3.8 NOISE

3.8.1 What is noise?

Noise is "any sound that is undesired or interferes with a person's hearing of something."[46] Noise or sound is a pressure on the ear drum that is measured on a scale from one to one billion. To simplify this scale, engineers and scientists have established a decibel scale (dB) of 1 to 180 through a mathematical process called a logarithm, which is easier to use. The human ear can only hear certain frequencies of noise, so, in order to show only the level or frequencies that can be heard by the human ear, the scale is given an A-weighting, designated by dBA. The scale of 1 to 180 dB provides a range for the sound levels that fall within a human's normal range of hearing for various types of noises. Table 3.25 provides an overview of several different types of noises and what the sound level is in dBA. The scale provides a better representation of the actual sound levels and how a person would be affected.

Table 3.25
Common Noises and dB Levels
Interstate 73 FEIS: I-95 to the Myrtle Beach Region

Outdoor Noise	dBA	Indoor Noise
	110	rock band at 16.4 feet
jet flyover at 984.3 feet		
pneumatic hammer	100	subway train
gas lawn mower at 3.3 feet		
	90	
downtown area of large city	80	garbage disposal at 3.3 feet
		shouting at 3.3 feet
lawn mower at 6.6 feet	70	
commercial area		normal speech at 3.3 feet
air conditioning unit	60	clothes dryer at 3.3 feet
babbling brook		large business office
quiet urban area during the daytime	50	dishwasher in the next room
quiet urban area during the nighttime	40	library
	30	
	20	
	10	
		threshold of hearing
	0	

Source: National Institute on Deafness and Other Communication Disorders, 2007.

[46] *Webster's New Collegiate Dictionary* (Springfield, Massachusetts: G&C Merriam Company, 1975).

Traffic noise, defined as unwanted sound, is associated with highway traffic usually in the form of loud or persistent noises from cars and trucks. Traffic noises are generated from engines, mufflers, and from tire contact with the roadway.

3.8.2 How are noise impacts estimated?

Noises affect people differently due to their environment and other various factors. Loud noises such as a car honking its horn would bother most people while they were trying to sleep, while a softer noise during the day might bother certain individuals if they were trying to study or concentrate on a difficult task. The FHWA has developed the Noise Abatement Criteria (NAC) to determine how noise from roadway traffic affects the surrounding environment. NAC were developed through noise level studies, determinations of land uses, and various types of daily activities. These analyses developed a table for determining what dBA levels of noise would disturb people during various activities and at various locations. When dBA levels reach the point that it creates a disruption for an activity, it is considered an impact.

The NAC separates land uses into five categories, which are grouped by the type of activity and includes how sensitive this activity is to noise (refer to Table 3.26). All five types of land uses are located within the project study area; however, the first three land uses (A, B, C) were used for analysis since they compare exterior noises and apply to all types of land uses.

Table 3.26
FHWA Noise Abatement Criteria
Interstate 73 FEIS: I-95 to the Myrtle Beach Region

Activity Category	dBA	Description of Activity Category
A	57 (exterior)	Lands on which serenity and quiet are of extraordinary significance and 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 above.
D	-	Undeveloped lands
E	52 (interior)	Residences, motels, hotels, public meeting rooms, schools, churches, libraries, hospitals and auditoriums.

Source: 23 CFR §772, USDOT, FHWA.

3.8.3 How was background noise determined in the project study area?

Sources of the background noise include cars, trucks, farm equipment, and trains. An established network of roadways and, as a result, background traffic noises already exist throughout the project study area. Existing traffic and background noises were measured at 16 different locations within the project study area using a dosimeter. The time and resources it would take to provide existing noise level readings for each receptor in the project study area would be very expensive. In view of this, the FHWA-developed Traffic Noise Model (TNM) was used to take into account the factors from current and future traffic volumes and composition, topography, buildings, and roadways. The three-dimensional model calculates noise levels for an entire area and can predict both existing and future noise levels using various criteria and information included in the model.

3.8.4 How was TNM tested to ensure accuracy?

The model was tested to ensure that it was accurately predicting noise levels for the project study area. To test the model, existing noise levels were predicted using existing traffic data and were compared to the same locations where ambient noise levels were measured in the field. The comparisons of these measurements determined the accuracy of the model and are shown in Table 3.27 (refer to page 3-110). In most cases, the predicted noise levels were higher than those taken in the field. There were a few locations where the existing noise levels were higher than the predicted noise levels. Additional background noises beyond traffic, such as a train passing, were noted for these locations. On average, the TNM over estimated by approximately one dBA what was measured in the field. Generally, it would take at least a five dBA difference for the human ear to perceive a difference in sound in most exterior environments. Due to this, the TNM should accurately predict noise levels within one dBA or slightly higher than what should occur, which is a reasonable margin of variation.

A noise analysis was performed for the project study area. This analysis was completed in accordance to FHWA's 23 CFR §772.15 "Procedures for Abatement of Highway Traffic Noise and Construction Noise." Noise impacts from roadway traffic can occur in two ways. When noise levels approach, or are within 1 dBA of the NAC criteria for each land use category or meet/exceed the NAC level, then it would be considered to impact a receptor. The second type of noise impact would occur when there has been a substantial increase (by 15 dBA or greater) in the future noise levels when compared to existing levels.

3.8.5 What happens when noise impacts occur?

When traffic noise impacts occur, an evaluation must be completed to determine if minimization is possible. Methods used to reduce noise levels must be practicable to build, as well as cost effective. Methods cannot be used if they are determined to be unsafe to construct or if the methods are too costly when compared to the benefits. The most common method of reducing noise is construction of a noise wall, which is built parallel to a roadway to minimize the amount of noise. SCDOT and FHWA have determined that a noise wall or other noise reduction methods are practicable if they would reduce the noise by at least five dBA and cost-effective if it would not cost more than $25,000 per benefited receiver. In addition, if a noise wall is constructed, the wall cannot be higher than 25 feet based on specifications by SCDOT and FHWA. The five dBA reduction is used since it usually takes at least a five dBA change in the noise level for the average person to hear the difference in an exterior setting.

