbidity generated during bridge construction.

The Mid-Currituck Bridge could be built using a temporary construction trestle (bridge), an overhead gantry crane, a launching truss (temporary truss attached to and extending out from completed foundations), or low draft barges with associated dredging in parts of Currituck Sound without existing SAV and less than 6 feet deep. The Mid-Currituck Bridge would likely be built beginning at both termini simultaneously, with construction meeting in the middle. If low draft barges are used, additional construction points may be started in the middle of the sound to expedite bridge construction. During final design, NCTA would coordinate with environmental resource and regulatory agencies on finalizing the construction techniques to be used with the goal of reducing potential temporary impacts to water quality and aquatic habitat to the extent practicable.

Should dredging be used during Mid-Currituck Bridge construction, it would occur in areas of shallow water less than 6 feet deep where there is no SAV. The bottom would be dredged to a depth of 6 feet. Dredging would occur parallel to the bridge. Dredging would primarily be along the west shore of Currituck Sound (2,000 feet for C1 or C2) and a section in the middle of the sound (5,100 feet for C1 and 2,600 feet for C2). The total dredging lengths would be approximately 7,100 feet for C1 (approximately 29 percent of the length of C1 over the sound) and 4,600 feet for C2 (approximately 17 percent of the length of C2 over the sound). The dredged area is anticipated to be 150 feet wide with roughly 3:1 side slopes beyond the dredged area to reach natural bottom. Given these assumptions, C1 would disturb approximately 25 acres of bottom area and C2 would disturb approximately 17 acres. Additionally, a temporary materials delivery dock could be placed on the west side of the sound adjacent to the proposed bridge or north of the bridge at a suitable staging area. Dredging may be necessary to construct and operate this dock, which would affect approximately 4 additional acres of bottom area.

Overall, ER2 would result in minor temporary impacts to aquatic habitat because ER2 only involves NC 12 and US 158 widening. Temporary construction easements on the mainland are located over four jurisdictional streams (S1-S4) along US 158 on the mainland. These easements would result in 171.7 linear feet of temporary clearing impacts to streams. Runoff from active construction areas could result in temporary increases in turbidity, siltation, and sedimentation in aquatic habitat areas, but these affects are expected to be minimal and cease after revegetation.

4.2.3.2 Permanent Impacts

Fill, pile placement, shading, and clearing would result directly in the permanent loss or alteration of aquatic habitat within the project area, as summarized in Table 10 and Table 11. Impacts to aquatic habitat are the same with Option A and Option B given that the only difference between the two options occurs in Maple Swamp, where there is no aquatic habitat. The greatest amount of fill to wetland freshwater marsh and open water areas would occur with the permanent drainage easements associated with ER2 and MCB2 (both bridge options and with or without the hurricane evacuation lane on mainland US 158). The greatest amount of permanent alteration (shading and clearing) to marsh and open water areas also would occur with MCB2/C2 and MCB4/C2 because of the longer bridge deck with the C2 bridge corridor, as well as because the C2 bridge corridor would be located in close proximity to extensive freshwater marsh areas.

Based on a recent survey mapping SAV areas within the project area (USACE, 2007), the greatest impacts to SAV within the project area would be associated with MCB2/C2 and MCB4/C2 (with or without the hurricane evacuation land on mainland US 158). Both of these detailed study alternatives would remove less than 0.1 acre of SAV because of pile placement, and shade 5.5 acres of SAV. MCB2/C1 and MCB4/C1 would remove and shade less than 0.1 acre and 4.3 acres of SAV, respectively. The only state-designated fish nursery/spawning area (primary, secondary, or anadromous spawning area) crossed by any of the detailed study alternatives is Jean Guite Creek, which is a PNA and would be crossed by the widening of US 158 with ER2 and MCB2, as well as the third outbound lane hurricane evacuation improvements with MCB4. Bridge widening would only include pile placement within the creek if the hurricane evacuation lane is added with MCB4.

In addition to permanent loss of habitat resulting from pile placement, the C1 and C2 bridge corridors could generate several other impacts, including changes in water quality, water flow, and light levels of the areas both underneath the bridge and for some distance surrounding the bridge. Altered light levels and the introduction of piles as a hard substrate previously unavailable in the area would have multiple effects, thereby resulting in changes to the existing food web structure. Decreased autotrophic productivity (phytoplankton and aquatic vegetation) resulting from lower light levels could result in decreased abundances of aquatic vegetative habitat (including SAV), heterotrophic grazers, and predators (zooplankton, benthic invertebrates, and fish). On the other hand, organisms could be attracted to bridge pilings as a reef structure. More detailed summaries of indirect and long-term impacts to aquatic habitat are included in Section 5.10.2 and the *Essential Fish Habitat Technical Report* (CZR Incorporated, 2009).

4.2.3.3 Impacts to Commercial Fisheries

Ongoing commercial fishing activity exists in the project area. The C1 and C2 bridge corridors with MCB2 and MCB4 should have little impact on commercial fishing operations. However, the presence of a bridge structure across Currituck Sound could potentially disrupt fishing operations by reducing trawling area and restricting net and crab pot deployment. While potential fishing areas could be eliminated in the vicinity of the bridge, impacts to commercial fishing in general would not be substantial since only a small portion of fishing area would be removed. In addition, commercial shellfish harvesting is currently prohibited in the vicinity of the C1 and C2 bridge corridors. There are no impacts to commercial fisheries expected with ER2.

4.3 Invasive Species

The diversity, abundance, and health of natural communities can be negatively affected by the introduction of exotic species. There were five species from the NCDOT Invasive Exotic Plant List for North Carolina (Smith, 2008) observed within the project area. Common reed (Threat Level 1) was observed in the project area within wetland freshwater marsh and wetland maritime shrub/grassland communities, as well as in man-dominated depressional areas and ditches. Japanese honeysuckle (Threat Level 2) was observed along the borders of mixed-pine/hardwood forest communities, as well as within man-dominated and shrub/scrub areas. Chinese privet (Threat Level 1) was found within mixed-pine/hardwood forest and shrub/scrub communities. Nepalese browntop (Threat Level 1) was observed in all terrestrial communities except maritime shrub/grassland and wetland freshwater marsh. Mimosa (Threat Level 2) was observed along the borders of mixed-pine/hardwood forest communities, as well as within man-dominated and shrub/scrub areas. The NCDOT will follow its BMPs for the management of invasive plant species.

5.0 Jurisdictional Issues

5.1 Clean Water Act Waters of the US

5.1.1 Characteristics

Six jurisdictional streams were identified within the project area (see Table 13). The locations of these streams are shown on Figure 4 in Appendix A. USACE and NCDENR-DWQ stream forms are included in Appendix C. The physical characteristics and water usage classifications of each stream are detailed in Section 3.2. All streams have been designated as warm water streams for the purpose of stream mitigation.

Table 13. Characteristics of Jurisdictional Streams in the Project Area

Map ID	Total Length (feet)[1]	Culverted Length (feet)	Total Length Subject to Mitigation (feet)[2]	Classification	Compensatory Mitigation Required	River Basin Buffers
S001	533.7	99.9	433.8	Intermittent	Yes	NA
S002	235.5	95.6	139.9	Intermittent	No	NA
S003	66.4	NA	66.4	Perennial	Yes	NA
S004	155.4	NA	155.4	Intermittent	Yes	NA
Jean Guite Creek	270.5	NA	270.5	Perennial	Yes	NA
S005	498.4	NA	498.4	Intermittent	Yes	NA

[1] Includes culverted sections.
[2] Culverted sections excluded.

Approximately 4,781 acres of wetlands and waters that are jurisdictional under Section 404 of the Clean Water Act were found in the project area (Table 14). The majority of this acreage (approximately 3,897 acres) is Currituck Sound. Delineation of wetlands in the project area occurred from September to December 2007, during May, July, and October 2008, and in January 2009. Jurisdictional areas identified in the project area were verified in the field by Bill Biddlecome of the USACE on November 1, 2007, December 6, 2007, January 8, 2008, and October 22, 2008. David Wainwright of the NCDENR-DWQ verified jurisdictional areas in the field on December 19, 2007 and October 22, 2008. Wetland boundaries approved by the USACE are depicted on Figure 4 in Appendix A. Wetlands occur in 11 communities within the project area: mixed herbaceous (in man-dominated area), disturbed shrub/scrub, mixed-pine/hardwood forest, hardwood forest, bay forest, swamp forest, maritime shrub/grassland, maritime forest, maritime swamp, freshwater marsh, and open-water (includes SAV). Descriptions of these wetland communities are found in Sections 4.1.1 and 4.2.1.

Table 14. Characteristics of Jurisdictional Wetlands and Waters in the Project Area

Map ID	Cowardin Classification	Hydrologic Classification	Area (acres)	Appendix A Figure Where Illustrated
Wetlands				
W001	PFO1/3F, PEM1/2B	Non-riverine	2.24	4(b)
W002	PFO1/3/4B/F	Non-riverine	3.39	4(b)
W002a	PFO1/3/4B/F	Non-riverine	0.08	4(b)
W003	PFO1/3E/F, PEM1/2B	Non-riverine	2.21	4(b)
W003a	PFO1/3E/F, PEM1/2B	Non-riverine	<0.01	4(b)
W003b	PFO1/3E/F	Non-riverine	<0.01	4(b)
W003c	PFO1/3E/F, PEM1/2B	Non-riverine	0.04	4(b)
W004	PFO1/3/4B	Non-riverine	0.71	4(b)
W005	PSS1/3/4B	Non-riverine	0.34	4(b)
W006	PFO1/3/4B	Non-riverine	1.01	4(b)
W006a	PFO1/3/4B	Tidal, Non-riverine	0.04	4(b)
W006b	PFO1/3/4B	Tidal, Non-riverine	0.24	4(b)
W006c	PFO1/3/4B	Tidal, Non-riverine	1.46	4(b)
W007	PFO1/3/4B	Non-riverine	1.27	4(b)
W008	PFO1/3E	Non-riverine	4.44	4(b)
W009	PFO1/3/4B	Non-riverine	4.30	4(b)
W010	PFO1/3/4B/E/F, PEM1/2B, PSS1/3/4B	Non-riverine	166.31	4(b), 4(d)
W011	PFO1/3/4B/E, PSS1/3/4B	Non-riverine	1.33	4(b)
W012	PEM1/2B, PSS1/3/4B	Non-riverine	0.02	4(b)
W013	PFO1/3/4B/E/F, PEM1/2B, PSS1/3/4B	Non-riverine	396.77	4(b)

Table 14 (continued). Characteristics of Jurisdictional Wetlands and Waters in the Project Area

Map ID	Cowardin Classification	Hydrologic Classification	Area (acres)	Appendix A Figure Where Illustrated
W014	PFO1/3/4B	Non-riverine	0.05	4(c)
W015	PFO1/3/4B/E/F	Non-riverine	95.84	4(b), 4(c)
W016	PFO1/3E	Non-riverine	0.39	4(d)
W017	E1UB2/3/4Kx	Non-riverine	0.35	4(d)
W018	PFO1/3E, PEM1/2B, PSS1/3/4B	Non-riverine	21.81	4(d)
W019	PFO1/3E	Non-riverine	0.08	4(d)
W020	PFO1/3E	Non-riverine	0.27	4(d)
W021	PFO1/3E, PSS1/3/4B	Non-riverine	0.23	4(d)
W022	PSS1/3/4B	Non-riverine	0.01	4(d)
W023	PFO1/3/4B, PEM1/2B, PSS1/3/4B	Non-riverine	1.41	4(d)
W024	PEM1/2B	Riverine	0.01	4(e)
W025	PEM1/2B	Riverine	<0.01	4(e)
W026	PFO1/3E	Non-riverine	0.04	4(e)
W027	PFO1/3E	Non-riverine	0.10	4(e)
W028	PFO1/3E	Non-riverine	0.01	4(e)
W029	PFO1/3E	Non-riverine	0.13	4(e)
W030	PFO1/3E	Non-riverine	0.02	4(e)
W031	PFO1/3E	Non-riverine	<0.01	4(e)
W032	PFO1/3E, PEM1/2B	Non-riverine	0.48	4(g)
W033	PFO1/3E, PEM1/2B	Non-riverine	0.29	4(g)
W034[1]	E2EM1P	Tidal	0.12	4(g)
W035	PFO1/3/4F	Tidal	0.15	4(h)
W036	PFO1/3/4A/B/F	Tidal	1.29	4(h)
W037	PFO1/3/4F	Non-riverine	0.27	4(h)
W038	PFO1/3/4B/F	Non-riverine	0.87	4(h)
W038a	PFO1/3/4F	Non-riverine	0.47	4(h)
W039	PEM1/2B, PSS1/3/4B	Non-riverine	0.15	4(h)

