MID-CURRITUCK BRIDGE STUDY

TRAFFIC NOISE TECHNICAL REPORT

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

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1.0 Introduction and Summary

The North Carolina Turnpike Authority (NCTA), a division of the North Carolina Department of Transportation (NCDOT), in cooperation with the Federal Highway Administration (FHWA), 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.

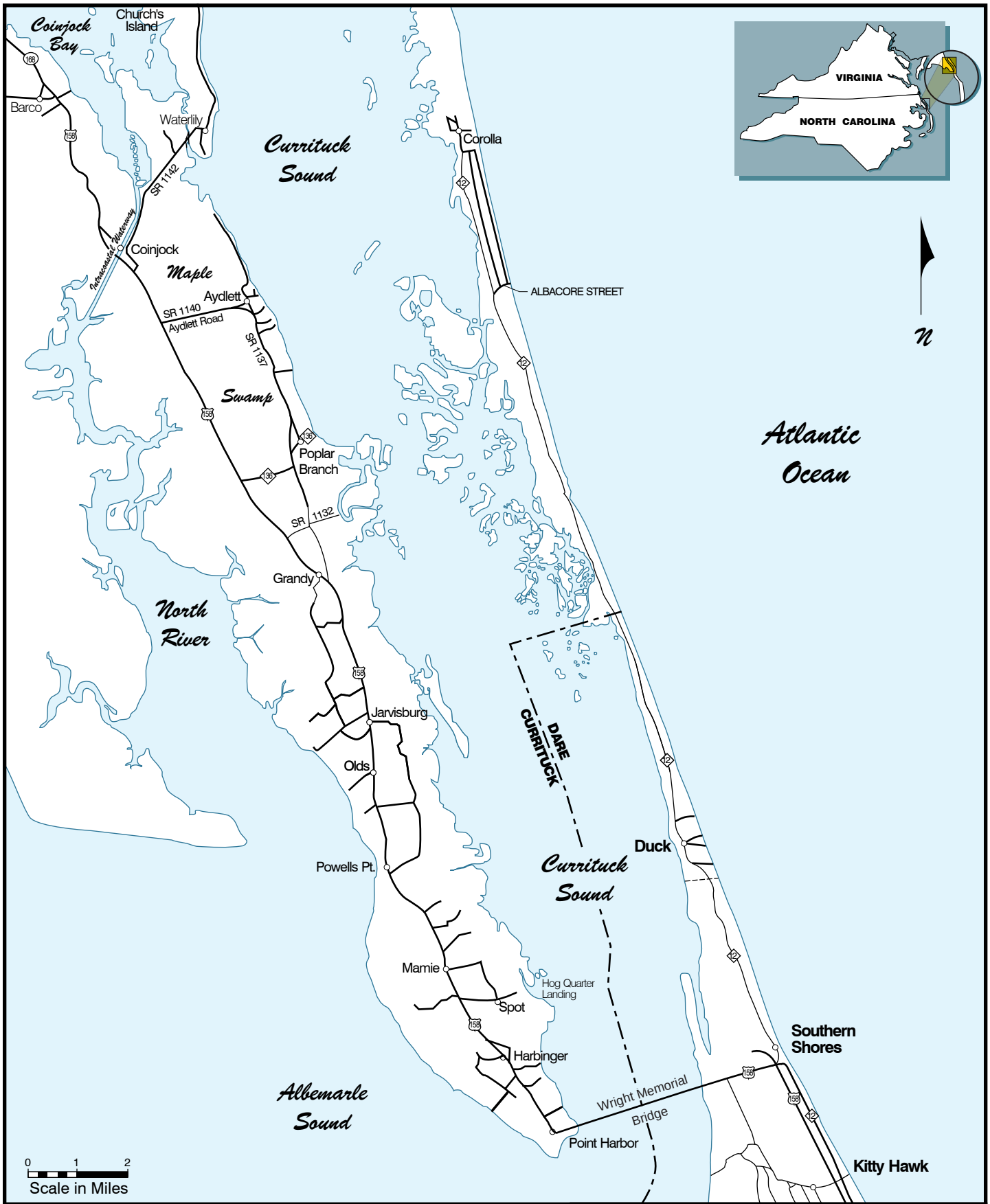
The project area is in northeastern North Carolina and includes the Currituck County peninsula on the mainland and its Outer Banks, as well as the Dare County Outer Banks north of Kitty Hawk (see Figure 1). The project area is south of the Virginia Beach-Norfolk, Virginia (Hampton Roads) metropolitan 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.

1.1 Summary of Impacts

The noise analysis found that:

- With ER2, noise is predicted to approach or exceed Noise Abatement Criteria (NAC) at 337 noise-sensitive sites on the Currituck County mainland and 355 noise-sensitive receptors on the Outer Banks.
- With MCB2, noise is predicted to approach or exceed NAC at 27 receptors on the Currituck County mainland, 411 receptors on the Outer Banks with bridge terminus C1, and 348 receptors on the Outer Banks with terminus C2.
- With MCB4, noise is predicted to approach or exceed NAC at 27 receptors on the Currituck County mainland, 146 receptors on the Outer Banks with bridge terminus C1, and 83 receptors on the Outer Banks with terminus C2.

These results would be the same for MCB2 and MCB4 with either Option A or Option B, and in the case of Option B, with or without the toll plaza.



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— - — County Boundaries

Project Area

Figure 1

The number shown as approaching or exceeding NAC on the Currituck County mainland is substantially higher on the mainland with ER2 (with the construction of a third outbound emergency lane) than with MCB2 and MCB4. This is because, with ER2, the relationship of the travel lanes to surrounding receptors would be changed for more than 20 miles with the wider pavement needed to provide for a third outbound emergency lane. This does not mean, however, that noise levels in this area would be substantially higher with ER2 and a third outbound emergency lane than with the No-Build Alternative. Predicted build noise levels would not be substantially higher; they would be imperceptibly (no more than 1 dBA) different. Instead the high number of affected receptors means that, because the location of travel lanes would be altered, FHWA requires that noise mitigation be considered even though the noise impact would exist without the project.

The detailed study alternatives would increase noise levels on the Outer Banks compared to the No-Build Alternative because their wider roads could carry more traffic at the speed limit, and travel lanes would be closer to noise sensitive properties. All noise levels were predicted for the maximum amount of traffic each road could carry traveling the speed limit. When this happens, traffic noise is at its loudest. Noise levels on NC 12 would be up to 10 dBA higher than with the No-Build Alternative. The NAC would not be exceeded in the community of Aydlett on the mainland with any alternatives, including with a toll plaza in Aydlett (MCB2/B and MCB4/B). The assessment found noise levels in Aydlett of less than 60 dBA at sensitive receptors with a Mid-Currituck Bridge. No properties in the project area under build conditions would experience a substantial increase in noise levels over existing levels.

Noise barriers were found to be economically reasonable at a few locations along NC 12 in Dare County and along NC 12 in Currituck County. However, noise barrier feasibility, as well as the noise reduction benefits of noise barriers, was found to be sporadic on the three-lane sections of NC 12 (with ER2 and MCB2) because driveway and street accessibility requirements limited the locations where acoustically effective barriers could feasibly be considered. In this area, 232 receptors would be adversely affected by traffic noise. Of those 232 receptors, three (one percent) would benefit from noise barriers. Those same barriers would lower noise levels for an additional 11 residential properties not adversely affected. Although economically reasonable, these barriers would dominate views at the homes and thus would not be reasonable from that perspective.

In the four-lane sections of NC 12 (with all detailed study alternatives), there are fewer street intersections and driveways, so the benefit of noise barriers would be more extensive. MCB2/C1 or MCB4/C1 would see 146 receptors adversely affected. Of those 146, 111 (76 percent) would benefit from noise barrier construction. Those same noise barriers would lower noise levels for an additional 100 receptors not adversely affected. With the MCB2/C2 or MCB4/C2, the four-lane section of NC 12 would see 83 receptors adversely affected by traffic noise. Of those 83, 67 (81 percent) would benefit from noise barrier construction. Those same noise barriers would provide lower noise levels for an additional 58 receptors not adversely affected. When considering the impact of barrier

visual dominance for MCB2/C1 or MCB4/C1 C1, barriers protecting 68 of the 111 receptors would be reasonable. With MCB2/C2 or MCB4/C2, barriers protecting 25 of the 83 receptors would be reasonable when visual dominance is considered. The NC 12 noise results for ER2 are similar to those predicted for MCB2/C2.

Barriers would disrupt the drainage patterns along NC 12 in two ways. First, along NC 12 in Dare County and southern Currituck County, the surrounding properties generally drain to the road or sound, so a barrier along NC 12 in that area would block normal drainage from surrounding properties. Second, during severe storms, the walls would be an impediment to flood flow.

The NCTA is committed to the construction of feasible and reasonable noise abatement measures at the noise-affected receptors identified in this Traffic Noise Technical Report, contingent upon the following conditions:

1. Detailed noise analysis updates during the final design process continue to support the opportunity to provide noise barriers at NSA 17 (noise barriers 17C and 17D), NSA 19, NSA 23, NSA 25, and NSA 26;

2. The outcome of hydraulic studies needed to determine the impact of proposed noise barriers on drainage and flood flows, whether the impact can be mitigated, and what would be required to mitigate and the associated cost;

3. Opinions have been solicited by NCTA from front row receptors about the noise abatement measures being considered and the majority of these receptors support the construction of the noise abatement measures;

4. Safety and engineering aspects as related to the roadway user and the adjacent property owner have been reviewed; and

5. Coordination with local officials to identify any new development that has occurred between the date of this report and the Date of Public Knowledge (i.e., the Record of Decision). Any new development would need to be assessed for noise impacts and given consideration for potential noise abatement measures during the final design process.

1.2 Project Description

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 2 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;

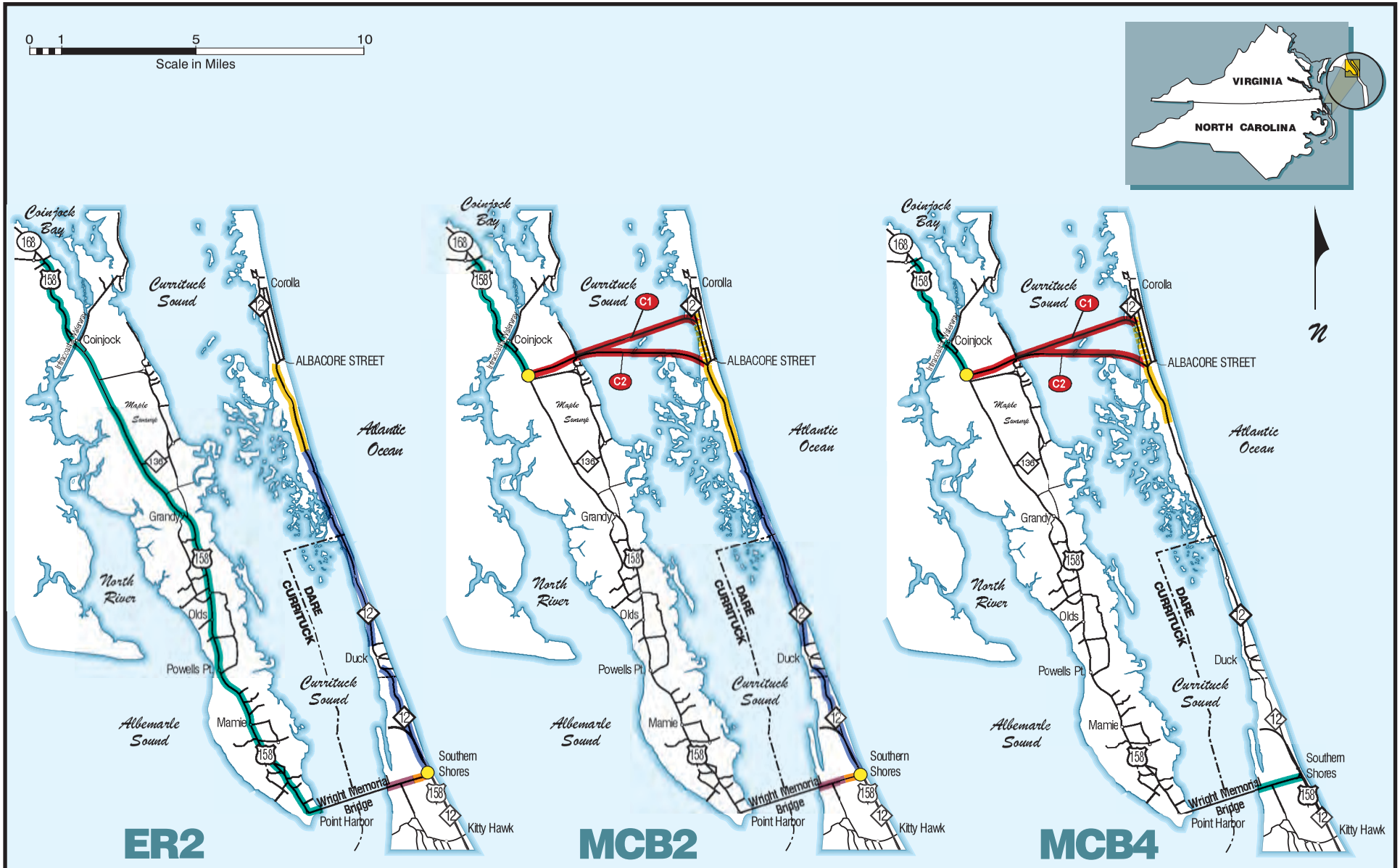
  - Widening US 158 to a six-lane super-street between the Wright Memorial Bridge and Cypress Knee Trail that widens to eight lanes between Cypress Knee Trail and the Home Depot driveway;

  - 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;



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- Eight Lanes (Super-street)
- Six Lanes (Super-street)
- Four Lanes
- Four Lanes (Only with C1)
- Three Lanes
- Mid-Currituck Bridge
- Third Outbound Lane (Contraflow of an existing lane is an option)
- C1 / C2 Bridge Corridor Alternatives
- Interchange

NOTE: Existing 3-lane segment of NC 12 in Duck is unchanged.

Detailed Study Alternatives

Figure

2

- 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 2) 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.

This Traffic Noise Technical Report (report) was prepared in accordance with Title 23 Code of Federal Regulations (CFR), Part 772, *Procedures for Abatement of Highway Traffic Noise and Construction Noise*, the FHWA *Highway Traffic Noise Analysis and Abatement Policy and Guidance* (June 1995), and the NCDOT *Traffic Noise Abatement Policy* (September 2004). All noise levels described herein are expressed in A-weighted decibels (dBA) in terms of one-hour equivalent steady-state sound level – L_{eq} (h).

The objectives of the traffic noise study are to:

- Identify noise-sensitive receptors adjacent to the project corridor;
- Evaluate future traffic noise levels at the receptors with and without the proposed project improvements;
- Identify impacts to noise sensitive receptors; and
- Evaluate the feasibility and reasonableness of potential noise abatement measures to mitigate these impacts.

Additional objectives include the evaluation of construction noise and the identification of future noise level contours adjacent to the project corridor.

2.0 Traffic Noise Analysis

Sound is created when an object moves; the rustling of leaves as the wind blows, the air passing through our vocal chords, the almost invisible movement of the speakers on a stereo. The movements cause vibrations of the molecules in air to move in waves like ripples on water. When the vibrations reach our ears, we hear what we call sound. Noise is basically defined as unwanted sound. It can be emitted from numerous sources, including airplanes, factories, railroads, power generation plants, trucks, and automobiles. Automobile noise is primarily comprised of noises from engine exhaust, drive train, and tire/roadway interaction.

The magnitude of noise is usually described by its sound pressure. Because the range of sound pressure varies greatly from object to object, a logarithmic scale is used to relate sound pressures to a common reference pressure, yielding the sound pressure level. Sound pressure levels are expressed in units of decibels (dB) and are often modified by frequency-weighted scales (e.g., A- or C-weighted scales). The A-weighted scale is used almost exclusively when measuring highway traffic noise because it places a stronger emphasis on the frequency range to which the human ear is most sensitive (approximately 1,000 to 6,000 hertz). Sound levels that are measured using the A-weighted scale are often expressed as dBA. Throughout this report, all noise levels will be expressed in dBA. Examples of sound pressure levels in dBA are listed in Table 1.

The hourly equivalent sound level, $L_{eq}(h)$, is the level of constant sound that, during a one-hour time interval, contains the same acoustic energy as a time-varying sound occurring during the same interval. The fluctuating sound levels of traffic noise in this report are presented in terms of $L_{eq}(h)$, in other words as a steady noise level with the same acoustic energy content as the fluctuating noise level occurring during the same period.

Table 1 indicates that most individuals in urbanized areas are exposed to fairly high noise levels from different sources as they go about their daily activities. The degree of disturbance or annoyance of unwanted sound essentially depends on three things:

1. The amount and nature of the intruding noise;

2. The relationship between background noise and the intruding noise; and

3. The type of activity occurring when the noise is heard.

In considering the first factor, it is important to note that individuals have different sensitivities to noise. Loud noises bother some people more than others and some individuals become upset if an unwanted noise persists. The time patterns of noise also

Table 1. Typical Noise Sources

Noise Level (dBA)	Description	Transportation Sources	Other Sources
130	Painfully loud		
120		Jet takeoff (200 feet)	
110	Maximum vocal effort	Car horn (3 feet)	
100			Shout (0.5 feet)
90	Very annoying; loss of hearing with prolonged exposure	Heavy truck (50 feet)	Jack hammer (50 feet) Home shop tools (3 feet)
85		Freight train on a structure (50 feet)	Backhoe (50 feet)
80	Annoying	City bus (50 feet)	Bulldozer (50 feet) Vacuum cleaner (3 feet)
75		Freight train (50 feet) or city bus at stop (50 feet)	Blender (3 feet)
70		Freeway traffic (50 feet)	Lawn mower (50 feet) Large office
65	Intrusive	Freight train in station (50 feet)	Washing machine (3 feet)
60			TV (10 feet)
55		Light traffic (50 feet)	Talking (10 feet)
50	Quiet	Light traffic (100 feet)	
45			Refrigerator (3 feet)
40			Library
30	Very quiet		Soft whisper (15 feet)

Sources: Federal Transit Administration, 1995; US Environmental Protection Agency, 1971 and 1974.

enter into an individual's judgment of whether or not a noise is disturbing. For example, noises that occur during sleeping hours are usually considered to be more disturbing than the same noises occurring during the daytime.

With regard to the second factor, individuals tend to judge the annoyance of an unwanted noise in terms of its relationship to noise from other sources (ambient noise). The honking of a car horn at night (when typical ambient noise levels are approximately 45 dBA) would generally be more objectionable than the honking of a car horn during the daytime when ambient noise might be 55 dBA.

The third factor is related to the interference of noise with activities of individuals. In an ambient noise environment of 60 dBA, normal conversation would be possible, while sleep might be difficult. Work activities requiring high levels of concentration may be interrupted by loud noises, while activities requiring manual effort may not be interrupted to the same degree. Over time, individuals tend to accept the noises that intrude into their daily lives, particularly if the noises are steady or occur at regular known intervals. Many of these noises are subject to regulations, including airplane noise, factory noise, railroad noise, and highway traffic noise.

2.1 Noise Abatement Criteria

The FHWA has developed noise abatement criteria (NAC) and procedures to be used in the planning and design of highways to determine noise levels at which mitigation should be considered. These NAC and procedures are based in Title 23 CFR, Part 772, *Procedures for Abatement of Highway Traffic Noise and Construction Noise*. A summary of the NAC for various land uses is presented in Table 2.

Table 2. Noise Abatement Criteria

Activity Category	L_{eq}(h) (dBA)	Description of Activity
A	57 Exterior	Lands on which serenity and quietness are of extraordinary significance, serve an important public need, and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose.
B	67 Exterior	Picnic areas, recreation areas, playgrounds, active sports areas, parks, residences, motels, hotels, schools, churches, libraries, and hospitals.
C	72 Exterior	Developed lands, properties, or activities not included in Categories A or B.
D	--	Undeveloped lands.
E	52 Interior	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals, and auditoriums.