Table 3.27
Ambient Noise Levels
Interstate 73 FEIS: I-95 to the Myrtle Beach Region

Site	Location	Field Measured Noise Level (dBA)	TNM Predicted Noise Level (dBA)	Difference (TNM minus Field Measurement)	Comments
Site 1	4 miles S of S.C. Route. 9 on U.S. Route 301	67.1	67.0	-0.1	
Site 2	2.4 miles S of S.C. Route 917 on U.S. Route 301	62.4	61.5	-0.9	Locomotive passed nearby
Site 3	1.2 miles S of U.S. Route 301 on U.S. Route 501	62.6	63.9	1.3	
Site 4	1 miles S of exit U.S. Route 76 on U.S. Route 501	64.1	66.0	1.9	
Site 5	1.25 miles E of U.S. Route 501 on U.S. Route 76	61.7	64.1	2.4	
Site 6	On I-95 just south of Exit 190	74.1	74.1	0.0	
Site 7	1.2 miles E of S.C. Route 38 on S.C. Route 917	61.0	63.2	2.2	
Site 8	6 miles S of U.S. Route 301 on S.C. Route 917	60.9	60.9	0.0	
Site 9	3.6 miles W of S.C. Route 917 on S.C. Alt. Route 41	58.1	61.5	3.4	
Site 10	6.2 miles S of U.S. Route 76 on S.C. Route 41	62.4	63.3	0.9	
Site 11	4.5 miles S of U.S. Route 76 on S.C. Route 917	64.8	63.6	-1.2	Joints on Bridge Deck added to measurement
Site 12	3 miles S of State Route 23 on S.C. Route 917	54.8	58.4	3.6	Very low traffic volume
Site 13	6 miles N of State Route 319 on U.S. Route 501	67.0	70.0	3.0	
Site 14	1.1 miles W of U.S. Route 501 on Middle School Rd.	58.0	52.4	-5.6	Very low traffic volume
Site 15	2 miles N of Horry Rd on U.S. Route 501	69.1	70.9	1.8	
Site 16	1 miles E of U.S. Route 501 on Horry Rd	60.3	60.3	0.0	

Traffic data for 2005 and 2030 peak-hour volumes, which would generate the most noise, were used to provide a worst-case scenario. Noise levels were predicted for the No-build and Preferred Alternatives and compared to the NAC and the existing noise levels to determine potential impacts.

Since the project study area was so large, locations were picked throughout to provide a uniform representation as to what the sound levels would be and what potential areas would be impacted. These sites were chosen because of their distance to the existing and proposed roadways and due to the number of structures that were around them and the types of land uses for each of the locations. The approximate distance to the different land use categories in the NAC are shown in Table 3.28. Table 3.29 (refer to page 3-112) lists the approximate distances to each of these land uses for the Preferred Alternative.

3.8.6 What are the anticipated noise impacts from the Preferred Alternative?

Detailed land use data and structural information for the project study area was collected in a GIS format. In order to analyze and compare specific categories of noise impacts associated with the Preferred Alternative, contour distances were determined by the TNM model and applied to the GIS data. This provided the ability to calculate the number and types of structures that fell within the contours associated with each NAC category for the Preferred Alternative. Category A receivers are identified as lands on which serenity and quiet are of extraordinary significance and 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. The Little Pee Dee Heritage Preserve was evaluated to determine if it met the Criteria as a Category A receiver. However, since it is immediately adjacent to the existing S.C. Route 917 and hunting is allowed on the preserve, it

Table 3.28
Approximate Distance to NAC Contours
For Existing, Future No-build, and Future Build
Interstate 73 FEIS: I-95 to the Myrtle Beach Region

Roadway	A (56 dBA) (feet)	B (66 dBA) (feet)	C (71 dBA) (feet)
I-95			
Existing (2005)	1,300	380	220
No-build (2030)	1,350	410	230
Build (2030)	1,400	440	250
U.S. Route 301			
Existing (2005)	300	110	80
No-build (2030)	420	160	100
Build (2030)	420	160	100
U.S. Route 76			
Existing (2005)	380	140	90
No-build (2030)	430	160	100
Build (2030)	480	180	110
S.C. Route 41			
Existing (2005)	180	70	50
No-build (2030)	240	100	60
Build (2030)	260	110	70
S.C. Route 917 (Near Little Pee Dee River)			
Existing (2005)	80	n/a	n/a
No-build (2030)	120	n/a	n/a
Build (2030)	320	60	20

Table 3.29
Approximate Distance to NAC Contour (feet)
Interstate 73 FEIS: I-95 to the Myrtle Beach Region

Location	Preferred Alternative
I-95 to U.S. Route 301	
A (56 dBA)	490
B (66 dBA)	160
C (71 dBA)	100
U.S. Route 301 to S.C. Route 41A	
A (56 dBA)	510
B (66 dBA)	160
C (71 dBA)	90
S.C. Route 41A to U.S. Route 76	
A (56 dBA)	540
B (66 dBA)	190
C (71 dBA)	120
U.S. Route 76 to S.C. Route 41	
A (56 dBA)	650
B (66 dBA)	220
C (71 dBA)	130
S.C. Route 41 to State Routes S-99/S-308	
A (56 dBA)	640
B (66 dBA)	220
C (71 dBA)	130
State Routes S-99/S-308 to S.C. Route 22	
A (56 dBA)	590
B (66 dBA)	200
C (71 dBA)	120

currently experiences traffic and other noises while serving its recreational purpose. Therefore, it is not considered a Category A receiver for these reasons. Since no Category A receivers were identified adjacent to the Preferred Alternative, the two contours of concern are the 66 dBA contour (Category B) and the 71 dBA contour (Category C). The GIS analysis provided a more detailed picture of where impacts are located along the alignment. The analysis determined that 13 Category B (residential) receivers and no Category C receivers would be impacted by the Preferred Alternative. Noise impacts associated with the Preferred Alternative are summarized in Table 3.30 (refer to page 3-114) and shown on Figure 3-27.

In addition to the original noise study, a supplemental noise analysis was completed for the six interchanges of the Preferred Alternative. The impact contours indicated that the amount of traffic on the ramps associated with the interchanges would not create any additional noise impacts (refer to Figure 3-27).

