Appendix C.3

Mobile Source Inventory Documentation

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1.0 INTRODUCTION AND SCOPE

Mobile sources comprise about 50% of the nitrogen oxides (NOx) emissions in Edgecombe and Nash Counties. Mobile sources can be subdivided into two subcategories, highway mobile sources and non-highway mobile sources. Off-road mobile sources are further divided into non-road mobile, railroad locomotives and aircraft engines. The larger contributor to the mobile source emissions is from highway mobile sources.

2.0 OVERALL METHODOLOGY

2.1 SOURCE CATEGORY IDENTIFICATION

Highway mobile sources were identified from the U. S. Environmental Protection Agency (USEPA) highway mobile model MOBILE6.2.

Off-road mobile sources were identified from the USEPA guidance document EPA-450/4-91-016, Procedures for the Preparation of Emissions Inventories for Carbon Monoxide and Precursors of Ozone (Procedures document); EPA-454/R-05-001 Emissions Inventory Guidance for Implementation of Ozone and Particulate Matter National Ambient Air Quality Standards (NAAQS) and Regional Haze Regulations; EPA-450/4-81-026d (Revised) Procedures for Emission Inventory Preparation, Volume IV; Mobile Sources (Mobile Source Procedures); and from the USEPA's off-road mobile model NONROAD2005a released February 10, 2006.

2.2 EMISSION ESTIMATION APPROACH

Mobile source emissions are estimated by the methodologies suggested in the USEPA document Emissions Inventory Guidance for Implementation of Ozone and Particulate Matter National Ambient Air Quality Standards (NAAQS) and Regional Haze Regulations. The estimation of emissions from mobile sources, like area sources, involves multiplying an activity level by an emission factor.

For highway mobile sources, the USEPA mobile model MOBILE6.2 is used to generate emission factors which are multiplied by the vehicle miles traveled (VMT) to determine the estimated emissions.

The majority of the off-road mobile emissions were estimated by using the USEPA off-road mobile model NONROAD2005a. Direct emissions are generated with this model. For aircraft engine emissions, the Federal Aviation Administration (FAA) Emissions and Dispersion Modeling System (EDMS) model was used. Aircraft operations were inputted into the model and the model predicts the engine emissions based on average landing and take-off practices for the aircraft type. For railroad locomotive emissions, emission factors were obtained from the Mobile Source Procedures document and the activity level was obtained from the various railroad companies.

3.0 QUALITY ASSURANCE MEASURES

The quality assurance (QA) procedures for the off-road mobile source categories were conducted in the same manner as the area source categories. That is, for each category, the completed emission estimate (including a discussion of the methodology) was given to an individual who was not involved with the compilation of emissions for that category. This individual reviewed the information and commented to the emissions inventory developer on any needed modifications.

The QA for the highway mobile source category can be broken into three components: 1) input files, 2) MOBILE6.2 outputs/summaries, and 3) VMT interpolation. Each of these components are detailed in the paragraphs below.

After the speed and VMT information is acquired from the North Carolina Department of Transportation (NCDOT), the speed information is checked for reasonableness against previous sets of speeds for the area. Once comfortable with the speeds, the North Carolina Division of Air Quality (NCDAQ) enters the speed information into MOBILE6.2 input files. In addition to the speed information, the following inputs are included in the input files: pollutants, fuel Reid Vapor Pressure (RVP), 24 hour temperature and relative humidity profiles, barometric pressure, inspection and maintenance program, anti-tampering program, calendar year, evaluation month, and the vehicle mix per road type. All input files are printed and checked by hand against a "key" with the original source of the information. This QA step is always performed by a person other than the one who generated the files. If any discrepancies are found, they are marked on the hard copy and supplied by to the person who generated the input files for correction. Another input is referenced in the actual MOBILE6.2 input file. It is the vehicle age distribution. This file is checked against the original spreadsheet from which it is generated. Again, if any discrepancies are found, they are noted and returned to the person responsible for generating those files.

Once the input files have passed through the QA procedure, MOBILE6.2 is run to generate emission factors. The emission factors are output into two forms from the MOBILE6.2 model. One set of outputs is formatted nicely for importing into a spreadsheet. Once in the spreadsheet, data can easily be formatted into summary tables. An additional step in the spreadsheet is to multiply the emission factors by the daily VMT to get daily emissions. The next step is then performed by comparing the summary tables containing emission factors to the other MOBILE6.2 output file (referred to as the "text output").

A final step is to check the VMT used in the preceding step in the summary spreadsheets against the original source of the VMT. If VMT was not provided for the specific years requested, then the NCDAQ performs a linear interpolation to calculate the exact year needed. This linear interpolation is checked by a person other than the one who generated the file to ensure no errors were introduced.

4.0 DISCUSSION OF MOBILE SOURCE CATEGORIES

Mobile sources produce volatile organic compounds (VOCs) and NOx. Emissions of these pollutants are estimated in the mobile source inventory required for the maintenance plan. There are two major source categories comprising of a number of individual mobile source types. Sections 4.1 and 4.2 addresses highway mobile sources and off-road mobile sources, respectively. The objective of each section is to describe the source category and the emissions estimation procedures. Each section also includes tables summarizing the estimated emissions for a typical summer day by county. In Section 5 are copies of the data used in the calculation of the estimated emissions, such as the MOBILE6.2 mobile model input and output files and the NONROAD2005a model input files.

4.1 HIGHWAY MOBILE SOURCE EMISSIONS

4.1.1 Introduction and Scope

Highway mobile sources are considered those vehicles that travel on the roadways. Mobile Sources comprise over 50 percent of the emissions of NOx emissions in North Carolina. In Edgecombe and Nash Counties highway mobile sources contribute 38% and 76% of the 2005 NOx, respectively. Emissions from motor vehicles occur throughout the day while the vehicle is in motion, at idle, parked, and during refueling. All of these emissions processes need to be estimated in order to properly reflect the total emissions from this source category. In its simplest terms, emissions from highway mobile sources are calculated by multiplying an activity level, in this case daily VMT as provided by the NCDOT, by an emission factor.

The USEPA developed the MOBILE model to estimate emission factors based on information on the way vehicles are driven in a particular area. The newest version of the MOBILE model (MOBILE6.2) was used. This model was released by the USEPA in 2002 and differs significantly from previous versions of the model. Key inputs for MOBILE6.2 include information on the age of vehicles on the roads, the average speed of those vehicles, what types of roads those vehicles are traveling on, any control technologies in place in an area to reduce emissions for motor vehicles (e.g., emissions inspection programs), and ambient temperature.

A very important component of the highway mobile emission estimation process is interagency consultation. The primary transporation partners involved in the Rocky Mount redesignation interagency consultation process included: NCDOT, USEPA, Federal Highway Administration (FHWA), and the City of Rocky Mount. Specifically the NCDOT was consulted for input data such as speeds and VMT. Also, an interagency consulation conference call was held to discuss some of the specific details on setting motor vehicle emissions budguts (MVEBs).

4.1.2 MOBILE6.2 Input Assumptions

The MOBILE6.2 input files and output files are compiled in Section 5 – Data.

Speed Assumptions

Emissions from motor vehicles vary with the manner in which the vehicle is operated. Vehicles traveling at 65 miles per hour (mph) emit a very different mix of pollutants than the car that is idling at a stoplight. In order to estimate emissions from vehicles for a typical day, the NCDOT provided speeds for Edgecombe and Nash Counties.

In Edgecombe and Nash Counties, the latest speeds were obtained from the NCDOT via e-mail on January 11, 2006. The speeds provided are based on a daily average. The Rocky Mount Urban Area Metropolitan Planning Organization (MPO) does not cover the entire Rocky Mount nonattainment area, only the urban portion. Therefore, the speeds for the urban area covered by the MPO, in both Edgecombe and Nash Counties, were generated from the travel demand model. The speeds for the remaining rural area are generated by a spreadsheet used to calculate speeds by the NCDOT. The MOBILE6.2 model was utilized to generate emission factors for the entire nonattainment area that included separate modeling runs for the speeds from the travel demand model and the calculated speeds for the rural area. The speeds were provided for the years 2005, 2008, 2011, 2014 and 2017.

Tables 4.1.2-1 and 4.1.2-2 provide a summary of the speeds. The column headings in these tables represent the road types used in the modeling and are listed below.