Source: Title 23 CFR, Part 772, *Procedures for Abatement of Highway Traffic Noise and Construction Noise*.

When predicted traffic noise levels "approach" or exceed the NAC, or when predicted traffic noise levels increase substantially from existing levels, the FHWA requires that noise abatement measures be considered. The NCDOT uses an "approach value" of 1 dBA less than the NAC (e.g., NAC 66 dBA for land use Activity Category B).

Noise abatement measures must be considered when future noise levels either approach or exceed the criteria levels, or if there are substantial increases over the ambient noise levels. NCDOT definitions for "substantial increases" are presented in Table 3. Title 23 CFR, Section 772.11(a) states, "In determining and abating traffic noise impacts, primary consideration is to be given to exterior areas. Abatement will usually be necessary only where frequent human use occurs and a lowered noise level would be of benefit." For this project, identified potentially noise-sensitive receptors were commercial uses, residences, a library, churches and recreation areas.

Table 3. NCDOT Definition of Substantial Increase in Noise Levels

Existing Average Noise Level (dBA)	Increase (in decibels) from Existing Noise Levels to Future Noise Levels Defined as a Substantial Increase
≥55	10 or more
54	11 or more
53	12 or more
52	13 or more
51	14 or more
≤50	15 or more

Source: NCDOT *Traffic Noise Abatement Policy*, September 2004.

2.2 Noise-Sensitive Receptors

A noise-sensitive receptor is any property (owner-occupied, rented, or leased) where human activity occurs (typically outdoors) and where a lowered noise level would be of benefit. Noise level contours, or points of equal noise levels, were calculated to identify the noise-sensitive receptors that may be exposed to noise levels that approach or exceed the NAC as a result of the detailed study alternatives in the 2035 design year. Because the noise-sensitive receptors within the study limits consist mostly of the exterior areas of low density and medium density residential areas and some businesses, the noise level contour locations were calculated for the 66 dBA and 71 dBA future noise levels. Activity Category B (which includes residences, churches, libraries, etc.) has a noise abatement criterion approach value of 66 dBA and Activity Category C (which includes businesses) has a noise abatement criterion approach value of 71 dBA Leq. The contour locations were calculated using FHWA's Traffic Noise Model® (TNM), Version 2.5 (released in 2004), and do not reflect any shielding of traffic noise by terrain features and structures between the receptor and roadway. The distances to the 66 and 71 dBA contours are measured perpendicularly out from the edge-of-pavement of NC 12, US 158, and the new roadway approaching the proposed Mid-Currituck Bridge for each of the detailed study alternatives. These distances are provided in Table 4. The unshielded noise contours provide a conservative estimate of noise levels valid only for preliminary identification of noise sensitive receptors potentially affected by future traffic noise.

The noise contours were overlaid onto base mapping and sensitive receptors within the contours were identified and numbered. There are 1,877 receptors assessed in this report. They are numbered in numeric order beginning with 1 within each of 29 noise sensitive areas (NSA) described below. The receptors and their numbers are shown on the plan sheets in Appendix A.

Table 4. 66 and 71 dBA Noise Contours for 2035 Detailed Study Alternatives

Proposed Improvement Segment	ER2	MCB2 /C1	MCB2 /C2	MCB4 /C1	MCB4 /C2	Distance (feet) to 66 dBA*	Distance (feet) to 71 dBA*
US 158 between NC 168 and Knapp Bridge	X	X	X	X	X	225	100
US 158 between Knapp Bridge and Mid-Currituck Bridge (either Option A or Option B)	X	X	X	X	X	200	100
US 158 between Mid-Currituck Bridge and Walnut Island Boulevard	X					200	100
US 158 between Walnut Island Boulevard and Wright Memorial Bridge	X					175	100
US 158 between Wright Memorial Bridge and Market Place	X	X	X			200	100
US 158 between Market Place and Byrd Street	X	X	X			200	100
US 158 between Byrd Street and West Bennett Street	X					175	75
US 158 between Byrd Street and West Bennett Street		X	X			200	100
NC 12 between Four Seasons Lane and US 158	X	X	X			50	Less than 25
NC 12 between Audubon Drive and Cook Drive	X	X	X			25	Less than 25
NC 12 between Spindrift Trail and Audubon Drive	X	X	X			25	Less than 25
NC 12 between Currituck Clubhouse Road and Spindrift Trail	X	X	X	X	X	75	Less than 25
NC 12 between Mid-Currituck Bridge (C2) and Currituck Clubhouse Road			X		X	100	50
NC 12 between Mid-Currituck Bridge (C1) or Albacore Street (ER) and Currituck Clubhouse Road	X	X		X		125	50
NC 12 roadway approach to Mid-Currituck Bridge (C1)		X		X		125	25
NC 12 north of Mid-Currituck Bridge (C1)		X		X		100	50
Mid-Currituck Bridge between US 158 and Currituck Sound with Option A)		X	X	X	X	Less than 25	Less than 25
Mid-Currituck Bridge between US 158 and Currituck Sound (2023 with Option B)		X	X	X	X	25	10
Mid-Currituck Bridge between US 158 and Currituck Sound (2035 with Option B)		X	X	X	X	50	20

* The "X" identifies the detailed study alternatives that apply to the proposed improvement segment. All distances measured perpendicularly out from the edge-of-pavement of the proposed roadway.

This noise study was based on the number and location of established noise-sensitive receptors, as well as currently vacant residential properties that had received building permits from applicable local governments, prior to completion of the noise analysis contained in this report. The noise contours should assist local authorities in exercising land use control over the remaining undeveloped lands adjacent to the roadway within the local jurisdiction. For example, with proper information on noise, the local authorities can prevent further development of incompatible activities and land uses with the predicted noise levels of an adjacent highway.

As noted above, the evaluation of the areas delineated by the 66 dBA noise contour revealed 1,877 noise-sensitive receptors (including single-family residences, apartments, condominiums, commercial properties, churches, and a library) that are either within or in proximity to the noise contour. Noise-sensitive receptors adjacent to NC 12 include isolated single family homes (adjacent to the roadway right-of-way), single family homes in new and established subdivisions, hotels, apartments, and condominiums. Noise-sensitive receptors adjacent to US 158 consist of established isolated homes adjacent to the roadway right-of- way, commercial properties, a visitor center, churches, and a library. Currituck County Middle School and Currituck County High School (located within the project limits on the east side of US 158 to the north of the Knapp Bridge) are both located over 300 feet from the roadway and beyond the 66 dBA noise contour and not subject to noise levels that would approach or exceed the NAC, so they were not considered in the noise analysis. One isolated residence on the north side of Aydlett Road is located over 1,000 feet from US 158 and from the right-of-way associated with the proposed interchange and toll plaza, so this residence also was not included in the noise analysis.

For the purpose of the noise study, the residences and other noise-sensitive receptors were grouped into 29 NSAs. Table 5 lists the location of each NSA and a brief description of the land use. The locations of the 29 NSAs are shown on the plan sheets in Appendix A.

Additional information on each NSA is discussed below:

- **NSA 1 –** NSA 1 is a residential area, consisting of one-story single-family homes. The Currituck County Library and Currituck County Middle School are adjacent to the east side of US 158. (See Figures A-37 and A-38.) The homes and library are located adjacent to the roadway right-of-way and have direct access to US 158.

- **NSA 2 –** NSA 2 is a residential area, consisting of one- and two-story single-family homes. A thick and dense line of trees is situated west of NSA 2. It is anticipated that six homes in NSA 2 would be displaced as a result of the proposed improvements. (See Figures A-35A, A-35B, A-36A, and A-36B.)

Table 5. Noise-Sensitive Areas

Noise-Sensitive Area	Location	Land Use	Years Constructed*
NSA 1	Both sides of US 158 between north of Sam Wilkins Lane and south of Currituck High School Road	single-family residences and library	2005-2008
NSA 2	East of US 158 between Young Road and Aydlett Road	single-family residences	2004-2005
NSA 3	Both sides of US 158, from approximately 600 feet north of Ark Court to approximately 1,200 feet north of Marshall Grandy Lane	single-family residences, commercial, and churches	1950-2008
NSA 4	Both sides of US 158, from approximately 1,200 feet north of Marshall Grandy Lane to Walnut Island Boulevard	single-family residences, commercial, and churches	1987-2008
NSA 5	Both sides of US 158, from Walnut Island Boulevard to approximately 200 feet south of Newbern Lane	single-family residences, commercial, and churches	1989-2008
NSA 6	Both sides of US 158, from approximately 200 feet south of Newbern Lane to approximately 300 feet north of Wild Geese Court	single-family residences, commercial, and churches	1996-2008
NSA 7	Both sides of US 158, from approximately 300 feet north of Wild Geese Court to approximately 1,000 feet south of South Spot Road	single-family residences, commercial, and churches	1998-2008
NSA 8	Both sides of US 158, from approximately 1,000 feet south of South Spot Road to Wright Memorial Bridge/Holly Lane	single-family residences, commercial, and churches	1998-2008
NSA 9	Both sides of US 158, from Wright Memorial Bridge to Bennett Street	single-family residences and commercial	1979-2008
NSA 10	Both sides of NC 12, from US 158 to 13th Avenue, including the Town of Southern Shores	single-family residences and commercial	1982-2008
NSA 11	Both sides of NC 12, from 13th Avenue to Plover Drive, south of the Town of Duck	single-family residences and condominiums	1985-2008
NSA 12	Both sides of NC 12, from Cook Drive to north of Baum Trail, north of the Town of Duck including the Sanderling area	single-family residences, hotels and apartment buildings	1985-2008
NSA 13	East of NC 12, from north of Baum Trail to Audubon Drive	single-family residences	1995-2008
NSA 14	Both sides of NC 12, from Audubon Drive to Sea Shell Lane	single-family residences	1987-2008
NSA 15	Both sides of NC 12, from Sea Shell Lane to Sand Hill Lane	single-family residences	1987-2008

Table 5 (concluded). Noise-Sensitive Areas

Noise-Sensitive Area	Location	Land Use	Years Constructed*
NSA 16	West of NC 12, from Marlin Way to Currituck Clubhouse Drive	single-family residences	2006-2007
NSA 17	East of NC 12, from south of Marlin Way to south of Sand Fiddler Trail	single-family residences	1991-2007
NSA 18	West of NC 12, from north of Sand Fiddler Trail to north of Seabird Way	single-family residences	2001-2005
NSA 19	East of NC 12, residential subdivision accessed by Seabird Way	single-family residences	1987-2008
NSA 20	West of NC 12, from north of Seabird Way to north of Driftwood Way	single-family residences	2003-2007
NSA 21	East of NC 12, from north of Seabird Way to north of Driftwood Way	single-family residences	1988-2007
NSA 22	East and west of NC 12, from south of Orion's Way to south of Monteray Drive	condominium and apartment buildings	1994-2008
NSA 23	West of NC 12, from south of Monteray Drive to Bonita Street	single-family residences	1988-2007
NSA 24	West of NC 12, from north of Bonita Street to north of Ocean Forest Court	single-family residences	1988-2007
NSA 25	East of NC 12, from south of Dolphin Street to Bonita Street	single-family residences	1991-2008
NSA 26	East of NC 12, from Bonita Street to north of Ocean Forest Court	single-family residences	1986-2007
NSA 27	West of NC 12, north of Ocean Forest Court to north of Harbor View North	single-family residences	2007-2008
NSA 28	Along Narrow Shore Road north of Whispering Pines Court	single-family residences	2005-2008
NSA 29	West of Narrow Shore Road and both sides of Lighthouse View	single-family residences	2000-2007

*Data on construction years were verified through field inspection, interviews with property owners, and the Currituck County and Dare County property appraisers' internet web sites.

- **NSA 3** – Located north of the Bertha community, NSA 3 consists largely of vacant land and a small number of single-family homes and small businesses with direct driveway access to US 158. The vacant land consists primarily of shrubs and small trees. (See Figures A-33 and A-34.)

- **NSA 4** – Located between the Bertha community and the Grandy community. Between Marshall Grandy Lane and Carolina Club Drive, there is primarily agricultural land with a small number of single-family homes and small businesses, as well as some vacant land. The homes and small businesses have direct driveway access to US 158. The vacant land consists of shrubs and small trees. South of Carolina Club Drive to Walnut Island Boulevard, in the Grandy community, is a

denser clustering of single-family homes and small businesses east and west of US 158. (See Figures A-24 through A-32.)

- **NSA 5** – Located in the Grandy community and the rural area to the south. The homes and businesses adjacent to US 158 have direct driveway access to US 158. (See Figures A-18 through A-23.)

- **NSA 6** – Includes the Mamie community. NSA 6 is a mixture of agricultural land, single-family homes, small businesses, and vacant land consisting of shrubs and small trees. Nearly all homes and businesses adjacent to US 158 have direct driveway access to US 158. (See Figures A-11 through A-18.)

- **NSA 7** – Includes the communities of Spot, Harbinger, and Point Harbor. NSA 7 is a mixture of agricultural uses, single-family homes, small business, and vacant land with shrubs and small trees. A large number of homes and businesses have direct driveway access to US 158. (See Figures A-8 through A-11.)

- **NSA 8** – NSA 8 is a mixture of agricultural uses, single-family homes, small business, and commercial and light industrial properties. The homes, commercial properties, and industrial businesses adjacent to US 158 have direct driveway access to US 158. (See Figures A-1 through A-8.)

- **NSA 9** – This area is a mixture of residential and commercial uses. The Albemarle Health Regional Medical Center and the Outer Banks Visitor Information Center are also within NSA 9 near the NC 12 and US 158 intersection. The visitor center (receptor US158/NC12S-20) has several park benches between 200 and 400 feet from US 158 and is collocated with the First in Flight Monument (both considered NAC Category B and a special use under NCDOT's *Traffic Noise Abatement Policy*). Kitty Hawk Elementary School is located on the east side of South Dogwood Trail, approximately 500 feet north of US 158. A baseball diamond is setback approximately 50 feet north of US 158. Just west of South Dogwood Trail and north of US 158 is a cluster of homes in a new subdivision built after 2000. These homes can access US 158 using either South Dogwood Trail or Landing Trail, which has a right turn-lane or slip-lane into the subdivision and connects the subdivision to US 158 approximately 500 feet west of South Dogwood Trail. A small retention basin, parallel to US 158, is located between South Dogwood Trail and Landing Trail. The basin is approximately 250 feet long, with a 50-foot setback north of US 158. There is an additional small water body within the subdivision near South Dogwood Trail. The closest home to US 158 in this subdivision is located on Landing Trail, with a setback of approximately 60 feet north of US 158. Two homes are within 100 feet of US 158, while 14 homes are within 250 feet of US 158. In total, the subdivision consists of two apartment or condominium complexes housing an estimated four units each, and 33 two-story, single-family homes. The homes closest to US 158 are situated on the west side of the retention basin and are partially facing US 158. The

homes north of the retention basin are between 200 and 250 feet north of US 158. There is vacant land west of the subdivision, north of US 158 consisting of sand and shrubs. Residential uses in NSA 9 primarily consist of two- and three-story single-family homes. Many homes have balconies facing US 158. Some homes have in-ground swimming pools. Most homes are located in subdivisions and do not have direct access to US 158, although approximately five homes south of the US 158/NC 12 intersection have both side-street access and direct access to US 158. Commercial uses (other than transient residential) are rarely considered noise-sensitive. Some of the commercial uses just west of the NC 12 and US 158 intersection include Home Depot, Wal-Mart, McDonald's, North Beach Center, Marketplace at Southern Shores (which includes a Starbucks and several shops), at least three banks (Wachovia, BB&T, and Gateway), Southern Shores Realty, and an additional commercial use under construction just west of Wal-Mart. Further west of the NC 12 and US 158 intersection is Outer Banks Family Cosmetic and Dentistry, Ocean Kayak and Islander Flags shops, Victory car dealership, Central Garden Center and Nursery, Outer Banks Appliance store, and several other small commercial buildings. South of the NC 12 and US 158 intersection on the east side of US 158 are Bushin Kan Karate, John Gaw Jr., Attorney at Law, Ambrose Furniture store, Beach Mortgage, Inc., and Joe Lamb Realtor. West of US 158 just north of Bennett Street is Coldwell Realty. Most of these commercial uses have direct access to US 158. There is substantial vacant land north and south of US 158 between Cypress Knee Trail and Pine Hill Lane consisting of sand, brush, and small trees. There is vacant land just south of the hospital which is zoned for medical uses, and vacant residential land (roughly five lots) north of Bennett Street, west of US 158. There are four small water bodies located between Cypress Knee Trail and South Dogwood Trail with setbacks ranging between 40 and 150 feet both north and south of US 158. There is a stream that ends roughly 40 feet north of US 158, east of Duck Woods Drive. There is another stream that crosses under US 158 just east of Wright Memorial Bridge. Finally, there is a small retention basin just east of Home Depot. West of US 158 and south of Grissom Street is a berm between 5 and 10 feet in height. The area surrounding the NC 12 and US 158 intersection has a 5-foot elevation. In addition, the area immediately behind the visitor center and near the monument has an elevation of roughly 30 feet, which quickly tapers off to sea-level north and south of the monument. A paved, six-foot-wide multi-use path extends west from the NC 12 and US 158 intersection to Barlow Lane on the north side of US 158. (See Figures A-40 through A-46.)

- **NSA 10** – NSA 10 consists primarily of two- and three-story single-family homes plus some commercial uses. The Southern Shores Fire Department is on the northeast corner of the NC 12 and East Dogwood Trail intersection. Many of the homes in NSA 10 have balconies that face NC 12 and many homes have in-ground swimming pools. Many of the homes along NC 12 have direct access to NC 12. The commercial uses include Southern Shores Realty, Rite Aid, several shops located

within a shared shopping complex called Southern Shores Crossing, Hilton Gardens hotel, a donations center, and a few other commercial uses, all of which are located near the intersection of NC 12 and US 158. These commercial uses have direct access to NC 12. There are approximately seven vacant residential properties between Hickory Trail and Periwinkle Place. There is a vacant residential property off Pelican Watch Way, east of NC 12. There are signalized intersections and pedestrian crossings on NC 12 at 13th Avenue, Hillcrest Drive, East Dogwood Trail, and Virginia Dare Trail. The NC 12 and US 158 intersection is signalized, but with no marked pedestrian crossings. Two small water bodies are located north and south of 10th Avenue (setback 300 feet east of NC 12) and north and south of Hillcrest Drive (setback 100 feet east of NC 12). Topographic features include three five-foot-high berms located east of NC 12 between 13th Avenue and 12th Avenue, between 12th Avenue and 11th Avenue, and south of Hickory Trail, respectively. The area surrounding the NC 12 and US 158 intersection also has a five-foot elevation. East of NC 12, there is a five-foot-high wooden fence immediately south of Hickory Trail and a six-foot-high wooden fence further south of Hickory Trail. A paved, six-foot-wide multi-use path extends the length of NSA 10, parallel to NC 12. This facility is located on the east side of NC 12 from 13th Avenue to East Dogwood Trail, where it crosses NC 12 at a pedestrian crosswalk and continues south on the west side of NC 12. (See Figures A-47 through A-55.)

- **NSA 11** – NSA 11 is a residential area consisting of two- and three-story single-family homes and condominiums. Many homes have rear balconies facing NC 12 and many homes have in-ground swimming pools. There is a mixture of homes with direct and indirect access to NC 12. NSA 11 includes the Osprey Ridge, Sand Dollar Shores, Sea Hawk, Tuckahoe, and Ocean Crest subdivisions. There are three private tennis courts off Tuckahoe Drive and Bias Drive with 25- to 100-foot setbacks west of NC 12. Topographic features within NSA 11 include several five-foot-high berms located: south of Plover Drive, west of NC 12; at Seabreeze Drive, east of NC 12; north of Tuckahoe Drive, east and west of NC 12; and between Tuckahoe Drive and Bias Drive, west of NC 12. A paved, six-foot-wide multi-use path extends the length of NSA 11, parallel to and east of NC 12. There is a signalized intersection and pedestrian crossing at 13th Avenue. (See Figures A-55 and A-56.)