Table 14 (continued). Characteristics of Jurisdictional Wetlands and Waters in the Project Area

Map ID	Cowardin Classification	Hydrologic Classification	Area (acres)	Appendix A Figure Where Illustrated
W040	PEM1/2B, PSS1/3/4B	Non-riverine	0.45	4(h)
W041	PFO1/3/4B	Non-riverine	0.16	4(h)
W042	PFO1/3/4F	Non-riverine	0.35	4(h)
W043	PFO1/3/4F	Non-riverine	0.13	4(h)
W044	PFO1/3/4A, PEM1/2B, PSS1/3/4B	Non-riverine	0.42	4(h)
W045	PFO1/3/4B/F	Non-riverine	0.27	4(h)
W046a[1]	E2EM1P, E2SS1/3/4P	Tidal	0.40	4(i)
W046b[1]	E2EM1P	Tidal	0.08	4(i)
W046c[1]	E2EM1P, E2SS/FO1/3/4P, PFO1/3/4B	Tidal	0.56	4(i)
W047[1]	E2EM1P, E2SS/FO1/3/4P	Tidal	0.51	4(i)
W047a[1]	E2EM1P	Tidal	<0.01	4(i)
W048[1]	E2EM1P	Tidal	0.13	4(i)
W049[1]	E2EM1P	Tidal	0.07	4(j)
W050[1]	E2EM1P, E2FO1/3/4P	Tidal	0.12	4(j)
W051	PSS1/3/4B	Non-riverine	0.04	4(j)
W051a[1]	E2EM1P	Tidal	0.02	4(j)
W051b[1]	E2SS1/3/4P	Tidal	0.02	4(j)
W051c[1]	E2EM1P	Tidal	0.01	4(j)
W051d[1]	E2EM1P	Tidal	0.01	4(j)
W051e	PFO1/2/3/4P	Non-riverine	0.02	4(j)
W051f	PFO1/2/3/4P	Non-riverine	0.05	4(j)
W051g	PFO1/2/3/4P	Non-riverine	0.02	4(j)
W052	PFO1/3/4B	Non-riverine	0.05	4(j)
W052a	PFO1/3/4B	Non-riverine	0.01	4(j)
W052b	PFO1/3/4B	Non-riverine	0.01	4(j)
W052c	PFO1/3/4B	Non-riverine	0.24	4(j)
W053	PFO1/3/4B	Non-riverine	0.08	4(j)

Table 14 (continued). Characteristics of Jurisdictional Wetlands and Waters in the Project Area

Map ID	Cowardin Classification	Hydrologic Classification	Area (acres)	Appendix A Figure Where Illustrated
W054	PSS1/3/4B	Non-riverine	0.13	4(j)
W055[1]	E2EM1P	Tidal	0.08	4(j)
W056	PSS1/3/4B	Non-riverine	0.04	4(j)
W057	PSS1/3/4B, PEM1/2B	Non-riverine	0.27	4(j)
W058	PSS1/3/4B, PEM1/2B	Non-riverine	0.17	4(j)
W058a	PSS1/3/4B, PEM1/2B	Non-riverine	0.08	4(j)
W059	PSS1/3/4B, PEM1/2B	Non-riverine	0.20	4(k)
W060	PFO1/3/4B	Non-riverine	0.66	4(k)
W060a	PFO1/3/4B	Non-riverine	<0.01	4(k)
W061	PFO1/3/4B	Non-riverine	0.28	4(k)
W062	PFO1/3/4B	Non-riverine	0.17	4(k)
W063	PFO1/3/4B	Non-riverine	0.24	4(k)
W063a	PFO1/3/4B	Non-riverine	0.02	4(k)
W064	PFO1/3/4B	Non-riverine	0.16	4(k)
W065	PFO1/3/4B	Non-riverine	0.05	4(k)
W066	PFO1/3/4B	Non-riverine	0.42	4(k)
W066a	PFO1/3/4B	Non-riverine	0.14	4(k)
W067	PFO1/3/4B	Non-riverine	<0.01	4(k)
W068	PSS1B, PEM2B	Non-riverine	0.02	4(k)
W069	PFO1/3/4B	Non-riverine	0.07	4(l)
W070[1]	E2EM1P, E2SS/FO1/3/4P, PFO1/3/4B/F	Tidal, Non-riverine	74.93	4(l)
W071	E2EM1P	Tidal	0.51	4(l)
W072	PSS2A	Non-riverine	<0.01	4(l)
W073	PFO1/3/4B	Non-riverine	0.05	4(l)
W074	PFO1/3/4B	Non-riverine	0.01	4(l)
W075	PSS2B	Non-riverine	<0.01	4(l)
W076	PSS1/3B, PEM2B	Non-riverine	<0.01	4(l)
W076a	PSS1/3B, PEM2B	Non-riverine	0.04	4(l)
W077	PSS1/3/4B, PEM2B	Non-riverine	0.10	4(l)

Table 14 (continued). Characteristics of Jurisdictional Wetlands and Waters in the Project Area

Map ID	Cowardin Classification	Hydrologic Classification	Area (acres)	Appendix A Figure Where Illustrated
W078	PSS1/3/4B, PEM2B	Non-riverine	<0.01	4(l)
W078a	PSS1/3/4B, PEM2B	Non-riverine	<0.01	4(l)
W079	PSS1/3/4B, PEM2B	Non-riverine	0.01	4(l)
W080	PSS1/3/4B, PEM1/2B	Non-riverine	0.27	4(l)
W081	PSS1/3/4B, PEM1/2B	Non-riverine	0.67	4(l)
W082	PSS1/3/4B, PEM2B	Non-riverine	0.14	4(l)
W083	PSS1/3/4B, PEM2B	Non-riverine	0.14	4(l)
W084	PSS1/3/4B, PEM2B	Non-riverine	0.15	4(l)
W085	PFO1/3/4B	Non-riverine	<0.01	4(l)
W086	PFO1/3/4B	Non-riverine	0.42	4(l)
W086a	PFO1/3/4B	Non-riverine	0.26	4(l)
W087	PFO1/3/4A/B	Non-riverine	0.24	4(l)
W088	PFO1/3/4A/B	Non-riverine	0.14	4(l)
W089	PFO1/3/4A/B	Tidal	0.01	4(l)
W090	PFO1/3/4A/B	Non-riverine	1.60	4(l)
W091	PEM2B	Non-riverine	0.03	4(l)
W092	PEM2B	Non-riverine	0.05	4(l)
W093	PFO1/3/4A/B	Non-riverine	0.05	4(l)
W094	PFO1/3/4A/B	Non-riverine	0.62	4(l)
W095	PFO1/3/4A/B	Non-riverine	0.06	4(l)
W096	PFO1/3/4A/B	Non-riverine	0.51	4(l)
W097	PFO1/3/4A/B	Non-riverine	0.03	4(l)
W098	PEM2B	Non-riverine	0.10	4(l)
W099[1]	E2EM1A, PFO1B	Tidal	11.30	4(l)
W100[2]	PFO1/3/4B	Non-riverine	0.36	4(l)
W101[2]	PFO1/3/4B	Non-riverine	0.29	4(l)
W102[2]	PFO1/3/4B	Non-riverine	0.11	4(l)

Table 14 (concluded). Characteristics of Jurisdictional Wetlands and Waters in the Project Area

Map ID	Cowardin Classification	Hydrologic Classification	Area (acres)	Appendix A Figure Where Illustrated
W103[1]	E2EM1A	Tidal	11.23	4(l)
W104[1]	E2EM1A	Tidal	47.30	4(l)
W105[1]	E2EM1A	Tidal	1.07	4(l)
Total Wetland Acreage			**871.40**	
Waters				
Currituck Sound	E1UB2/3/4L/M	Tidal	3,896.85	4(c), 4(g), 4(i), 4(j), 4(l)
AIWW	E1UB2/3/4Lx	Tidal	1.85	4(b)
Jean Guite Creek	E1UB2/3/4Lx	Tidal	0.45	4(h)
S001	E1UB2/3/4Lx	Riverine	0.11	4(d)
S002	E1UB2/3/4Lx	Riverine	0.03	4(d)
S003	E1UB2/3/4Lx	Riverine	0.02	4(e)
S004	E1UB2/3/4Lx	Riverine	0.02	4(e)
S005	E1UB2/3/4Lx	Riverine	0.06	4(l)
P001	PUB2/3/4Hx	Non-riverine	0.18	4(c)
P002	PUB2/3/4H	Non-riverine	<0.01	4(h)
P003	E1UB2/3/4Lx	Tidal	0.14	4(h)
P004	PUB2/3/4Hx	Non-riverine	0.04	4(h)
P005	PUB2/3/4H	Non-riverine	<0.01	4(i)
P006	PUB2/3/4H	Non-riverine	0.22	4(i)
P007	PUB2/3/4Hx	Non-riverine	0.07	4(j)
P008	PUB2/3/4Hx	Non-riverine	0.06	4(j)
P009	PUB2/3/4Hx	Non-riverine	0.24	4(j)
P010	PUB2/3/4Hx	Non-riverine	0.02	4(k)
P011	PUB2/3/4Hx	Non-riverine	0.44	4(k)
P012	PUB2/3/4Hx	Non-riverine	0.17	4(k)
P013	PUB2/3/4Hx	Non-riverine	0.15	4(l)
P014	PUB2/3/4Hx	Non-riverine	0.18	4(l)
P015	PUB2/3/4Hx	Non-riverine	0.56	4(l)
P016	E1UB2/3/4Lx	Tidal	0.99	4(l)
P017	PUB2/3/4Hx	Non-riverine	4.85	4(l)
P018	PUB2/3/4Hx	Non-riverine	0.67	4(l)
P019	PUB2/3/4H	Non-riverine	0.71	4(l)
P020	PUB2/3/4H	Non-riverine	0.20	4(l)
Total Water Acreage			**3,909.29**	
Total Jurisdictional Wetland and Waters Acreage			**4,780.69**	

[1] Portions of these polygons contain CAMA coastal wetlands (wetland freshwater marsh).

[2] Determined to be isolated wetlands during previous delineation.

5.1.2 Impacts

Summaries of the approximate amount of jurisdictional and non-jurisdictional impacts by impact type that would occur for each detailed study alternative are shown in Table 15 and Table 16, respectively. The numbers in parentheses reflect the impact if reversing the center turn lane is used to reduce hurricane evacuation clearance times rather than constructing a third outbound lane on mainland US 158. When there is no number in parentheses, the impact would be identical for either hurricane evacuation option.

Temporary impacts to jurisdictional areas include areas that are contained within temporary construction easements that would be disturbed during construction activities, but should return to their natural state after construction is completed. Without construction of a third outbound lane for hurricane evacuation on mainland US 158, there would be no temporary impacts to jurisdictional streams, except for 171.7 feet of temporary clearing to streams with ER2. With construction of a third outbound lane, there would be no more than 2.1 acres total temporary impacts to jurisdictional areas under any detailed study alternative.