RI	Rural Interstate	UI	Urban Interstate
RPA	Rural Other Principle Arterial	UF	Urban Freeway & Expressway
RMA	Rural Minor Arterial	UPA	Urban Other Principal Arterial
RMjC	Rural Major Collector	UMiA	Urban Minor Arterial
RMiC	Rural Minor Collector	UC	Urban Collector
RL	Rural Local	UL	Urban Local

Table 4.1.2-1 Travel Demand Model Speeds for the Rocky Mount Area

County	UI	UF	UPA	UMiA	UC	UL	RI	RPA	RMA	RMjC	RMiC	RL
For 2005												
Edgecombe	N/A	65	35	41	40	37	N/A	65	51	53	52	47
Nash	65	65	46	44	39	34	65	60	53	52	50	41
For 2008												
Edgecombe	N/A	65	35	42	40	38	N/A	65	51	53	52	47
Nash	65	65	45	44	39	34	65	61	53	52	50	42
For 2011												
Edgecombe	N/A	65	35	42	40	38	N/A	65	51	53	52	47
Nash	65	65	45	44	39	34	65	61	53	52	50	42
For 2014												
Edgecombe	N/A	65	35	42	40	38	N/A	65	51	53	52	47
Nash	65	65	45	44	39	34	65	61	53	52	50	42
For 2017												
Edgecombe	N/A	65	35	42	40	38	N/A	65	52	53	52	47
Nash	65	65	45	44	40	35	65	61	53	52	50	42

Table 4.1.2-2 Rural Area Speeds for the Rocky Mount Area

County	UI	UF	UPA	UMiA	UC	UL	RI	RPA	RMA	RMjC	RMiC	RL
For 2005												
Edgecombe	N/A	56	29	32	31	30	N/A	45	44	43	42	42
Nash	N/A	56	29	32	31	30	66	47	44	43	42	42
For 2008												
Edgecombe	N/A	55	29	32	31	30	N/A	45	44	43	42	42
Nash	N/A	56	29	32	31	30	66	47	44	43	42	42
For 2011												
Edgecombe	N/A	55	29	32	31	30	N/A	45	44	43	42	42
Nash	N/A	56	29	32	31	30	66	47	44	43	42	42
For 2014												
Edgecombe	N/A	55	29	32	31	29	N/A	45	44	43	42	42
Nash	N/A	56	29	32	31	30	65	47	44	43	42	42
For 2017												
Edgecombe	N/A	55	29	32	31	29	N/A	45	44	43	42	42
Nash	N/A	56	29	32	31	30	65	47	44	43	42	42

The MOBILE6.2 command "AVERAGE SPEED" was used to enter the daily speeds provided by NCDOT. This command requires two data elements: average speed and a roadway scenario. As with all average speed inputs to MOBILE6.2, average speeds may range from 2.5 to 65 miles per hour. The roadway scenario data element indicates the type of driving that the user intends for the average speed input to model. NCDAQ and NCDOT follow the USEPA *Technical Guidance on the Use of MOBILE6.2 for Emission Inventory Preparation* (Office of Transportation, and Air Quality EPA420-R-04-013, August 2004) to match FHWA roadways to MOBILE6.2 driving cycles with the exception of urban local roads. However, for urban local roads, NCDAQ follows the USEPA advice on provided on page 30 of the same guidance document:

> *Note that the MOBILE6.2 driving cycle used for local roadways may differ from the range of activity on the roadways defined as local by USDOT Publication No. FHWA-ED-90-006 revised March 1989 (Highway Functional Classification) for both rural and urban local VMT. The local roadway driving cycle used in MOBILE6.2 likely constitutes only a small subset of urban local VMT as defined by FHWA. When in doubt, EPA recommends that any roadway VMT that does not clearly match the MOBILE6.2 driving cycle for local roadways be included with MOBILE6.2 arterial/collector VMT rather than included with MOBILE6.2 local roadway VMT.*

Roadway scenarios per facility type are defined as follows:

Rural interstate	Non-Ramp
Rural principle arterial	Non-Ramp
Rural minor arterial	Arterial
Rural major collector	Arterial
Rural minor collector	Arterial
Rural local	Arterial
Urban interstate	Non-Ramp
Urban freeway	Non-Ramp
Urban principle arterial	Arterial
Urban minor arterial	Arterial
Urban collector	Arterial
Urban local	Arterial

Interstates are modeled as “Non-Ramp” instead of “Freeway” because both speed and VMT for ramps are included in the functional classification for the major facility it is connected to in the model. This is consistent with the USEPA guidance mentioned above.

Vehicle Age Distribution

The vehicle age distribution comes from annual registration data for North Carolina from the NCDOT. For this analysis the data was generated for 2004. The NCDOT provided the latest available count data based on the number of vehicle types per year from 1974 through 2004. Vehicles greater than 25 years old were combined and included as the 25th model year. The vehicle count information is provided for nine vehicle types; light duty gas vehicles (LDGV), light duty diesel vehicles (LDDV), light duty gas trucks 1 (LDGT1), light duty gas trucks 2 (LDGT2), light duty diesel trucks 1 (LDDT1), light duty diesel trucks 2 (LDDT2), heavy duty gas vehicles (HDGV), heavy duty diesel vehicles (HDDV) and motorcycles (MC). LDDT1 and LDDT2 are combined and labeled as light duty diesel trucks (LDDT). This vehicle distribution corresponds to the old MOBILE5 format and does not correlate to the USEPA MOBILE6.2 model vehicle types. In order to convert the data provided by the NCDOT into the MOBILE6.2 model format, the NCDAQ used an utility developed by the USEPA that disaggregates the 8 MOBILE5 model vehicle types into the 16 MOBILE6.2 vehicle types. The count data provided by the NCDOT is converted to fractions by dividing each count per vehicle type per year by the total number of vehicles in that classification for all years. For example, the number of 2004 light duty vehicles divided by the total number of light duty vehicles for all years. The fractions are arranged into MOBILE5 format for conversion to the 16 vehicle types required by the MOBILE6.2 model using the USEPA conversion utility.

Vehicle Mix Assumptions

The vehicle mix refers to the percentage of different vehicle types on each of the 12 FHWA road types. These road types are listed above in the speed assumptions section. It is critical for estimating mobile emissions in an area to use data that accurately reflects the vehicles types traveling on each of these different road types.

Historically, the North Carolina statewide vehicle mix was created using spreadsheets that were developed in the mid-1990s. In August 2004, the USEPA released the guidance document EPA420-R-04-013, *Technical Guidance on the Use of MOBILE6.2 for Emission Inventory Preparation*. The NCDAQ created a new statewide mix based on this methodology. Outlined below is the methodology used to convert the 13 Highway Performance Monitoring System (HPMS) vehicle types count data reported to FHWA and generate a state specific vehicle mix.

The North Carolina HPMS data that was used to generate the new statewide vehicle mix was based on 1999 through 2001 data counts. This is the latest available statewide count information. Table 4.1.2-3 shows the percent of vehicles per vehicle type for each of the 12 road classes.

Table 4.1.2-3 Percentage of Vehicles Per Vehicle Type by Functional Road Class

	PASS CARS	PICK UPS	BUS	2-A TRK	3-A TRK	4-A TRK	4-A TTST	5-A TTST	6-A TTST	5-A TWIN	6-A TWIN	7-A TWIN	MC
Rural													
Interstate	56.93%	10.80%	1.06%	2.50%	1.56%	1.09%	4.79%	19.23%	0.48%	0.73%	0.24%	0.11%	0.49%
Oth Prin Art*	69.34	15.79	0.71	2.80	1.48	0.25	2.07	6.67	0.26	0.16	0.05	0.04	0.40
Minor Art**	70.58	17.23	0.59	3.19	1.87	0.27	1.79	3.69	0.21	0.05	0.01	0.02	0.49
Major Col*	73.21	17.52	0.51	3.01	1.45	0.24	1.63	1.84	0.18	0.02	0.01	0.02	0.36
Minor Col*	74.00	16.50	0.65	3.00	1.55	0.17	1.75	1.50	0.30	0.05	0.02	0.06	0.45
local	71.93	18.66	0.51	4.09	1.06	0.02	1.54	1.60	0.05	0.00	0.00	0.00	0.55
Urban													
Interstate	68.68	12.84	0.89	2.12	1.68	0.42	2.70	9.29	0.45	0.36	0.09	0.10	0.36
Oth Freeway	74.79	13.97	0.57	2.48	1.17	0.42	2.56	3.42	0.17	0.07	0.01	0.03	0.33
Oth Prin Art**	76.64	14.84	0.46	2.20	1.30	0.13	1.66	2.12	0.21	0.04	0.01	0.04	0.32
Minor Art	79.35	14.43	0.47	2.16	1.08	0.10	1.26	0.66	0.11	0.00	0.00	0.02	0.36
Collectors	81.15	13.42	0.43	2.02	1.12	0.07	0.99	0.40	0.05	0.00	0.00	0.01	0.34
local	75.56	16.59	0.82	2.57	1.73	0.03	0.95	1.05	0.10	0.00	0.00	0.00	0.59

Disaggregating State Specific Information

Section 4.1.5 of *Technical Guidance on the Use of MOBILE6.2 for Emission Inventory Preparation*, illustrates how to map the HPMS statewide vehicle data to general vehicle categories. This mapping is outlined below:

HPMS Category	**General Category**
Motorcycle	Motorcycle (MC)
Passenger Car	Passenger Car (LDV)
Other 2-Axel, 4-Tire Vehicles	Light Truck (LDT)
Busses	Bus (HDB)
All Other Trucks: Single unit, 2-axel, 6-tire Single unit, 3-axel Single unit, 4 or more axel Single trailer, 4 or fewer axel Single trailer, 5-axel Single trailer, 6 or more axel Multi-trailer, 5 or fewer axel Multi-trailer, 6-axel Multi-trailer, 7 or more axel	Heavy Duty Truck (HDV)

The HPMS data in Table 4.1.2-3 was grouped into these five general categories for each road type. In order to expand the five general categories to the 16 vehicle types used in MOBILE6.2, the national average VMT fractions by each vehicle class were used. The 2000 fractions were used since the state specific data is from 1999 through 2001. The national average data was obtained from Table 4.1.2 in *Technical Guidance on the Use of MOBILE6.2 for Emission Inventory Preparation*. An example for rural interstates is illustrated below:

From Table 4.1.2-3 above:

Passenger Cars	= 56.93%		5 axel Trailer	=	19.23%
Pickup Trucks	= 10.80%		6 axel Trailer	=	0.48%
Bus	= 1.06%		5 axel Multi Trailer	=	0.73%
2 axel Trucks	= 2.50%		6 axel Multi Trailer	=	0.24%
3 axel Trucks	= 1.56%		7 axel Multi Trailer	=	0.11%
4 axel Trucks	= 1.09%		Motorcycles	=	0.49%
4 axel Trailer	= 4.79%				

Therefore, the five general categories are:

Motorcycles	=	0.49%
Light Duty Vehciles	=	56.93%
Light Duty Trucks	=	10.80%
Heavy Duty Buses	=	1.06%
Heavy Duty Vehicles	=	30.73%

From Table 4.1.2 in *Technical Guidance on the Use of MOBILE6.2 for Emission Inventory Preparation*, the 2000 national average vehicle mix for light duty trucks, buses and heavy duty trucks are:

Light Duty Trucks

LDT1	=	0.0655
LDT2	=	0.2179
LDT3	=	0.0672
LDT4	=	0.0309
Total	**=**	**0.3815**

Buses

HDBS	=	0.0019
HDBT	=	0.0009
Total	**=**	**0.0028**

Heavy Duty Trucks

HDV2B	=	0.0380
HDV3	=	0.0038
HDV4	=	0.0029
HDV5	=	0.0022
HDV6	=	0.0082
HDV7	=	0.0098
HDV8A	=	0.0108
HDV8B	=	0.0386
Total	**=**	**0.1143**

Using the methodology described in Section 4.1.5 in *Technical Guidance on the Use of MOBILE6.2 for Emission Inventory Preparation* the new 2000 North Carolina statewide mix was developed. The basic formula for developing the mix is shown below,

$$\text{Vehicle Type} = (\text{2000 M6.2 fraction for vehicle}) \times \frac{(\text{99-01 State total for group})}{(\text{2000 M6.2 total for subcategory})}.$$

Table 4.1.2-4 displays the calculation for each vehicle type for the 2000 rural interstate vehicle mix.

Table 4.1.2-4 Calculation of New 2000 Statewide Rural Interstate Vehicle Mix

Vehicle Type		Calculation		New 2000 Mix
LDV	=	LDV	=	0.5693
MC	=	MC	=	0.0049
Light Duty Trucks				
LDT1	=	0.0655 x (0.1080/0.3815)	=	0.0185
LDT2	=	0.2179 x (0.1080/0.3815)	=	0.0617
LDT3	=	0.0672 x (0.1080/0.3815)	=	0.0190
LDT4	=	0.0309 x (0.1080/0.3815)	=	0.0087
Heavy Duty Vehicles				
HDV2B	=	0.0380 x (0.3073/0.1143)	=	0.1022
HDV3	=	0.0038 x (0.3073/0.1143)	=	0.0102
HDV4	=	0.0029 x (0.3073/0.1143)	=	0.0078
HDV5	=	0.0022 x (0.3073/0.1143)	=	0.0059
HDV6	=	0.0082 x (0.3073/0.1143)	=	0.0220
HDV7	=	0.0098 x (0.3073/0.1143)	=	0.0263
HDV8A	=	0.0108 x (0.3073/0.1143)	=	0.0290
HDV8B	=	0.0386 x (0.3073/0.1143)	=	0.1038
Buses				
HDBS	=	0.0019 x (0.0106/0.0028)	=	0.0072
HDBT	=	0.0009 x (0.0106/0.0028)	=	0.0034

<u>2005, 2008, 2011, 2014 and 2017 Statewide Vehicle Mix</u>

Once the 2000 vehicle mix was generated, the other years were created using the methodology described in Section 4.1.4 in *<u>Technical Guidance on the Use of MOBILE6.2 for Emission Inventory Preparation</u>*. This method grouped light duty vehicles, light duty trucks and motorcycles together and heavy duty buses, heavy duty trucks and heavy duty vehicles together. The combined percentages for these groupings are listed below.

Light Duty Vehicles = 68.22%
Heavy Duty Vehicles = 31.78%

The MOBILE6.2 vehicle mix fractions for the year being developed were obtained from Table 4.1.2 in *Technical Guidance on the Use of MOBILE6.2 for Emission Inventory Preparation*. The MOBILE6.2 vehicle fractions for 2005 are listed below.

Light Duty Vehicles

LDV	=	0.4231
LDT1	=	0.0774
LDT2	=	0.2577
LDT3	=	0.0794
LDT4	=	0.0365
MC	=	0.0057
Total	**=**	**0.8798**

Heavy Duty Vehicles

HDV2B	=	0.0387
HDV3	=	0.0038
HDV4	=	0.0031
HDV5	=	0.0023
HDV6	=	0.0086
HDV7	=	0.0102
HDV8A	=	0.0111
HDV8B	=	0.0395
HDBS	=	0.0020
HDBT	=	0.0009
Total	**=**	**0.1202**

The North Carolina 2005 vehicle mix was normalized to the MOBILE6.2 fractions using the following formula:

$$\text{Vehicle Type} = (\text{2005 M6 fraction for vehicle}) \times \frac{(\text{2000 State total for group})}{(\text{2005 M6 total for group})}$$

Table 4.1.2-5 below displays the calculations used to generate the 2005 North Carolina vehicle mix for rural interstate.

Table 4.1.2-5 Calculation of 2005 Statewide Rural Interstate Vehicle Mix

Vehicle Type		Calculation		2005 State Mix
Light Duty Vehicles				
LDV	=	0.4231 x (0.6822/0.8798)	=	0.3281
LDT1	=	0.0774 x (0.6822/0.8798)	=	0.0600
LDT2	=	0.2577 x (0.6822/0.8798)	=	0.1998
LDT3	=	0.0794 x (0.6822/0.8798)	=	0.0616
LDT4	=	0.0365 x (0.6822/0.8798)	=	0.0283
MC	=	0.0057 x (0.6822/0.8798)		0.0044
Heavy Duty Vehicles				
HDV2B	=	0.0387 x (0.3178/0.1202)	=	0.1023
HDV3	=	0.0038 x (0.3178/0.1202)	=	0.0100
HDV4	=	0.0031 x (0.3178/0.1202)	=	0.0082
HDV5	=	0.0023 x (0.3178/0.1202	=	0.0061
HDV6	=	0.0086 x (0.3178/0.1202)	=	0.0227
HDV7	=	0.0102 x (0.3178/0.1202)	=	0.0270
HDV8A	=	0.0111 x (0.3178/0.1202)	=	0.0293
HDV8B	=	0.0395 x (0.3178/0.1202)	=	0.1044
HDBS	=	0.0020 x (0.3178/0.1202)	=	0.0053
HDBT	=	0.0009 x (0.3178/0.1202)	=	0.0024

This method was used to generate all of the future year vehicle mixes that were needed to compute the emission factors. The North Carolina transportation partners consider the statewide vehicle mix to be the best representation of the vehicle population in Edgecombe and Nash Counties.

Temperature, Relative Humidity and Barometric Pressure Assumptions

The MOBILE6.2 command “HOURLY TEMPERATURES” was used to enter 24 hourly temperatures to estimate mobile source emissions. This command requires the command name followed by the 24 hourly temperatures in the data field in the RUN SECTION of the mobile input files. The temperatures must be listed beginning with the 6 a.m. and continuing through 5 a.m. the next day. The first 12 values must be on the same line as the command; the remaining twelve must be on the next line. For the Rocky Mount mobile source emission estimates, the

NCDAQ used average July 2005 24 hour temperature profile from the Automated Surface Observing System at the Rocky Mount/Wilson Regional Airport (KRWI).