- **NSA 12** – The majority of NSA 12 is a residential area consisting mostly of two- and three-story, single-family homes and several multistory apartment complexes. Many homes have balconies facing NC 12, and many homes have in-ground swimming pools. There is a mixture of homes with direct and indirect access to NC 12 within NSA 12. Several subdivisions are within this area, including (from north to south) Sanderling, Ocean Pines, Caffey's Inlet, Sea Tern, Port Trinitie, Wood Duck Dunes, Carolina Dunes, Sea Ridge, Snow Geese Dunes, Snow Geese South, Brindley Beach, Sea Ridge, Sandy Ridge, Old Duck Beach, and Colony by the Sea. Several commercial uses are located between Baum Trail and Station Bay Drive (Sanderling Racquet and Swim Club, The Pavilion, Sanderling Inn Hotel, and Station Bay Marina

Seafood Market), between Ocean Pines Drive and Sea Tern Drive (Beach Realty and Construction, Kitty Hawk Rentals, North Duck Watersports, and Caffey's Inlet), and between Sandy Ridge Road and Cook Drive (Sunset Grill, Sharky's Bait and Tackle, Barrier Island Office Plaza, Resort Realty, and Tommy's Market). Most commercial uses have direct access to NC 12. Vacant land consisting of sand and brush makes up the area between Nor Banks Drive and Sandy Ridge Road, with the exception of the Duck Police and Fire Station (adjacent to NC 12) and the US Army Corp of Engineers facility (setback 1,000 feet east of NC 12). Just north of Rudy Duck Lane are two water bodies, one east of NC 12 with a setback ranging from 5 to 50 feet, and one west of NC 12 with a setback of 10 feet. The water feature east of NC 12 extends approximately 500 feet parallel to NC 12. Just south of Oyster Catcher Lane is a small water body with a setback of roughly 10 feet east of NC 12. North of Cedar Drive is a small water feature with a setback of about 10 feet. Currituck Sound is relatively close to NC 12 throughout NSA 12, ranging from a few feet to a few hundred feet, including in the vicinity of Baum Trail (100 feet), Oyster Catcher Lane (50 feet), and Barrier Island Station (between 10 and 20 feet). Other notable topographic features include a berm with a height of approximately five feet between Wood Duck Drive and Pintail Drive, east of NC 12; a 10-foot-high berm north of Spyglass Road, east of NC 12; a 10-foot-high berm south of Nor Banks Drive immediately east and west of NC 12; a ridge extending east from NC 12 along Sandy Ridge Road with a height ranging from five to 10 feet; and a ridge extending east from NC 12 along Dune Road with a height ranging from five to 15 feet. Bicycle facilities extend the length of NSA 12, including a paved, six-foot-wide multi-use path parallel to and east of NC 12 from Baum Trail south to Sandy Ridge Road. From Sandy Ridge Road, the pavement transitions to a six-foot-wide concrete path for a short distance before transitioning a third time into bicycle lanes on both sides of NC 12, roughly midway between Shipswatch Drive and Barrier Island Station. (See Figures A-57 through A-65.)

- **NSA 13** – NSA 13 is a residential area consisting of three-story single-family homes east of NC 12. Many homes have rear balconies facing NC 12 and most homes have in-ground swimming pools. All of these homes are situated along one of multiple access roads parallel to NC 12, and most of the homes do not have direct access to NC 12. Between these access roads and NC 12 is a thin strip of land approximately 50 feet wide consisting of sand and shrubs. West of NC 12 in this area is primarily vacant land consisting of sand, shrubs, and small trees. The only developed land use to the west of NC 12 is a private airport serving small aircraft, which extends from south of Audubon Drive to north of Long Fellow Cove. There are no bicycle facilities within NSA 13. However, there is an outside shoulder on both sides of NC 12 that is between three and four feet wide. (See Figures A-65 through A-69.)

- **NSA 14** – NSA 14 is primarily a residential area, consisting of three-story single-family homes, including the Pine Island subdivision. Many homes have balconies facing NC 12 and most homes have in-ground swimming pools. In the northern

portion of NSA 14 near Sea Shell Lane and Ocean Sands, there are approximately 10 vacant residential properties scattered between constructed homes. Further south, between Ocean Sands and Old Stoney Road, is a visitor center, a restaurant, a beach rental shop, and about 12 homes, although the majority of this area is vacant land consisting of sand and shrubs both east and west of NC 12. East of NC 12, where Old Stoney Road and NC 12 intersect, is the Southern Currituck County Public Beach Access, including a small parking lot, a sand trail with beach access, a gazebo, public bathrooms, and a surf shack setback approximately 200 feet from NC 12. West of NC 12, between Old Stoney Road and Audubon Drive, is vacant land consisting of sand and shrubs, with the exception of the Currituck County Fire Department facility and a water tower near Old Stoney Road. East of NC 12, between Old Stoney Road and Audubon Drive, is a dense clustering of homes, with about five vacant residential properties just south of Old Stoney Road and about 1,000 feet of vacant land north of Audubon Drive. East of NC 12, from the end of Deep Neck Road (parallel to NC 12) to Audubon Drive is vacant land consisting of sand and shrubs. Homes north of Ocean Sands Way tend to have direct access to NC 12, while homes south of Old Stoney Drive tend to have access to NC 12 by way of an access road (the area between is largely vacant). There are no bicycle facilities within NSA 14. However, there is an outside shoulder on both sides of NC 12 between three and four feet wide. There are several small water bodies within NSA 14, which are located: north of Spindrift Trail/Hunt Club Drive (setback 75 feet west of NC 12); between Spindrift Trail/Hunt Club Drive and Old Stoney Road (setback 75 feet west of NC 12); east of NC 12 and south of Old Stoney Road (setback 25 feet east of NC 12); and south of Black Pine Drive (setback 25 feet east of NC 12). (See Figures A-69 through A-73.)

- **NSA 15** – NSA 15 is a residential area consisting of three-story single-family homes adjacent to the roadway right-of-way for NC 12 with direct access to NC 12. This is the only NSA where the homes face NC 12 in Currituck County. NSA 15 includes the Ocean Sands subdivision. The Currituck Club Golf Course property is situated to the west of the residential properties on the west side of NC 12 within NSA 15. (See Figures A-74 and A-75.)

- **NSA 16** – NSA 16 is a residential area, consisting of three-story single-family homes. NSA 16 includes the Currituck Cottages subdivision. A limited business/hotel district, designed to accommodate smaller scale businesses that primarily serve local clientele rather than regional needs, is located north of NSA 16. The subdivision homes and businesses have indirect access to NC 12 via local collector roads. NSA 16 is buffered from NC 12 by approximately 30 feet of flat sand. (See Figure A-76.)

- **NSA 17** – NSA 17 is a residential area, consisting of three-story single-family homes with balconies. A few homes have in-ground swimming pools. NSA 17 includes the Ocean Sands subdivision. The limited business/hotel district discussed above is located west of NSA 17 and west of NC 12. The subdivision homes and businesses

have indirect access to NC 12 via local collector roads. A portion of NSA 17 is buffered from NC 12 by approximately 100 feet of flat sand. (See Figures A-75 and A-76.)

- **NSA 18** – NSA 18 is a residential area, consisting of two- and three-story single-family homes. NSA 18 includes the subdivisions of The Hammocks and Currituck Club. The Currituck Club Golf Course property is situated west of the NSA 18 properties. The subdivision homes and businesses have indirect access to NC 12 via local collector roads. Some properties within NSA 18 include a five-foot-high wooden fence. Through NSA 18, NC 12 is lined with shrubs that are level with the road. (See Figures A-77 and A-78.)

- **NSA 19 –** NSA 19 is a residential area, consisting of three-story single-family homes with balconies in the fronts and the backs of the houses. The balconies in the backs of the houses face NC 12. Most homes have in-ground swimming pools. NSA 19 includes the Ocean Sands subdivision, which has indirect access to NC 12 via local collector roads. (See Figures A-77 and A-78.)

- **NSA 20** – NSA 20 is a residential area, consisting of two- and three-story single-family homes. NSA 20 includes the Currituck Club subdivision. Portions of NSA 20 include a six-foot-high wooden fence. A two-lane subdivision road is located between the homes and NC 12 within Currituck Club, and the homes have indirect access to NC 12 via local collector roads. There is also a clubhouse/swimming pool facility located between the houses and NC 12. (See Figures A-78 through A-80.)

- **NSA 21** – NSA 21 is a residential area, consisting of three-story single-family homes with balconies in the fronts and the backs of the houses. The balconies in the backs of the houses face NC 12. Most homes have in-ground swimming pools. NSA 21 includes the Ocean Sands subdivision, which has indirect access to NC 12 via local collector roads. (See Figures A-78 through A-80.)

- **NSA 22** – NSA 22 consists of apartment buildings and condominiums, three stories each. NSA 22 includes the Buck Island and Beachmar Commercial Condominiums subdivisions. The condominiums are in a general business district, which is the least restricted commercial district designed to accommodate a wide range of businesses. The homes and businesses have indirect access to NC 12 via local collector roads. Some buildings in this commercial district provide shielding to noise-sensitive receptors in NSA 22. (See Figures A-79 to A-81.)

- **NSA 23** – NSA 23 is a residential area, consisting of three-story single-family homes. A few homes have in-ground swimming pools. NSA 23 includes the Monteray Shores subdivision, which has indirect access to NC 12 via local collector roads. A portion of NSA 23 is buffered from NC 12 by small trees and sand. (See Figures A-81 through A-84.)

- **NSA 24** – NSA 24 is a residential area, consisting of three-story single-family homes. Most homes have in-ground swimming pools. NSA 24 includes the Monteray Shores subdivision, which has indirect access to NC 12 via local collector roads. (See Figures A-84 and A-85.)

- **NSA 25** – NSA 25 is a residential area, consisting of three-story single-family homes. A few homes have second floor balconies facing NC 12. Most homes have in-ground swimming pools. NSA 25 includes the Whalehead Beach subdivision, which has indirect access to NC 12 via local collector roads. (See Figures A-81 through A-84.)

- **NSA 26** – NSA 26 is a residential area, consisting of three-story single-family homes. A few homes have second floor balconies facing NC 12. Most homes have in-ground swimming pools. NSA 26 includes the Whalehead Beach and Monteray Shores subdivisions, which have indirect access to NC 12 via local collector roads. A portion of NSA 26 is buffered from NC 12 by approximately 100 feet of small trees and sand. It is anticipated that four homes within NSA 26 would be displaced as a result of the proposed improvements. (See Figures A-84 and A-85.)

- **NSA 27** – NSA 27 is a residential area, consisting of three-story single-family homes. NSA 27 includes the Corolla Bay subdivision, which has indirect access to NC 12 via local collector roads. Currently, there are only three constructed homes in Corolla Bay. Most of the homes are located in the second row of homes back from NC 12. There are vacant residential properties between the constructed homes and also in front of the homes (between the homes and the proposed improvements). Some of the homes within NSA 27 are currently buffered from NC 12 by approximately 100 feet of trees and sand that comprise the vacant residential properties. (See Figures A-85 and A-86.)

- **NSA 28** – NSA 28 is a residential area, consisting of two-story single-family homes. A few homes have above-ground swimming pools. NSA 28 includes the Aydlett Soundside subdivision. Access to the proposed roadway would not be provided in this area, but would be provided at the proposed Mid-Currituck Bridge/US 158 interchange. A thick and dense tree zone is situated south of NSA 28 and Currituck Sound is east of NSA 28. (See Figure A-39A and A-39B.)

- **NSA 29** – NSA 29 is a residential area, consisting of one- and two-story single-family homes. Access to the proposed roadway would not be provided in this area, but would be provided at the proposed Mid-Currituck Bridge/US 158 interchange. (See Figure A-39A and A-39B.)

2.3 Noise Model

In general, the traffic situation is composed of a large number of variables, including vehicles driving at different speeds through a continually changing highway

configuration and surrounding terrain. Because of the complexity of the problem, certain assumptions and simplifications must be made to predict highway traffic noise. The model used to predict future noise levels was the FHWA's Traffic Noise Model® (TNM), Version 2.5, released in 2004.

TNM calculates noise levels at selected receptor locations (see Section 2.2) using input parameter estimates such as projected traffic volumes; vehicle mix (percentages of cars, medium trucks, and heavy trucks) and speed; roadway lengths and gradients; distances between sources, barriers, and receptors; and shielding provided by intervening terrain, barriers, and structures. Future traffic projections and operating characteristics used are described in Section 2.4. All data was incorporated in the model in English units.

For this project, the propagation path between the noise-sensitive receptors and the proposed roadway and bridge improvements is primarily soft (vegetated) with the default ground type characterized as lawn. Propagation paths consisting of sand were included in the model as loose soil ground zone. Large areas of pavement (commercial property parking lots) also were included in the model, where they may affect the propagation path. The boundaries of areas with significant dense, evergreen vegetation were included in the model as tree zones.

The preliminary designs of the detailed study alternatives, including profiles and horizontal alignments for all travel lanes, were used to develop roadway geometry in TNM. The roadway geometry and receptor locations were evaluated in the field and mapped in state-plane coordinates using MicroStation and November 2006 aerial photography. All roadway lanes of travel were modeled in TNM. Paved median turn lanes and the proposed hurricane evacuation shoulder/lane were modeled as a one-lane roadway with no traffic volumes in order to simulate pavement width only. Non-vehicular traffic noise sources, such as aircraft, trains, commercial/industrial operations, and construction activities, are not included in the TNM modeling process.

The noise analysis included the following steps:

1. Noise sensitive receptors were identified, such as homes, schools, libraries, churches, and businesses, in proximity to the detailed study alternatives (see Section 2.2). Receptors were set at 5 feet above the existing ground elevation and, as applicable, second and third story elevations. The 1,877 noise sensitive receptors identified are shown and numbered on the figures in Appendix A. They included existing noise-sensitive receptors, noise-sensitive receptors under construction at the time of the analysis, and receptors for which building permits had been issued at the time the assessment was conducted. Existing noise levels were assigned to each receptor using either existing noise measurements (where traffic was not the dominant noise source) or the results of TNM model runs where traffic was the dominant noise source).

2. Measurements of existing noise levels were taken (see Section 2.5).

3. Predicted future (generally in year 2035) noise levels for the detailed study alternatives were calculated and compared to the No-Build Alternative and to existing conditions noise levels at the noise-sensitive receptors (see Section 2.6).

4. At locations where the FHWA noise abatement criteria would be approached or exceeded or where there would be a substantial increase in noise levels over existing conditions, the feasibility and reasonableness of noise mitigation was considered in accordance with NCDOT's *Traffic Noise Abatement Policy* (September 2004) (see Section 3.4).

5. Detailed TNM modeling was conducted in areas where approximately three or more receptors were identified as being potentially affected. In these noise study areas, a three-dimensional TNM model was developed. For receptors that would be affected, noise barriers were developed and evaluated for feasibility and reasonableness. The three-dimensional TNM model included terrain features such as hills, fill slopes, and cut slopes, where appropriate, to resemble actual conditions as closely as possible.

2.4 Traffic Data

Consistent with FHWA policy, noise level predictions are made for the traffic characteristics that yield the worst hourly-traffic noise on a regular basis. Generally, the worst hourly-traffic-noise volume is the level-of-service (LOS) C traffic volume, or the demand LOS volume, whichever is less. The demand LOS volume was based on the summer weekday volumes. The design year for the project is 2035.

The LOS C volume was used for future (2035) conditions on NC 12, even though the demand LOS was typically much worse (higher traffic volume) than LOS C. Traffic predictions showed that the demand LOS volume increases from 2006 existing conditions to 2035 were relatively low for most segments. Roadway noise propagation depends on vehicle type, traffic volume, and traffic speed. Higher traffic volume does not necessarily contribute to higher traffic noise. Noise may be relatively lower when the general traffic speed decreases because the traffic volume cannot be accommodated by the roadway and impedes free-flow. Using the LOS C volumes provided the worst hourly-traffic noise condition in this case. The LOS C and demand LOS traffic volumes are routinely compared prior to use in the noise model to determine which would provide the highest traffic noise from the highest volume at free-flow conditions, and this is considered the worst hourly-traffic from a noise study standpoint.

With MCB2/B and MCB4/B, two noise analyses were conducted in Aydlett, one with the toll plaza (year 2023) and one without the toll plaza (year 2035). After 2023, it is anticipated that all tolls would be collected electronically with no need for vehicles to stop at a toll plaza. Noise associated with 2023 traffic slowing and accelerating at the toll plaza was modeled. In both cases, using the LOS C traffic volumes and assuming it operated at the speed limit produced the worst hourly-traffic noise condition.

A peak-hour factor (K) of 8 percent (based on summer weekday traffic analysis) was used along the project corridor for all three scenarios (i.e., existing conditions, No-Build, and Build) to calculate the hourly traffic volumes from the Annual Average Daily Traffic (AADT) volumes that is inputted into TNM. Medium and heavy truck percentages range from 1 to 2 percent. Recreational vehicle percentages range from 4 to 5 percent and were added to the medium truck percentage because the vehicle types were assumed to be similar based on traffic counts and observations in the field. The posted speed of 45 mph was used for the NC 12 segments and 55 mph was used for the US 158 segments, as well as the Mid-Currituck Bridge and roadway on new alignment. The roadway segments and their corresponding data are provided in detail in Appendix B.

2.5 Measured Noise Levels

In order to validate the computer noise model, field measurements were conducted at locations within the project area which are representative of noise-sensitive receptors within the study limits. Field measurements were conducted according to procedures described in *Measurement of Highway-Related Noise* (FHWA, May 1996). Noise levels were measured with a tripod-mounted Brüel & Kjær 2231 sound level meter (SLM) and a tripod-mounted Quest 2900 SLM equipped with a microphone and windscreen. The Brüel & Kjær SLM and its microphone were calibrated in the laboratory on September 13, 2007 and September 13, 2008 by West Caldwell Calibration Laboratories, Inc. The Quest 2900 SLM and its microphone were calibrated in the laboratory on January 28, 2008 by Wilner-Greene Associates, Inc. The laboratory calibrations were checked in the field with an acoustic calibrator. The microphones were mounted at an approximate height of five feet above ground level, which correlates to the average position of the human ear. Traffic speeds were observed from the posted speeds or the general speed of vehicles in the traffic flow (approximated by pacing traffic) during the time of field measurement. Traffic volumes by vehicle classification and vehicle speeds were observed and noted during each 20-minute measurement period. Ambient noise measurements were performed for 10-minute periods in areas where traffic noise is not the predominant noise source. Three consecutive noise measurements were done for each location and the results were averaged.

The locations of the 24 noise measurements are shown on the plan sheets in Appendix A. Table 6 presents the field measurements and the validation results.

TNM modeling predictions are considered within an acceptable level of accuracy if measured and predicted noise levels are within 3 dBA. As shown in Table 6, the ability of TNM to predict satisfactorily noise levels for this project was validated.