Permanent impacts include fill and piling placement, shading (not calculated in this section), drainage easements, and permanently cleared areas under proposed bridge structures. Fill in wetland areas would be greatest for MCB2/B and MCB4/B (amounts range from 36.0 to 42.9 acres versus 5.9 to 12.8 acres for their Option A version). Fill in wetlands would be the least for ER2 and MCB4/A/C2. Open water impacts would be greatest for MCB2/A/C1, MCB2/B/C1, and MCB2/A/C2.

A separate permanent impact calculation is included that calculates the fill area within the slope-stake line, and within jurisdictional areas included in an additional 25-foot buffer. This calculation is included to provide a conservative estimate of impacts to wetlands resulting from topographical changes during construction. A similar pattern emerges with MCB2/B and MCB4/B having the greatest impact, with C1 having a lower impact than C2. Fill in wetlands again would be the least for ER2 and MCB4/A/C2.

Clearing of wetlands would be greatest with MCB2 and MCB4 because of the inclusion of a Mid-Currituck Bridge. Temporary construction easements on US 158 on the mainland with ER2 would result in 171.7 linear feet of temporary clearing impacts to streams.

5.2 Clean Water Act Permits

An Individual Permit from the USACE for the entire project would be required pursuant to Section 404 of the Clean Water Act (33 CFR, Part 323) for discharges of dredged or fill material into waters of the United States. The Clean Water Act provides for public notice and review of Section 404 permit applications, as well as review by the USFWS and approval by the US Environmental Protection Agency (USEPA).

Table 15. Summary of Jurisdictional Impacts by Detailed Study Alternative for ER2, MCB2/A, and MCB4/A

	ER2 (acres)	MCB2/A/C1 (acres)	MCB2/A/C2 (acres)	MCB4/A/C1 (acres)	MCB4/A/C2 (acres)
Wetlands					
Fill	5.1 (4.6)	12.8 (12.4)	10.2 (9.8)	8.5 (8.1)	5.9 (5.5)
Pilings	0.0	0.0	0.0	0.0	0.0
Clearing	0.0	25.7	30.6	25.8	30.6
Total Permanent Impacts	5.1 (4.6)	38.6 (38.2)	40.7 (40.3)	34.4 (34.0)	36.5 (36.1)
Temporary	2.1 (0.0)	1.7 (0.0)	1.7 (0.0)	2.1 (0.0)	2.1 (0.0)
Total Wetland Impacts	7.2 (4.6)	40.3 (38.2)	42.4 (40.3)	36.6 (34.0)	38.7 (36.1)
Open Water					
Fill	0.1	0.1	0.1	0.0	0.0
Pilings	0.0	0.2	0.2	0.2	0.2
Clearing	0.0	0.0	0.0	0.0	0.0
Total Permanent Impacts	0.1	0.3	0.3	0.2	0.2
Temporary	0.1 (0.0)	0.0	0.0	0.0	0.0
Total Open Water Impacts	0.1 (0.0)	0.3	0.3	0.2	0.2
Total Stream Impacts[1] (acres/feet)	0.0/171.7 in temporary clearing (0.0/0.0)	0.0/0.0	0.0/0.0	0.0/0.0	0.0/0.0
Total Pond Impacts (Fill)	0.3	1.2	0.2	1.1	0.1
Total Jurisdictional Impacts	7.6 (5.1)	41.9 (39.9)	42.8 (40.8)	37.8 (35.4)	39.0 (36.5)
Wetland within Slope-Stake Line, plus Additional 25-foot buffer					
Total Impact	12.6 (8.6)	21.1 (17.1)	16.5 (12.5)	15.4 (10.6)	10.9 (6.0)

The numbers in parentheses reflect the impact if reversing the center turn lane is used to reduce hurricane evacuation clearance times rather than constructing a third outbound lane. When there is no number in parentheses, the impact would be identical for either hurricane evacuation option. Also, the numbers in this table were rounded to the nearest tenth, so minor rounding error exists when adding the individual numbers to get the totals.

[1]If a third outbound lane is added for hurricane evacuation on US 158 over Jean Guite Creek with MCB4, a single piling would be installed in the creek and the existing bridge over the creek would be widened by 18 feet (shade impact). With ER2 and MCB2, the bridge over Jean Guite Creek would be widened by 36 feet for the widening of US 158 (shade impact). MCB2/C2 and MCB4/C2 also would result in a small amount of shading over a single stream on the Outer Banks.

Table 16. Summary of Jurisdictional Impacts by Detailed Study Alternative for MCB2/B and MCB4/B

	MCB2/B/C1 (acres)	MCB2/B/C2 (acres)	MCB4/B/C1 (acres)	MCB4/B/C2 (acres)
Wetlands				
Fill	42.9 (42.4)	40.3 (39.9)	38.6 (38.2)	36.0 (35.6)
Pilings	0.0	0.0	0.0	0.0
Clearing	0.3	5.1	0.3	5.1
Total Permanent Impacts	43.2 (42.8)	45.3 (44.9)	38.9 (38.5)	41.1 (40.6)
Temporary	1.7 (0.0)	1.7 (0.0)	2.1 (0.0)	2.1 (0.0)
Total Wetland Impacts	44.9 (42.8)	47.0 (44.9)	41.1 (38.5)	43.2 (40.6)
Open Water				
Fill	0.1	0.1	0.0	0.0
Pilings	0.1	0.0	0.1	0.0
Clearing	0.0	0.0	0.0	0.0
Total Permanent Impacts	0.3	0.1	0.2	0.0
Temporary	0.0	0.0	0.0	0.0
Total Open Water Impacts	0.3	0.1	0.2	0.0
Total Stream Impacts[1] (acres/feet)	0.0/0.0	0.0/0.0	0.0/0.0	0.0/0.0
Total Pond Impacts (Fill)	1.2	0.2	1.1	0.1
Total Jurisdictional Impacts	46.4 (44.3)	47.3 (45.2)	42.3 (39.7)	43.3 (40.7)
Wetland within Slope-Stake Line, plus Additional 25-foot buffer				
Total Impact	47.1 (43.1)	42.5 (38.5)	41.4 (36.6)	36.9 (32.0)

The numbers in parentheses reflect the impact if reversing the center turn lane is used to reduce hurricane evacuation clearance times rather than constructing a third outbound lane. When there is no number in parentheses, the impact would be identical for either hurricane evacuation option. Also, the numbers in this table were rounded to the nearest tenth, so minor rounding error exists when adding the individual numbers to get the totals.

[1]If a third outbound lane is added for hurricane evacuation on US 158 over Jean Guite Creek with MCB4, a single piling would be installed in the creek and the existing bridge over the creek would be widened by 18 feet (shade impact). With ER2 and MCB2, the bridge over Jean Guite Creek would be widened by 36 feet for the widening of US 158 (shade impact). MCB2/C2 and MCB4/C2 also would result in a small amount of shading over a single stream on the Outer Banks.

A Water Quality Certification pursuant to Section 401 of the Clean Water Act would be needed from the NCDENR-DWQ. This permit is required in association with the USACE Section 404 permitting process.

5.3 Construction Moratorium

There is no specific statute or regulation that designates or references the waters of Currituck Sound as subject to a construction moratorium. However, there is a possibility that a moratorium could be imposed on the project via a permit condition during the USACE Section 404 and CAMA permitting review processes. The only state designated fish nursery/spawning area (primary, secondary, or anadromous spawning area) crossed by any alternative is Jean Guite Creek, which is a PNA and would be crossed by the widening of US 158 with ER2 and MCB2, as well as third outbound lane hurricane evacuation improvements with MCB4. Although each project is reviewed on a case-by-case basis and coordinated with the NC Division of Marine Fisheries, the dates for a potential moratorium, depending on extent and type of impact, could range from February 15 through September 30.

5.4 North Carolina River Basin Buffer Rules

The waters of the project area are located entirely within the Pasquotank River Basin. There are currently no Riparian Buffer rules being administered by NCDENR-DWQ in this river basin.

5.5 Rivers and Harbors Act Section 10 Navigable Waters

Within the project area, Currituck Sound, the AIWW, and Jean Guite Creek have been designated by the USACE as Navigable Waters under Section 10 of the Rivers and Harbors Act.

5.6 Wetland and Stream Mitigation

Applications for USACE dredge and fill permits under Section 404 must meet mitigation requirements found in the "Memorandum of Agreement (MOA) Between the Environmental Protection Agency and the Department of the Army Concerning the Determination of Mitigation Under the Clean Water Act Section 404(b)(1) Guidelines" (February 1990). This MOA requires the applicant to utilize a sequencing process that includes avoidance of impacts, minimization of impacts, and, finally, compensation of unavoidable impacts to aquatic resource values. Executive Order 11990 requires action to be taken to minimize the destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands. If there is no practicable alternative to construction in wetlands and all practicable measures to minimize harm to wetlands have been provided, compensation of wetland impacts is required.

5.6.1 Avoidance and Minimization

Avoidance and minimization of considerable wetland impacts occurred with the elimination of some bridge corridors proposed and analyzed during the preliminary alternatives study. The NCTA will attempt to avoid and minimize impacts to streams and wetlands to the greatest extent practicable in choosing a preferred alternative and during project design. At this time, no final decisions have been made with regard to the location or design of the preferred alternative. Substantial wetland impacts in northern Maple Swamp would be avoided by the selection of design alternatives that include a bridge over the swamp as opposed to road construction on fill through the swamp. With MCB2/B and MCB4/B, impacts of the road on the hydrology of Maple Swamp would be minimized with the installation of numerous drainage culverts and wildlife crossing structures. Impacts to the more pristine loblolly bay forest in Maple Swamp and other areas of wetland forest were also avoided by shifting the bridge crossing to the north in the vicinity of an actively cleared and maintained utility corridor.

During final design, NCTA would coordinate with environmental resource and regulatory agencies on finalizing the construction techniques to be used with the goal of reducing potential temporary impacts to water quality and aquatic habitat to the extent practicable.

In the design of the road-widening portions for all of the detailed study alternatives, steps were taken to avoid and minimize impacts to wetland areas. Where practicable, road widening would occur on the non-jurisdictional upland sides of existing roads. Impacts to Great Swamp were avoided and minimized in this manner. However, symmetrical road widening would occur when wetland impacts and business and/or home displacement would be unbalanced if the widening occurred entirely on one side of the existing road. In addition, utilizing the existing center turn lane to provide a third outbound emergency lane is being considered in addition to adding a third outbound emergency lane. This is the case for the third outbound emergency lane with ER2 between the Wright Memorial Bridge and the Knapp (Intracoastal Waterway) Bridge. Use of this option would eliminate temporary wetland impacts resulting from constructing a third outbound emergency lane. The construction of a third outbound lane on US 158, however, would offer the greatest reductions in hurricane evacuation clearance time, bringing the 2035 clearance time down to 21 hours, 3 hours above the state clearance time standard of 18 hours. Times are not reduced as much (to 27.4 hours) when reversing the center lane to serve outbound traffic because during the evacuation, traffic would also continue to use it as a turn lane, slowing travel.

5.6.2 Compensatory Mitigation of Impacts

Compensatory mitigation options to offset wetland impacts could include the following: preservation of unique wetland communities; enhancement of existing wetlands; creation of new wetlands; and restoration of wetland areas. Considerations for candidate sites for wetlands mitigation include: proximity to impacted wetlands; proximity to the drainage basin of impacted wetlands; topographic and hydrological characteristics; and chance of successful mitigation for lost wetland functions. Preservation and, where appropriate, enhancement and/or restoration of approximately 612 acres in the vicinity of the proposed roadway through Maple Swamp would be included with MCB2/B or MCB4/B; and similarly approximately 263 acres would be included with MCB2/A or MCB4/A. Additional details on these areas are found in Section 4.1.1.20.