The MOBILE6.2 command “RELATIVE HUMIDITY” was used to enter 24 hourly relative humidity values to estimate mobile source emissions. This command requires the 24 hourly values be in the same format as the HOURLY TEMPERATURES command. The relative humidity values are entered in the SCENARIO section of the mobile input files. Just as the temperatures, the relative humidity data represents an average July 2005 profile from KRWI. When the RELATIVE HUMIDITY command is used, the user supplied relative humidity values are converted to absolute humidity. This conversion requires values of temperature and barometric pressure.

The BAROMETRIC PRES command allows the user to change the default value of barometric pressure used in the humidity conversion. The value used was based upon the National Oceanic and Atmospheric Administration Cooperative Institute for Research in Environmental Sciences Climate Diagnostics Center (NOAA-CIRES CDC) reanalysis web page. The Figure below provides the mean barometric pressure for July based upon 1948-2004 data. As one can see, the average July pressure in the Rocky Mount, North Carolina area is between 1016.5 mb and 1017.5 mb or 30.01 and 30.04 inches of mercury. Therefore, a pressure of 30.0 inches of mercury is used in the exercise.

Figure 4.1.2-1. Mean barometric pressure for July based upon 1948-2004 data

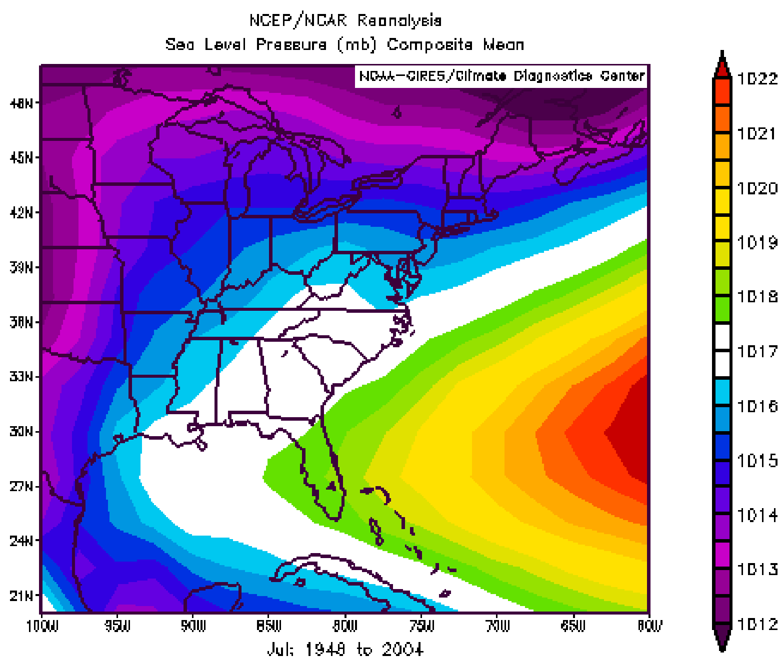


Table 4.1.2-6 provides the tempertatures, relative humidy and barometric pressure data and format used in this analysis.

Table 4.1.2-6 Temperatures, Relative Humidity and Pressure used in Mobile Emission Estimates

```
HOURLY TEMPERATURES: 73. 73. 74. 76. 78. 80. 82. 84. 86. 88. 88. 88.
                     86. 85. 84. 81. 79. 77. 75. 74. 73. 73. 73. 73.

RELATIVE HUMIDITY  : 97. 96. 89. 81. 79. 71. 64. 56. 54. 51. 51. 52.
                     58. 62. 68. 71. 77. 83. 87. 92. 95. 95. 96. 97.

BAROMETRIC PRES    : 30.0
```

Vehicle Inspection and Maintenance Program Assumptions

In 2002, North Carolina implemented a new vehicle emissions inspection program referred to as onboard diagnostics (OBDII). This program covers all light duty gasoline powered vehicles that are model year 1996 and newer. The program was initially implemented in 9 counties and was expanded to include a total of 48 counties between July 2002 and January 2006. Edgecombe and Nash Counties were phased-in during Phase 5 which began on January 1, 2005. The OBDII compliance rate used in the mobile source emission estimates is 95 percent. In addtion, the inspection stations are required to administer an anti-tampering check to ensure that emissions control equipment on any vehicle 1968 and newer has not been altered.

Reid Vapor Pressure Assumptions

RVP reflects a gasoline’s volatility. An RVP of 9.0 pounds per square inch is required during May through September for the Rocky Mount area. Lower RVP leads to lower VOC emissions from gasoline handling and lowers vapor losses from motor vehicles.

4.1.3 VMT Assumptions

In order to calculate emissions from on-road mobile sources, emission factors are developed as discussed throughout this document. The emission factors are then multiplied by an activity level, which for on-road mobile sources is daily VMT.

The daily VMT for the Rocky Mount area was provided by the NCDOT via e-mail on January 11, 2006 for 2002, 2010, 2020, and 2030 (see Section 4.1.7). A linear interpolation was conducted for the years 2005, 2008, 2011, 2014, and 2017. The VMT was reported as inside the Rocky Mount Urban Area MPO boundary and outside the MPO. This definition is to distinguish the Rocky Mount urban portion (under the jurisdiction of the MPO) from the remaining rural portion of the area. Because the urban area of Edgecombe and Nash Counties is modeled using the travel demand model, the VMT for the urban portion is derived from this model and the remaining rural area is generated from the NCDOT's "new rural spreadsheet" calculations. The NCDOT's new version of this rural spreadsheet accounts for the impact of added lane miles on forecasted VMT. This adjustment is done using the following formula:

*Road type VMT for the analysis year = Road type HPMS VMT + [(total base year VMT/total base year lane miles) * added lane miles for the road type in analysis year]*

The VMT for Edgecombe and Nash Counties are summarized in Tables 4.1.3-1 and 4.1.3-2.

Table 4.1.3-1 Vehicle Miles Traveled for Edgecombe County

Road Type	2005	2008	2011	2014	2017
Edgecombe County (Urban Area)					
Urban Interstate	0	0	0	0	0
Freeway & Expressway	109,780	123,378	133,720	137,552	141,384
Urban Other Principle Arterial	19,508	20,583	21,495	22,081	22,667
Urban Minor Arterial	101,490	107,816	115,839	127,257	138,675
Urban Collector	15,746	16,557	17,213	17,560	17,907
Urban Local	55,036	59,843	63,988	66,808	69,628
Rural Interstate	0	0	0	0	0
Rural Other Principle Arterial	154,914	179,460	201,164	217,182	233,200
Rural Minor Arterial	8,209	8,356	8,549	8,831	9,113
Rural Major Collector	98,489	90,541	87,401	93,878	100,355
Rural Minor Collector	63,041	65,403	67,869	70,546	73,223
Rural Local	77,237	83,141	88,162	91,416	94,671
Edgecombe County (Rural Area)					
Urban Interstate	0	0	0	0	0
Freeway & Expressway	53,154	61,908	69,088	73,120	77,152
Urban Other Principle Arterial	57,955	62,369	66,608	70,495	74,382
Urban Minor Arterial	83,245	93,910	103,024	109,037	115,049
Urban Collector	9,805	10,842	11,762	12,449	13,135
Urban Local	44,236	47,795	51,162	54,148	57,134
Rural Interstate	0	0	0	0	0
Rural Other Principal Arterial	211,198	225,749	240,120	254,134	268,147
Rural Minor Arterial	79,495	85,851	91,876	97,238	102,600
Rural Major Collector	204,903	212,713	222,244	235,214	248,184
Rural Minor Collector	114,627	124,572	133,805	141,614	149,423
Rural Local	64,591	69,242	73,778	78,084	82,390

Table 4.1.4-2 Vehicle Miles Traveled for Nash County

Road Type	2005	2008	2011	2014	2017
Nash County (Urban Area)					
Urban Interstate	28,247	30,657	33,151	35,811	38,471
Freeway & Expressway	330,360	345,909	357,667	361,842	366,017
Urban Other Principle Arterial	274,611	276,027	282,531	299,208	315,886
Urban Minor Arterial	409,499	446,313	482,286	518,816	544,787
Urban Collector	64,512	71,231	75,927	76,573	77,220
Urban Local	154,814	164,009	171,843	176,954	182,065
Rural Interstate	665,931	727,630	788,957	849,541	910,124
Rural Other Principal Arterial	192,431	201,176	213,157	231,610	250,063
Rural Minor Arterial	65,244	71,079	76,176	79,797	83,418
Rural Major Collector	234,282	258,890	288,777	329,220	369,663
Rural Minor Collector	232,475	257,734	283,053	308,488	333,924
Rural Local	106,788	116,191	124,523	130,714	136,906
Nash County (Rural Area)					
Urban Interstate	0	0	0	0	0
Freeway & Expressway	66,614	72,469	77,520	80,963	84,406
Urban Other Principle Arterial	121,678	133,472	143,458	149,830	156,202
Urban Minor Arterial	97,177	104,817	111,562	116,517	121,472
Urban Collector	27,528	29,613	31,469	32,867	34,265
Urban Local	28,464	30,002	31,493	32,891	34,290
Rural Interstate	318,891	335,398	351,609	367,226	382,843
Rural Other Principal Arterial	225,668	235,034	244,904	255,781	266,659
Rural Minor Arterial	37,454	40,839	43,744	45,686	47,629
Rural Major Collector	191,538	205,173	217,483	227,143	236,802
Rural Minor Collector	127,429	135,643	143,239	149,601	155,963
Rural Local	49,348	51,386	53,537	55,915	58,293

4.1.4 Off Model Calculations

Not all 100 counties in North Carolina have a motor vehicle emission inspection and maintenance (I/M) program to address mobile emissions. As a direct result, such a control measure must be evaluated based on commuting activities to account for the vehicles that are not subject to such a program traveling throughout the nonattainment area. A methodology was developed using accident data that is tracked by the NCDOT as a surrogate for commuting patterns. The accident data used in this analysis is for 2001. This methodology was approved by the USEPA and will be used in this analysis.