Table 6. Noise Model Validation

Location	Date	Time	Field Measured (dBA)	Computer Predicted (dBA)[1]	Difference (dBA)	Figure No.
M1 - Residence at 4881 US 158 (southeast quadrant of US 158 and Young Road intersection)	4/30/08	12:52 pm to 2:00 pm	64	64	0	A-36A, A-36B
M2 - Residence at 123 Lighthouse Road (north side of proposed roadway and bridge on new alignment)	4/30/08	3:46 pm to 4:30 pm	43	N/A	N/A	A-39A, A-39B
M3 - Residence at 383 Narrow Shore Road (south side of proposed roadway and bridge on new alignment)	4/30/08	4:56 pm to 5:40 pm	48	N/A	N/A	A-39A, A-39B
M4 - Vacant residential property in Corolla Bay (west of NC 12)	5/1/08	10:04 am to 10:40 am	49	N/A	N/A	A-86
M5 - Residence at 992 Cruz Bay Court in Corolla Bay (west of NC 12)	5/1/08	11:00 am to 11:40 am	48	N/A	N/A	A-85
M6 - Residence at 960 North Harbor View (Monteray Shores subdivision east of NC 12)	5/1/08	12:30 pm to 1:35 pm	56	58	2	A-85
M7 - Residence at 846 Sea Cliff Court (Monteray Shores subdivision west of NC 12)	5/1/08	3:14 pm to 4:40 pm	56	57	1	A-83
M8 - Residence at 567 NC 12 (southeast quadrant of NC 12 and Sand Hill Road intersection)	5/1/08	5:21 pm to 6:24 pm	61	59	2	A-74; A-75
M9 - Residence at 4171 US 158 (southeast quadrant of US 158 and Sam Wilkins Lane intersection)	5/2/08	10:40 am to 11:40 am	66	64	2	A-38
M10 - Residence at 472 Island Lead Road (subdivision east of NC 12 between Old Stoney Road and Black Pine Road)	11/11/08	11:14 am to 12:19 pm	56	57	1	A-72
M11 - Residence at 147 Salt House Road (subdivision east of NC 12 between Codwell Road and Black Cottage Cove Road)	11/11/08	12:51 pm to 1:54 pm	59	57	2	A-66
M12 - Residence at 1474 Duck Road (west side of NC 12 between Royal Tern Lane and Oyster Catcher Lane)	11/11/08	3:28 pm to 4:30 pm	62	64	2	A-61

[1]Computer predicted noise levels are not applicable to locations where traffic noise is not the predominant noise source.

Table 6 (concluded). Noise Model Validation

Location	Date	Time	Field Measured (dBA)	Computer Predicted (dBA)[1]	Difference (dBA)	Figure No.
M13 - Residence at 98 Wood Duck Drive (southwest quadrant of NC 12 and Wood Duck Drive intersection)	12/15/08	9:53 am to 10:58 am	59	59	0	A-59
M14 - Residence at 114 Landing Trail (northeast quadrant of US 158 and Landing Trail intersection)	11/11/08	5:00 pm to 6:05 pm	61	64	3	A-41
M15 - Residence at 100 Sandy Ridge Road (southeast quadrant of NC 12 and Sandy Ridge Road intersection)	11/12/08	9:08 am to 10:11 am	60	62	2	A-57
M16 - Residence at 100 E. Bias Ln (northeast quadrant of NC 12 and E. Bias Lane intersection)	11/12/08	10:30 am to 11:35 am	61	60	1	A-55
M17 - Residence at 129 NC 12 (east of NC 12 between Ocean Blvd. and Porpoise Run)	11/12/08	11:50 am to 12:50 pm	71	68	3	A-50
M18 - Residence at 6 Circle Drive (subdivision east of NC 12 On Hickory Trail)	11/12/08	12:00 pm to 1:02 pm	65	65	0	A-53
M19 - Residence at 4917 US 158 (west of US 158 between E. Eckner Street and Luke Street)	12/15/08	8:22 am to 9:32 am	64	64	0	A-45; A-46
M20 - Residence at 43 NC 12 (west of NC 12 after split from US 158)	11/12/08	2:30 pm to 3:35 pm	68	68	0	A-48; A-49
M21 - Residence at 5636 US 158 (west of US 158)	12/15/08	11:38 am to 12:45 pm	57	60	3	A-34
M22 - Residence at 6201 US 158 (north quadrant of US 158 and Grandy Road intersection)	12/15/08	1:05 pm to 2:10 pm	59	59	0	A-29
M23 - Residence at 7600 US 158 (east of US 158 between Forbes Road and Meadow Lake Circle)	12/15/08	2:27 pm to 3:35 pm	64	66	2	A-16
M24 - Residence at US 158 and N. Spot Road (northwest quadrant of US 158 and N. Spot Road intersection)	11/12/08	4:15 pm to 5:19 pm	69	70	1	A-10

[1]Computer predicted noise levels are not applicable to locations where traffic noise is not the predominant noise source.

2.6 Predicted Noise Levels

Predicted noise levels for the detailed study alternatives were calculated and compared to the No-Build Alternative and to the existing conditions noise levels at 1,877 noise-sensitive receptors adjacent to the proposed roadway improvements., Table 7, Table 8, and Table 9 present the predicted noise levels for existing conditions, the No-Build Alternative, and the detailed study alternatives and compare the increase in the predicted detailed study alternatives noise levels to the predicted existing conditions. The locations of the representative receptors modeled are presented on the plan sheets provided in Appendix A. A receptor may represent one home or multiple homes. A receptor that is located a certain distance from the roadway and representing a number of homes, may represent also a commercial or other outside land use nearby and at the same distance from the roadway. A summary of the predicted noise levels by receptor and the TNM output files are provided in Appendix C. (Note that the "Report Receiver [receptor] Name" column in Appendix C corresponds to the receptor numbers shown on the figures in Appendix A.)

Additional information on the affected receptors within each NSA is discussed below:

NSA 1 – Twenty-five of the 27 residences within NSA 1 are predicted to be exposed to noise levels that would approach or exceed the NAC as a result of ER2. Twenty-six of the 27 residences are predicted to be exposed to noise levels that would approach or exceed the NAC as a result of MCB2 or MCB4. The 66 dBA contour line shows that a portion of the tennis courts at Currituck County Middle School would be affected. ER2, MCB2, and MCB4 are the same within NSA 1 and consist of adding an outside, northbound evacuation lane along US 158, and a shift in the US 158 alignment. The addition of the evacuation lane would not involve a roadway capacity improvement. The proposed improvements include a 12-foot shift of the US 158 alignment to the west, which would move traffic away from residences located on the east side of US 158 and also from the affected tennis courts at Currituck County Middle School, so the noise would be relatively lower. Noise abatement was considered for the affected residences and the tennis courts, which are considered a special use under NCDOT's *Traffic Noise Abatement Policy*. However, these residences each have driveways connected to NC 12, so the necessary openings in the noise barrier for driveway connections would prevent the construction of a necessarily continuous and acoustically effective (i.e., feasible) noise barrier. Also, the difference between the base year and future year noise level was less than 3 dBA (maximum 1.3 dBA), which is barely perceptible to the human ear, so noise abatement would not be considered reasonable. In accordance with NCDOT's *Traffic Noise Abatement Policy*, noise abatement measures were considered but a detailed analysis was not performed for the 25 affected residences and the tennis courts.

Table 7. Predicted Traffic Noise Levels with ER2

NSA	TNM Receptor Numbers[1]	Number of Receptors Evaluated	Predicted Minimum – Maximum (dBA)[2]			Difference Existing vs. ER2 (dBA)[3]	Number of Sites Affected[4]
			Existing (2006)	No-Build (2035)	ER2 (2035)		
1	US158N-1 to US158N-27	27	65 to 77	65 to 77	66 to 76	-1 to 2	25
2	US158S-1 to US158S-8	8	61 to 76	61 to 76	61 to 76	0	7
3	US158A-1 to US158A-13	13	64 to 75	64 to 75	64 to 76	0 to 2	12
4	US158B-1 to US158B-61	61	63 to 77	63 to 77	64 to 78	0 to 3	56
5	US158C-1 to US158C-63	63	62 to 78	62 to 78	63 to 79	-1 to 1	62
6	US158D-1 to US158D-91	91	61 to 79	61 to 79	62 to 80	-1 to 1	83
7	US158E-1 to US158E-45	45	65 to 77	65 to 77	66 to 77	-1 to 1	45
8	US158F-1 to US158F-54	54	57 to 79	57 to 79	57 to 79	-1 to 2	47
9	US158/NC12S-1 to US158/NC12S-48	97	54 to 72	54 to 72	57 to 73	-2 to 4	36
10	US158/NC12N-1 to US158/NC12N-67	398	49 to 69	49 to 69	49 to 71	-4 to 5	82
11	N13thAve-1 to N13thAve-43	90	49 to 66	49 to 66	52 to 69	-4 to 5	17
12	NCookDr-1 to NCookDr-99	335	50 to 70	50 to 70	52 to 71	-1 to 3	109
13	NSanderling-1 to NSanderling-36	104	50 to 64	50 to 64	51 to 66	0 to 3	2
14	NAirport-1 to NAirport-34	76	52 to 64	52 to 64	53 to 72	0 to 8	22

[1]The locations of the noise sensitive receptors modeled are shown on the plan sheets provided in Appendix A. The TNM receptor may represent one or several noise sensitive receptors. The number of noise sensitive receptors represented is indicated in the column "Number of Receptors Evaluated."

[2]The predicted noise levels by receptor are provided in Appendix C.

[3]The minimum and maximum numbers are rounded to the nearest decibel. The upper and lower limits of the differences do not necessarily match the minimums and maximums in the preceding columns. The range provided for the difference in existing and the build alternative is for two actual receptors for the particular NSA, one with the lowest change and the other with the highest change in decibel. These receptors are not necessarily the same as receptors predicted to have the minimum or maximum dBA for the existing, No-Build, or detailed study alternative, and may actually be in the middle of this range.

[4]The term "affected" is defined as the receptors that are predicted to experience noise levels that approach or exceed the NAC as a result of the detailed study alternatives.

Table 7 (concluded). Predicted Traffic Noise Levels with ER2

NSA	TNM Receptor Numbers[1]	Number of Receptors Evaluated	Predicted Minimum – Maximum (dBA)[2]			Difference Existing vs. ER2 (dBA)[3]	Number of Receptors Affected[4]
			Existing (2006)	No-Build (2035)	ER2 (2035)		
15	SandHillLane-1 to SandHillLane-21	24	55 to 69	55 to 69	61 to 75	3 to 9	14
16	CurrituckCottages-1 to CurrituckCottages-3	3	60 to 65	60 to 65	64 to 72	3 to 7	2
17	OceanSands1-1 to OceanSands1-26	44	55 to 65	55 to 65	61 to 72	5 to 7	10
18	TheHammocks-1 to TheHammocks-20	56	51 to 64	51 to 64	56 to 71	3 to 7	12
19	OceanSands2-1 to OceanSands2-22	40	54 to 64	54 to 64	60 to 71	4 to 7	21
20	CurrituckClub-1 to CurrituckClub-12	13	48 to 59	48 to 59	54 to 63	4 to 7	0
21	OceanSands3-1 to OceanSands3-13	37	54 to 65	54 to 65	59 to 70	5 to 7	24
22	Apt1-1F to Apt3-3F	36	50 to 58	50 to 58	57 to 66	5 to 8	4
	Total						**692**

[1]The locations of the noise sensitive receptors modeled are shown on the plan sheets provided in Appendix A. The TNM receptor may represent one or several noise sensitive receptors. The number of noise sensitive receptors represented is indicated in the column "Number of Receptors Evaluated."

[2]The predicted noise levels by receptor are provided in Appendix C.

[3]The minimum and maximum numbers are rounded to the nearest decibel. The upper and lower limits of the differences do not necessarily match the minimums and maximums in the preceding columns. The range provided for the difference in existing and the build alternative is for two actual receptors for the particular NSA, one with the lowest change and the other with the highest change in decibel. These receptors are not necessarily the same as receptors predicted to have the minimum or maximum dBA for the existing, No-Build, or detailed study alternative, and may actually be in the middle of this range.

[4]The term "affected" is defined as the receptors that are predicted to experience noise levels that approach or exceed the NAC as a result of the detailed study alternatives.

Table 8. Predicted Traffic Noise Levels with MCB2

NSA	TNM Receptor Numbers[1]	Number of Receptors Evaluated	Predicted Minimum – Maximum (dBA)[2]			Difference Existing vs. MCB2 (dBA)[3]	Number of Receptors Affected[4]
			Existing (2006)	No-Build (2035)	MCB2 (2035)		
1	US158N-1 to US158N-27	27	65 to 77	65 to 77	66 to 76	-1 to 2	26
2 (Option A)	US158S-1 to US158S-8	8	61 to 76	61 to 76	61 to 71	0	1
2 (Option B)	US158S-1 to US158S-8	8	61 to 76	61 to 72	61 to 70	0	1
9	US158/NC12S-1 to US158/NC12S-48	97	54 to 72	54 to 72	56 to 73	-3 to 5	33
10	US158/NC12N-1 to US158/NC12N-67	398	49 to 69	49 to 69	49 to 71	-4 to 5	82
11	N13thAve-1 to N13thAve-43	90	49 to 66	49 to 66	52 to 69 (C1/C2)	-4 to 5 (C1/C2)	17
12	NCookDr-1 to NCookDr-99	335	50 to 70	50 to 70	52 to 71 (C1/C2)	-1 to 3 (C1/C2)	109
13	NSanderling-1 to NSanderling-36	104	50 to 64	50 to 64	51 to 66	0 to 3 (C1/C2)	2
14	NAirport-1 to NAirport-36	76	52 to 64	52 to 64	53 to 72 (C1/C2)	0 to 8 (C1/C2)	22
15	SandHillLane-1 to SandHillLane-21	24	55 to 69	55 to 69	61 to 75 (C1/C2)	3 to 9 (C1/C2)	14
16	CurrituckCottages-1 to CurrituckCottages-3	3	60 to 65	60 to 65	64 to 72 (C1/C2)	3 to 7 (C1/C2)	2
17	OceanSands1-1 to OceanSands1-26	44	55 to 65	55 to 65	61 to 72 (C1/C2)	5 to 7 (C1/C2)	10
18	TheHammocks-1 to TheHammocks-20	56	51 to 64	51 to 64	56 to 71 (C1/C2)	3 to 7 (C1/C2)	12

[1]The locations of the noise sensitive receptors modeled are shown on the plan sheets provided in Appendix A. The TNM receptor may represent one or several noise sensitive receptors. The number of noise sensitive receptors represented is indicated in the column "Number of Receptors Evaluated."

[2]The predicted noise levels by receptor are provided in Appendix C.

[3]The minimum and maximum numbers are rounded to the nearest decibel. The upper and lower limits of the differences do not necessarily match the minimums and maximums in the preceding columns. The range provided for the difference in existing and the build alternative is for two actual receptors for the particular NSA, one with the lowest change and the other with the highest change in decibel. These receptors are not necessarily the same as receptors predicted to have the minimum or maximum dBA for the existing, No-Build, or detailed study alternative, and may actually be in the middle of this range.

[4]The term "affected" is defined as the receptors that are predicted to experience noise levels that approach or exceed the NAC as a result of the detailed study alternatives.

Table 8 (continued). Predicted Traffic Noise Levels with MCB2

NSA	TNM Receptor Numbers[1]	Number of Receptors Evaluated	Predicted Minimum – Maximum (dBA)[2]			Difference Existing vs. MCB2 (dBA)[3]	Number of Receptors Affected[4]
			Existing (2006)	No-Build (2035)	MCB2 (2035)		
19	OceanSands2-1 to OceanSands2-22	40	54 to 64	54 to 64	60 to 71 (C1/C2)	4 to 7 (C1/C2)	21
20	CurrituckClub-1 to CurrituckClub-12	13	48 to 59	48 to 59	54 to 63 (C1) 54 to 64 (C2)	4 to 7 (C1) 5 to 7 (C2)	0 (C1) 0 (C2)
21	OceanSands3-1 to OceanSands3-13	37	54 to 65	54 to 65	59 to 70 (C1) 60 to 71 (C2)	5 to 7 (C1) 5 to 7 (C2)	24 (C1) 24 (C2)
22	Apt1-1F to Apt3-3F	36	50 to 58	50 to 58	57 to 66 (C1) 57 to 65 (C2)	5 to 8 (C1) 6 to 8 (C2)	4 (C1) 0 (C2)
23	MonteryShores1-1 to MonteryShores1-25	47	52 to 67	52 to 67	59 to 72 (C1)	5 to 7 (C1)	12
24	MonteryShores2-1 to MonteryShores2-13	14	48 to 64	48 to 64	58 to 73 (C1)	7 to 10 (C1)	6
25	MonteryShores3-1 to MonteryShores3-23	47	50 to 61	50 to 61	58 to 69 (C1)	5 to 9 (C1)	25
26	MonteryShores4-1 to MonteryShores4-16	24	53 to 66	53 to 66	62 to 73 (C1)	4 to 9 (C1)	16
27	CorollaBay-1 to CorollaBay-3	3	46 to 54	46 to 54	52 to 59 (C1)	4 to 8 (C1)	0
28 (Option A)	MCBS-1 to MCBS-8	8	None	None	49 to 59	N/A	0

[1]The locations of the noise sensitive receptors modeled are shown on the plan sheets provided in Appendix A. The TNM receptor may represent one or several noise sensitive receptors. The number of noise sensitive receptors represented is indicated in the column "Number of Receptors Evaluated."

[2]The predicted noise levels by receptor are provided in Appendix C.

[3]The minimum and maximum numbers are rounded to the nearest decibel. The upper and lower limits of the differences do not necessarily match the minimums and maximums in the preceding columns. The range provided for the difference in existing and the build alternative is for two actual receptors for the particular NSA, one with the lowest change and the other with the highest change in decibel. These receptors are not necessarily the same as receptors predicted to have the minimum or maximum dBA for the existing, No-Build, or detailed study alternative, and may actually be in the middle of this range.

[4]The term "affected" is defined as the receptors that are predicted to experience noise levels that approach or exceed the NAC as a result of the detailed study alternatives.

Table 8 (concluded). Predicted Traffic Noise Levels with MCB2

NSA	TNM Receptor Numbers[1]	Number of Receptors Evaluated	Predicted Minimum – Maximum (dBA)[2]			Difference Existing vs. MCB2 (dBA)[3]	Number of Receptors Affected[4]
			Existing (2006)	No-Build (2035)	MCB2 (2035)		
28 (Option B)	MCBS-1 to MCBS-8	8	None	54 to 65	53 to 65	N/A	0
29 (Option A)	MCBN-1 to MCBN-19	19	None	None	48 to 58	N/A	0
29 (Option B)	MCBN-1 to MCBN-8 and MCBN-10 to MCBN-19	18	None	51 to 57	50 to 56	N/A	0
	Total						**438 (C1)** **375 (C2)**

[1]The locations of the noise sensitive receptors modeled are shown on the plan sheets provided in Appendix A. The TNM receptor may represent one or several noise sensitive receptors. The number of noise sensitive receptors represented is indicated in the column "Number of Receptors Evaluated."

[2]The predicted noise levels by receptor are provided in Appendix C.

[3]The minimum and maximum numbers are rounded to the nearest decibel. The upper and lower limits of the differences do not necessarily match the minimums and maximums in the preceding columns. The range provided for the difference in existing and the build alternative is for two actual receptors for the particular NSA, one with the lowest change and the other with the highest change in decibel. These receptors are not necessarily the same as receptors predicted to have the minimum or maximum dBA for the existing, No-Build, or detailed study alternative, and may actually be in the middle of this range.

[4]The term "affected" is defined as the receptors that are predicted to experience noise levels that approach or exceed the NAC as a result of the detailed study alternatives.