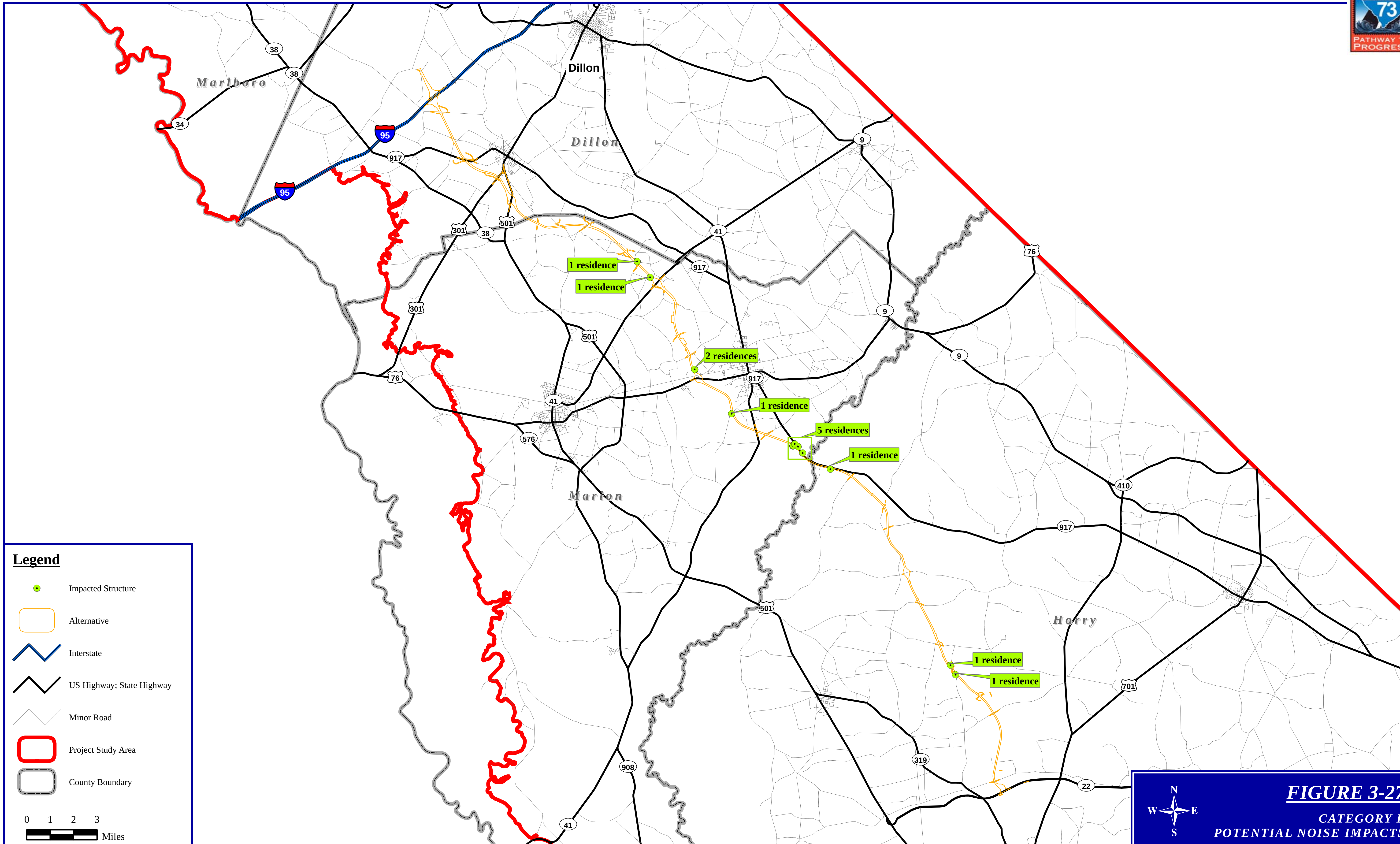


FIGURE 3-27
CATEGORY B
POTENTIAL NOISE IMPACTS

Table 3.30 Noise Impacts Based on GIS Analysis Interstate 73 FEIS: I-95 to the Myrtle Beach Region	
Location	**Category B Receivers**
I-95 to U.S. Route 301	0
U.S. Route 301 to S.C. Route 41A	2
S.C. Route 41A to U.S. Route 76	2
U.S. Route 76 to S.C. Route 41	1
S.C. Route 41 to Roads S-99/S-308	6
Roads S-99/S-308 to S.C. Route 22	2
Total Impacts	**13**

Areas along the Preferred Alternative could be affected by noise generated from various construction activities. The major construction elements of this project are expected to be earth moving, hauling, grading, and paving. General construction noise impacts to individuals living or working near the project would be expected. Overall, construction noise impacts are expected to be minimal since construction noise would be relatively short in duration and could be restricted to daytime hours.

3.8.7 How could noise impacts be mitigated?

Due to the rural setting of the project study area, areas of high density development were avoided to the extent possible during development and refinement of the Preferred Alternative. The alignment was adjusted to avoid, as much as possible, the smaller communities and neighborhoods. The avoidance of developed areas reduced potential noise impacts.

The following noise abatement measures were evaluated for areas with the highest potential for noise impacts. The various noise abatement measures were studied to determine the feasibility and reasonableness of their implementation.

3.8.7.1 No-build Alternative

This noise abatement measure would involve not constructing the project. The No-build Alternative would have no impacts associated with the construction of I-73. However, this measure would not satisfy the purpose and need for the project.

3.8.7.2 Highway Alignment

Highway alignment selection involves the horizontal or vertical orientation of the proposed project in such a way as to minimize impacts and costs. The selection of alternative alignments for noise abatement purposes must consider the balance between noise impacts and other engineering and environmental parameters. For noise abatement, a horizontal alignment selection is primarily a matter of placing the roadway at a sufficient distance from noise sensitive areas. As stated above, this method was used during alternative development and refinement of the Preferred Alternative.

3.8.7.3 Traffic System Management Measures

Traffic management measures that limit vehicle type, speed, volume and time of operations are often effective noise abatement measures. However, an interstate facility design is generally not conducive to limiting vehicles' use, type and speed. An interstate consists of a controlled access roadway designed to move traffic from point A to point B in a safe and efficient manner. Limiting one or all of the above variables not only reduces the effectiveness of the facility, but may also create an unsafe roadway environment. Traffic management measures are not considered appropriate for noise abatement due to their limiting effect on the capacity, level-of-service, and safety of the proposed project.