Edgecombe and Nash Counties were phased-into the North Carolina emission inspection program on January 1, 2005. The final counties were incorporated into the program on January

1, 2006 so the 2008, 2011, 2014, and 2017 runs will have the same I/M fraction. Table 4.1.4-1 summarizes the I/M fractions used to calculate the tons per day emissions for each of the counties being analyzed.

Table 4.1.4-1 I/M Fractions

County	2005	2008, 2011, 2014 and 2017
Edgecombe	0.46	0.89
Nash	0.47	0.86

The calculation of tons per day is as follows:

$$\text{Emissions} = \frac{[\text{I/M EF} \times \text{I/M fraction} \times \text{VMT}] + [\text{Non I/M EF} \times (1-\text{I/M fraction}) \times \text{VMT}]}{C}$$

Where:

I/M EF = all vehicle emission factor from M6.2 inspection and maintenance run output for each road type (grams/mile)

I/M fraction = calculated I/M fraction for the analysis year

VMT = daily vehicle miles traveled (miles/day)

Non I/M EF = all vehicle emission factor from M6.2 non-inspection and maintenance output for each road type

C = conversion factor from grams to tons = 907185 grams per ton

4.1.5 Estimated Emissions From Mobile Sources

Each road type will have a different emission, which is then summed for each county for each year evaluated. A summary of emissions in tons per day, by county, is provided in Tables 4.1.5-1 and 4.1.5-2 for VOC and NOx emissions, respectively.

Table 4.1.5-1 VOC Road Type Emissions by County (tons/day)

Road Type	2005	2008	2011	2014	2017
Edgecombe County					
Urban Freeway & Expressway	0.23	0.21	0.18	0.15	0.13
Urban Other Principle Arterial	0.13	0.11	0.09	0.08	0.06
Urban Minor Arterial	0.30	0.25	0.23	0.19	0.17
Urban Collector	0.05	0.03	0.03	0.02	0.02
Urban Local	0.17	0.14	0.13	0.10	0.08
Rural Other Principal Arterial	0.53	0.46	0.41	0.34	0.29
Rural Minor Arterial	0.13	0.11	0.10	0.08	0.07
Rural Major Collector	0.47	0.36	0.30	0.25	0.21
Rural Minor Collector	0.27	0.23	0.20	0.16	0.13
Rural Local	0.22	0.18	0.16	0.13	0.11
Total VOC for Edgecombe	**2.50**	**2.08**	**1.83**	**1.50**	**1.27**
Nash County					
Urban Interstate	0.04	0.03	0.03	0.02	0.02
Urban Freeway & Expressway	0.56	0.46	0.40	0.33	0.26
Urban Other Principle Arterial	0.63	0.51	0.44	0.34	0.31
Urban Minor Arterial	0.82	0.69	0.61	0.49	0.43
Urban Collector	0.16	0.13	0.11	0.08	0.07
Urban Local	0.31	0.25	0.21	0.17	0.14
Rural Interstate	1.24	1.05	0.94	1.23	0.68
Rural Other Principal Arterial	0.61	0.49	0.42	0.40	0.30
Rural Minor Arterial	0.16	0.13	0.11	0.10	0.08
Rural Major Collector	0.65	0.55	0.50	0.41	0.37
Rural Minor Collector	0.55	0.47	0.42	0.34	0.30
Rural Local	0.25	0.20	0.18	0.14	0.13
Total VOC for Nash	**5.98**	**4.96**	**4.37**	**4.05**	**3.09**

Table 4.1.5-2 NOx Road Type Emissions by County (tons/day)

Road Type	2005	2008	2011	2014	2017
Edgecombe County					
Urban Freeway & Expressway	0.44	0.37	0.29	0.20	0.16
Urban Other Principle Arterial	0.13	0.11	0.08	0.06	0.05
Urban Minor Arterial	0.27	0.23	0.19	0.15	0.12
Urban Collector	0.03	0.03	0.02	0.02	0.02
Urban Local	0.16	0.13	0.11	0.08	0.06
Rural Other Principal Arterial	1.03	0.85	0.67	0.50	0.39
Rural Minor Arterial	0.18	0.14	0.11	0.09	0.07
Rural Major Collector	0.55	0.41	0.31	0.24	0.19
Rural Minor Collector	0.32	0.26	0.20	0.15	0.12
Rural Local	0.25	0.20	0.16	0.13	0.09
Total NOx for Edgecombe	**3.36**	**2.73**	**2.14**	**1.62**	**1.27**
Nash County					
Urban Interstate	0.11	0.09	0.07	0.05	0.04
Freeway & Expressway	1.09	0.86	0.64	0.45	0.34
Urban Other Principle Arterial	0.68	0.53	0.41	0.31	0.25
Urban Minor Arterial	0.77	0.63	0.51	0.40	0.33
Urban Collector	0.13	0.11	0.09	0.07	0.06
Urban Local	0.29	0.23	0.18	0.14	0.11
Rural Interstate	5.92	4.76	3.57	2.49	1.86
Rural Other Principal Arterial	1.14	0.89	0.67	0.49	0.38
Rural Minor Arterial	0.21	0.18	0.14	0.11	0.08
Rural Major Collector	0.79	0.65	0.53	0.41	0.34
Rural Minor Collector	0.66	0.55	0.44	0.34	0.27
Rural Local	0.28	0.22	0.17	0.13	0.10
Total NOx for Nash	**12.07**	**9.70**	**7.42**	**5.39**	**4.16**

4.1.6 Motor Vehicle Emissions Budget for Conformity

Transportation Conformity

The purpose of transportation conformity is to ensure that Federal transportation actions occurring in a nonattainment areas does not hinder the area from maintaining the 8-hour ozone standard. This means that the level of emissions estimated by the NCDOT or the MPOs for the Transportation Implementation Plan and Long Range Transportation Plan must not exceed the MVEB as defined in this maintenance plan.

Highway Mobile Source VOC Insignificance

Section 93.109(k) in the Transportation Conformity Rule Amendments for the new 8-hour ozone and fine particulate matter NAAQS addresses areas with insignificant motor vehicle emissions. It reads:

> *Notwithstanding the other paragraphs in this section, an area is not required to satisfy a regional emissions analysis for §93.118 and/or §93.119 for a given pollutant/precursor and NAAQS, if EPA finds through the adequacy or approval process that a SIP demonstrates that regional motor vehicle emissions are an insignificant contributor to the air quality problem for that pollutant/precursor and NAAQS. The SIP would have to demonstrate that it would be unreasonable to expect that such an area would experience enough motor vehicle emissions growth in that pollutant/precursor for a NAAQS violation to occur.*

The rule suggests that such a finding would be based on a number of factors, including the percentage of motor vehicle emissions in the context of the total State Implementation Plan (SIP) inventory, the current state of air quality as determined by monitoring data for that NAAQS, the absence of SIP motor vehicle control measures, and historical trends and future projections of the growth of motor vehicle emissions.

The NCDAQ has examined the sources of VOC emissions and their contribution to ozone formation in North Carolina. Because of the generally warm and moist climate of North Carolina, vegetation abounds in many forms, and forested lands naturally cover much of the state. The biogenic sector is the most abundant source of VOCs in North Carolina and accounts for approximately 90% of the total VOCs statewide. The overwhelming abundance of biogenic VOCs makes the majority of North Carolina a NO_x limited environment for the formation of ozone. This holds true in Edgecombe and Nash Counties. Since biogenic emissions were not generated specifically for this maintenance plan, we used emission summaries from the NCDAQ's 2002 and 2009 modeling effort underway for the attainment demonstrations in other portions of North Carolina. Figures 4.1.6-1 through 4.1.6-4 provides the percent contributions from point, highway mobile, area, off-road mobile and biogenic sources to the total VOC emissions in Edgecombe and Nash Counties in 2002 and 2009, respectively.