Table 9. Predicted Traffic Noise Levels with MCB4

NSA	TNM Receptor Numbers[1]	Number of Receptors Evaluated	Predicted Minimum – Maximum (dBA)[2]			Difference Existing vs. MCB4 (dBA)[3]	Number of Receptors Affected[4]
			Existing (2006)	No-Build (2035)	MCB4 (2035)		
1	US158N-1 to US158N-27	27	65 to 77	65 to 77	66 to 76	-1 to 2	26
2 (Option A)	US158S-1 to US158S-8	8	61 to 76	61 to 76	61 to 71	0	1
2 (Option B)	US158S-1 to US158S-8	8	61 to 76	61 to 72	61 to 70	0	1
15	SandHillLane-1 to SandHillLane-21	24	55 to 69	55 to 69	61 to 75 (C1/C2)	3 to 9 (C1/C2)	14
16	CurrituckCottages-1 to CurrituckCottages-3	3	60 to 65	60 to 65	64 to 72 (C1/C2)	3 to 7 (C1/C2)	2
17	OceanSands1-1 to OceanSands1-26	44	55 to 65	55 to 65	61 to 72 (C1/C2)	5 to 7 (C1/C2)	10
18	TheHammocks-1 to TheHammocks-20	56	51 to 64	51 to 64	56 to 71 (C1/C2)	3 to 7 (C1/C2)	12
19	OceanSands2-1 to OceanSands2-22	40	54 to 64	54 to 64	60 to 71 (C1/C2)	4 to 7 (C1/C2)	21
20	CurrituckClub-1 to CurrituckClub-12	13	48 to 59	48 to 59	54 to 63 (C1) 54 to 64 (C2)	4 to 7 (C1) 5 to 7 (C2)	0 (C1) 0 (C2)
21	OceanSands3-1 to OceanSands3-13	37	54 to 65	54 to 65	59 to 70 (C1) 60 to 71 (C2)	5 to 7 (C1) 5 to 7 (C2)	24 (C1) 24 (C2)
22	Apt1-1F to Apt3-3F	36	50 to 58	50 to 58	57 to 66 (C1) 57 to 65 (C2)	5 to 8 (C1) 6 to 8 (C2)	4 (C1) 0 (C2)
23	MonteryShores1-1 to MonteryShores1-25	47	52 to 67	52 to 67	59 to 72 (C1)	5 to 7 (C1)	12
24	MonteryShores2-1 to MonteryShores2-13	14	48 to 64	48 to 64	58 to 73 (C1)	7 to 10 (C1)	6

[1]The locations of the noise sensitive receptors modeled are shown on the plan sheets provided in Appendix A. The TNM receptor may represent one or several noise sensitive receptors. The number of noise sensitive sites represented is indicated in the column "Number of Receptors Evaluated."

[2]The predicted noise levels by receptor are provided in Appendix C.

[3]The minimum and maximum numbers are rounded to the nearest decibel. The range provided for the difference in existing and the build alternative is for two actual receptors for the particular NSA, one with the lowest change and the other with the highest change in decibel. These receptors are not necessarily the same as receptors predicted to have the minimum or maximum dBA for the existing, No-Build, or detailed study alternative, and may actually be in the middle of this range.

[4]The term "affected" is defined as the receptors that are predicted to experience noise levels that approach or exceed the NAC as a result of the detailed study alternatives.

Table 9 (concluded). Predicted Traffic Noise Levels with MCB4

NSA	TNM Receptor Numbers[1]	Number of Receptors Evaluated	Predicted Minimum – Maximum (dBA)[2]			Difference Existing vs. MCB4 (dBA)[3]	Number of Receptors Affected[4]
			Existing (2006)	No-Build (2035)	MCB4 (2035)		
25	MonteryShores3-1 to MonteryShores3-23	47	50 to 61	50 to 61	58 to 69 (C1)	5 to 9 (C1)	25
26	MonteryShores4-1 to MonteryShores4-16	24	53 to 66	53 to 66	62 to 73 (C1)	4 to 9 (C1)	16
27	CorollaBay-1 to CorollaBay-3	3	46 to 54	46 to 54	52 to 59 (C1)	4 to 8 (C1)	0
28 (Option A)	MCBS-1 to MCBS-8	8	None	None	49 to 59	N/A	0
28 (Option B)	MCBS-1 to MCBS-8	8	None	54 to 65	53 to 65	N/A	0
29 (Option A)	MCBN-1 to MCBN-19	19	None	None	48 to 58	N/A	0
29 (Option B)	MCBN-1 to MCBN-8 and MCBN-10 to MCBN-19	18	None	51 to 57	50 to 56	N/A	0
	Total						**173 (C1) 110 (C2)**

[1]The locations of the noise sensitive receptors modeled are shown on the plan sheets provided in Appendix A. The TNM receptor may represent one or several noise sensitive receptors. The number of noise sensitive receptors represented is indicated in the column "Number of Receptors Evaluated."

[2]The predicted noise levels by receptor are provided in Appendix C.

[3]The minimum and maximum numbers are rounded to the nearest decibel. The range provided for the difference in existing and the build alternative is for two actual receptors for the particular NSA, one with the lowest change and the other with the highest change in decibel. These receptors are not necessarily the same as receptors predicted to have the minimum or maximum dBA for the existing, No-Build, or detailed study alternative, and may actually be in the middle of this range.

[4]The term "affected" is defined as the receptors that are predicted to experience noise levels that approach or exceed the NAC as a result of the detailed study alternatives.

- **NSA 2** – One of the eight residences within NSA 2 is predicted to be exposed to noise levels that would approach or exceed the NAC as a result of MCB2/A or MCB4/A. Seven of the eight residences within NSA 2 are predicted to be exposed to noise levels that approach or exceed the NAC as a result of ER2. The discrepancy between the numbers of affected residences is attributable to six residential displacements that would occur to accommodate the Mid-Currituck Bridge and US 158 interchange if MCB2/A or MCB4/A is selected. None of these displacements would occur for ER2. In accordance with NCDOT's *Traffic Noise Abatement Policy*, noise abatement measures were considered but a detailed analysis was not performed for the isolated affected residence for MCB2/A and MCB4/A, because a continuous noise barrier would not be reasonable. In accordance with NCDOT's *Traffic Noise Abatement Policy*, noise abatement measures were considered but a detailed analysis was not performed for the 7 affected residences for ER2 because gaps in the noise barrier for driveway connections would prevent the construction of a necessarily continuous and acoustically effective (i.e., feasible) noise barrier. Also, the difference between the base year and future year noise level was less than 3 dBA, so noise abatement would not be reasonable.

  MCB2/A and MCB4/A at NSA 2 consist of adding an outside, northbound evacuation lane along US 158, an interchange, a westbound and eastbound toll plaza, and a shift in the US 158 alignment. The US 158 interchange would connect to a two-lane bridge through Maple Swamp to the Mid-Currituck Bridge. As stated previously, six residences would be displaced with MCB2/A or MCB4/A, and there are no remaining residences near the proposed interchange and toll plazas. The remaining two residences are at the southeast quadrant of the US 158 and Young Road intersection; they are greater than 1,000 feet from the proposed westbound toll plaza and greater than 500 feet from the end of the proposed ramp from the toll plaza to the improved US 158. The segment of the improved US 158 adjacent to the remaining residences was considered the predominant traffic noise source and the only roadway included in the detailed study alternatives noise analysis for NSA 2. ER2 at NSA 2 consists of adding an outside, northbound evacuation lane along US 158 and a shift in the US 158 alignment.

  MCB2/B and MCB4/B at NSA 2 consist of adding an outside, northbound evacuation lane along US 158 to an interchange configuration that is shifted to the east of US 158. This interchange would not include a toll plaza. The US 158 interchange would connect to a two-lane roadway on fill through Maple Swamp to the Mid-Currituck Bridge. Through future year 2023, the roadway at Aydlett (near NSAs 28 and 29) would include a toll plaza, service roads, and an interchange. For future year 2035, the toll plaza would have been removed and replaced with a two-lane at-grade roadway with electronic toll collection; however, the service roads and interchange at Aydlett would remain. For MCB2/B and MCB4/B, the same six residences would be displaced as with MCB2/A and MCB4/A, and two residences would remain at the southeast quadrant of the US 158 and Young Road intersection

and potentially would be exposed to traffic noise. As with MCB2/A and MCB4/A, one of the residences (receptor 8 on Figure A-36B) is predicted to be exposed to noise levels that would approach or exceed the NAC with MCB2/B and MCB4/B with either the 2023 or 2035 future year traffic. In accordance with NCDOT's *Traffic Noise Abatement Policy*, noise abatement measures were considered but a detailed analysis was not performed for this isolated affected residence, because a continuous noise barrier would not be reasonable.

- **NSA 3** – Twelve of the 13 residences within NSA 3 are predicted to be exposed to noise levels that would approach or exceed the NAC as a result of ER2. ER2 within NSA 3 consists of adding an outside, northbound evacuation lane along US 158, and a shift in the US 158 alignment. In accordance with NCDOT's *Traffic Noise Abatement Policy*, noise abatement measures were considered but a detailed analysis was not performed for the 12 affected residences because gaps in the noise barrier for driveway connections would prevent the construction of a necessarily continuous and acoustically effective (i.e., feasible) noise barrier. Also, the difference between the base year and future year noise level was less than 3 dBA, so noise abatement would not be reasonable.

- **NSA 4** – Fifty-six of the 61 residences within NSA 4 are predicted to be exposed to noise levels that would approach or exceed the NAC as a result of ER2. ER2 within NSA 4 consists of adding an outside, northbound evacuation lane along US 158, and a shift in the US 158 alignment. In accordance with NCDOT's *Traffic Noise Abatement Policy*, noise abatement measures were considered but a detailed analysis was not performed for the 56 affected residences because gaps in the noise barrier for driveway connections would prevent the construction of a necessarily continuous and acoustically effective (i.e., feasible) noise barrier. Also, the difference between the base year and future year noise level was less than 3 dBA, so noise abatement would not be reasonable.

- **NSA 5** – Sixty-two of the 63 residences within NSA 5 are predicted to be exposed to noise levels that would approach or exceed the NAC as a result of ER2. ER2 within NSA 5 consists of adding an outside, northbound evacuation lane along US 158, and a shift in the US 158 alignment. In accordance with NCDOT's *Traffic Noise Abatement Policy*, noise abatement measures were considered but a detailed analysis was not performed for the 62 affected residences because gaps in the noise barrier for driveway connections would prevent the construction of a necessarily continuous and acoustically effective (i.e., feasible) noise barrier. Also, the difference between the base year and future year noise level was less than 3 dBA, so noise abatement would not be reasonable.

- **NSA 6** – Eighty-three of the 91 residences within NSA 6 are predicted to be exposed to noise levels that would approach or exceed the NAC as a result of ER2. ER2 within NSA 6 consists of adding an outside, northbound evacuation lane along

US 158, and a shift in the US 158 alignment. In accordance with NCDOT's *Traffic Noise Abatement Policy*, noise abatement measures were considered but a detailed analysis was not performed for the 83 affected residences because gaps in the noise barrier for driveway connections would prevent the construction of a necessarily continuous and acoustically effective (i.e., feasible) noise barrier. Also, the difference between the base year and future year noise level was less than 3 dBA, so noise abatement would not be reasonable.

- **NSA 7** – All 45 residences within NSA 7 are predicted to be exposed to noise levels that would approach or exceed the NAC as a result of ER2. ER2 within NSA 7 consists of adding an outside, northbound evacuation lane along US 158, and a shift in the US 158 alignment. In accordance with NCDOT's *Traffic Noise Abatement Policy*, noise abatement measures were considered but a detailed analysis was not performed for the 45 affected residences because gaps in the noise barrier for driveway connections would prevent the construction of a necessarily continuous and acoustically effective (i.e., feasible) noise barrier. Also, the difference between the base year and future year noise level was less than 3 dBA, so noise abatement would not be reasonable.

- **NSA 8** – Forty-seven of the 54 residences within NSA 8 are predicted to be exposed to noise levels that would approach or exceed the NAC as a result of ER2. ER2 within NSA 8 consists of adding an outside, northbound evacuation lane along US 158 and a shift in the US 158 alignment. In accordance with NCDOT's *Traffic Noise Abatement Policy*, noise abatement measures were considered but a detailed analysis was not performed for the 47 affected residences because gaps in the noise barrier for driveway connections would prevent the construction of a necessarily continuous and acoustically effective (i.e., feasible) noise barrier. Also, the difference between the base year and future year noise level was less than 3 dBA, so noise abatement would not be reasonable.

- **NSA 9** – Out of 97 noise-sensitive receptors within NSA 9 (residences and commercial properties along US 158 between Bennett Street and the Wright Memorial Bridge), 36 are predicted to be exposed to noise levels that would approach or exceed the NAC as a result of ER2 and 33 residences are predicted to be exposed to noise levels that would approach or exceed the NAC as a result of MCB2. ER2 and MCB2 within NSA 9 consist of converting the existing intersection of NC 12 and US 158 into an interchange, with three lanes north of the interchange, eight lanes west of the interchange, and six lanes south of the interchange. The differences between ER2 and MCB2 are the interchange alignments and the alignments of the six lanes south of the interchange. The park benches at the visitor center and the First in Flight Monument were included in the noise analysis, and the park benches were predicted to be exposed to noise levels that approach or exceed the NAC as a result of MCB2. In accordance with NCDOT's *Traffic Noise Abatement Policy*, noise abatement measures were considered for the affected residences along US 158, but a

detailed noise analysis was not performed because the difference between the base year and future year noise level was less than 3 dBA, so noise abatement would not be reasonable. Noise abatement measures were considered for the affected park benches at the visitor center, but a detailed analysis was not performed because gaps in the noise barrier from numerous driveway connections to US 158 would prevent the construction of a necessarily continuous and acoustically effective (i.e., feasible) noise barrier.

- **NSA 10** – Eighty-two of the 398 residences within NSA 10 are predicted to be exposed to noise levels that would approach or exceed the NAC as a result of ER2 or MCB2. ER2 and MCB2 within NSA 10 are the same and consist of adding a third lane from south of the NC 12 and 13th Avenue intersection to north of the NC 12 and US 158 intersection. The added lane would become a center turn lane. In accordance with NCDOT's *Traffic Noise Abatement Policy*, noise abatement measures were considered but a detailed analysis was not performed for the 82 affected residences because gaps in the noise barrier from numerous driveway connections along NSA 10 would prevent the construction of a necessarily continuous and acoustically effective (i.e., feasible) noise barrier. Also, with the exception of the affected TNM receptor US158/NC-12N-66, which is isolated, the difference between the base year and future year noise level was less than 3 dBA, so noise abatement would not be reasonable.

- **NSA 11** – Seventeen of the 90 residences within NSA 11 are predicted to be exposed to noise levels that would approach or exceed the NAC as a result of ER2 or MCB2. ER2 and MCB2 within NSA 11 are the same and include adding a third lane from south of the intersection of NC 12 and Plover Drive to north of the intersection of NC 12 and 13th Avenue. The added third lane would become a center turn lane. Based on the number of affected residences and the feasibility of providing noise abatement, noise abatement measures were evaluated for three of the 17 affected residences and are discussed in Section 1.0. Noise abatement measures were not feasible for the remaining 14 affected residences (represented by receptors N13thAve-5, 11, 26, 32, and 38) because these residences have driveways with direct connection to NC 12. Hence, the construction of a continuous and effective noise barrier would not be feasible based on NCDOT's *Traffic Noise Abatement Policy*.

- **NSA 12** – One-hundred-nine of the 335 residences within NSA 12 are predicted to be exposed to noise levels that would approach or exceed the NAC as a result of ER2 or MCB2. ER2 and MCB2 within NSA 12 are the same and consist of adding a third lane from north of the NC 12 and Baum Trail intersection to south of the NC 12 and Cook Drive intersection. The added lane would become a center turn lane. In accordance with NCDOT's *Traffic Noise Abatement Policy*, noise abatement measures were considered but a detailed noise analysis was not performed for the 109 affected residences because the difference between the base year and future year noise level was less than 3 dBA, so noise abatement would not be reasonable.

- **NSA 13** – Two of the 104 residences evaluated at NSA 13 are predicted to be exposed to noise levels that would approach or exceed the NAC. ER2 and MCB2 within NSA 13 are the same and consist of adding a third lane from the NC 12 and Pine Gate Road intersection to south of the NC 12 and Codwell Road intersection. The added lane would become a center turn lane. In accordance with NCDOT's *Traffic Noise Abatement Policy*, noise abatement measures were considered but a detailed noise analysis was not performed for the two affected residences because the difference between the base year and future year noise level was less than 3 dBA, so noise abatement would not be reasonable.

- **NSA 14** – Twenty-two of the 76 residences within NSA 14 are predicted to be exposed to noise levels that would approach or exceed the NAC as a result of either ER2 or MCB2. ER2 and MCB2 within NSA 14 are the same and can be described in two parts. The first part is from the NC 12 and Audubon Drive intersection to the NC 12 and Hunt Club Drive/Spindrift Trail intersection and consists of adding a lane to the existing two-lane configuration. The additional lane would be a center turn lane. The second part is from the NC 12 and Hunt Club Drive/Spindrift Trail intersection to the NC 12 and Seashell Lane intersection and consists of changing the existing two-lane configuration on NC 12 to a four-lane configuration with four northbound and two southbound lanes. In accordance with NCDOT's *Traffic Noise Abatement Policy*, noise abatement measures were considered but a detailed analysis was not performed for the 22 affected residences because gaps in the noise barrier from numerous driveway connections along NSA 14 would prevent the construction of a necessarily continuous and acoustically effective (i.e., feasible) noise barrier.

- **NSA 15** – Fourteen of the *24 residences within NSA 15 are* predicted to be exposed to noise levels that would approach or exceed the NAC as a result of ER2, MCB2, or MCB4. The three detailed study alternatives are the same within NSA 15 and include a four-lane roadway on shifted alignment (south of the C1/C2 bridge and roadway approach for MCB2 and MCB4). The affected residences each have driveways connected to NC 12. In accordance with NCDOT's *Traffic Noise Abatement Policy,* noise abatement measures were considered but a detailed analysis was not performed for the 14 affected residences because gaps in the noise barrier for driveway connections would prevent the construction of a necessarily continuous and acoustically effective (i.e., feasible) noise barrier.

- **NSA 16** – Two of three residences evaluated within NSA 16 are predicted to be exposed to noise levels that would approach or exceed the NAC as a result of ER2, MCB2, or MCB4. The three detailed study alternatives are the same within NSA 16 and include a four-lane roadway on shifted alignment (south of the C1/C2 bridge and roadway approach for MCB2 and MCB4). The two residences are situated in a subdivision on a bluff adjacent to the proposed improvements and elevated 10 to 15 feet above NC 12. The residences are far apart from each other and separated by vacant residential properties (which were not included in the detailed study

alternatives noise analysis because residential building permits for the properties had not been obtained at the time of the study). These residences are considered isolated. In accordance with NCDOT's *Traffic Noise Abatement Policy, n*oise abatement measures were considered, but a detailed analysis was not performed because a continuous noise barrier would not be reasonable.

- **NSA 17** – Ten of the 44 residences within NSA 17 are predicted to be exposed to noise levels that would approach or exceed the NAC as a result of ER2, MCB2, or MCB4. The three detailed study alternatives are the same within NSA 17 and include a four-lane roadway on shifted alignment (south of the C1/C2 bridge and roadway approach for MCB2 and MCB4). Noise abatement measures were evaluated and are discussed in Section 1.0.

- **NSA 18** – Twelve of the 56 residences within NSA 18 are predicted to be exposed to noise levels that would approach or exceed the NAC as a result of ER2, MCB2, or MCB4. The three detailed study alternatives are the same within NSA 18 and include a four-lane roadway on shifted alignment (south of the C1/C2 bridge and roadway approach for MCB2 and MCB4). Noise abatement measures were evaluated and are discussed in Section 1.0.

- **NSA 19** – Twenty-one of the 40 residences within NSA 19 are predicted to be exposed to noise levels that would approach or exceed the NAC as a result of ER2, MCB2, and MCB4. The three detailed study alternatives are the same within NSA 19 and include a four-lane roadway on shifted alignment (south of the C1/C2 bridge and roadway approach for MCB2 and MCB4). Noise abatement measures were evaluated and are discussed in Section 1.0.

- **NSA 20** – None of the thirteen residences evaluated at NSA 20 are predicted to be exposed to noise levels that would approach or exceed the NAC. ER2, MCB2, and MCB4 within NSA 20 include a four-lane roadway on shifted alignment (south of the C1/C2 bridge and roadway approach for MCB2 and MCB4). Noise abatement measures are not required to be evaluated when the predicted noise levels do not approach or exceed the NAC.