NCTA would investigate potential on-site stream and wetland mitigation opportunities once a final decision is developed for the Selected Alternative. If on-site mitigation is not feasible, mitigation would be provided by NCDENR's Ecosystem Enhancement Program (EEP). In accordance with the July 22, 2003, "Memorandum of Agreement Among the North Carolina Department of Transportation, and the U.S. Army Corps of Engineers, Wilmington District," the EEP would be requested to provide off-site mitigation to satisfy the federal Clean Water Act compensatory mitigation requirements for this project. The EEP is often utilized by the NCTA for the compensatory mitigation required for transportation projects. The Northwest River and Tull Creek watershed is recognized as having high potential for stream and wetland restoration (NCWRP, 2002), and is the probable location of future EEP mitigation projects.

5.7 Endangered Species Act Protected Species

As of February 24, 2009, the USFWS identifies 13 federally-protected species as occurring in Currituck and Dare counties (USFWS, 2009). These protected species, along with information on the presence of habitat in the project area and a Biological Conclusion for each species, are listed in Table 17. Information is based on the current best available information from referenced literature and USFWS correspondence. An expanded list of protected species that also includes federal species of concern, state-listed species, and likelihood of occurrence in the project area is included in Appendix B.

Red wolf
USFWS optimal survey window: year round

Habitat Description: Red wolves were extirpated from North Carolina and most other southeastern states by the 1920s. In the mid 1980s, the USFWS reintroduced the species to the Alligator River National Wildlife Refuge (ARNWR) in eastern North Carolina. Since that time, the wolves have expanded their range outside the refuge. Red wolves are generally crepuscular predators, preying on deer, nutria, raccoon, rabbits, and other small mammals. Any area that provides sufficient size, adequate food and water, and the basic cover requirement of heavy vegetation should be suitable habitat for the red wolf. Telemetry studies indicate that red wolf home range requirements vary from about 25 to 50 square miles (NatureServe, 2007; USFWS, 2008a).

Table 17. Federally-Protected Species Listed for Currituck and Dare Counties

Scientific Name	Common Name	Federal Status[1]	Habitat Present	Biological Conclusion[2]	
				MCB2 and MCB4	ER2
Canis rufus	Red wolf	E-EXP	Yes	No effect	No effect
Trichechus manatus	West Indian manatee	E	Yes	MA-NLAA	No effect
Charadrius melodus	Piping plover	T	Yes	MA-NLAA	No effect
Picoides borealis	Red-cockaded woodpecker	E	Yes	No effect	No effect
Sterna dougallii	Roseate tern	E	No	No effect	No effect
Alligator mississippiensis	American alligator	T(S/A)	Yes	NA	NA
Chelonia mydas	Green sea turtle	T	Yes	MA-NLAA	No effect
Eretmochelys imbricata	Hawksbill sea turtle	E	No	No effect	No effect
Lepidochelys kempii	Kemp's ridley sea turtle	E	Yes	MA-NLAA	No effect
Dermochelys coriacea	Leatherback sea turtle	E	No	No effect	No effect
Caretta caretta	Loggerhead sea turtle	T	Yes	MA-NLAA	No effect
Acipenser brevirostrum	Shortnose sturgeon	E	No	MA-NLAA	No effect
Amaranthus pumilus	Seabeach amaranth	T	Yes	No effect	No effect

Source: NCNHP, 2008; USFWS, 2009.
[1] T – Threatened
T(S/A) – Threatened because of similarity of appearance to American crocodile
E – Endangered
E-EXP – Endangered and population is experimental
[2] MA-NLAA – May affect – Not likely to adversely affect
NA-Not applicable; no biological conclusion required

Biological Conclusion: MCB2, MCB4, and ER2 – NO EFFECT

The extensive swamp forests within Great Swamp and Maple Swamp provide potential habitat for the red wolf, however, there are no records of this species in the project area (NCNHP, 2008). In addition, it is unlikely that the reintroduced population in ARNWR will cross vast waterbodies (Albemarle, Roanoke, and/or Croatan sounds) and reach the project area. The low likelihood of occurrence within the project area, combined with the close management of this experimental population by the USFWS, does not support establishment of this species in the project area. Provided that the red wolf population is restricted to ARNWR and the surrounding areas, and that bridge construction and road widening would occur primarily in disturbed, man-dominated areas, adverse impacts to this species are unlikely.

West Indian manatee

USFWS optimal survey window: year round

Habitat Description: Manatees have been observed in all the North Carolina coastal counties. Manatees are found in canals, sluggish rivers, estuarine habitats, salt water bays, and as far off shore as 3.7 miles. They utilize freshwater and marine habitats at shallow depths of 5 to 20 feet. In the winter, between October and April, manatees concentrate in areas with warm water. During other times of the year habitats appropriate for the manatee are those with sufficient water depth, an adequate food supply, and proximity to freshwater. Manatees require a source of freshwater to drink. Manatees are primarily herbivorous, feeding on any aquatic vegetation present, but they may occasionally feed on fish.

Biological Conclusion: MCB2 and MCB4 – MAY AFFECT – NOT LIKELY TO ADVERSELY AFFECT; ER2 – NO EFFECT

The shallow waters of Currituck Sound and the extensive SAV beds found in the area provide potential foraging habitat for manatees. The NCNHP shows sporadic occurrences of manatee in the vicinity of Currituck Sound over the past several decades (NCNHP, 2008). The northern limit of the manatee's range extends to North Carolina, but low temperatures prevent this species from commonly occurring in the area. The presence of a bridge structure and associated construction activities could disrupt potential manatee foraging areas; however, the rarity of its occurrence in the vicinity of the project area makes impacts to this species unlikely (NatureServe, 2007; NCWRC, 2008; USFWS, 2008a). Construction contracts would require compliance with the USFWS's *Guidelines for Avoiding Impacts to the West Indian Manatee: Precautionary Measures for Construction Activities in North Carolina Waters* (USFWS, 2003).

Piping plover

USFWS optimal survey window: year round

Habitat Description: The piping plover breeds along the entire eastern coast of the United States. North Carolina is uniquely positioned in the species' range, being the only state where the piping plover's breeding and wintering ranges overlap and the birds are present year-round. They nest most commonly where there is little or no vegetation, but some may nest in stands of beachgrass. The nest is a shallow depression in the sand that is usually lined with shell fragments and light colored pebbles (NatureServe, 2007; USFWS, 2008a).

Biological Conclusion: MCB2 and MCB4 – MAY AFFECT – NOT LIKELY TO ADVERSELY AFFECT; ER2 – NO EFFECT

While suitable habitat for the piping plover exists within the project area, it is unlikely that they would be impacted by any of the detailed study alternatives. Piping plover have not been documented within the project area, but there are sightings from CNWR approximately 4 miles to the north (NCNHP, 2008). Open sandy beaches that serve as nesting, foraging, and resting habitat are not present in the project area, but potential foraging habitat occurs when irregular wind tides expose mud flats within Currituck Sound. Piping plovers have been documented using soundside habitats in the vicinity of nesting sites. Although there is no nesting habitat in the project area, other shorebirds have been observed foraging along soundside mudflats within the project area. Construction of a bridge across shoreline habitats does have the potential to effect piping plover foraging habitat, but because the habitat is limited and occurs irregularly, the project is not likely to adversely affect this species.

Red-cockaded woodpecker

USFWS optimal survey window: year round; November through early March (optimal)

Habitat Description: The red-cockaded woodpecker (RCW) typically occupies open, mature stands of southern pines, particularly longleaf pine, for foraging and nesting/roosting habitat. The RCW excavates cavities for nesting and roosting in living pine trees, aged 60 years or older, which are contiguous with pine stands at least 30 years of age to provide foraging habitat. The foraging range of the RCW is normally no more than 0.5 mile (USFWS, 2008a).

Biological Conclusion: MCB2, MCB4, and ER2 – NO EFFECT

There are no mature stands of pine forests present in the project area or surrounding areas. Some older pine trees do occur along the pine/hardwood fringes of upland and wetland areas. However, these trees, usually loblolly pines, and the surrounding habitat are not characteristic of those occupied by RCWs. The species is currently not known from Currituck County. The USFWS indicated the status of this species as historic with no valid records within the past fifty years. The NCNHP database contains an unconfirmed report from 1979 in a tree near the east side of North River, approximately 1.25 miles west of the project area. Currently the closest known active colony is over 2.5 miles west of the project area, near Indian Island, on the NCWRC North River Game Lands in Camden County (personal communication, John Fussell, March 30, 2008). While areas suitable for foraging are present within the project area, the lack of an active colony within 0.5 mile of the project area makes the presence of the detailed study alternatives, including construction activities, not likely to adversely affect this species.

Roseate tern

USFWS optimal survey window: June through August

Habitat Description: In North Carolina, the roseate tern is most likely to be seen on barrier islands as it passes through the area to and from northern breeding grounds. March through May and August through October are the most likely times to see these birds. Although sight records of this species exist for June, July, and August, these are likely non-breeding males. Only one nesting record for this species has been documented for the state within the past 20 years. However, if this species expands its range, it is likely to choose coastal areas of the state for nesting. The roseate tern nests on isolated, less disturbed coastal islands in areas characterized by sandy, rocky, or clayey substrates with either sparse or thick vegetation. Eggs are usually laid such that grasses or overhanging objects provide shelter. They may also nest in marshes, but it is an uncommon occurrence (NatureServe, 2007; USFWS, 2008a).

Biological Conclusion: MCB2 and MCB4 – NO EFFECT; ER2 – NO EFFECT

In North Carolina this species is found in association with open sandy beach and inlet habitats. There are no USFWS or NCNHP records from Currituck County. It is listed in Dare County most likely because of records within Cape Hatteras (or Cape Point). There is only one documented nest of this species from North Carolina in Carteret County (Lee and Parnell, 1990). There is no potential nesting habitat (coastal sandy beach or inlet habitats) within the project area. Although the open waters of Currituck Sound could provide potential foraging habitat, the lack of records, rarity of this species in North Carolina, and preference for coastal beach habitats indicate that the presence of the detailed study alternatives, including construction activities, would have no effect on this species.

American alligator

USFWS optimal survey window: year round (only warm days in winter)

Habitat Description: In North Carolina, alligators have been recorded in nearly every coastal county, and many inland counties to the fall line. The alligator is found in rivers, streams, canals, lakes, swamps, and coastal marshes. Adult animals are highly tolerant of salt water, but the young are apparently more sensitive, with salinities greater than 5 parts per thousand considered harmful. The American alligator remains on the protected species list because of its similarity in appearance to the Endangered American crocodile (NatureServe, 2007; USFWS, 2008a).

Biological Conclusion: MCB2, MCB4, and ER2 – NOT APPLICABLE – NO BIOLOGICAL CONCLUSION REQUIRED

The project area is located at the northern extreme of the range of the American alligator, which is largely because of the species' inability to tolerate low temperatures. While alligators are commonly found on the Dare County mainland, there is only one record from Currituck County (photo and reported to NCNHP by CZR Incorporated, December 3, 2008). This record was during the summer of 2003 from an unnamed tributary/canal to Deep Creek adjacent to the project area. Although appropriate habitat for the American alligator is present, the species is rare in the project area, so the presence of the detailed study alternatives, including construction activities, is unlikely to adversely affect this species.

Green sea turtle

USFWS optimal survey window: April through August

Habitat Description: The green sea turtle is found in temperate and tropical oceans and seas. Nesting in North America is limited to small communities on the east coast of Florida requiring beaches with minimal disturbances and a sloping platform for nesting (they do not nest in North Carolina). The green sea turtle can be found in shallow waters. They are attracted to lagoons, reefs, bays, mangrove swamps and inlets where an abundance of marine grasses can be found, as this is the principle food source for the green sea turtle (NatureServe, 2007; NOAA, 2008; USFWS, 2008a).