3.8.7.4 Noise Barriers

Noise barriers involve constructing solid barriers to effectively diffract, absorb, and/or reflect highway traffic noise, which may include earth berms and/or noise walls. The evaluation of the reasonableness and feasibility of noise wall construction is based on many factors, some of which include constructability, cost, height, anticipated noise increase, noise reduction obtained, number of receptors benefited, residents' views, land use type, and whether land use changes are expected. For this analysis, noise barriers were studied for areas where there are more than two or three isolated receptors located within approximately 400 feet of the Preferred Alternative. Table 3.31 explains the potential cost and benefit information about the barriers analyzed. A construction cost of $20 per square foot was used for the cost analysis, with the exception of barrier number six, which was priced at $28 per square foot since it would be located on a bridge. The cost of the benefited receptors was calculated by dividing the cost of the noise wall by the number of receptors benefited by the wall.

A review of Table 3.31 shows that, based on preliminary analysis, none of the noise barriers would be reasonable based on cost per benefited receptor. SCDOT has defined a reasonable cost for noise abatement as $25,000 per benefited receptor. As defined by the SCDOT Noise Abatement Policy, a benefited receptor is one who receives at least a 5 dBA reduction in noise levels as a result of the noise abatement measure. In order to be effective, a noise wall must be tall enough to block the "line of sight" between the receptor and the noise source. In addition, the noise wall must be long enough to block the "line of sight" from a length of roadway approximately six to eight times the distance between the receptor and roadway. The distance between receptors as well as the distance between the roadway and many of the receptors studied, contributed to the need for the noise walls to be of such great length and height as to render them cost ineffective. The lowest cost obtained for any wall studied for the Preferred Alternative was over $42,000 per benefited receptor, and was not considered reasonable due to cost.

Table 3.32 lists the various mitigation techniques and a brief explanation of why they would not be reasonable and/or feasible. Although some of the methods could help to reduce impacts, the main tool in controlling future noise impacts is for state and local authorities to use the impact noise contour table to help in preventing or minimizing development in areas that have a high potential for noise impacts. The results of the noise analyses will be given to local governments to aid in future planning in their respective areas.

Table 3.31
Noise Barrier Analysis
Interstate 73 FEIS: I-95 to the Myrtle Beach Region

Barrier Number	Location	Number of Receptors Benefited	Length (feet)	Average Height (feet)	Cost	Cost per Benefited Receptor
3	North of S.C. Route 41A	7	1,200	21	$496,000	$70,900
4	North of S.C. Route 41A	12	1,750	22	$754,000	$62,800
5	North of U.S. Route 76	13	1,856	17	$612,000	$47,100
6	South of S.C. Route 41	8	1,026	12	$340,000	$42,500
7	South of S.C. Route 308	5	3,223	15	$986,000	$197,200
8	North of U.S. Route 301	3	2,627	13	$702,000	$234,000

Table 3.32
Noise Abatement Analysis
Interstate 73 FEIS: I-95 to the Myrtle Beach Region

Abatement Techniques	Reasonable	Feasible	Effectiveness
No-Build Alternative	No	No	Purpose and Need would not be met.
Change Highway Alignment	Yes	Yes	On-going during project development.
Traffic System Management	No	No	Effect capacity and level of service.
Noise Barriers	No	Yes	Not cost effective due to sparse development.

3.9 AIR QUALITY

3.9.1 How is air quality measured?

The USEPA established the National Ambient Air Quality Standards (NAAQS) for atmospheric pollutants that are considered harmful to public health in accordance with the *Clean Air Act of 1970*, as amended (CAA). The SCDHEC Bureau of Air Quality is responsible for regulating and ensuring compliance with the CAA in South Carolina.

The criteria pollutants that are measured under NAAQS are carbon monoxide, lead, nitrogen dioxide, ozone, particulate matter, and sulfur dioxide.[47] In Table 3.33 (refer to page 3-117), these pollutants are listed, along with their attainment standards, description, sources, and the potential effects they may have

[47] USEPA, "What are the Six Common Air Pollutants?," http://www.epa.gov (July 30, 2007).

Table 3.33
Criteria Pollutants Measured Under the NAAQS
Interstate 73 FEIS: I-95 to the Myrtle Beach Region

Pollutant	Standard: Averaging Time	Standard: PPM†	Standard: µG/M³ *	Standard: Type of standard¥	Description	Possible Effects to Human Health
Carbon monoxide	1 hour 8 hours	35 9	40,000 10,000	Primary Primary	Carbon monoxide forms when carbon is not completely burned in fuel. It is an odorless and colorless gas that is mainly formed from vehicle exhaust.	Breathing carbon monoxide reduces the body's ability to deliver oxygen to vital organs in the body. It can affect the heart, lungs, and central nervous system. Inhaled in high amounts, it can cause poisoning or death.
Lead	1 quarter	-	1.5	Primary & Secondary	Lead is usually released into the environment as a result of processing metals. Utilities, waste incinerators, and lead-acid battery manufacturers are sources of lead.	Lead can cause damage to the major organs such as the brain, liver, and kidneys. It can cause seizures, mental disorders, reproductive problems, high blood pressure, anemia, and osteoporosis.
Nitrogen dioxide	1 year	0.053	100	Primary & Secondary	Nitrogen dioxide is an odorless and colorless gas that comes from various sources such as vehicle, industrial, and utility emissions.	It is a component of ozone, which causes numerous respiratory problems.
Ozone	8 hours	0.08	157	Primary & Secondary	Ozone is created when nitrogen oxide compounds mix with volatile organic compounds in the presence of sunlight. Sources of the compounds creating ozone include vehicle and industrial emissions, gasoline vapors, and chemical solvents.	Ozone causes respiratory problems such as decreased lung function, asthma, wheezing, coughing, pain when breathing, and higher susceptibility to respiratory illnesses such as pneumonia and bronchitis.
Particulate Matter diameter less than/equal to 10 µm	24 hours 1 year	- -	150 50	Primary & Secondary Primary & Secondary	Particulate matter forms when small solid particles combine with liquid droplets to form dust, dirt, haze, soot, or smoke. These can be emitted from primary sources such as unpaved roads, construction sites, fields, or smokestacks. They can also be emitted as a result of secondary reactions of gases released from automobiles and industrial plants.	Particulate matter causes a variety of respiratory problems, from asthma and bronchitis, to decreased lung capacity and function. If particulate matter is very small, it can be transferred to the cardiovascular system and cause irregular heartbeat and even non-fatal heart attacks.
Particulate Matter diameter less than/equal to 25 µm	24 hours 1 year	- -	65 15	Primary & Secondary Primary & Secondary		
Sulfur oxides	3 hours 24 hours 1 year	0.50 0.14 0.03	1,300 365 80	Secondary Primary Primary	Sulfur dioxide is formed when fuel such as coal and oil is burned and sulfur is released into the atmosphere and mixes with oxygen. Main sources of sulfur dioxide include fuel burning utility plants, petroleum refineries, large ships and locomotives, and metals processing plants.	Sulfur dioxide can cause respiratory illnesses such as asthma, decreased lung function, and susceptibility to other illnesses such as pneumonia and bronchitis. It can also aggravate existing heart diseases.