- **NSA 21** – Twenty-four of the 37 residences within NSA 21 are predicted to be exposed to noise levels that would approach or exceed the NAC as a result of ER2, MCB2, or MCB4. The three detailed study alternatives are the same within NSA 21 and include a four-lane roadway on shifted alignment (south of the C1/C2 bridge and roadway approach for MCB2 and MCB4). Noise abatement measures were evaluated and are discussed in Section 1.0.

- **NSA 22** – Four of the 36 residences within NSA 22 are predicted to be exposed to noise levels that would approach or exceed the NAC as a result of the following detailed study alternatives: ER2, MCB2 with bridge corridor C1, and MCB4 with

bridge corridor C1. With bridge corridor C2, none of the residences are predicted to be exposed to noise levels that exceed the NAC as a result of MCB2 or MCB4. The detailed study alternatives within NSA 22 include a four-lane roadway on shifted alignment (south of the C1 bridge corridor and roadway approach for MCB2 and MCB4). These residences are third-floor units of a three-story condominium complex of Buck Island. The remaining residences (first- and second-floor residences) would not be exposed to noise levels that would approach or exceed the NAC and noise abatement measures are not required. In accordance with NCDOT's *Traffic Noise Abatement Policy*, noise abatement measures were considered but a detailed analysis was not performed for the third-floor residences.

- **NSA 23** – Twelve of the 47 residences within NSA 23 are predicted to be exposed to noise levels that would approach or exceed the NAC as a result of MCB2 or MCB4. MCB2 and MCB4 within NSA 23 include a four-lane roadway on shifted alignment south of the C1 bridge corridor and roadway approach. Noise abatement measures were evaluated and are discussed in Section 1.0.

- **NSA 24** – Six of the 14 residences within NSA 24 are predicted to be exposed to noise levels that would approach or exceed the NAC as a result of MCB2 or MCB4. One residence (represented by TNM receptor MonterayShores2-12) is predicted to experience an increase of 10 dBA (from 48 dBA to a predicted result of 58 dBA). However, this is not considered a substantial increase as defined by NCDOT's *Traffic Noise Abatement Policy* because the existing noise level for this receptor is less than 50 dBA, and NCDOT's Policy states that for receptors with existing noise levels equal to or less than 50 dBA, a substantial increase is defined as an increase of 15 dBA or more. Therefore, noise abatement is not necessary. MCB2 and MCB4 within NSA 24 include a four-lane roadway on shifted alignment south of the C1 bridge corridor and roadway approach. The six residences are adjacent to the detailed study alternatives but are separated from each other by access roads to NC 12. In accordance with NCDOT's *Traffic Noise Abatement Policy*, noise abatement measures were considered, but a detailed analysis was not performed because the access roads to NC 12 between these residences would prevent the construction of a necessarily continuous and acoustically effective (i.e., feasible) noise barrier.

- **NSA 25** – Twenty-five of the 47 residences within NSA 25 are predicted to be exposed to noise levels that would approach or exceed the NAC as a result of MCB2 or MCB4. MCB2 and MCB4 within NSA 25 include a four-lane roadway on shifted alignment south of the C1 bridge corridor and roadway approach. Noise abatement measures were evaluated and are discussed in Section 1.0.

- **NSA 26** – Sixteen of the 24 residences within NSA 26 are predicted to be exposed to noise levels that would approach or exceed the NAC as a result of MCB2 or MCB4. MCB2 and MCB4 within NSA 26 include a four-lane roadway on shifted alignment

south of the C1 bridge corridor and roadway approach. Noise abatement measures were evaluated and are discussed in Section 1.0.

- **NSA 27** – None of the three residences evaluated at NSA 27 are predicted to be exposed to noise levels that would approach or exceed the NAC. MCB2 and MCB4 within NSA 27 include a four-lane roadway on shifted alignment and the C1 bridge corridor and roadway approach. Noise abatement measures are not required to be evaluated when the predicted noise levels do not approach or exceed the NAC.

- **NSA 28** – None of the eight residences evaluated at NSA 28 are predicted to be exposed to noise levels that would approach or exceed the NAC with MCB2/A or MCB4/A. MCB2/A and MCB4/A within NSA 28 would include a two-lane bridge approach roadway on fill and the bridge crossing Currituck Sound. Noise abatement measures are not required to be evaluated when the predicted noise levels do not approach or exceed the NAC.

  MCB2/B and MCB4/B would include a toll plaza, service roads, and interchange at Aydlett through future year 2023. For future year 2035, the toll plaza would have been removed and replaced with a two-lane at-grade roadway with electronic toll collection; however, the service roads and interchange at Aydlett would remain. With MCB2/B and MCB4/B, none of the eight residences evaluated for future years 2023 or 2035 are predicted to be exposed to noise levels that would approach or exceed the NAC, so noise abatement measures are not required.

- **NSA 29** – None of the 19 residences evaluated at NSA 29 are predicted to be exposed to noise levels that would approach or exceed the NAC with MCB2/A or MCB4/A. MCB2/A and MCB4/A within NSA 29 would include a two-lane bridge approach roadway on fill on and the bridge crossing Currituck Sound. Noise abatement measures are not required to be evaluated when the predicted noise levels do not approach or exceed the NAC.

  MCB2/B and MCB4/B would include a toll plaza, service roads, and interchange at Aydlett through future year 2023. For future year 2035, the toll plaza would have been removed and replaced with a two-lane at-grade roadway with electronic tolls; however, the service roads and interchange at Aydlett would remain. With MCB2/B and MCB4/B, the north service road (relocated Narrow Shore Road) would be elevated on fill to allow Narrow Shore Road to cross over the toll plaza on structure. These proposed improvements would displace one of the 19 residences (represented by receptor 9 on Figure A-39B) at NSA 29. None of the remaining 18 residences evaluated for future year 2023 or 2035 for MCB2/B or MCB4/B are predicted to be exposed to noise levels that would approach or exceed the NAC, so noise abatement measures are not required.

3.0 Evaluation of Noise Abatement Alternatives

The NCDOT requires that when the noise levels attributed to a proposed roadway project approach or exceed the NAC, noise abatement measures must be considered. Also, when predicted future noise levels result in a substantial increase over existing noise levels in accordance with NCDOT's *Traffic Noise Abatement Policy*, noise abatement must be considered. However, in addition to these requirements for considering noise abatement, there also must be noise impacts as a result of the proposed project to noise-sensitive receptors for abatement to be considered. Because noise levels at locations along the study corridor were determined to approach or exceed the NAC for Activity Category B and C, the feasibility and reasonableness of noise abatement measures were evaluated. These measures included vegetative buffers, Transportation Systems Management measures, alignment modifications, and noise barriers.

3.1 Vegetative Buffer

Vegetation must be a minimum of 100 feet thick, a minimum of 20 feet high, and so dense that it cannot be seen through in order to provide at least a 5-dBA noise reduction. The psychological effect of the vegetative buffer visually shielding highway traffic can be beneficial. However, a vegetative buffer that is less than 100 feet thick would not provide adequate noise abatement.

The existing right-of-way on NC 12 is limited and would not support the minimum requirements for an effective vegetative buffer. Significant additional right-of-way would be required to provide the necessary width and thickness for the vegetative buffer, and would involve the displacement of adjacent residences.

In most cases, the use of vegetative buffers as a mitigation measure would involve land acquisition. Typically the affected residences would be displaced with the placement of this mitigation measure on the acquired properties. The remaining residences, if any, would be farther away from the proposed roadway improvements, and generally would not have predicted noise values that would approach or exceed the NAC.

The use of vegetation for noise abatement is not considered reasonable for this project because of the substantial amount of right-of-way necessary to make vegetative barriers effective. The cost to acquire the additional property and affected receptors within the buffer zone would exceed the allowable cost per benefited receptor and thus not be reasonable.

3.2 Transportation Systems Management Measures

Transportation Systems Management (TSM) measures are defined as alternatives that seek to maximize the efficiency of the existing transportation system without a major capital investment. The TSM Alternative examined in the *Alternatives Screening Report* (Parsons Brinckerhoff, 2009) included the following components:

- Optimizing signal timing on US 158 and NC 12 in the project area to improve traffic flow through signalized intersections;
- Improving major intersections on NC 12 (those that service numerous homes) with left turn lanes and/or traffic signals; and
- Restricting side-road access on some other intersections, generally in the form of right in-right out only turning from local streets and, where alternate access is available, intersection closures to reduce the number of points where drivers would slow to make turns.

It was determined that the TSM Alternative would provide very modest congestion relief and reduction in travel times to the Currituck County Outer Banks (as documented in the *Alternatives Screening Report*). It was concluded that the TSM Alternative would not meet the purpose and need and is not a reasonable alternative.

3.3 Alignment Modifications

Alignment modification involves orienting and/or siting the roadway at sufficient distances from the residential areas in order to minimize traffic noise. For most of the detailed study alternatives, because they involve lane additions to the existing roadway, the existing alignment dictates the proposed horizontal and vertical alignment. Because of limited right-of-way, shifting the alignment to reduce noise impacts would likely result in more severe impacts, including property acquisitions, residential and business relocations, and other environmental impacts. In addition on NC 12, residential areas line both sides of the road in many areas so altering the alignment would increase noise levels for residents on one side of the road, while decreasing them on another.

Alternative alignments were considered in the alternatives screening for the Mid-Currituck Bridge. No noise impacts would occur along the Mid-Currituck Bridge and its approach road on the mainland. It can be seen in Table 8 and Table 9 that the implementation of a bridge at the C2 Outer Banks terminus would notably reduce impacts (53 receptors) over the implementation of a bridge at the C1 Outer Banks terminus.

Modifications to the highway alignment were not considered reasonable for this project.

3.4 Noise Barriers

Noise barriers reduce noise levels by blocking the sound path between a roadway and noise-sensitive receptors. To be effective in reducing traffic-induced noise levels, a noise barrier must be relatively long, continuous (with no intermittent openings), sufficiently dense, and high enough to provide the necessary reduction in noise levels.

For a barrier to be considered feasible and reasonable, it should meet the following criteria:

- Provide a minimum insertion loss (IL) (noise reduction) of at least 5 dBA for first row receptors.
- Cost must not exceed $35,000 per benefited receptor plus an incremental increase of $500 per dBA average increase in the predicted exterior noise levels of the impacted receptors of the area.
- The visual impact on nearby receptors and other land features. A high noise wall alongside low, single-family residences could have an adverse visual effect. Thus, the height of a noise wall above the ground should not exceed 25 feet. Furthermore, the horizontal distance of the noise wall from residences should be greater than four times the height of the noise wall from the residences.

This is a partial list of the criteria to be considered in determining feasibility and reasonableness. A complete listing of these criteria can be found in NCDOT's *Traffic Noise Abatement Policy* in Appendix D.

Noise barriers were determined to be the only potentially feasible and reasonable abatement measure for some portions of this project. Noise barriers were considered at areas along the project corridor where noise impacts were predicted as a result of the detailed study alternatives. Where noise barriers were determined to be potentially feasible and reasonable, a detailed noise abatement analysis was completed using TNM. Each potential noise barrier was analyzed at varying heights ranging from 8 to 24 feet (if necessary), in height intervals of 2 feet, and for various lengths in order to determine the most optimal barrier design (i.e., the maximum noise reduction benefits for the least cost).

Section 8.3 of the FHWA *Highway Noise Barrier Design Handbook* (February 2000) recommends noise barrier height limitations based on aesthetics, drainage/utility, and structural considerations. For aesthetic considerations, it is recommended that the visual dominance of a very tall noise barrier be reduced. This can be done by locating the barrier at least 2 to 4 times its height from the nearest modeled receptor. NCDOT's *Traffic Noise Abatement Policy* indicates that the horizontal distance of the noise wall from residences should be greater than four times the height of the noise wall from the residences (criteria No. 2 under Reasonableness). In situations where the noise barrier

must be located near the right-of-way and existing receptors are close to the right-of-way, the height of the feasible and reasonable noise barrier should be considered if it would pose as a visual dominance. Since many receptors along NC 12 are adjacent to the right-of-way, the recommended optimal height of noise barriers at a 4:1 ratio (horizontal distance to height) was calculated for each noise barrier evaluation based on the distance of the noise barrier to the nearest receptor.

Noise barrier evaluations were completed for affected receptors at NSA 11, NSA 17, NSA 18, NSA 19, NSA 21, NSA 23, NSA 25, and NSA 26. The preferred barrier height for each noise barrier evaluation is highlighted. This height was selected based on an evaluation of the 4:1 height to distance ratio, insertion loss and noise barrier total cost. It should be noted that some of the noise barriers shown on the plan sheets in Appendix A appear to be outside of the right-of-way because the proposed right-of-way is not shown; however, all of the evaluated noise barriers evaluated are within the existing or proposed right-of-way.

The determinations of feasible and reasonable noise barriers contained in this section are preliminary and subject to change based on final design, building permits issued as of the Date of Public Knowledge, and the public involvement process.

3.4.1 NSA 11

Seventeen of the 90 residences within NSA 11 (residences west and east of NC 12 from 13th Avenue to Plover Drive) are predicted to be exposed to noise levels that approach or exceed the NAC as a result of ER2 or MCB2. Most of the affected receptors are located adjacent to NC 12 and have driveways with direct access to this roadway. Noise Barrier 11 (see Figure A-56) was modeled adjacent to affected receptors and at least 5 feet within the NC 12 proposed right-of-way. The barrier is located on the west side of NC 12, between 13th Avenue and Charles Jenkins Lane. The noise barrier was evaluated with heights up to 22 feet. The distance between the noise barrier and nearest receptors is approximately 8 feet. Noise barriers at any height would create a visual dominance. Alternatives ER2 and MCB2 share the same alignment and typical section within NSA 11. Hence, the results of the barrier evaluation are similar for both alternatives.

The results of the barrier analysis indicate that at heights of 8 to 22 feet the barrier would provide an insertion loss of at least 5 dBA to three affected residences. The affected residences would receive an average insertion loss of 10 to 13 dBA, depending on barrier height.

The noise analysis determined an average increase in predicted exterior noise levels of 4 dBA for affected and benefited residences, which equates to an allowable cost per benefited residence amount of $37,000. Feasible noise barriers at heights of 8 to 22 feet would meet the reasonable criterion of $37,000 per benefited residence. The noise barriers would range in cost between $93,720 and $257,730, depending on barrier height.

However, no noise barriers are considered reasonable because noise barriers at any height would not satisfy the 4:1 criterion. Table 10 summarizes the barrier analysis for Barrier 11.

Table 10. Noise Barrier Evaluation Matrix for Barrier 11

Barrier Height (feet)	Residences with Insertion Loss of (dBA)						Number of Benefited Residences			Barrier Length (feet)	Total Noise Barrier Cost[2]	Cost Per Benefited Residence/Allowable Cost Per Benefited Residence[3]	Cost Reasonable Yes/No
	5	6	7	8	9	10 or >	Affected	Other[1]	Total				
8	3	-	-	-	1	4	3	5	8	781	$93,720	$11,715 / $37,000	Yes
10	3	-	-	-	-	5	3	5	8	781	$117,150	$14,644 / $37,000	Yes
12	3	-	-	-	-	5	3	5	8	781	$140,580	$17,573 / $37,000	Yes
14	-	3	-	-	-	5	3	5	8	781	$164,010	$20,501 / $37,000	Yes
16	-	3	-	-	-	5	3	5	8	781	$187,440	$23,430 / $37,000	Yes
18	-	3	-	-	-	5	3	5	8	781	$210,870	$26,359 / $37,000	Yes
20	6	3	-	-	-	5	3	11	14	781	$234,300	$16,736 / $37,000	Yes
22	6	3	-	-	-	5	3	11	14	781	$257,730	$18,409 / $37,000	Yes

[1]Residences determined to be unaffected by the project (traffic noise levels less than 66 dBA) but benefited by the noise barrier.

[2]Total Noise Barrier Cost was calculated using $15 per square foot.

[3]The cost effectiveness calculation is described in the introduction to Section 3.4.

3.4.2 NSA 17

Ten of the 44 residences within NSA 17 (residences east of NC 12, from south of Marlin Way and south of Sand Fiddler Trail) are predicted to be exposed to noise levels that approach or exceed the NAC as a result of ER2, MCB2, or MCB4. Two sets of noise barriers (Barriers 17A and 17B and Barriers 17C and 17D) were modeled adjacent to the receptors and 5 feet within the NC 12 right-of-way. The noise barriers were evaluated with heights up to 16 feet.

3.4.2.1 Barriers 17A and 17B

Barriers 17A and 17B (see Figures A-74 through A-76) are on the east side of NC 12, south of Marlin Way and between Marlin Way and Schooner Ridge, respectively. The distance between the noise barrier and nearest receptors is approximately 34 feet, and would allow for the construction of noise barriers up to 8 feet without creating a visual dominance.

The results of the barrier analysis indicate that at heights of 8 to 16 feet the barriers would provide at least the minimum insertion loss of at least 5 dBA to at least 2 and up

to all five affected residences. The affected residences would receive an average insertion loss of 7 to 8 dBA, depending on barrier height.

The noise analysis determined an increase in predicted exterior noise levels of 7 dBA for affected and benefited residences, which equates to an allowable cost per benefited residence amount of $38,500. Noise barriers at heights of 10 to 16 feet would meet the reasonable criterion of $38,500 per benefited residence. The noise barriers would range in cost from $204,450 to $327,120, depending on barrier height. However, none of these noise barriers are considered reasonable because they would not satisfy the 4:1 criterion. The 8-foot tall barrier analyzed would satisfy the 4:1 criterion but would not be economically reasonable. Table 11 summarizes the barrier analysis for Barriers 17A and 17B.

Table 11. Noise Barrier Evaluation Matrix for Barriers 17A and 17B

Barrier Height (feet)	Residences with Insertion Loss of (dBA)						Number of Benefited Residences			Com-bined Barrier Length (feet)	Total Noise Barrier Cost[2]	Cost Per Benefited Residence/Allowable Cost Per Benefited Residence[3]	Cost Reasonable Yes/No
	5	6	7	8	9	10 or >	Affected	Other[1]	Total				
8	1	-	1	-	-	-	2	-	2	1363	$163,560	$81,780 / $38,500	No
10	4	3	-	-	1	-	5	3	8	1363	$204,450	$25,556 / $38,500	Yes
12	1	3	2	-	2	1	5	4	9	1363	$245,340	$27,260 / $38,500	Yes
14	1	3	4	-	1	3	5	7	12	1363	$282,230	$23,853 / $38,500	Yes
16	5	2	2	4	-	4	5	12	17	1363	$327,120	$19,242 / $38,500	Yes

[1]Residences determined to be unaffected by the project (traffic noise levels less than 66 dBA) but benefited by the noise barrier.
[2]Total Noise Barrier Cost was calculated using $15 per square foot.
[3]The cost effectiveness calculation is described in the introduction to Section 3.4.

3.4.2.2 Barriers 17C and 17D

Barriers 17C and 17D (see Figure A-76) are on the east side of NC 12, between Schooner Ridge and Sand Fiddler Trail and north of Sand Fiddler Trail, respectively. The distance between the noise barrier and nearest receptors is approximately 42 feet, and would allow for the construction of noise barriers up to 10 feet without creating a visual dominance.

The results of the barrier analysis indicate that at heights of 8 to 16 feet the noise barriers would provide at least the minimum insertion loss of at least 5 dBA to at least four and up to all five affected residences. The affected residences would receive an average insertion loss of 6 to 9 dBA, depending on barrier height.

The noise analysis determined an increase in predicted exterior noise levels of 7 dBA for affected and benefited residences, which equates to an allowable cost per benefited residence amount of $38,500. Noise barriers at heights of 8 to 16 feet would meet the reasonable criterion of $38,500 per benefited residence. The noise barriers would range in cost from $162,840 to $325,680, depending on barrier height. Eight-foot or 10-foot tall noise barriers would satisfy the 4:1 criterion. Table 12 summarizes the barrier analysis for Barriers 17C and 17D.