Figure 4.1.6-1 Edgecombe County 2002 Daily Summertime VOC Emissions

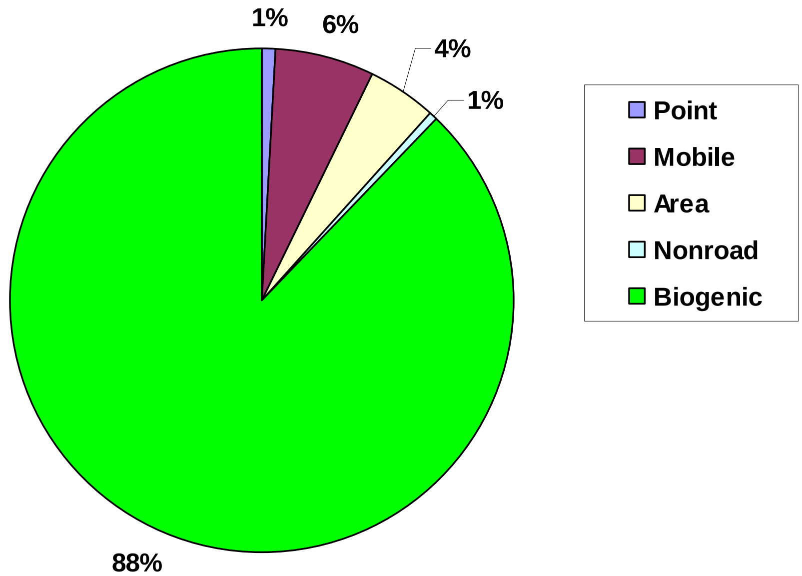


Figure 4.1.6-2 Edgecombe County 2009 Daily Summertime VOC Emissions

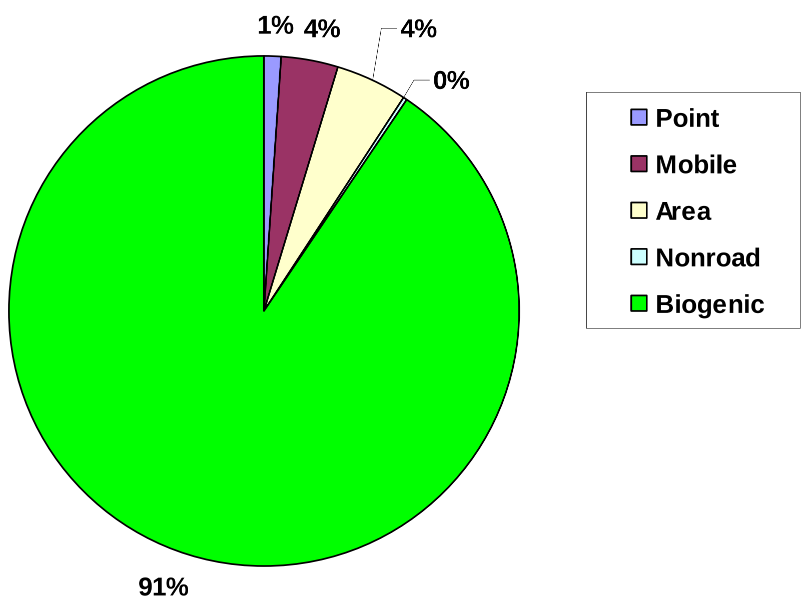


Figure 4.1.6-3 Nash County 2002 Daily Summertime VOC Emissions

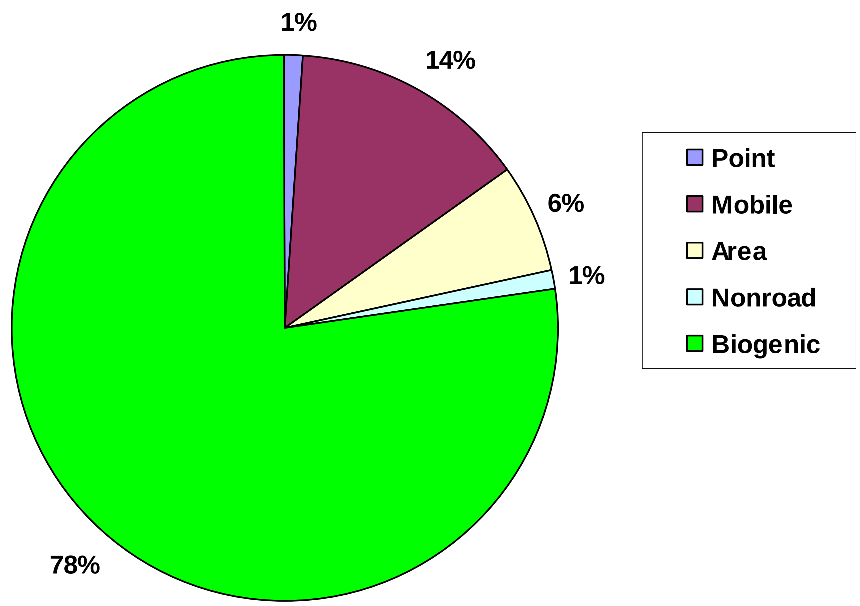
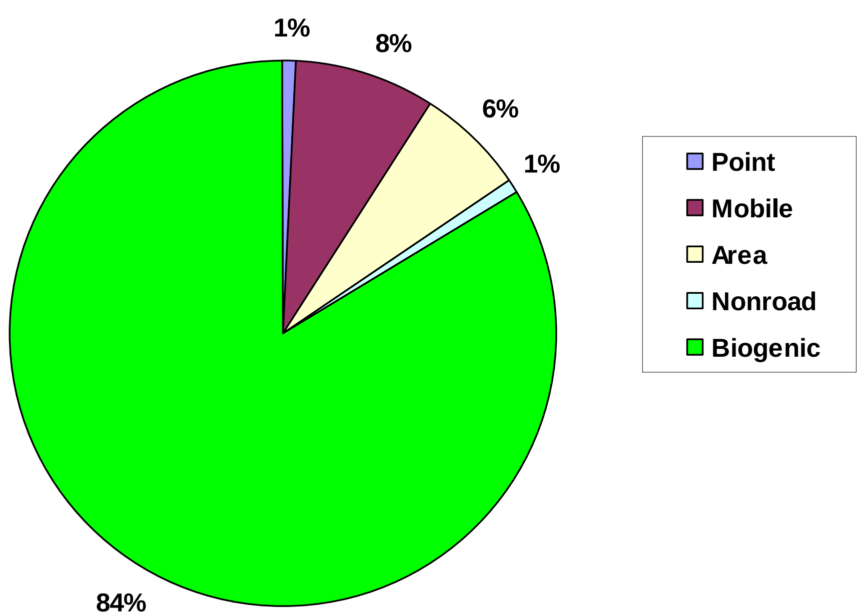


Figure 4.1.6-4 Nash County 2009 Daily Summertime VOC Emissions



In Edgecombe County, highway mobile sources contrbute only 6 and 4 percent of the 2002 and 2009 total VOC inventories, respectively. In Nash County, highway mobile sources contribue only 14 and 8 percent of the 2002 and 2009 total VOC inventories, respectively.

Also noteworthy are the projected decreases in highway mobile VOC emissions through the year 2017 despite projected VMT increases. These reductions are due mainly to the retirement of older vehicles and the growing fleet of Tier 2 vehicles on the roads in future years. Some additional reductions are attributable to North Carolina's I/M program in Edgecombe and Nash Counties. The VMT and VOC projections are summarized in Figures 4.1.6-5 and 4.1.6-6 below.