Biological Conclusion: MCB2 and MCB4 – MAY AFFECT – NOT LIKELY TO ADVERSELY AFFECT; ER2 – NO EFFECT

Currituck Sound provides potential foraging habitat for the green sea turtle because of the abundance of SAV found in the area. However, nesting does not occur in North Carolina. The occurrence of sea turtles in Currituck Sound is rare, and there are no records of living individuals being observed in the area. The NCNHP has no records of sea turtles occurring in the area; however, unpublished NCWRC stranding data shows three sea turtle carcasses having been found in Currituck Sound over the past 10 years. One of these was an unidentified skeleton found September 23, 2005, and could possibly have been a green sea turtle (personal communication, Wendy Cluse, NCWRC, December 18, 2008). Whether these sea turtles were foraging in the sound or were transported into the sound post mortem via wind tides cannot be determined. Sea turtles are unlikely to be found in the project area and are more commonly found in the higher salinity waters of Albemarle Sound. Currituck Sound is also located over 25 miles from the nearest inlet (Oregon Inlet). For these reasons, a bridge structure across the sound is unlikely to adversely affect this species.

Hawksbill sea turtle

USFWS optimal survey window: April through August

Habitat Description: Hawksbill sea turtles are found in tropical and subtropical oceans. Sightings have been reported on the east coast of the United States as far north as Massachusetts, although rarely north of Florida. Sightings have been recorded from a handful of counties in North Carolina, but the turtle is not known to breed here. Adult hawksbills are found in coastal waters, especially around coral reefs, rocky outcrops, shoals, mangrove bays, and estuaries. Juveniles are often seen offshore in floating mats of seaweed. This species nests on a wide range of beach types and substrates, using both low- and high-energy beaches on islands and mainland sites. The nest is typically placed near or under vegetation of some sort (NatureServe, 2007; NOAA, 2008; USFWS, 2008a).

Biological Conclusion: MCB2 and MCB4 – NO EFFECT; ER2 – NO EFFECT

There are no known occurrences of this species recorded from Currituck County or in the vicinity of the project area (NCNHP, 2008; NCWRC, unpublished data). Based on the rarity of this species in North Carolina and its preference to tropical open-ocean and beach habitats, the presence of the detailed study alternatives, including construction activities, would have no effect on this species.

Kemp's ridley sea turtle

USFWS optimal survey window: April through August

Habitat Description: Kemp's ridley sea turtle is the smallest of the sea turtles that visit North Carolina's coast. While the majority of this sea turtle's nesting occurs in Mexico, the species is known to nest on North Carolina beaches infrequently. Sightings of the species exist for most coastal counties. Kemp's ridley sea turtle can lay eggs as many as three times during the April to June breeding season. Kemp's ridley sea turtles prefer beach sections that are backed up by extensive swamps or large bodies of open water with seasonal narrow ocean connections and a well defined, elevated dune area. The species prefers neritic (nearshore) areas with sandy or muddy bottoms (NatureServe, 2008; NCNHP, 2008; NOAA, 2008; USFWS, 2008a).

Biological Conclusion: MCB2 and MCB4 – MAY AFFECT – NOT LIKELY TO ADVERSELY AFFECT; ER2 – NO EFFECT

Currituck Sound provides potential foraging habitat for the Kemp’s ridley sea turtle because of the abundance of SAV found in the area. However, nesting is uncommon in North Carolina and there is no potential nesting habitat (beach) in the project area. The occurrence of sea turtles in Currituck Sound is rare, and there are no records of living individuals from Currituck County or the project area. The NCNHP has no records of sea turtles occurring in the sound; however, unpublished NCWRC stranding data shows three sea turtle carcasses having been found in Currituck Sound over the past 10 years. One of these was a Kemp's ridley sea turtle found July 11, 2000 (personal communication, Wendy Cluse, NCWRC, December 18, 2008). Whether these sea turtles were foraging in the sound or were transported into the sound post mortem via wind tides cannot be determined. Sea turtles are unlikely to be found in the project area and are more commonly found in the higher salinity waters of Albemarle Sound. Currituck Sound is also located over 25 miles from the nearest inlet (Oregon Inlet). For these reasons, a bridge structure across the sound is not likely to adversely affect this species.

Leatherback sea turtle

USFWS optimal survey window: April through August

Habitat Description: Leatherbacks are distributed world-wide in tropical waters of the Atlantic, Pacific, and Indian oceans. They are generally open-ocean species, and may be common off the North Carolina coast during certain times of the year. However, in northern waters leatherbacks are reported to enter into bays, estuaries, and other inland bodies of water. Major nesting areas occur mainly in tropical regions. In the United States, primary nesting areas are in Florida; however, nests are known from Georgia, South Carolina, and North Carolina as well. Nesting occurs from April to August. Leatherbacks need sandy beaches backed with vegetation in the proximity of deep water and generally with rough seas. Beaches with a relatively steep slope are usually preferred (NatureServe, 2007; NOAA, 2008; USFWS; 2008).

Biological Conclusion: MCB2 and MCB4 – NO EFFECT; ER2 – NO EFFECT

There are no known occurrences of this species recorded in the vicinity of the project area (NCNHP, 2008; NCWRC, unpublished data). Based on the rarity of this species in North Carolina and its preference to tropical open-ocean and beach habitats, the presence of the detailed study alternatives, including construction activities, would have no effect on this species.

Loggerhead sea turtle

USFWS optimal survey window: April through August

Habitat Description: The loggerhead is widely distributed within its range, and is found in three distinct habitats during their lives. These turtles may be found hundreds of miles out in the open-ocean, in neritic (nearshore) areas, or on coastal beaches. In North Carolina, this species has been observed in every coastal county. Loggerheads occasionally nest on North Carolina beaches, and are the most common of all the sea turtles that visit the North Carolina coast. They nest nocturnally, at two to three year intervals, between May and

September on isolated beaches that are characterized by fine-grained sediments. In nearshore areas, loggerheads have been observed in bays, lagoons, salt marshes, creeks, ship channels, and the mouths of large rivers. Coral reefs, rocky places, and shipwrecks are often used as foraging areas (NatureServe, 2007; NOAA, 2008; USFWS, 2008a).

Biological Conclusion: MCB2 and MCB4 – MAY AFFECT – NOT LIKELY TO ADVERSELY AFFECT; ER2 – NO EFFECT

Currituck Sound provides potential foraging habitat for the loggerhead sea turtle because of the abundance of SAV found in the area. The species nests along all North Carolina coastal beaches, but more commonly to the south. The occurrence of sea turtles in Currituck Sound is rare, and there are no records of living individuals from the project area. The NCNHP has no records of sea turtles occurring in the sound; however, unpublished NCWRC stranding data shows three sea turtle carcasses reported in Currituck Sound over the past 10 years. One of these was a loggerhead sea turtle found September 25, 2001 (personal communication, Wendy Cluse, NCWRC, December 18, 2008). Whether these sea turtles were foraging in the sound or were transported into the sound post mortem via wind tides cannot be determined. Sea turtles are unlikely to be found in the project area and are more commonly found in higher salinity waters. Currituck Sound is also located over 25 miles from the nearest inlet (Oregon Inlet). For these reasons, a bridge structure across the sound is not likely to adversely affect this species.

Shortnose sturgeon

USFWS optimal survey window: surveys not required; assume presence in appropriate waters

Habitat Description: Shortnose sturgeon occur in most major river systems along the eastern seaboard of the United States. The species prefers the nearshore marine, estuarine, and riverine habitats of large river systems. It is an anadromous species that migrates to faster-moving freshwater areas to spawn in the spring, but spends most of its life within close proximity of the river's mouth. Large freshwater rivers that are unobstructed by dams or pollutants are imperative to successful reproduction. Distribution information by river/waterbody is lacking for the rivers of North Carolina; however, records are known from most coastal counties (NatureServe, 2007; NOAA; 2008; USFWS, 2008a).

Biological Conclusion: MCB2 and MCB4 – MAY AFFECT – NOT LIKELY TO ADVERSELY AFFECT; ER2 – NO EFFECT

The estuarine waters, soft-bottom substrate, and extensive SAV beds in Currituck Sound provide potential foraging habitat for the shortnose sturgeon. This species was most recently observed in the waters of the northern Albemarle Sound in May 1999 (NCNHP, 2008); however, there are no known records of this species occurring within Currituck Sound. The absence of fast currents and rough bottom substrate make spawning unlikely in the vicinity of the project area. In addition, any occurrence of this species within the project area would likely be short-term and in conjunction with annual spring migrations. The presence of a bridge across the sound could result in a decrease in benthic invertebrate food sources in the vicinity of the bridge structure. Overall, the presence of the detailed study alternatives, including construction activities, would not likely adversely affect this species.

Seabeach amaranth

USFWS optimal survey window: July through October

Habitat Description: Seabeach amaranth occurs on barrier island beaches where its primary habitats consists of overwash flats at accreting ends of islands, lower foredunes, and upper strands of noneroding beaches (landward of the wrack line). In rare situations, this annual is found on sand spits 160 feet or more from the base of the nearest foredune. It occasionally establishes small temporary populations in other habitats, including sound-side beaches, blowouts in foredunes, interdunal areas, and on sand and shell material deposited for beach replenishment or as dredge spoil. The plant's habitat is sparsely vegetated with annual herbs (forbs) and, less commonly, perennial herbs (mostly grasses) and scattered shrubs. It is intolerant of vegetative competition and does not occur on well-vegetated sites. The species usually is found growing on a nearly pure silica sand substrate, occasionally with shell fragments mixed-in. Seabeach amaranth appears to require extensive areas of barrier island beaches and inlets that function in a relatively natural and dynamic manner. These characteristics allow it to move around in the landscape, occupying suitable habitat as it becomes available (NCNHP, 2001; Schafale and Weakley, 1990; USFWS, 1996; USFWS, 2006; USFWS, 2008a).

Biological Conclusion: MCB2 and MCB4 – NO EFFECT; ER2 – NO EFFECT

The preferred habitats for seabeach amaranth are associated with dynamic barrier island features (foredunes, overwash fans, and inlets), which do not occur in the project area. The closest record of this species was in 1988, over 6.0 miles north of the project area on the Outer Banks (NCNHP, 2008). Based on the lack of suitable habitat, the presence of the detailed study alternatives, including construction activities, would have no effect on this species.

5.8 Bald Eagle and Golden Eagle Protection Act

Habitat for nesting bald eagles primarily consists of mature forest in proximity to large bodies of open water for foraging. Large, dominant trees are utilized for nesting sites, typically within 1.0 mile of open water. Suitable nesting habitat exists throughout the area, but primarily in association with the shorelines of Currituck Sound and North

River, as well as within Maple Swamp. Surveys conducted by the NCWRC show two nests within proximity to the project area (personal communication, David Allen, NCWRC, February 4, 2009).

One bald eagle nest occurs approximately 2.25 miles south of the proposed bridge corridor on the western shore of Currituck Sound, in the vicinity of the Poplar Branch community. This nest was last active in 2007. It is possible the nesting pair built a new nest in the same vicinity in 2008, but this was not verified. Data show that nesting eagle pairs often build new nests in proximity to old nests. The second nest is an active nest located approximately 1.75 miles south of the project area in Dare County on the northern side of Kitty Hawk Bay (see Figure 6 in Appendix A). In 2006 and 2007, a pair of eagles also had a nest located in the same area, but approximately 0.5 mile further to the south (personal communication, David Allen, NCWRC, February 4, 2009). Several eagles were observed foraging within the project area over Currituck Sound during field work; however, the presence of vast waterbodies throughout the area and the lack of significant impacts to fishery food sources make disturbance to foraging eagles unlikely. Because nest sites vary from year to year and the potential for nesting eagles is present throughout the area, construction and/or clearing activity for the detailed study alternatives would have the potential to disturb future nest sites if they occur in close proximity to these activities. However, provided future nest locations are similar to recent nest sites, the presence of the detailed study alternatives, including construction activities, would be unlikely to adversely affect this species. All construction will follow USFWS guidelines for the protection of eagles as described in the *National Bald Eagle Management Guidelines* (USFWS, 2007).