Table 12. Noise Barrier Evaluation Matrix for Barriers 17C and 17D

Barrier Height (feet)	Residences with Insertion Loss of (dBA)						Number of Benefited Residences			Com-bined Barrier Length (feet)	Total Noise Barrier Cost[2]	Cost Per Benefited Residence/Allowable Cost Per Benefited Residence[3]	Cost Reasonable Yes/No
	5	6	7	8	9	10 or >	Affected	Other[1]	Total				
8	3	2	-	-	-	-	4	1	5	1357	$162,840	$32,568 / $38,500	Yes
10	3	-	3	2	-	-	4	4	8	1357	$203,550	$25,444 / $38,500	Yes
12	3	3	-	3	2	-	4	7	11	1357	$244,260	$22,205 / $38,500	Yes
14	1	3	3	3	-	2	5	7	12	1357	$284,970	$23,748 / $38,500	Yes
16	-	3	2	2	3	2	5	7	12	1357	$325,680	$27,140 / $38,500	Yes

[1]Residences determined to be unaffected by the project (traffic noise levels less than 66 dBA) but benefited by the noise barrier.
[2]Total Noise Barrier Cost was calculated using $15 per square foot.
[3]The cost effectiveness calculation is described in the introduction to Section 3.4.

3.4.3 NSA 18

Twelve of the 56 residences within NSA 18 (residences west of NC 12, from north of Sand Fiddler Trail to north of Seabird Way) are predicted to be exposed to noise levels that approach or exceed the NAC as a result of ER2, MCB2, or MCB4. One continuous noise barrier (Barrier 18 – see Figures A-77 and A-78) was modeled adjacent to the receptors 5 feet within the NC 12 right-of-way. The noise barrier is located on the west side of NC 12, between Sand Fiddler Trail and north of Seabird Way. The barrier was evaluated with heights up to 16 feet. The distance between the noise barrier and nearest receptors is approximately 30 feet, and would allow for the construction of noise barriers up to 8 feet without creating a visual dominance.

The results of the barrier analysis indicate that at heights of 10 to 16 feet the barrier would provide at least the minimum insertion loss of at least 5 dBA to at least seven and up to all 12 affected residences. The affected residences would receive an average insertion loss of 7 to 8 dBA, depending on barrier height.

The noise analysis determined an increase in predicted exterior noise levels of 7 dBA for affected and benefited residences, which equates to an allowable cost per benefited residence amount of $38,500. Noise barriers at heights of 14 to 16 feet would meet the reasonable criterion of $38,500 per benefited residence. The noise barriers would range in cost from $478,170 to $546,840, depending on barrier height. However, none of these noise barriers are considered reasonable because they would not satisfy the 4:1 criterion. The 8-foot tall barrier analyzed would satisfy the 4:1 criterion but would not be economically reasonable. Table 13 summarizes the barrier analysis within NSA 18.

Table 13. Noise Barrier Evaluation Matrix for Barrier 18

Barrier Height (feet)	Residences with Insertion Loss of (dBA)						Number of Benefited Residences			Barrier Length (feet)	Total Noise Barrier Cost[2]	Cost Per Benefited Residence/Allowable Cost Per Benefited Residence[3]	Cost Reasonable Yes/No
	5	6	7	8	9	10 or >	Affected	Other[1]	Total				
8	-	-	-	-	-	-	-	-	-	2277	$273,240	N/A	No
10	-	7	-	-	-	-	7	-	7	2277	$341,550	$48,793 / $38,500	No
12	3	-	-	7	-	-	9	1	10	2277	$409,860	$40,986 / $38,500	No
14	7	3	1	2	2	5	12	8	20	2277	$478,170	$23,909 / $38,500	Yes
16	3	5	2	4	-	9	12	11	23	2277	$546,840	$23,760 / $38,500	Yes

[1]Residences determined to be unaffected by the project (traffic noise levels less than 66 dBA) but benefited by the noise barrier.
[2]Total Noise Barrier Cost was calculated using $15 per square foot.
[3]The cost effectiveness calculation is described in the introduction to Section 3.4.

3.4.4 NSA 19

Twenty-one of the 40 residences within NSA 19 (residences east of NC 12, from north of Sand Fiddler Trail to north of Seabird Way) are predicted to be exposed to noise levels that approach or exceed the NAC as a result of ER2, MCB2, or MCB4. Two noise barriers (Barriers 19A and 19B – see Figures A-77 and A-78) were modeled adjacent to the receptors and 5 feet within the NC 12 right-of-way. The noise barriers are located on the east side of NC 12, between north of Sand Fiddler Trail and north of Seabird Way. The barriers were evaluated with heights up to 24 feet. The distance between the noise barrier and nearest receptors is approximately 36 feet, and would allow for the construction of noise barriers up to 8 feet without creating a visual dominance.

The results of the barrier analysis indicate that at heights of 8 to 24 feet the barriers would provide at least the minimum insertion loss of at least 5 dBA to all 21 affected residences. The affected residences would receive an average insertion loss of 7 to 12 dBA, depending on barrier height.

The noise analysis determined an increase in predicted exterior noise levels of 7 dBA for affected and benefited residences, which equates to an allowable cost per benefited residence amount of $38,500. Noise barriers at heights of 8 to 24 feet would meet the reasonable criterion of $38,500 per benefited residence. The preliminarily determined feasible and reasonable noise barriers would range in cost from $305,160 to $915,480, depending on barrier height. An eight-foot tall noise barrier would satisfy the 4:1 criterion. Table 14 summarizes the barrier analysis for Barriers 19A and 19B.

Table 14. Noise Barrier Evaluation Matrix for Barriers 19A and 19B

Barrier Height (feet)	Residences with Insertion Loss of (dBA)						Number of Benefited Residences			Com-bined Barrier Length (feet)	Total Noise Barrier Cost[2]	Cost Per Benefited Residence/Allowable Cost Per Benefited Residence[3]	Cost Reasonable Yes/No
	5	6	7	8	9	10 or >	Affected	Other[1]	Total				
8	14	4	3	-	2	1	21	4	25	2543	$305,160	$12,715 / $38,500	Yes
10	2	8	9	51	3	3	21	6	27	2543	$381,450	$14,671 / $38,500	Yes
12	7	1	6	12	1	6	21	13	33	2543	$457,740	$13,871 / $38,500	Yes
14	6	5	3	6	10	7	21	17	37	2543	$534,030	$14,433 / $38,500	Yes
16	4	2	6	2	11	12	21	17	37	2543	$610,320	$16,495 / $38,500	Yes
18	1	6	6	-	7	18	21	18	38	2543	$686,610	$18,069 / $38,500	Yes
20	1	6	1	5	5	20	21	18	38	2543	$762,900	$20,076 / $38,500	Yes
22	1	2	5	5	-	25	21	18	38	2543	$839,190	$22,084 / $38,500	Yes
24	1	-	6	1	5	25	21	18	38	2543	$915,480	$24,092 / $38,500	Yes

[1]Residences determined to be unaffected by the project (traffic noise levels less than 66 dBA) but benefited by the noise barrier.
[2]Total Noise Barrier Cost was calculated using $15 per square foot.
[3]The cost effectiveness calculation is described in the introduction to Section 3.4.

3.4.5 NSA 21

Twenty-four of the 37 residences within NSA 21 (residences east of NC 12, from north of Seabird Way to north of Driftwood Way) are predicted to be exposed to noise levels that approach or exceed the NAC as a result of ER2, MCB2, or MCB4. Two noise barriers (Barriers 21A and 21B – see Figures A-78 through A-80) were modeled adjacent to the receptors and 5 feet within the NC 12 right-of-way. The noise barriers are located on the east side of NC 12, between Seabird Way and Driftwood Way and between Driftwood Way and the wastewater treatment plant property, respectively. The barriers were evaluated with heights up to 16 feet. The distance between the noise barrier and nearest receptors is approximately 15 feet. Noise barriers at any height would create a visual dominance.

The results of the barrier analysis indicate that at heights of 8 to 16 feet the noise barriers would provide at least the minimum insertion loss of at least 5 dBA to all 24 affected residences. The affected residences would receive an average insertion loss of 9 to 10 dBA, depending on barrier height.

The noise analysis determined an increase in predicted exterior noise levels of 7 dBA for affected and benefited residences, which equates to an allowable cost per benefited residence amount of $38,500. Noise barriers at heights of 8 to 16 feet would meet the reasonable criterion of $38,500 per benefited residence. The noise barriers would range in cost from $404,080 to $812,160, depending on barrier height. However, none of these noise barriers are considered reasonable because they would not satisfy the 4:1 criterion. Table 15 summarizes the barrier analysis for Barriers 21A and 21B.

Table 15. Noise Barrier Evaluation Matrix for Barriers 21A and 21B

Barrier Height (feet)	Residences with Insertion Loss of (dBA)						Number of Benefited Residences			Com-bined Barrier Length (feet)	Total Noise Barrier Cost[2]	Cost Per Benefited Residence/Allowable Cost Per Benefited Residence[3]	Cost Reasonable Yes/No
	5	6	7	8	9	10 or >	Affected	Other[1]	Total				
8	-	3	7	4	-	10	24	-	24	3384	$406,080	$16,920 / $38,500	Yes
10	-	-	-	3	7	14	24	-	24	3384	$507,600	$21,150 / $38,500	Yes
12	1	4	-	-	3	21	24	5	29	3384	$609,120	$21,004 / $38,500	Yes
14	3	5	-	-	-	24	24	8	32	3384	$710,640	$22,208 / $38,500	Yes
16	6	1	4	-	-	24	24	11	35	3384	$812,160	$23,205 / $38,500	Yes

[1]Residences determined to be unaffected by the project (traffic noise levels less than 66 dBA) but benefited by the noise barrier.
[2]Total Noise Barrier Cost was calculated using $15 per square foot.
[3]The cost effectiveness calculation is described in the introduction to Section 3.4.

3.4.6 NSA 23

Twelve of the 47 residences within NSA 23 (residences west of NC 12, from south of Monteray Drive to Bonita Street) are predicted to be exposed to noise levels that approach or exceed the NAC as a result of MCB2 or MCB4. Three noise barriers (Barriers 23A, 23B, and 23C) were modeled adjacent to the receptors and five feet within the NC 12 right-of-way. The barrier was evaluated with heights up to 16 feet.

3.4.6.1 Barrier 23A

Barrier 23A (see Figure A-81) is located on the west side of NC 12, between 200 feet north of Monteray Drive and approximately 800 feet north of Monteray Drive. The distance between the noise barrier and nearest receptors is approximately 45 feet, and

would allow for the construction of noise barriers up to 10 feet without creating a visual dominance.

The results of the barrier analysis indicate that at heights of 8 to 16 feet the noise barriers would provide at least the minimum insertion loss of at least 5 dBA for three to four affected residences. The affected residences would receive an average insertion loss of 7 to 9 dBA, depending on barrier height.

The noise analysis determined an increase in predicted exterior noise levels of 7 dBA for affected and benefited residences, which equates to an allowable cost per benefited residence amount of $38,500. Noise barriers at heights of 8 to 16 feet would meet the reasonable criterion of $38,500 per benefited residence. The noise barriers would range in cost from $94,080 to $188,160, depending on barrier height. Eight-foot or 10-foot tall noise barriers would satisfy the 4:1 criterion. Table 16 summarizes the barrier analysis for Barrier 23A.

Table 16. Noise Barrier Evaluation Matrix for Barrier 23A

Barrier Height (feet)	Residences with Insertion Loss of (dBA)						Number of Benefited Residences			Barrier Length (feet)	Total Noise Barrier Cost[2]	Cost Per Benefited Residence/Allowable Cost Per Benefited Residence[3]	Cost Reasonable Yes/No
	5	6	7	8	9	10 or >	Affected	Other[1]	Total				
8	-	1	2	-	-	-	3	-	3	784	$94,080	$31,360 / $38,500	Yes
10	1	-	-	1	2	-	4	-	4	784	$117,600	$29,400 / $38,500	Yes
12	-	1	-	-	1	2	4	-	4	784	$141,120	$35,280 / $38,500	Yes
14	2	1	-	-	-	3	4	2	6	784	$164,640	$27,440 / $38,500	Yes
16	3	-	1	-	-	3	4	3	7	784	$188,160	$26,880 / $38,500	Yes

[1]Residences determined to be unaffected by the project (traffic noise levels less than 66 dBA) but benefited by the noise barrier.
[2]Total Noise Barrier Cost was calculated using $15 per square foot.
[3]The cost effectiveness calculation is described in the introduction to Section 3.4.

3.4.6.2 Barrier 23B

Barrier 23B (see Figure A-83) is located on the west side of NC 12, near Sea Cliff Drive and Sea Escape Court cul-de-sacs. The distance between the noise barrier and nearest receptors is approximately 45 feet, and would allow for the construction of noise barriers up to 10 feet without creating a visual dominance.

The results of the barrier analysis indicate that at heights of 8 to 16 feet the noise barriers would provide at least the minimum insertion loss of at least 5 dBA at both affected residences. The affected residences would receive an average insertion loss of 6 to 8 dBA, depending on barrier height.

The noise analysis determined an increase in predicted exterior noise levels of 7 dBA for affected and benefited residences, which equates to an allowable cost per benefited residence amount of $38,500. Noise barriers at heights of 10 feet and 14 to 16 feet would meet the reasonable criterion of $38,500 per benefited residence. The noise barriers would range in cost from $128,400 to $205,440, depending on barrier height. A 10-foot tall noise barrier would satisfy the 4:1 criterion. The 8-foot tall barrier analyzed would satisfy the 4:1 criterion but would not be economically reasonable. Table 17 summarizes the barrier analysis for Barrier 23B.

Table 17. Noise Barrier Evaluation Matrix for Barrier 23B

Barrier Height (feet)	Residences with Insertion Loss of (dBA)						Number of Benefited Residences			Barrier Length (feet)	Total Noise Barrier Cost[2]	Cost Per Benefited Residence/Allowable Cost Per Benefited Residence[3]	Cost Reasonable Yes/No
	5	6	7	8	9	10 or >	Affected	Other[1]	Total				
8	1	-	1	-	-	-	2	-	2	856	$102,720	$51,360 / $38,500	No
10	-	2	-	1	1	-	2	2	4	856	$128,400	$32,100 / $38,500	Yes
12	-	2	-	1	1	-	2	2	4	856	$154,080	$38,520 / $38,500	No
14	3	2	-	1	-	1	2	5	7	856	$179,760	$25,680 / $38,500	Yes
16	3	2	-	-	1	1	2	5	7	856	$205,440	$29,349 / $38,500	Yes

[1]Residences determined to be unaffected by the project (traffic noise levels less than 66 dBA) but benefited by the noise barrier.
[2]Total Noise Barrier Cost was calculated using $15 per square foot.
[3]The cost effectiveness calculation is described in the introduction to Section 3.4.

3.4.6.3 Barrier 23C

Barrier 23C (see Figures A-83 and A-84) is located on the west side of NC 12, between Bonita Street and approximately 2,200 feet south of Bonita Street. The distance between the noise barrier and nearest receptors is approximately 45 feet, and would allow for the construction of noise barriers up to 10 feet without creating a visual dominance.

The results of the barrier analysis indicate that at heights of 8 to 16 feet the noise barriers would provide at least the minimum insertion loss of at least 5 dBA at all six affected residences. The affected residences would receive an average insertion loss of 8 to 10 dBA, depending on barrier height.

The noise analysis determined an increase in predicted exterior noise levels of 7 dBA for affected and benefited residences, which equates to an allowable cost per benefited residence amount of $38,500. Noise barriers at heights of 10 to 16 feet would meet the reasonable criterion of $38,500 per benefited residence. The noise barriers would range in cost from $328,500 to $525,600, depending on barrier height. A 10-foot tall noise

barrier would satisfy the 4:1 criterion. The 8-foot tall barrier analyzed would satisfy the 4:1 criterion but would not be economically reasonable. Table 18 summarizes the barrier analysis for Barrier 23C.

Table 18. Noise Barrier Evaluation Matrix for Barrier 23C

Barrier Height (feet)	Residences with Insertion Loss of (dBA)						Number of Benefited Residences			Barrier Length (feet)	Total Noise Barrier Cost[2]	Cost Per Benefited Residence/Allowable Cost Per Benefited Residence [3]	Cost Reasonable Yes/No
	5	6	7	8	9	10 or >	Affected	Other[1]	Total				
8	-	-	3	1	-	2	6	-	6	2190	$262,800	$43,800 / $38,500	No
10	4	2	-	3	-	3	6	6	12	2190	$328,500	$27,375 / $38,500	Yes
12	2	4	2	-	3	3	6	8	14	2190	$394,200	$28,157 / $38,500	Yes
14	2	1	4	2	-	6	6	9	15	2190	$459,900	$30,660 / $38,500	Yes
16	1	1	4	1	2	6	6	9	15	2190	$525,600	$35,040 / $38,500	Yes

[1]Residences determined to be unaffected by the project (traffic noise levels less than 66 dBA) but benefited by the noise barrier.
[2]Total Noise Barrier Cost was calculated using $15 per square foot.
[3]The cost effectiveness calculation is described in the introduction to Section 3.4.

3.4.7 NSA 25

Twenty-five of the 47 residences within NSA 25 (residences east of NC 12, between Albacore Street and Bonita Street) are predicted to be exposed to noise levels that approach or exceed the NAC as a result of MCB2 or MCB4. One continuous noise barrier (Barrier 25 – see Figures A-81, A-83, and A-84) was modeled adjacent to the receptors and 5 feet within the NC 12 right-of-way. The barrier is located on the east side of NC 12 and extends from north of Dolphin Street to south of Bonita Street. The barrier was evaluated with heights up to 16 feet. The distance between the noise barrier and nearest receptors is approximately 45 feet, and would allow for the construction of noise barriers up to 10 feet without creating a visual dominance.

The results of the barrier analysis indicate that at heights of 8 to 16 feet the noise barrier would provide the minimum insertion loss of 5 dBA to 17 of the total 25 affected residences. The affected residences would receive an average insertion loss of 6 to 10 dBA, depending on barrier height.

Noise abatement measures were not feasible on five affected residences represented by receptor Monteray Shores 3-1 and Monteray Shores 3-23. Monteray Shores 3-1 is an isolated affected residence (buffered from the other residences by multiple vacant residential properties). Monteray Shores 3-23 is adjacent to the noise barrier opening at

the Bonita Street connection to NC 12. These residences are not receiving the minimum insertion loss from a noise barrier because they are located at the noise barrier openings.

The noise analysis determined an increase in predicted exterior noise levels of 9 dBA for affected and benefited residences, which equates to an allowable cost per benefited residence amount of $39,500. Noise barriers at heights of 8 to 16 feet would meet the reasonable criterion of $39,500 per benefited residence. The noise barriers would range in cost from $544,800 to $1,089,600, depending on barrier height. An 8-foot or 10-foot tall noise barriers would satisfy the 4:1 criterion. Table 19 summarizes the barrier analysis within NSA 25.

Table 19. Noise Barrier Evaluation Matrix for Barrier 25

Barrier Height (feet)	Residences with Insertion Loss of (dBA)						Number of Benefited Residences			Barrier Length (feet)	Total Noise Barrier Cost[2]	Cost Per Benefited Residence/Allowable Cost Per Benefited Residence[3]	Cost Reasonable Yes/No
	5	6	7	8	9	10 or >	Affected	Other[1]	Total				
8	20	11	-	-	-	-	17	14	31	4540	$544,800	$17,574 / $39,500	Yes
10	-	18	8	5	-	-	17	14	31	4540	$681,000	$21,968 / $39,500	Yes
12	2	2	-	20	11	-	17	18	35	4540	$817,200	$23,349 / $39,500	Yes
14	1	1	2	5	15	11	17	18	35	4540	$953,400	$27,240 / $39,500	Yes
16	-	2	-	2	5	26	17	18	35	4540	$1,089,600	$31,131 / $39,500	Yes

[1]Residences determined to be unaffected by the project (traffic noise levels less than 66 dBA) but benefited by the noise barrier.
[2]Total Noise Barrier Cost was calculated using $15 per square foot.
[3]The cost effectiveness calculation is described in the introduction to Section 3.4.