Figure 4.1.6-5 Edgecombe County VMT and VOC emissions growth

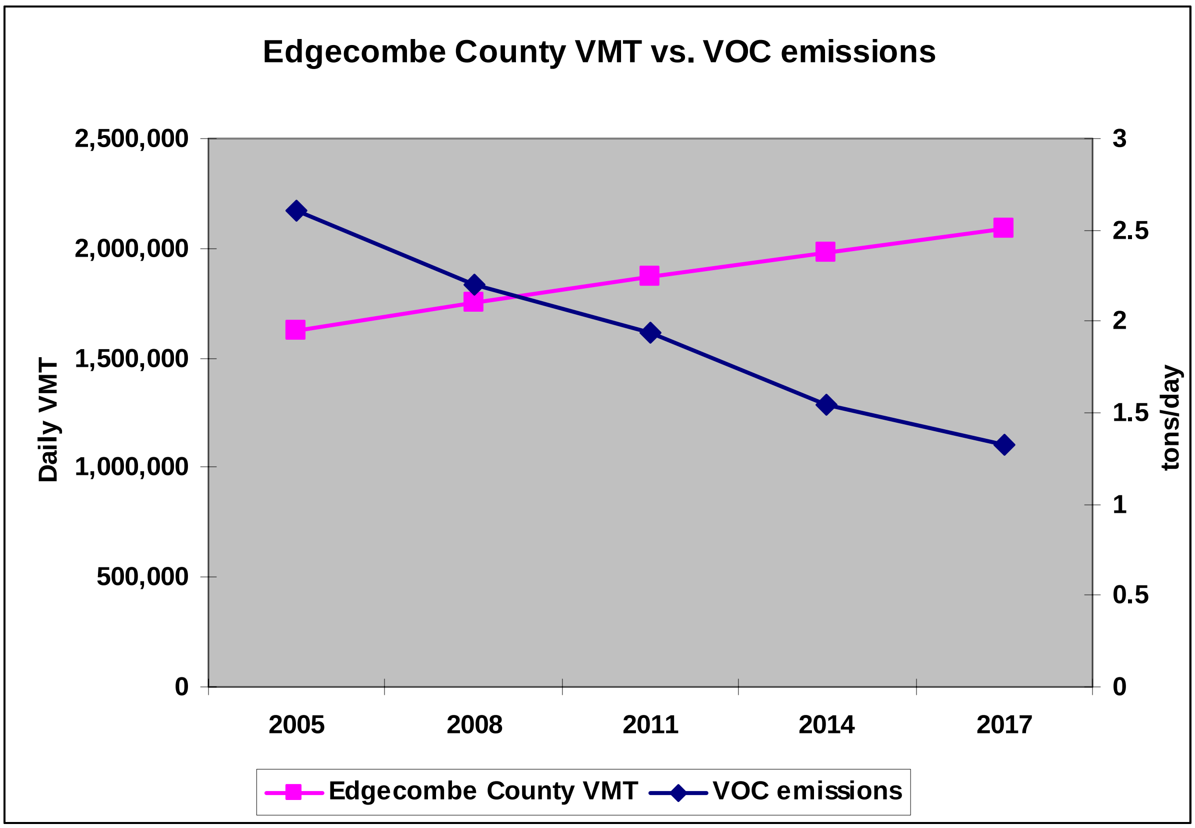
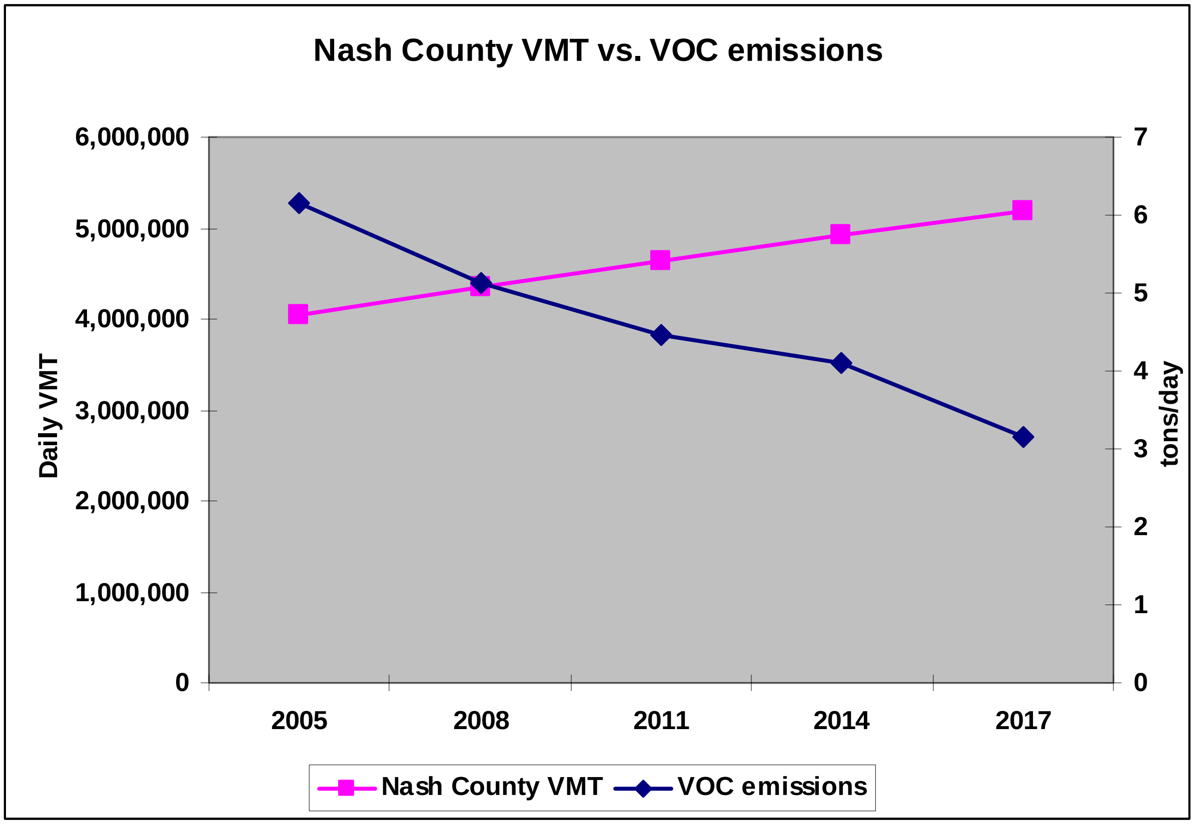


Figure 4.1.6-6 Nash County VMT and VOC emissions growth

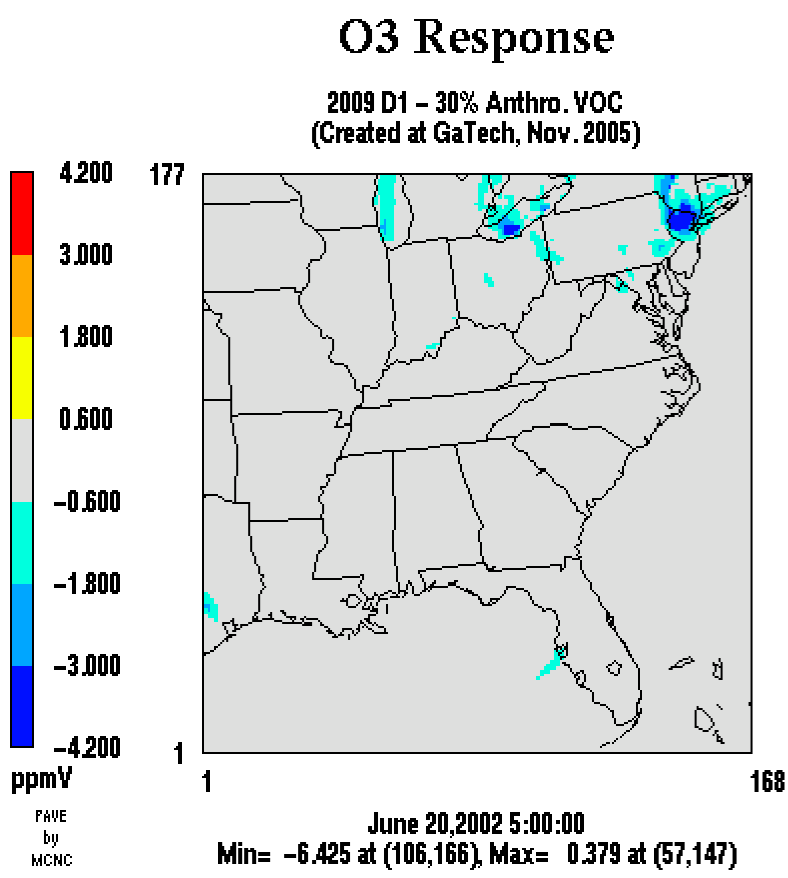


The current state of air quality in the Rocky Mount nonattainment area is steadily improving. The current ozone design value in the Rocky Mount nonattainment area is 0.079 parts per million (ppm) based on data from 2003-2005. This is well below the NAAQS of 0.084 ppm.

A recent modeling sensitivity test was performed by the Association for Southeastern Integrated Planning (ASIP) that allows an analysis of VOC contributions to ozone concentrations in the Southeastern United States. ASIP is a regional collaborative, set up by the Southeastern States Air Resource Managers, Inc. (SESARM), focused on the coordination of planning activities associated with the analysis of fine particulate matter and 8-hour ozone nonattainment areas and development of options for attaining and maintaining the NAAQS. One of the analyses conducted by ASIP is a series of emissions sensitivity modeling runs to quantify the contributions of various emission sources to ozone and fine particles. The modeling system used in this analysis consisted of 3 components: 1) the Penn State University/National Center for Atomospheric Research Mesoscale Model (MM5 version 3.6.1+), 2) the Sparse Matrix Operator Kernel Emissions Modeling System (SMOKE version 2.1), and 3) the Community Multiscale Air Quality (CMAQ version 4.4) model. Model configurations, input data, and modeling methods are consistent with those suggested by USEPA in "Guidance on the Use of Models and Other Analyses in Attainment Demonstrations for the 8-hour Ozone NAAQS".