5.9 Endangered Species Act Candidate Species

Seven species occurring in North Carolina are identified by the USFWS as "candidate" species (USFWS, 2009). These species are not protected by federal law, but may be elevated to listed status in the near future.

The only candidate species with the potential to occur in the project area is the red knot (*Calidris canutus rufa*). The red knot is a highly migratory shorebird that regularly use coastal beaches, inlets, and mudflats for foraging and nesting. Although they strongly prefer coastal surf and tidal areas, this species could visit soundside mudflats when the habitat is available during spring and fall migration. The red knot frequents coastal beaches of Currituck and Dare counties during spring and fall migrations and has been documented in the vicinity of the project area (Parnell et al., 1987). Because of the irregular occurrence of appropriate habitat (exposed mudflats) within the project area, the presence of the detailed study alternatives, including construction activities, would be unlikely to affect the red knot. None of the remaining candidate species have been documented in Currituck or Dare counties.

5.10 Coastal Zone Issues

5.10.1 Coastal Area Management Act Areas of Environmental Concern

The North Carolina Coastal Resources Commission, through its staff at the NCDENR-DCM, issues Coastal Area Management Act (CAMA) permits for development in Areas of Environmental Concern (AEC). Four types of AEC occur within the project area: coastal wetlands, estuarine waters, coastal shorelines, and public trust waters. The shorelines and waters of Currituck Sound, as well as the wetland freshwater marsh communities found within the project area, are all considered AEC under CAMA. This also includes Jean Guite Creek, which is a PNA. In addition, Jean Guite Creek, Currituck Sound, and the AIWW are considered public trust waters that fall under CAMA jurisdiction. Within the project area, Currituck Sound comprises approximately 3,896.85 acres, Jean Guite Creek comprises approximately 0.45 acre, and the AIWW approximately 1.85 acres.

While a formal CAMA delineation has not been conducted, CAMA coastal wetlands occur within the approximately 100 acres of wetland freshwater marsh community within the project area. All mapped communities were mapped via aerial photographs and confirmed during field investigations (see Appendix A, Figure 5). The estuarine shorelines within the project area are considered coastal and not inland shorelines because they fall under joint responsibility of the NCDMF and NCWRC. Coastal shoreline areas (including a 75-foot offset from open water boundaries) have not been quantified in the project area and are not included in the impact analysis. A CAMA major permit would be required for all of the detailed study alternatives. A summary of impacts to CAMA areas (excluding coastal shorelines) that would occur for each detailed study alternative is shown in Table 18. Option A and B would result in the same CAMA impacts given that the differences in the options occur in Maple Swamp where there are no impacts to CAMA features. The numbers in parentheses reflect the impact if reversing the center turn lane is used to reduce hurricane evacuation clearance times rather than constructing a third outbound lane on mainland US 158. When there is no number in parentheses, the impact would be identical for either hurricane evacuation option. There is no difference, or less than an acre of difference, in CAMA wetlands impacts with or without including construction of a third outbound lane on mainland US 158 for hurricane evacuation.

The greatest impacts to CAMA wetlands and CAMA AEC would occur with MCB2/C2, followed by MCB4/C2, with and without the hurricane evacuation lane on mainland US 158. MCB4/C1 would involve the least amount of impact to CAMA wetlands and CAMA AEC with and without the hurricane evacuation lane.

Table 18. Summary of Impacts to CAMA Jurisdictional Areas by Detailed Study Alternative

Type of Impact[1]	ER2 (acres)	MCB2/C1 (acres)	MCB2/C2 (acres)	MCB4/C1 (acres)	MCB4/C2 (acres)
CAMA Wetlands[2]					
Fill	0.7	0.7	0.7	0.0	0.0
Pilings	0.0	0.0	0.0	0.0	0.0
Clearing	0.0	0.0	1.4	0.0	0.0
Total Permanent Impacts	0.7	0.7	2.2	0.0	0.0
Temporary	0.0	0.0	0.0	0.0	0.0
Total Wetland Impacts	0.7	0.7	2.2	0.0	0.0
CAMA AEC[3]					
Fill	0.9 (0.8)	0.9	0.9	0.0	0.0
Pilings	0.0	0.1	0.2	0.1	0.2
Clearing	0.0	0.0	1.5	0.0	1.5
Total Permanent Impacts	0.9 (0.8)	1.0	2.5	0.1	1.6
Temporary	0.0	0.0	0.0	0.0	0.0
Total CAMA AEC Impacts	0.9 (0.8)	1.0	2.5	0.1	1.6

Note: The numbers in parentheses reflect the impact if reversing the center turn lane is used to reduce hurricane evacuation clearance times rather than constructing a third outbound lane. When there is no number in parentheses, the impact would be identical for either hurricane evacuation option. Also, the numbers in this table were rounded to the nearest tenth, so minor rounding error exists when adding the individual numbers to get the totals.

[1]Coastal shoreline impacts are not included in these totals.

[2]Equivalent to the wetland freshwater marsh biotic community.

[3]Includes CAMA wetlands, Currituck Sound, and Jean Guite Creek.

5.10.2 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 the identification and creation of management and conservation plans for EFH. Each council is required to amend existing fisheries management plans (FMPs) to include EFH designations and conservation requirements. The National Marine Fisheries Service (NMFS), SAFMC, and MAFMC currently manage nine fish species that are known to occur within the project area (MAFMC, 2008; SAFMC, 2008), as shown in Table 19. These agencies have identified the SAV, intertidal flats, palustrine emergent and forested wetlands, aquatic bed (tidal freshwater), and estuarine water column of Currituck Sound as EFH for these species. Jean Guite Creek (a PNA) is also designated as EFH. Table 19 also lists the life stages for the managed fish

Table 19. Managed Fish Species Known to Occur in the Project Area

Species	Life Stages Present in Project Area
Black sea bass[1] (*Centropristis striata*)	Larvae, juveniles, adults
Bluefish (*Pomatomus saltatrix*)	Juveniles, adults
Butterfish (*Peprilus triacanthus*)	Eggs, larvae, juveniles, adults
Summer flounder (*Paralichthys dentatus*)	Larvae, juveniles, adults
Penaeid and Rock shrimp (*Penaeus* sp. & *Sicyonia* sp.)	Larvae, juveniles, adults
Red drum (*Sciaenops ocellatus*)	Juveniles, adults
Spanish mackerel[2] (*Scomberomorus maculatus*)	Larvae, juveniles, adults
Red Grouper[1] (*Epinephelus morio*)	Larvae, juveniles, adults
Atlantic Spadefish[1] (*Chaetodipterus faber*)	Larvae, juveniles, adults

Source: MAFMC, 2008; SAFMC, 2008
[1] Included in the Snapper Grouper Management Unit by the SAFMC.
[2] Included in the Coastal Migratory Pelagic Unit by the SAFMC.

species known to occur in the project area. A summary of the approximate amount of permanent impacts to EFH that would occur with each of the detailed study alternatives is shown in Table 20. Removal of the hurricane evacuation lane on US 158 and differences between Option A and B do not affect impacts to EFH areas. A more thorough analysis of EFH and managed species in the project area can be found in the *Essential Fish Habitat Technical Report* (CZR Incorporated, 2009).

5.10.2.1 Findings

MCB4 would avoid the construction of drainage easements in several EFH areas that are associated with road widening for ER 2 and MCB2. The temporary negative impacts to water quality associated with bridge construction would be somewhat reduced by the shorter length of the C1 bridge corridor (7.0 miles) when compared to the C2 bridge corridor (7.5 miles). For these reasons, MCB4/C1 would have the least potential for affecting EFH. When considering permanent loss (fill and pile impacts) of EFH with all five detailed study alternatives, the area affected from greatest to least would be: MCB2/C2 (2.0 acres), MCB2/C1 (1.9 acres), ER2 (1.8 acres), MCB4/C2 (0.2 acre), and MCB4/C1 (0.1 acre).

Table 20. Permanent Impacts to Essential Fish Habitat by Detailed Study Alternative

Community[1]	ER2 (acres)				MCB2/C1 (acres)				MCB2/C2 (acres)				MCB4/C1 (acres)				MCB4/C2 (acres)			
	Fill	Pilings	Shading	Clearing	Fill	Pilings	Shading	Clearing	Fill	Pilings	Shading	Clearing	Fill	Pilings	Shading	Clearing	Fill	Pilings	Shading	Clearing
Palustrine forested wetland	1.0	0.0	0.0	0.0	1.0	0.0	0.2	0.0	1.0	0.0	0.9	1.8	0.0	0.0	0.0	0.0	0.0	0.0	0.6	1.8
Palustrine emergent wetland	0.7	0.0	0.0	0.0	0.7	0.0	0.0	0.0	0.7	0.0	0.6	1.4	0.0	0.0	0.0	0.0	0.0	0.0	0.9	1.4
Aquatic bottom (tidal freshwater) (total/<6 feet)[2]	0.1/ 0.1	0.0/ 0.0	0.1/ 0.1	0.0/ 0.0	0.1/ 0.1	0.1/ 0.1	28.2/ 14.5	0.0/ 0.0	0.1/ 0.1	0.2/ 0.1	28.2/ 17.8	0.0/ 0.0	0.0/ 0.0	0.1/ 0.1	28.1/ 14.5	0.0/ 0.0	0.0/ 0.0	0.2/ 0.1	29.1/ 17.8	0.0/ 0.0
TOTAL EFH IMPACT[3]	1.8	0.0	0.1	0.0	1.8	0.1	28.4	0.0	1.8	0.2	30.7	3.2	0.0	0.1	28.1	0.0	0.0	0.2	30.6	3.2
Primary nursery areas[4] Acres/linear ft	0.0/ 0.0	0.0/ 0.0	0.0 36.0	0.0/ 0.0	0.0/ 0.0	0.0/ 0.0	0.0/ 36.0	0.0/ 0.0	0.0/ 0.0	0.0/ 0.0	0.0/ 36.0	0.0/ 0.0	0.0/ 0.0	0.0/ 5.0	0.0/ 18.0	0.0/ 0.0	0.0/ 0.0	0.0/ 5.0	0.0/ 18.0	0.0/ 0.0
SAV																				
Confirmed SAV	0.0	0.0	0.0	0.0	0.0	0.0	4.3	0.0	0.0	0.0	5.5	0.0	0.0	0.0	4.3	0.0	0.0	0.0	5.5	0.0
Probable SAV habitat (<4 feet)	0.1	0.0	0.1	0.0	0.1	0.0	3.4	0.0	0.1	0.0	7.0	0.0	0.0	0.0	3.4	0.0	0.0	0.0	7.0	0.0
Potential SAV habitat (4-6 feet)	0.0	0.0	0.0	0.0	0.0	0.0	6.8	0.0	0.0	0.0	5.3	0.0	0.0	0.0	6.8	0.0	0.0	0.0	5.3	0.0
Unlikely SAV habitat (>6 feet)	0.0	0.0	0.0	0.0	0.0	0.1	13.7	0.0	0.0	0.1	11.3	0.0	0.0	0.1	13.7	0.0	0.0	0.1	11.3	0.0

[1]Communities that have not been mapped include intertidal flats and oyster reef/shell bank.
[2]Includes all SAV sub-categories and is equivalent to estuarine water column (volume not calculated).
[3]Includes palustrine and forested, emergent wetlands and aquatic bottom.
[4]Area in association with Jean Guite Creek and already included in probable SAV habitat totals. Total area is <0.05 acre.
Impacts are the same with and without the hurricane evacuation lane on mainland US 158 except for a minute amount of piling (<0.05 acre) and shading (<0.05 acre) impacts to Jean Guite Creek with MCB4.