3.4.8 NSA 26

Sixteen of the 24 residences within NSA 26 (residences east of NC 12, between Bonita Street and north of Ocean Forest Court) are predicted to be exposed to noise levels that approach or exceed the NAC as a result of MCB2 or MCB4. Two noise barriers (Barriers 26A and 26B – see Figures A-84 and A-85) were modeled adjacent to the receptors and 5 feet within the NC 12 right-of-way. The barriers are located on the east side of NC 12, between Bonita Street and South Harbor View and north of South Harbor View, respectively. The barriers were evaluated with heights up to 16 feet. The distance between the noise barrier and nearest receptors is approximately 36 feet, and would allow for the construction of noise barriers up to 8 feet without creating a visual dominance.

The results of the barrier analysis indicate that at heights of 8 to 16 feet the noise barrier would provide at least the minimum insertion loss of at least 5 dBA to at least 14 and up

to 15 of the 16 total affected residences. The affected residences would receive an average insertion loss of 7 to 9 dBA, depending on barrier height.

Noise abatement measures were not feasible on one residence (represented by receptor Monteray Shores 4-5) because this residence is adjacent to the noise barrier opening at the South Harbor View roadway connection to NC 12 and was not receiving the minimum insertion loss.

The noise analysis determined an increase in predicted exterior noise levels of 9 dBA for affected and benefited residences, which equates to an allowable cost per benefited residence amount of $39,500. Noise barriers at heights of 8 and 16 feet would meet the reasonable criterion of $39,500 per benefited residence. The noise barriers would cost $338,760 and $677,520, respectively. Eight-foot tall noise barriers would satisfy the 4:1 criterion. Table 20 summarizes the barrier analysis for Barriers 26A and 26B.

Table 20. Noise Barrier Evaluation Matrix for Barriers 26A and 26B

Barrier Height (feet)	Residences with Insertion Loss of (dBA)						Number of Benefited Residences			Com-bined Barrier Length (feet)	Total Noise Barrier Cost[2]	Cost Per Benefited Residence/Allowable Cost Per Benefited Residence[3]	Cost Reasonable Yes/No
	5	6	7	8	9	10 or >	Affected	Other[1]	Total				
8	3	5	4	-	2	-	14	-	14	2823	$338,760	$24,197 / $39,500	Yes
10	-	3	3	5	1	2	14	-	14	2823	$423,450	$30,246 / $39,500	Yes
12	2	4	-	6	1	5	14	6	20	2823	$508,140	$25,407 / $39,500	Yes
14	2	2	4	-	6	6	15	7	22	2823	$592,830	$26,947 / $39,500	Yes
16	2	-	4	2	3	9	15	7	22	2823	$677,520	$30,796 / $39,500	Yes

[1]Residences determined to be unaffected by the project (traffic noise levels less than 66 dBA) but benefited by the noise barrier.
[2]Total Noise Barrier Cost was calculated using $15 per square foot.
[3]The cost effectiveness calculation is described in the introduction to Section 3.4.

4.0 Construction Noise

The major construction elements of this project are expected to be earth removal, hauling, grading, and paving. General construction noise impacts, such as temporary speech interference for passersby and individuals living or working near the project, can be expected, particularly from noise from paving operations and from the earth moving equipment during grading operations. High noise levels of impact pile driving and combustion-engine-powered equipment usually are the main contributors to bridge construction equipment noise levels. Construction noise impacts are expected to be generally minimal because construction noise is relatively short in duration (as it moves along the project reach). Furthermore, on land the transmission loss characteristics of the surrounding wooded areas and other natural and development features are considered sufficient to moderate the effects of intrusive construction noise.

5.0 Public Coordination

5.1 Coordination with Local Officials

Local officials can promote compatibility between land development and highways. The findings contained in this report will be made available to local officials responsible for controlling land use. These officials include the Town of Duck, the Town of Southern Shores, the Town of Kitty Hawk, Currituck County, and Dare County. The distances to the 66 dBA and 71 dBA noise contours previously described and other predicted noise levels provided in this report can be used to regulate development of exterior land uses associated with residences, motels, schools, churches, recreational facilities, businesses, and other uses that would be considered incompatible with traffic noise generated from the proposed highway improvements. Local officials can use the noise contour data to establish compatible development of currently undeveloped parcels or compatible redevelopment in areas where land use changes.

5.2 Public Involvement

The comments made by citizens at the February 2008 Citizens Informational Workshops regarding the bridge alternatives included concerns about potential noise impacts. Concerns were raised about the increased noise that would result from the increased traffic, as well as about construction noise, including noise from the driving of piles for the bridge. The comments made by citizens at these workshops regarding improvement of existing roads also included concerns about potential noise impacts. Some citizens commented that widening the existing roads would present a health risk as there would be an associated increase in noise pollution because of receptors being closer to the roadway. The Town of Duck also expressed concern that widening existing roads would cause additional noise impacts because of decreased distance to the roadway for residents and businesses.

One citizen comment on the *Alternatives Screening Report* (Parsons Brinckerhoff, 2009) expressed the concern that noise impacts to the Town of Aydlett were neglected from the report. It was suggested that the environmental impacts be minimized by utilizing a corridor through a former shooting club (now "The Currituck Club" a developing subdivision). This alternative is addressed in the *Alternatives Screening Report* and was found not to be reasonable.

6.0 Conclusions and Recommendations for Further Study

A total of 1,877 noise-sensitive receptors within Currituck and Dare counties were included in the noise analysis. Three proposed detailed study alternatives, along with the No-Build, were separately evaluated using TNM. The three detailed study alternatives include ER2, MCB2 (with bridge corridors C1 and C2) and MCB4 (with bridge corridors C1 and C2). For ER2, traffic noise levels at 1,715 noise-sensitive receptors were modeled. The noise study results for ER2 indicated that 692 receptors are predicted to be exposed to noise levels that approach or exceed the NAC for Activity Category B. For MCB2, traffic noise levels at 1,550 noise-sensitive receptors were modeled. The number of receptors predicted to be exposed to noise levels that approach or exceed the NAC for Activity Category B as a result of MCB2 is 438 with bridge corridor C1 or 375 with bridge corridor C2. For MCB4, traffic noise levels at 450 noise-sensitive receptors were modeled. The number of receptors predicted to be exposed to noise levels that approach or exceed the NAC for Activity Category B as a result of MCB4 is 173 with the C1 bridge corridor or 110 with the C2 bridge corridor.

Noise abatement was considered for all affected receptors. Noise barriers were determined to be the only potentially feasible and reasonable noise abatement measure for this project. Detailed noise barrier evaluations were completed for residences at NSA 11, NSA 17, NSA 18, NSA 19, NSA 21, NSA 23, NSA 25, and NSA 26. Noise barriers were not evaluated at NSA 1, NSA 2, NSA 3, NSA 4, NSA 5, NSA 6, NSA 7, NSA 8, NSA 9, NSA 10, NSA 12, NSA 14, NSA 15, NSA 16, NSA 20, NSA 22, and NSA 24 because it was determined that it would not be feasible to construct effective noise barriers at those locations, or the difference between the base year and the future year noise levels is less than 3 dBA and noise abatement is not reasonable based on NCDOT's *Traffic Noise Abatement Policy*. Noise barriers were not evaluated for NSA 13, NSA 27, NSA 28, and NSA 29 because noise-sensitive receptors at those locations were not predicted to be exposed to noise levels that approach or exceed the NAC as a result of the detailed study alternatives.

6.1 Analytical Results

Based on the barrier evaluation presented in this report, noise barriers adjacent to NSA 11, NSA 17, NSA 18, NSA 19, NSA 21, NSA 23, NSA 25, and NSA 26 were determined to be feasible and would provide at least the minimum insertion loss of 5 dBA.

6.1.1 NSA 11

Seventeen of the 90 residences within NSA 11 are predicted to be exposed to noise levels that approach or exceed the NAC as a result of the proposed ER2 or MCB2

improvements. Noise Barrier 11 was modeled adjacent to affected receptors and at least 5 feet within the NC 12 proposed right-of-way. The barrier is located on the east side of NC 12, between 13th Avenue and Charles Jenkins Lane.

Noise barriers with a combined length of 781 feet and at heights of 8 to 22 feet would meet the cost reasonable criterion of $37,000 per benefited residence. The noise barriers would range in cost between $93,720 and $257,730, depending on barrier height. However, based on the 4:1 criterion, no noise barriers would be reasonable.

6.1.2 NSA 17

Ten of the 44 residences within NSA 17 are predicted to be exposed to noise levels that approach or exceed the NAC as a result of ER2, MCB2, or MCB4. Two sets of noise barriers (Barriers 17A and 17B and Barriers 17C and 17D) were modeled adjacent to the receptors and 5 feet within the NC 12 right-of-way.

Barriers 17A and 17B are located on the east side of NC 12, south of Marlin Way and between Marlin Way and Schooner Ridge, respectively. Noise barriers with a combined length of 1,363 feet and at heights of 10 to 16 feet would meet the cost reasonable criterion of $38,500 per benefited residence. The noise barriers would range in cost from $204,450 to $327,120, depending on barrier height. However, based on the 4:1 criterion, no noise barriers would be reasonable.

Barriers 17C and 17D are located on the east side of NC 12, between Schooner Ridge and Sand Fiddler Trail and north of Sand Fiddler Trail, respectively. Noise barriers with a combined length of 1357 feet and at heights of 8 to 16 feet would meet the cost reasonable criterion of $38,500 per benefited residence. The noise barriers would range in cost from $162,840 to $325,680, depending on barrier height. However, based on the 4:1 criterion, only an 8-foot tall or a 10-foot tall noise barrier would be reasonable.

6.1.3 NSA 18

Twelve of the 56 residences within NSA 18 are predicted to be exposed to noise levels that approach or exceed the NAC as a result of the proposed ER2, MCB2 or MCB4 improvements. One continuous noise barrier was modeled adjacent to the receptors 5 feet within the NC 12 right-of-way. The noise barrier is located on the west side of NC 12, between Sand Fiddler Trail and north of Seabird Way.

A 2,277-foot long noise barrier at heights of 14 to 16 feet would meet the cost reasonable criterion of $38,500 per benefited residence. The noise barrier would range in cost from $478,170 to $546,840, depending on the barrier height. However, based on the 4:1 criterion, the noise barrier would not be reasonable.

6.1.4 NSA 19

Twenty-one of the 40 residences within NSA 19 are predicted to be exposed to noise levels that approach or exceed the NAC as a result of the proposed ER2, MCB2 or MCB4 improvements. Two noise barriers (Barriers 19A and 19B) were modeled adjacent to the receptors and 5 feet within the NC 12 right-of-way. The noise barriers are located on the east side of NC 12, between north of Sand Fiddler Trail and north of Seabird Way.

Noise barriers with a combined length of 2,543 feet and at heights of 8 to 24 feet would meet the cost reasonable criterion of $38,500 per benefited residence. The noise barriers would range in cost from $305,160 to $915,480, depending on barrier the height. However, based on the 4:1 criterion, only an 8-foot tall or a 10-foot tall noise barrier would be reasonable.

6.1.5 NSA 21

Twenty-four of the 37 residences within NSA 21 are predicted to be exposed to noise levels that approach or exceed the NAC as a result of the proposed ER2, MCB2 or MCB4 improvements. Two noise barriers (Barriers 21A and 21B) were modeled adjacent to the receptors and 5 feet within the NC 12 right-of-way. The noise barriers are located on the east side of NC 12, between Seabird Way and Driftwood Way and between Driftwood Way and the wastewater treatment plant property, respectively.

Noise barriers with a combined length of 3,384 feet and at heights of 8 to 16 feet would meet the cost reasonable criterion of $38,500 per benefited residence. The noise barriers would range in cost from $406,080 to $812,160, depending on barrier height. However, based on the 4:1 criterion, no noise barriers would be reasonable.

6.1.6 NSA 23

Twelve of the 47 residences within NSA 23 are predicted to be exposed to noise levels that approach or exceed the NAC as a result of the proposed MCB2 or MCB4 improvements. Three noise barriers (Barriers 23A, 23B, and 23C) were modeled adjacent to the receptors and 5 feet within the NC 12 right-of-way.

Barrier 23A is located on the west side of NC 12, between 200 feet north of Monteray Drive and approximately 800 feet north of Monteray Drive. A 784-foot long noise barrier at heights of 8 to 16 feet would meet the cost reasonable criterion of $38,500 per benefited residence. The noise barriers would range in cost from $94,080 to $188,160, depending on barrier height. However, based on the 4:1 criterion, only an 8-foot tall or 10-foot tall noise barrier would be reasonable.

Barrier 23B is located on the west side of NC 12 near the Sea Cliff Drive and Sea Escape Court cul-de-sacs. A 856-foot long noise barrier at heights of 10 feet and 14 to 16 feet would meet the cost reasonable criterion of $38,500 per benefited residence. The noise

barriers would range in cost from $128,400 to $205,440, depending on the barrier height. However, based on the 4:1 criterion, only a 10-foot tall noise barrier would be reasonable.

Barrier 23C is located on the west side of NC 12, between Bonita Street and approximately 2,200 feet south of Bonita Street. A 2,190-foot long noise barrier at heights of 10 to 16 feet would meet the cost reasonable criterion of $38,500 per benefited residence. The noise barriers would range in cost from $328,500 to $525,600, depending on the barrier height. However, based on the 4:1 criterion, only a 10-foot tall noise barrier would be reasonable.

6.1.7 NSA 25

Twenty-five of the 47 residences within NSA 25 are predicted to be exposed to noise levels that approach or exceed the NAC as a result of the proposed MCB2 or MCB4 improvements. One continuous noise barrier was modeled adjacent to the receptors and 5 feet within the NC 12 right-of-way. The barrier is located on the east side of NC 12 and extends from north of Dolphin Street to south of Bonita Street.

A 4,450-foot long noise barrier at heights of 8 to 16 feet would meet the cost reasonable criterion of $39,500 per benefited residence. The noise barriers would range in cost from $544,800 to $1,086,600, depending on barrier height. However, based on the 4:1 criterion, only an 8-foot tall or 10-foot tall noise barrier would be reasonable.

6.1.8 NSA 26

Sixteen of the 24 residences within NSA 26 are predicted to be exposed to noise levels that approach or exceed the NAC as a result of the proposed MCB2 or MCB4 improvements. Two noise barriers (Barriers 26A and 26B) were modeled adjacent to the receptors and 5 feet within the NC 12 right-of-way. The barriers are located on the east side of NC 12, between Bonita Street and South Harbor View and north of South Harbor View, respectively.

Noise barriers with a combined length of 2823 feet and at heights of 8 and 16 feet would meet the cost reasonable criterion of $39,500 per benefited residence. The noise barriers would cost $338,760 and $677,520, respectively. However, based on the 4:1 criterion, only an 8-foot tall noise barrier would be reasonable.

6.2 Other Factors in Noise Barrier Reasonableness

Barriers on the Outer Banks would have a sporadic benefit in the three-lane sections of NC 12 with ER2 and MCB2, substantial visual impact beyond the impact of visual dominance on the benefited receptors, affect drainage patterns, and be an impediment to

flood flow. Additionally, barriers on the Outer Banks would impede air flow and provide unwanted shadows.

6.2.1 Extent of Noise Barrier Benefit

The noise reduction benefit of noise barriers would be sporadic on NC 12 in the three-lane sections of NC 12 (with ER2 and MCB2) because the large numbers of driveways and street intersections limit the locations where effective noise barriers could feasibly be considered. In this area, 232 receptors would be adversely affected by noise levels. Of those 232, three (1 percent) would benefit from noise barriers. Those same barriers would lower noise levels for an additional 11 receptors not adversely affected.

In the four-lane sections of NC 12, there are fewer street intersections and driveways and so the benefit of noise barriers would be more extensive. MCB2 or MCB4 with C1 would see 146 receptors adversely affected. Of those 146, 111 (76 percent) would benefit from noise barriers. Those same barriers would lower noise levels for an additional 100 receptors not adversely affected. With C2, the four-lane section of NC 12 would see 83 receptors adversely affected. Of those 83, 67 (81 percent) would benefit from noise barriers. Those same barriers would lower noise levels for an additional 58 receptors not adversely affected.

6.2.2 Visual

The barriers would create a visual impact. When one applies the NCDOT visual dominance criteria listed in Section 3.4 to the three receptors that would benefit from barriers along three-lane sections of NC 12 with ER2 and MCB2, the barriers would not be reasonable. In the four-lane sections of NC 12, the 111 receptors for which barriers would be economically reasonable for MCB2 or MCB4 with C1 would drop to 68 receptors for which barriers would be both economically and visually reasonable. The 83 receptors for which barriers would be economically reasonable for MCB2 or MCB4 with C1 would drop to 25 receptors for which barriers would be both economically and visually reasonable.

Also, from the perspective of those using vacation homes, any barrier would block views of the road, but also the landscape across the road from vacation homes. In locations, such as Monteray Shores (NSA 16 to NSA 23) where NC 12 is close to Currituck Sound and the subdivisions are narrow, a barrier would be confining. A barrier in Monteray Shores would block views to the east, leaving views from this narrow subdivision confined to those of Currituck Sound to the west.

In addition, barriers along NC 12 (barriers associated with NSA 11 to 26) would block views of the adjoining landscape for motorists including, depending on the location, vacation homes, Currituck Sound, and ocean-front dunes. The appearance of the barriers would not complement the natural character of the Outer Banks along NC 12.

Barriers also would affect views of pedestrians and bicyclists using the multi-use paths that line US 158 and NC 12 on the Outer Banks, blocking views of natural features and vacation homes with a barrier (wall) on one or both sides of the road.

US 158 on the Outer Banks is more of a commercial corridor, so the visual impacts described along NC 12 would occur, but would be less notable.

Barriers would require frequent maintenance to collect debris, particularly following major storm events.

Finally, all of the barrier locations would be along surface roads where access to the right-of-way is not limited. People would have unlimited access to barriers along NC 12 and US 158, potentially making them attractive targets for graffiti.

6.2.3 Drainage and Flooding

Barriers would disrupt the drainage patterns along NC 12 in two ways. First, along NC 12 in Dare County and southern Currituck County, the surrounding properties generally drain to the road or sound, so a barrier in NSA 11 would block normal drainage from surrounding properties. Drainage features would need to be built behind the barrier (adding to the impacts and perhaps in some cases displacing homes that the barrier would be designed to protect). In addition, road drainage systems would be designed to handle a ten-year storm. In more severe storms, water would collect behind the barriers, altering flooding patterns, and potentially increasing the risk of property damage.

Second, during severe storms, barriers would be an impediment to flood flow. They would interfere with the storm surge (both from ocean to sound and back from sound to ocean) and with the water's attempt to equalize water levels in the floodplain. This could result in a higher flood elevation in some locations, increasing the risk of property damage.

6.3 Recommendations for Further Study

The NCTA is committed to the construction of feasible and reasonable noise abatement measures at the noise-affected receptors identified and discussed in this Traffic Noise Technical Report, contingent upon the following conditions:

1. Detailed noise analysis updates during the final design process continue to support the opportunity to provide noise barriers at NSA 17 (noise barriers 17C and 17D), NSA 19, NSA 23, NSA 25, and NSA 26;

2. The outcome of hydraulic studies needed to determine the impact of proposed noise barriers on drainage and flood flows, whether the impact can be mitigated, and what would be required to mitigate it and the associated cost;

3. Opinions have been solicited by NCTA from front row receptors about the noise abatement measures being considered and the majority of these receptors support the construction of the noise abatement measures;

4. Safety and engineering aspects as related to the roadway user and the adjacent property owner have been reviewed; and

5. Coordination with local officials to identify any new development that has occurred between the date of this report and the Date of Public Knowledge (i.e., the Record of Decision). Any new development would need to be assessed for noise impacts and given consideration for potential noise abatement measures during the final design process.

7.0 References

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