†PPM = parts per million. * µG/M³ = micrograms per cubic meter.
¥ Primary standards are set to protect public health. Secondary standards are designed to protect public welfare.
Source: USEPA, Air and Radiation Section, http://www.epa.gov/air/criteria.html Last accessed March 16, 2006.

on human health. Transportation projects contribute to four of the six criteria pollutants listed: ozone, carbon monoxide, particulate matter, and nitrogen dioxide.[48]

The United States is divided into geographical areas that are classified as either in non-attainment or attainment for air quality. If an area has exceeded the NAAQS levels for any of the six criteria pollutants, then it is in non-attainment. In these areas, the USEPA requires states to develop a State Implementation Plan to address regional goals for attaining NAAQS. Each plan includes measures to reduce transportation pollutant emissions. Geographic areas that have all six criteria pollutants below NAAQS standards are considered to be in attainment. All three counties in the project study area are considered to be in attainment of the NAAQS.

3.9.2 What are the potential air quality issues associated with a transportation project?

In 1997, the USEPA determined that the 1-hour "peak" NAAQS standard for ground-level ozone was not adequately protecting human health and changed it to an 8-hour average standard of 0.08 parts per million.[49] This standard would be phased in, and once an area has reached this 8-hour average standard for three years, it would continue using it. However, if geographical areas were already meeting the 1-hour standard, they could voluntarily enter into an Early Action Compact with the USEPA through their state's State Implementation Plan to set milestones to meet the more stringent 8-hour standard. As long as these areas worked to reach milestones set in the compact, then the USEPA would defer requiring the ozone 8-hour average standard. Geographical areas, consisting of local, county, and state officials, worked to develop milestones and submitted them in 2002. Once the USEPA approved these compacts, and the milestones were reached, these areas would receive deferrals from the 8-hour average standard.

In 2002, SCDHEC developed an Early Action Compact State Implementation Plan for implementing measures to attain the 8-hour average standard so that areas in the state could develop Early Action Compacts. Early Action Compacts were submitted for both the Pee Dee Region (containing Dillon and Marion Counties) and the Waccamaw Region (containing Horry County) in December of 2002 and resubmitted in 2004.[50] Two monitoring stations exist for the Pee Dee and Waccamaw Regions to monitor the 8-hour ozone standard. Neither station (the Pee Dee Region station is located in Darlington County and the Waccamaw Region station is located in Williamsburg County) has exceeded the 8-hour standard for ozone in the past three years.[51]

As part of the Early Action Compact State Implementation Plan (SIP), transportation conformity is not required. However, through interagency meetings, air quality and transportation officials agreed on the importance of considering air quality goals in transportation planning. As a result, FHWA, Federal Transit Authority, and SCDOT met with SCDHEC, USEPA, and local and county officials (MPOs) signed a

[48] FHWA, "Air Quality Planning for Transportation Officials," http://www.fhwa.dot.gov/environment/aqplan/index.htm (September 11, 2007).
[49] USEPA, USEPA's Revised Ozone Standards, http://www.epa.gov/ttn/oarpg/naaqsfin/o3fact.html (September 11, 2007).
[50] USEPA, Ozone Early Action Compacts, http://www.epa.gov/ttn/naaqs/ozone/eac/ (July 30, 2007).
[51] SCDHEC, Bureau of Air Quality, "Ambient Air Quality Summaries," http://www.scdhec.gov/environment/baq/modeling.aspx (September 22, 2007).

memorandum of agreement outlining consultation procedures for transportation conformity and developing a Smart Highways Checklist to be used when developing Long Range Transportation Plans and Transportation Improvement Programs to meet state and federal air quality standards, as well as goals set forth in the Early Action Compacts.[52]

With the approval of the 2004 SIP revision, when an area in South Carolina is deemed nonattainment, it is then required to implement transportation conformity and the necessary consultation procedures, outlined in the MOA. Areas in South Carolina that were designated nonattainment for the 8-hour ozone standard but had the effective date of the designation deferred as a result of the Early Action Compact are not required to implement transportation conformity. Under this guidance, no further action to evaluate air quality is required for the I-73 project.

In addition to the criteria air pollutants for which there are NAAQS, the USEPA also regulates 188 hazardous air toxics under the CAA. The USEPA has designated 21 of these as mobile source air toxics (MSATs),[53] which are toxic chemical compounds that are emitted from both on and off-road vehicles. These MSATs are considered to potentially cause harmful health or environmental effects.[54] Six of these have been identified as priority MSATs, and include benzene, formaldehyde, acetaldehyde, diesel particulate matter/diesel exhaust organic gases, acrolein, and 1,3-butadiene.[55]