Permanent loss or alteration of palustrine emergent and forested areas, SAV, intertidal flats, and tidal freshwater aquatic bed would result directly from shading and pile placement and possible long-term sediment change could result if dredging occurs with the bridge structure associated with MCB2 and MCB4. In addition, ER2 and MCB2 would involve permanent loss of palustrine emergent and forested areas through the construction of permanent drainage easements at scattered locations on the Outer Banks between NC 12 and the Currituck Sound, and also result in increased shading of Jean Guite Creek (a PNA and probable SAV habitat). Addition of a hurricane evacuation lane across the existing Jean Guite Creek with MCB4 would result in less than 0.1 acre of shading and piling impact. If US 158 is widened across Jean Guite Creek with ER2 or MCB2, an even smaller amount of additional shading would occur.

The presence of the bridge and pile placement also could result in several additional impacts, including changes to water quality, water flow, and light levels of the area below the bridge and for some distance surrounding the bridge. Altered light levels and the introduction of piles as a hard substrate previously unavailable in the area would have multiple effects, thereby resulting in changes to the existing food web structure. Decreased autotrophic productivity (phytoplankton and aquatic vegetation) resulting from lower light levels could result in decreased abundances of aquatic vegetative habitat (including SAV), heterotrophic grazers, and predators (zooplankton, benthic invertebrates, and fish) near the Mid-Currituck Bridge. On the other hand, organisms could be attracted to bridge pilings as a reef structure. Shading likely would have less of an effect on EFH with the C1 bridge corridor than with the C2 bridge corridor because it is shorter and the orientation of the bridge structure (southwest to northeast) would allow more variability in sunlight exposure to areas under the bridge.

The temporary effects to EFH of bridge pile placement and other bottom disturbance, such as dredging if it were used, with MCB2 and MCB4 would be a short-term increase in noise, turbidity, benthic disturbance (including sediment removal), and siltation. Suspended fine sediments would settle and could result in burial of organisms and/or sediment drift, which depending on the currents, could spread outside the direct impact area. The result would be short-term adverse effects from bridge construction on biota and managed species that use benthic habitats. However, if dredging is not used, benthic organisms are expected to recover after construction ceases and other organisms also are expected to re-colonize the area afterwards. The aquatic substrate could be slow to recover if dredging occurs, and adverse affects would vary depending on areas disturbed and post-construction water depths and sediment composition. Construction activities associated with permanent drainage easements and road-widening for all of the detailed study alternatives would result in similar temporary, short-term impacts as discussed above; however, they would occur at much lower levels. Preventative measures could be implemented in terrestrial construction areas, thus greatly reducing runoff (and associated increases in turbidity and sedimentation) into EFH areas.

5.10.2.2 Conclusion

The detailed study alternatives would not have a substantial long-term adverse impact on EFH or managed species for the following reasons:

- With all detailed study alternatives, fill and pile impacts resulting in the permanent loss of EFH would be small at 0.1 to 2.0 acres. Clearing impacts also would be small at 0.0 to 3.2 acres.

- Shading impact with a Mid-Currituck Bridge would range from 28.1 to 30.7 acres. Most of the shading would occur over Currituck Sound, however, and Currituck Sound is large (97,920 acres) compared to the small area that would be affected by shading. Shading would not affect fish passage.

- With MCB2 and MCB4, the bridge pilings would increase habitat complexity and provide some hard structure that would potentially provide additional habitat for some managed species.

- Temporary impacts would occur during construction but the aquatic substrate generally would be expected to recover after construction. Impacts would result primarily bottom disturbance and associated raising of sediments, but most adult fish are mobile and would actively avoid direct impacts. Some impairment of ability of EFH managed species to find prey items could occur, but this effect would be temporary and spatially limited to the immediate vicinity of construction activities. Although the direct impact on EFH managed species would be largely temporary, the extent of impact and length of the recovery time would be affected by how, when, and if dredging occurs. Dredging would not be used in areas of existing SAV habitat. Bridge construction techniques would be evaluated during final design in order to determine the most appropriate technique for constructing structures in Currituck Sound. Final construction methods would be selected as part of the permitting process.

- The bridge alternatives would introduce a new source of pollution (via bridge runoff) into Currituck Sound. Pollutants discharged into Currituck Sound near the bridge may not dissipate because of poor water circulation and could result in higher sediment pollutant levels and bioaccumulation near the bridge. NCTA would examine cost-effective options for treating the first inch of bridge runoff during development of a Mid-Currituck Bridge design if MCB2 or MCB4 is selected for implementation.

- Bridge replacement and/or widening of US 158 over Jean Guite Creek (a PNA) is proposed for all alternatives. Although some potential adverse impacts to EFH would occur during the construction phases, the impacts would be temporary and are not expected to result in substantial short-term effects on managed species because with ER2 and MCB2, a new US 158 bridge over the creek is expected to not place piles in the creek. The additional hurricane evacuation lane that could be associated with MCB4 is expected to duplicate the existing US 158's single pile foundation in the creek.

6.0 Literature Cited

6.1 Publications and Technical Reports

Bard, A.M., H.T. Smith, T.V. Harber, G.W. Stewart, J.S. Weske, M.M. Browne, and S.D. Emslie. 2001. *International conference on ecology and transportation*. Keystone, Colorado.

Borawa, J. C., J. H. Kerby, M. T. Huish, and A. W. Mullis. 1978. "Currituck Sound Fish Populations Before and After Infestation by Eurasian Water-milfoil." *Proc. An. Conf. S.E. Assoc. Fish and Wildl. Agencies*.

Brandenburg, D.M. 1996. "Effects of roads on behavior and survival of black bears in coastal North Carolina." M.S. Thesis. University of Tennessee, Knoxville.

Brody, A.J., and M.R. Pelton. 1989. "Effects of roads on black bear movements in western North Carolina." *Wildlife Society Bulletin*, 17: 5-10.

Caldwell, William S. 2001. *Hydrologic and Salinity Characteristics of Currituck Sound and Selected Tributaries in North Carolina and Virginia, 1998-1999*. US Geological Survey, Water-Resources Investigations Report 01-4097.

Clevenger, A.P., and N. Waltho. 2005. "Performance indices to identify attributes of highway crossing structures facilitating movement of large animals." Biological Conservation 121:453-464.

Coffin, Alisa W. 2007. "From roadkill to road ecology: a review of the ecological effects of roads." *Journal of Transport Geography*, 15: 396-406.

Copeland, B. J. and J. Gray. 1989. "The Albemarle-Pamlico Estuarine System. A summary of the preliminary status and trends report of the Albemarle-Pamlico Estuarine Study." *Albemarle-Pamlico Estuarine Study Report 89-13B*.

Cowardin, Lewis M., Virginia Carter, Francis C. Golet, and Edward T. LaRoe. 1979. *Classification of Wetlands and Deepwater Habitats of the United State*s. US Department of the Interior, Fish and Wildlife Service Office of Biological Sciences, Washington, DC.

Cramer, P.C., and J.A. Bissonette. 2009. "Transportation Ecology and Wildlife Passages: The State of the Practice and Science of Making Roads Better for Wildlife." TR News May/June (No. 262), pp 12-19.

CZR Incorporated. 2009. *Essential Fish Habitat Technical Report*. Prepared for Parsons Brinckerhoff and the North Carolina Turnpike Authority.

Davis, G. J. and D. F. Carey, Jr. 1981. "Trends in Submersed Macrophyte Communities of the Currituck Sound: 1977-1979." *J. Aquat. Plant Manage*. 19:3-8.

Davis, G. J. and M. M. Brinson. 1983. "Trends in Submersed Macrophyte Communities of the Currituck Sound: 1909-1979." *J. Aquat. Plant Manage*. 21:83-87.

Donaldson, B.M. 2005. "The use of highway underpasses by large mammals in Virginia and factors influencing their effectiveness." Virginia Transportation Research Council. Final Report for VTRC 06-R2. 34pp.

Earley, L. S. 1993. "End of an Era Part I: Paradise Lost?" *Wildlife in North Carolina.* June.

Environmental Laboratory. 1987. *Corps of Engineers Wetlands Delineation Manual, Technical Report Y-87-1.* US Army Engineer Waterways Experiment Station, Vicksburg, MS.

Ferguson, R.L., and L.L. Wood. 1994. *Rooted Vascular Beds in the Albemarle-Pamlico Estuarine System*. US Environmental Protection Agency, National Estuary Program, NC Department of Environment, Health, and Natural Resources. Report No. 94-02.

Findlay, C.S., and J. Bourdages. 2000. "Response time of wetland biodiversity to road construction on adjacent lands." Conservation Biology 14(1):86-94.

Forman, R.T.T, and L.E. Alexander. 1998. "Roads and their major ecological effects." *Annual Review of Ecology and Systematics*, 29: 207-231.

Frost, Cecil C., Harry E. LeGrand, and Richard E. Schneider. 1990. *Regional Inventory for Critical Natural Areas, Wetland Ecosystems, and Endangered Species Habitats of the Albemarle-Pamlico Estuarine Region: Phase 1.* North Carolina Natural Heritage Program.

Hanson, J., M. Helvey, and Russ Strach. 2004. *Non-Fishing Impacts to Essential Fish Habitat and Recommended Conservation Measures*. National Marine Fisheries Service (NOAA Fisheries), Version 1. Southwest Region, Long Beach, California.

Huijser, M.P., P. McGowen, A.P. Clevenger, and R. Ament. 2008. "Best practices manual: Wildlife-vehicle collision reduction study." Report to Congress, Federal Highway Administration, U.S. Dept. of Transportation, Washington, D.C.

Jones, E.R. 2008. "The effectiveness of wildlife crossing structures for black bears in Madison County, NC." Master's thesis, NC State University.

Kornegay, J. W. 1989. *Currituck Sound Fish Population Survey. Final Report. Federal Aid in Fish Restoration Project F-22-14*. North Carolina Wildlife Resources Commission.

Lee, D. S., and J. F. Parnell. 1990. *Endangered, threatened, and rare fauna of North Carolina, Part III, a re-evaluation of birds*. Occasional papers of the North Carolina Biological Survey.

Lopazanski, M. J., J. P. Evans, and R. E. Shaw. 1988. *An Assessment of Maritime Forest Resources on the North Carolina Coast.* Division of Coastal Management, NC Department of Natural Resources and Community Development.

Lovallo, M.J. and E.M. Anderson. 1996. "Bobcat movements and home ranges relative to roads in Wisconsin." *Wildlife Society Bulletin*, 24: 71-76.

Martin, T. E., and D. M. Finch (EDS.). 1995. "Ecology and Management of Neotropical Migratory Birds: a Synthesis and Review of Critical Issues". *Oxford University Press*, New York, NY.

Matta, J. 1977. *Beach Fauna Study of the CERC Field Research Facility, Duck, North Carolina. Miscellaneous Report No. 77-6*. US Army Corps of Engineers. Fort Belvoir, Virginia.

Mumme, L.R., J.S. Schoech, E.G. Woolfenden, and W.J. Fitzpatrick. 2000. "Life and death in the fast lane: demographic consequences of road mortality in the Florida scrub-jay". *Conservation Biology*, 14: 501-512.

National Marine Fisheries Service. 1998. *Recovery Plan for the Shortnose Sturgeon (Acipenser brevirostrum).* Prepared by the Shortnose Sturgeon Recovery Team for the National Marine Fisheries Service, Silver Spring, Maryland. 104 pages.

North American Waterfowl Management Plan, Plan Committee. 2004. *North American Waterfowl Management Plan 2004. Implementation Framework: Strengthening the Biological Foundation*. Canadian Wildlife Service, US Fish and Wildlife Service. Secretaria de Medio Ambiente y Recursos Naturales.

North Carolina Department of Environment, Health, and Natural Resources. 1994. *Currituck Sound Outstanding Resource Water Evaluation.* Division of Environmental Management, Water Quality Section (Now the NC Department of Environment and Natural Resources, Division of Water Quality). Unpublished Report.