Mobile Source Air Toxics

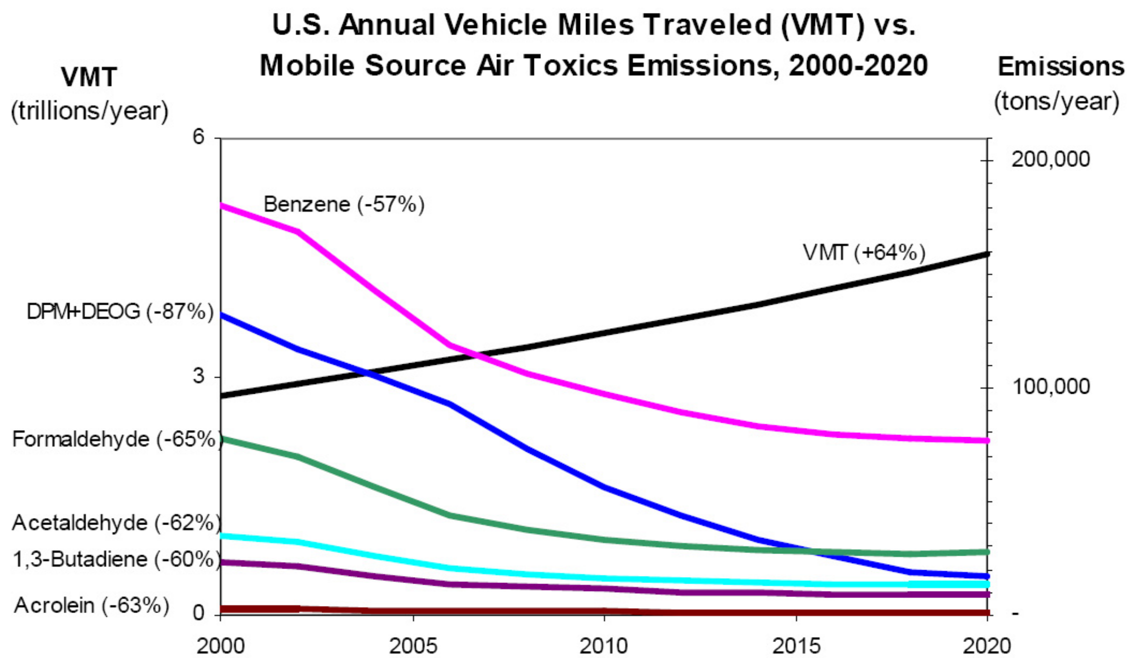
Mobile Source Air Toxics (MSATs) are a subset of the 1888 air toxics defined by the Clean Air Act. The MSATs are compounds emitted from highway vehicles and non-road equipment. Some toxic compounds are present in fuel and are emitted to the air when the fuel evaporates or passes through the engine unburned. Other toxics are emitted from the incomplete combustion of fuels or as secondary combustion products. Metal air toxics also result from engine wear or from impurities in oil or gasoline.

FHWA has provided interim guidance on addressing MSATs in the NEPA analysis through *Memorandum HEPN-10: Interim Guidance on Air Toxic Analysis in NEPA Documents*.[56] This memorandum is included in Appendix G. While a basic discussion of potential MSAT emission impacts from the proposed project has been addressed, technical resources are not available at this time to determine project-specific health impacts from MSATs associated with the project alternatives. Due to the lack of technical resources, a discussion regarding incomplete or unavailable information is provided below, along with FHWA guidance and CEQ guidance (specifically 40 CFR §1502.22(b)).

The USEPA is the lead Federal Agency for administering the CAA and has certain responsibilities regarding the health effects of MSATs. The USEPA issued a Final Rule on Controlling Emissions of Hazardous Air Pollutants from Mobile Sources, 66 FR 17229 (March 29, 2001). This rule was issued under the authority

[52] SCDHEC, Bureau of Air Quality, "South Carolina Early Action Compact SIP," http://www.scdhec.gov/environment/baq/eap.aspx (September 20, 2007).
[53] Federal Register, *Control of emissions of Hazardous Air Pollutants from Mobile Sources,* 66 FR 17235.
[54] USEPA, Mobile Source Air Toxics Website, http://www.epa.gov/otaq/toxics.htm (September 11, 2007).
[55] FHWA, *HEPN-10: Interim Guidance on Air Toxic analysis in NEPA Documents,* (February 3, 2006), http://www.fhwa.dot.gov/ENVIRONMENT/airtoxic/020306guidapc.htm (September 11, 2007).
[56] *Ibid.*

in Section 202 of the CAA. In its rule, USEPA examined the impacts of existing and newly promulgated mobile source control programs, including its reformulated gasoline (RFG) program, its national low emission vehicle (NLEV) standards, its Tier 2 motor vehicle emissions standards and gasoline sulfur control requirements, and its proposed heavy duty engine and vehicle standards and on-highway diesel fuel sulfur control requirements. Between 2000 and 2020, FHWA projects that even with a 64 percent increase in VMT, these programs will reduce on-highway emissions of benzene, formaldehyde, 1,3-butadiene, and acetaldehyde by 57 percent to 65 percent, and will reduce on-highway diesel PM emissions by 87 percent, as shown in Chart 3.1.



Notes: For on-road mobile sources. Emissions factors were generated using MOBILE6.2. MTBE proportion of market for oxygenates is held constant, at 50%. Gasoline RVP and oxygenate content are held constant. VMT: *Highway Statistics 2000*, Table VM-2 for 2000, analysis assumes annual growth rate of 2.5%. "DPM +DEOG" is based on MOBILE6.2-generated factors for elemental carbon, organic carbon and SO4 from diesel-powered vehicles, with the particle size cutoff set at 10.0 microns.

Chart 3.1: U.S. Annual Vehicle Miles Traveled (VMT) vs. Mobile Source Air Toxics Emissions, 2000-2020

As a result, USEPA concluded that no further motor vehicle emissions standards or fuel standards were necessary to further control MSATs. The agency is preparing another rule under authority of CAA Section 202(l) that will address these issues and could make adjustments to the full 21 and the primary six MSATs.

3.9.2.1 Unavailable Information for Project Specific MSAT Impact Analysis

This FEIS includes a basic analysis of the likely MSAT emission impacts of this project. However, available technical tools do not enable us to predict the project-specific health impacts of the emission changes associated with the alternatives in this FEIS. Due to these limitations, the following discussion is included in accordance with CEQ regulations (40 CFR 1502.22(b)) regarding incomplete or unavailable information.

3.9.2.2 Information that is Unavailable or Incomplete

Evaluating the environmental and health impacts from MSATs on a proposed highway project would involve several key elements, including emissions modeling, dispersion modeling in order to estimate ambient concentrations resulting from the estimated emissions, exposure modeling in order to estimate human exposure to the estimated concentrations, and then final determination of health impacts based on the estimated exposure. Each of these steps is encumbered by technical shortcomings or uncertain science that prevents a more complete determination of the MSAT health impacts of this project.

3.9.2.3 Emissions

The USEPA tools to estimate MSAT emissions from motor vehicles are not sensitive to key variables determining emissions of MSATs in the context of highway projects. While MOBILE 6.2 is used to predict emissions at a regional level, it has limited applicability at the project level. MOBILE 6.2 is a trip-based model—emission factors are projected based on a typical trip of 7.5 miles, and on average speeds for this typical trip. This means that MOBILE 6.2 does not have the ability to predict emission factors for a specific vehicle operating condition at a specific location at a specific time. Because of this limitation, MOBILE 6.2 can only approximate the operating speeds and levels of congestion likely to be present on the largest-scale projects, and cannot adequately capture emissions effects of smaller projects. For particulate matter, the model results are not sensitive to average trip speed, although the other MSAT emission rates do change with changes in trip speed. Also, the emissions rates used in MOBILE 6.2 for both particulate matter and MSATs are based on a limited number of tests of mostly older-technology vehicles. Lastly, in its discussions of PM under the conformity rule, USEPA has identified problems with MOBILE 6.2 as an obstacle to quantitative analysis.

These deficiencies compromise the capability of MOBILE 6.2 to estimate MSAT emissions. MOBILE 6.2 is an adequate tool for projecting emissions trends, and performing relative analyses between alternatives for very large projects, but it is not sensitive enough to capture the effects of travel changes tied to smaller projects or to predict emissions near specific roadside locations.

3.9.2.4 Dispersion

The tools to predict how MSATs disperse are also limited. The USEPA's current regulatory models, CALINE3 and CAL3QHC, were developed and validated more than a decade ago for the purpose of predicting episodic concentrations of carbon monoxide to determine compliance with the NAAQS. The performance of dispersion models is more accurate for predicting maximum concentrations that can occur at some time at some location within a geographic area. This limitation makes it difficult to predict accurate exposure patterns at specific times at specific highway project locations across an urban area to assess potential health risk. The NCHRP is conducting research on best practices in applying models and other technical methods in the analysis of MSATs. This work also will focus on identifying appropriate methods of documenting and communicating MSAT impacts in the NEPA process and to the general public. Along with these general limitations of dispersion models, FHWA is also faced with a lack of monitoring data in most areas for use in establishing project-specific MSAT background concentrations.

3.9.2.5 Exposure Levels and Health Effects

Finally, even if emission levels and concentrations of MSATs could be accurately predicted, shortcomings in current techniques for exposure assessment and risk analysis preclude us from reaching meaningful conclusions about project-specific health impacts. Exposure assessments are difficult because it is difficult to accurately calculate annual concentrations of MSATs near roadways, and to determine the portion of a year that people are actually exposed to those concentrations at a specific location. These difficulties are magnified for 70-year cancer assessments, particularly because unsupportable assumptions would have to be made regarding changes in travel patterns and vehicle technology (which affects emissions rates) over a 70-year period. There are also considerable uncertainties associated with the existing estimates of toxicity of the various MSATs, because of factors such as low-dose extrapolation and translation of occupational exposure data to the general population. Because of these shortcomings, any calculated difference in health impacts between alternatives is likely to be much smaller than the uncertainties associated with calculating the impacts. Consequently, the results of such assessments would not be useful to decision makers, who would need to weigh this information against other project impacts that are better suited for quantitative analysis.

3.9.2.6 Summary of Existing Credible Scientific Evidence Relevant to Evaluating the Impacts of MSATs

Research into the health impacts of MSATs is ongoing. For different emission types, there are a variety of studies that show that some either are statistically associated with adverse health outcomes through epidemiological studies (frequently based on emissions levels found in occupational settings) or that animals demonstrate adverse health outcomes when exposed to large doses.

Exposure to toxics has been a focus of a number of USEPA efforts. Most notably, the agency conducted the National Air Toxics Assessment (NATA) in 1996 to evaluate modeled estimates of human exposure applicable to the county level. While not intended for use as a measure of or benchmark for local exposure, the modeled estimates in the NATA database best illustrate the levels of various toxics when aggregated to a national or State level.

The USEPA is in the process of assessing the risks of various kinds of exposures to these pollutants. The USEPA Integrated Risk Information System (IRIS) is a database of human health effects that may result from exposure to various substances found in the environment. The IRIS database is located at http://www.epa.gov/iris. The following toxicity information for the six prioritized MSATs was taken from the IRIS database Weight of Evidence Characterization summaries. This information is taken verbatim from USEPA's IRIS database and represents the Agency's most current evaluations of the potential hazards and toxicology of these chemicals or mixtures.

- Benzene is characterized as a known human carcinogen.
- The potential carcinogenicity of acrolein cannot be determined because the existing data are inadequate for an assessment of human carcinogenic potential for either the oral or inhalation route of exposure.
- Formaldehyde is a probable human carcinogen, based on limited evidence in humans, and sufficient evidence in animals.
- 1,3-butadiene is characterized as carcinogenic to humans by inhalation.
- Acetaldehyde is a probable human carcinogen based on increased incidence of nasal tumors in male and female rats and laryngeal tumors in male and female hamsters after inhalation exposure.
- Diesel exhaust (DE) is likely to be carcinogenic to humans by inhalation from environmental exposures. Diesel exhaust as reviewed in this document is the combination of diesel particulate matter and diesel exhaust organic gases.
- Diesel exhaust also represents chronic respiratory effects, possibly the primary noncancer hazard from MSATs. Prolonged exposures may impair pulmonary function and could produce symptoms, such as cough, phlegm, and chronic bronchitis. Exposure relationships have not been developed from these studies.

There have been other studies that address MSAT health impacts in proximity to roadways. The Health Effects Institute, a non-profit organization funded by USEPA, FHWA, and industry, has undertaken a major series of studies to research near-roadway MSAT hot spots, the health implications of the entire mix of mobile source pollutants, and other topics. The final summary of the series is not expected for several years.