North Carolina Department of Environment and Natural Resources, Division of Water Quality. 2006. *North Carolina's 303(d) list.*

North Carolina Department of Environment and Natural Resources, Division of Water Quality. 2008a. *Surface Water Classification*s. North Carolina Department of Environment and Natural Resources.

North Carolina Natural Heritage Program. 2001. *Guide to Federally Listed Endangered and Threatened Species of North Carolina*. Raleigh, NC. 134 pp.

North Carolina Natural Heritage Program. 2005. Biennial Protection Plan: List of Significant Natural Heritage Areas.

North Carolina Watershed Restoration Program. 2002. *Watershed Restoration Plan for the Pasquotank River Basin.* NCDENR-DWQ.

Owens, L.K., and R.W. James. 1991. *Mitigation of traffic mortality of endangered brown pelicans on coastal bridges*. Transportation Research Record No. 1312, Energy and Environmental Issues, pp. 3-12.

Parnell, J. F., P. E. Hosier, D. J. Sieren, W. D. Webster, and S. Cooper. 1987. *Ecological Reconnaissance Currituck Shooting Club Property, Final Report*. September.

Parsons Brinckerhoff. 2009. *Alternatives Screening Report.* Prepared for the North Carolina Turnpike Authority.

Parsons Brinckerhoff. 2009. *Assessment of Alternatives for Treating Bridge Runoff.* Prepared for the North Carolina Turnpike Authority.

Parsons Brinckerhoff. 2009. *Indirect and Cumulative Effects Technical Report.* Prepared for the North Carolina Turnpike Authority.

Platania, S. P. and D. Lee. 1978a. *Results of a Four-week Herpetological Survey of the Coinjock Region (NC) of the Great Dismal Swamp*. North Carolina State Museum of Natural History. Raleigh, NC.

Platania, S. P. and D. Lee. 1978b. *Results of a Five-week Mammal Survey of the Coinjock Region (NC) of the Great Dismal Swamp*. North Carolina State Museum of Natural History. Raleigh, NC.

Radle, A.L. 2006. *The effect of noise on wildlife: a literature review*. World Forum for Acoustic Ecology (Master's Thesis), Oregon University.

Reijnen, R., R. Foppen, and H. Meeuwsen. 1996. "The effects of traffic on the density of breeding birds in Dutch agricultural grasslands." *Biological Conservation*, 75: 255-260.

Reijnen, R., R. Foppen, C.T. Braak, and J. Thissen. 1995. "The effects of car traffic on breeding bird populations in woodland III: reduction of density in relation to the proximity of main roads." *The Journal of Applied Ecology*, 32: 187-202.

Rich, A. C., D. S. Dobkin, and L. J. Niles. 1994. "Defining Forest Fragmentation by Corridor Width: the Influence of Narrow Forest-dividing Corridors on Forest-nesting Birds in Southern New Jersey". *Conservation Biology* 8: 1109-1121.

Rideout, R. R. 1990. *A Comprehensive Management Plan for the Currituck Sound Drainage Basin: Background Investigations*. US Environmental Protection Agency.

Riggs, S. R., J. R. Bray, R. A. Wyrick, C. R. Klingman, J. C. Hamilton, D. V. Ames, and J. S. Watson. 1993. *Sedimentation and Sediment Quality in the North Landing River, Currituck County Estuarine System, North Carolina and Virginia.* US Environmental Protection Agency, National Estuary Program, NC Department of Environment, Health, and Natural Resources. Report No. 92-22.

Schafale, M. P. and A. S. Weakley. 1990. *Classification of the Natural Communities of North Carolina, 3rd Approximation*. North Carolina Department of Environment, Health, and Natural Resources, Division of Parks and Recreation, Natural Heritage Program.

Schafale, M. P. 1999. *Non-riverine Hardwood Forests in North Carolina, Status and Trends.* North Carolina Natural Heritage Program.

Scott, V. E., K. E. Evans, D. R. Patton, and C. P. Stone. 1977. *Cavity-nesting Birds of North American Forests*. US Department of Agriculture, Agriculture Handbook 511.

Sincock, J. L. 1966. *Back Bay-Currituck Sound Data Report.* Patuxent Wildlife Research Center.

Smith, Cherri. 2008. *Invasive Exotic Plants of North Carolina*. NC Department of Transportation.

Terborgh, J. 1989. "Where Have all the Birds Gone?" *Princeton University Press*, Princeton, N.J

Thurber, J.M., R.O. Peterson, T.D. Drummer, and S.A. Thomasma. 1994. "Gray wolf response to refuge boundaries and roads in Alaska." *Wildlife Society Bulletin*, 22: 61-67.

US Army Corps of Engineers. 2007. *Currituck Sound Hydrographic and Submerged Aquatic Vegetation Survey*. Field Research Facility. Duck, NC.

US Fish and Wildlife Service. 1996. *Recovery Plan for Seabeach Amaranth (Amaranthus pumilius).* Rafinesque. Atlanta, Georgia.

US Fish and Wildlife Service. 2007. *National Bald Eagle Management Guidelines*.

US Fish and Wildlife Service. 2003. *Guidelines for Avoiding Impacts to the West Indian Manatee: Precautionary Measures for Construction Activities in North Carolina Waters*. Raleigh Field Office, Raleigh, North Carolina

Wicker, Anton M., and Keith M. Endres. 1995. "Relationship between waterfowl and American coot abundance with submersed macrophytic vegetation in Currituck Sound, North Carolina." *Estuaries*. 18:428-431.

Winslow, S. E., N. S. Sanderlin, G. W. Judy, J. H. Hawkins, B. F. Holland, Jr., C. A. Fischer, and R. A. Rulifson. 1983. *North Carolina Anadromous Fisheries Management Program, Completion Report for Project AFCS-16*. North Carolina Department of Natural Resources and Community Development, Division of Marine Fisheries.

6.2 Web Sites

Insurance Institute for Highway Safety. Available: http://www.iihs.org. Accessed: August 13, 2009.

Mid-Atlantic Fishery Management Council. 2008. Fishery Management Plans. Available: http://www.mafmc.org/mid-atlantic/fmp/fmp.htm. Accessed: December and January, 2009.

National Oceanic and Atmospheric Administration. 2008. Fisheries, Office of Protected Resources. Available: http://www.nmfs.noaa.gov/pr/species/. Accessed: February, 2008.

Natural Resources Conservation Service. 2008. Soil Data Mart. US Department of Agriculture. Available: http://soildatamart.nrcs.usda.gov/. Accessed: May 5, 2008.

Natural Resources Conservation Service . 2008a. Hydric Soils List for North Carolina. US Department of Agriculture. Available: http://soils.usda.gov/use/hydric/ lists/state.html. Accessed: May 5, 2008.

NatureServe. 2007. NatureServe Explorer: An online encyclopedia of life [web application]. Version 6.2. NatureServe, Arlington, Virginia. Available: http://www.natureserve.org/explorer. Accessed: February 15, 18, 2008.

North Carolina Department of Environment and Natural Resources, Division of Coastal Management. 2007. CAMA Handbook for Development in Coastal North Carolina. NC Department of Environment and Natural Resources. Available: http://dcm2.enr.state.nc.us/Handbook/contents.htm. Accessed: May 22, 2008.

North Carolina Department of Environment and Natural Resources, Division of Water Quality. 2006. Basinwide Assessment Report-Pasquotank River Basin. NC Department of Environment and Natural Resources. Available: http://www.esb.enr.state.nc.us/Basinwide/PASQUOTANK2006Final.pdf. Accessed: April 29, 2008.

North Carolina Department of Environment and Natural Resources, Division of Water Quality. 2008. North Carolina Waterbodies Reports. NC Department of Environment and Natural Resources. Available: http://h2o.enr.state.nc.us/bims/reports/reportsWB.html. Accessed: May 21, 2008.

North Carolina Natural Heritage Program. *Lepidochelys kempii* – Atlantic Ridley. Available: http://149.168.1.196/nhp/makeMap.php?sciName=Lepidochelys%20kempii. Accessed: February 21, 2008.

North Carolina Natural Heritage Program. 1990. Executive Summary: Natural Areas of Currituck County, North Carolina. Available: http://www.ncnhp.org/Images/CurrituckSummary7_14_06.pdf. Accessed: October 19, 2007.

North Carolina Natural Heritage Program. 2006. North Carolina Natural Heritage Program List of the Rare Animal Species of North Carolina. Available: http://www.ncnhp.org/Images/2006RareAnimalList.pdf. Accessed: May 29, 2008.

North Carolina Natural Heritage Program. 2006a. North Carolina Natural Heritage Program List of the Rare Plant Species of North Carolina. Available: http://www.ncnhp.org/Images/2006RarePlantList.pdf. Accessed: May 29, 2008.

North Carolina Natural Heritage Program. 2008. Heritage Data. Available: http://www.ncnhp.org/Pages/heritagedata.html. Accessed: May 7 and December 8, 2008.

North Carolina Natural Heritage Program. 2008a. GIS data layers: Natural History Element Occurrences and Significant Natural Heritage Areas. Available: http://www.nconemap.com/default.aspx?tabid=286. Accessed: May 16 and June 5, 2008.

North Carolina Wildlife Resources Commission. 2005. North Carolina Wildlife Action Plan. Raleigh, NC. Available: http://www.ncwildlife.org/pg07_WildlifeSpeciesCon/pg7c1_3.htm. Accessed: May 29, 2008.

North Carolina Wildlife Resources Commission. 2008. Wildlife Profiles: West Indian Manatee (*Trichechus manatus*). Available: http://www.ncwildlife.org/pg07_WildlifeSpeciesCon/Profiles/manateewindian.pdf. Accessed: February 18, 2008.

South Atlantic Fishery Management Council. 2008. Fishery Management Plans. Available: http://www.safmc.net/Library/FisheryManagementPlansAmendments/tabid/395/Default.aspx. Accessed: December and January, 2009.

US Fish and Wildlife Service. American alligator (*Alligator mississippiensis*). Available: http://www.fws.gov/species/species_accounts/bio_alli.html. Accessed: February 15, 2009.

US Fish and Wildlife Service. 2006. Optimal Survey Windows for North Carolina's Federally Threatened and Endangered Plant Species. Available: http://www.fws.gov/nces/es/plant_survey.html. Accessed: February 18, 2008.

US Fish and Wildlife Service. 2008. South Atlantic Migratory Bird Initiative Aerial Survey Data for Currituck National Wildlife Refuge. Available: http://samigbird.fws.gov/sawindex.html. Accessed: December 16, 2008.

US Fish and Wildlife Service. 2008a. Threatened and Endangered Species Descriptions. Available: http://www.fws.gov/nc-es/. Accessed: January-February, 2008.

US Fish and Wildlife Service. 2009. Threatened and Endangered Species in North Carolina. Available: http://www.fws.gov/nc%2Des/es/countyfr.html. Accessed: May 7 and December 8, 2008, and February 25, 2009.

University of North Carolina. 2008. NCU Flora of the Southeast. University of North Carolina. Available: http://www.herbarium.unc.edu/seflora/firstviewer.html. Accessed: March 20, 2008.

6.3 Personal Communications

Allen, David. North Carolina Wildlife Resources Commission. February 4, 2009.

Berry, Ron. North Carolina Department of Environment and Natural Resources, Division of Water Quality. April 28, 2008.

Cameron, Sue. North Carolina Wildlife Resources Commission. October 30, 2007.

Cluse, Wendy. North Carolina Wildlife Resources Commission. December 18, 2008.

Dockendorf, Kevin. North Carolina Wildlife Resources Commission. June 13, 2008.

Fussell, John. Author: A Birder's Guide to Coastal Carolina. March 30, 2008.

Vinzani, Gil. North Carolina Department of Environment and Natural Resources, Division of Water Quality. April 28, 2008.

Winslow, Sara. North Carolina Department of Environment and Natural Resources, Division of Marine Fisheries. May 15, 2008.