Some recent studies have reported that proximity to roadways is related to adverse health outcomes - particularly respiratory problems.[57] Much of this research is not specific to MSATs, instead surveying the full spectrum of both criteria and other pollutants. The FHWA cannot evaluate the validity of these studies, but more importantly, they do not provide information that would be useful to alleviate the uncertainties listed above and enable us to perform a more comprehensive evaluation of the health impacts specific to this project.

[57] South Coast Air Quality Management District, "Multiple Air Toxic Exposure Study-II," (2000); The Sierra Club, "Highway Health Hazards," (summarizing 24 Studies on the relationship between health and air quality) (2004); Environmental Law Institute, 'NEPA's Uncertainty in the Federal Legal Scheme Controlling Air Pollution from Motor Vehicles," 35 ELR 10273 with health studies cited therein, (2005).

3.9.2.7 Relevance of Unavailable or Incomplete Information to Evaluating Reasonably Foreseeable Significant Adverse Impacts on the Environment, and Evaluation of impacts based upon theoretical approaches or research methods generally accepted in the scientific community.

Because of the uncertainties outlined above, a quantitative assessment of the effects of air toxic emissions impacts on human health cannot be made at the project level. While available tools do allow us to reasonably predict relative emissions changes between alternatives for larger projects, the amount of MSAT emissions from each of the project alternatives and MSAT concentrations or exposures created by each of the project alternatives cannot be predicted with enough accuracy to be useful in estimating health impacts. (As noted above, the current emissions model is not capable of serving as a meaningful emissions analysis tool for smaller projects.) Therefore, the relevance of the unavailable or incomplete information is that it is not possible to make a determination of whether any of the alternatives would have "significant adverse impacts on the human environment."

3.9.3 What potential air quality impacts would the Preferred Alternative have?

Air quality is not likely to be impacted by the Preferred Alternative. The three-county area is currently in attainment of the NAAQS standards. In general, the project should alleviate traffic congestion along existing routes to the Myrtle Beach region, which would have positive effects on the region's air quality. In addition, these counties have entered into Early Action Compacts to set goals for cleaner air in the three-county area. This project also has been included in the South Carolina Transportation Infrastructure Program (STIP), which is reviewed for air quality compliance. With the Early Action Compacts in place, and standard review of the project as part of the South Carolina Transportation Infrastructure Program, the project is not likely to impact air quality in the three-county area.

As discussed above, technical shortcomings of emissions and dispersion models and uncertain science with respect to health effects prevent meaningful or reliable estimates of MSAT emissions and effects of this project. However, even though reliable methods do not exist to accurately estimate the health impacts of MSATs at the project level, it is possible to qualitatively assess the levels of future MSAT emissions under the project. Although a qualitative analysis cannot identify and measure health impacts from MSATs, it can give a basis for identifying and comparing the potential differences among MSAT emissions. The qualitative assessment presented below is derived in part from a study conducted by the FHWA entitled *A Methodology for Evaluating Mobile Source Air Toxic Emissions Among Transportation Project Alternatives*, found at: www.fhwa.dot.gov/environment/airtoxic/msatcompare/msatemissions.htm.

Emissions associated with Preferred Alternative would likely be lower than projected in the design year as a result of EPA's national control programs that are anticipated to reduce MSAT emissions by 57 to 87 percent from 2000 to 2020. Local conditions may differ from these national projections in terms of fleet mix and turnover, VMT growth rates, and local control measures. However, the magnitude of the EPA-projected reductions is so great (even after accounting for VMT growth) that future MSAT emissions in the project study area are anticipated to be lower in virtually all cases.

During the development of the Preferred Alternative, areas of high density development, communities, neighborhoods, and residential areas were avoided to the extent possible. However, the Preferred Alternative would move traffic closer to some nearby homes and businesses; therefore, there may be localized areas where ambient concentrations of MSATs could be higher under the Preferred Alternative than the No-build Alternative.

As discussed above, the magnitude and the duration of these potential increases compared to the No-build Alternative cannot be accurately quantified due to the inherent deficiencies of current models. In sum, when a highway is built and, as a result, moves closer to receptors, the localized level of MSAT emissions for the Preferred Alternative could be higher relative to the No-build Alternative. This could be offset due to a higher speed on an interstate facility, which reduces congestion (which are associated with lower MSAT emissions). Also, MSATs would be lower in other locations when traffic shifts away from receptors. However, on a regional basis, USEPA's vehicle and fuel regulations, coupled with fleet turnover, will over time cause substantial reductions that may cause region-wide MSAT levels to be significantly lower than today.

3.9.4 Would air quality be impacted from construction of the Preferred Alternative?

Air quality impacts may occur during construction due to the dust and fumes from equipment, earthwork activities, and vehicles accessing the construction site. Air quality impacts may also occur from an increase of vehicle emissions from traffic delays due to construction activities. Construction activities could include staging of construction for interchange locations, delivery of equipment and materials, and longer waiting times at traffic signals.

Best management practices (BMPs) that limit dust generation are described in the *South Carolina Stormwater Management and Sediment Control Handbook for Land Disturbance Activities*[58] and *A Guide to Site Development and Best Management Practices for Stormwater Management and Sediment Control.*[59] These methods include vegetative cover, mulch, spray-on adhesive, calcium chloride applications, water sprinkling, stone, tillage, wind barriers, and construction of a temporary graveled entrance/exit to the construction site.

In accordance with Section 107.07 of the South Carolina Highway Department Standard Specifications for Highway Construction,[60] the contractor would comply with *South Carolina Air Pollution Control Laws, Regulations and Standards*.[61] The contractor would also comply with county and other local air pollution regulations. Any burning of cleared materials would be conducted in accordance with applicable state and local laws, regulations and ordinances, and the regulations of the South Carolina's State Implementation Plan for air quality, in compliance with Regulation 62.2, Prohibition of Open Burning.

[58] SCDHEC-OCRM, *South Carolina Stormwater Management and Sediment Control Handbook for Land Disturbance Activities* (2003), Appendix E.
[59] SCDHEC-OCRM, *A Guide to Site Development and Best Management Practices for Stormwater Management and Sediment Control.*
[60] SCDOT, *Standard Specifications for Highway Construction* (2000).
[61] SCDHEC, Bureau of Air Quality Control, *South Carolina Air Pollution Control Laws, Regulations, and Standards.*