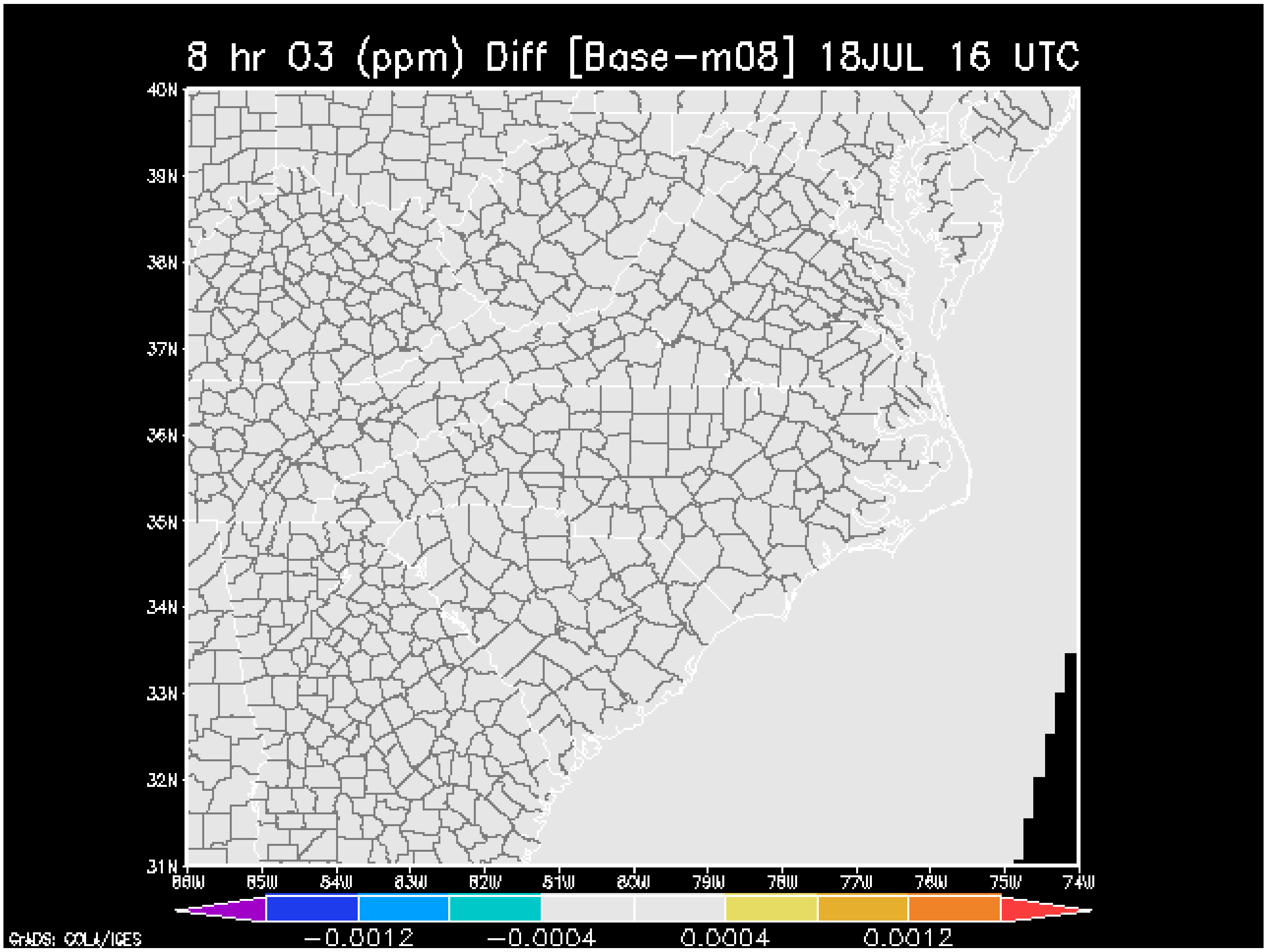
The emissions sensitivities are calculated by taking the difference between two air quality model simulations: one with base case emissions and another with reduced emissions inputs. The emissions sensitivity discussed here reduces *all* athropogenic VOCs in the modeling domain by 30% from 2009 emission levels. Translating this to the Edgecombe and Nash Counties emissions, this 30% athropogenic VOC reduction is equivalent to a 77% highway mobile VOC reduction in Edgecombe County in 2009 and a 60% highway mobile VOC reduction in Nash County in 2009. This emissions sensitivitiy was run for a 39 day period (June 1-July 9). In all 39 days of the modeling simulation, the 8-hour ozone maximum concentrations were unchanged in Edgecombe and Nash Counties – a clear indicator that highway mobile VOC is an insignificant contributor to ozone formation in that area. In fact, there was not an 8-hour ozone response as high as 1 ppb anywhere in North Carolina during the sensitivity simulation. Figure 4.1.6-7 provides an example from the 30% athropogenic VOC reduction modeling illustrating the lack of ozone response North Carolina.

Figure 4.1.6-7 8-hour Ozone response to 30% athropogenic VOC reductions in 2009



Additional mobile source sensitivity simulations have been conducted by the NCDAQ. These modeling runs focused specifically on the impact of mobile source VOC emissions on ozone. The first sensitivity reduced mobile source VOC by 50% in Edgecombe and Nash Counties as well as all of the counties in the Triangle ozone nonattainment area (Person, Granville, Orange, Durham, Chatham, Wake, Franklin, and Johnston Counties) in the year 2008. This emissions sensitivitiy was run for a 7 day period (July 13-19). In all 7 days of the modeling simulation, the 8-hour ozone maximum concentrations were unchanged in Edgecombe and Nash Counties (and all of North Carolina), a clear indicator that highway mobile VOC is an insignificant contributor to ozone formation in that area. Figure 4.1.6-8 provides an example of the lack of an 8-hour ozone response from the 50% mobile VOC reduction sensitivity modeling.

Figure 4.1.6-8 8-hour Ozone Response to 50% mobile VOC decrease in 2008



The second sensitivity conducted by the NCDAQ focused on a 50% increase of mobile source VOC in the same counties and over the same 7-day period mentioned above. The results were identical, no change in 8-hour ozone concentrations indicating highway mobile VOC is an insignificant contributor to ozone formation in the Rocky Mount area.

Based on the information discussed above, the NCDAQ steadfastly believes highway mobile VOCs are insignificant contributors to ozone formation in Edgecombe and Nash Counties. Emission estimates indicate highway mobile VOC is a small percentage of the total VOC emissions inventory. Highway mobile VOC emissions are projected to decrease into the future notwithstanding VMT increases. The area is currently well below the NAAQS and emission sensitivity modeling performed by ASIP and the NCDAQ indicates no change in future ozone concentrations when VOC emissions are significantly changed. Further, the NCDAQ considers it unreasonable to expect that Edgecombe and Nash Counties will experience enough motor vehicle emissions growth for a future ozone violation to occur. For these reasons, the NCDAQ will not be setting MVEB for VOC for the Rocky Mount area.

Safety Margin

A safety margin is the difference between the attainment level of emissions from all source categories (i.e., point, area, and mobile) and the projected level of emissions from all source categories. The State may choose to allocate some of the safety margin to the MVEB, for transportation conformity purposes, so long as the total level of emissions from all source categories remains equal to or less than the attainment level of emissions.

The NCDAQ has decided to allocate safety margin to the MVEB to account for new emissions models, VMT projections models, as well as changes to future vehicle mix assumptions, etc. that influence the emission estimations. Since 2008 is a historic year, the NCDAQ decided to allocate the entire safety margin available to the MVEBs. For 2017, the NCDAQ estimated the amount needed to account for the current emission model and VMT projections model and then added an additional 21% to account for any future changes to the emission model, projection model and other input data.

Motor Vehicle Emission Budgets

The NCDAQ did not receive any comments regarding the geographic extent of the MVEB from any of the Rocky Mount transportation partners during the maintenance plan interagency consultation process. However, there was discussion through the interagency consultation process on the years to set MVEB for the Rocky Mount maintenance plan. According to Section 93.118 of the transportation conformity rule, a maintenance plan must establish a MVEB for the last year of the maintenance plan (in this case, 2017). Through the interagency consultation process, it was decided that another MVEB would be set for the year 2008 in the Rocky Mount maintenance plan.

The NCDAQ will set MVEB, for transportation conformity purposes, as county budgets within the Rocky Mount nonattainment area for 2008 and 2017. Tables 4.1.6-1 and 4.1.6-2 below list out the NOx MVEB, for transportation conformity purposes, by county for the years 2008 and 2017. Upon the USEPA's approval of these county-by-county sub-area MVEB, these MVEB will become the applicable MVEB for each county.

Table 4.1.6-1 Edgecombe County MVEB in kilograms per day

	2008	2017
NOx Emissions (kg/day)		
Base Emissions	2,483	1,143
Safety Margin Allocated to MVEB	1,674	1,108
NOx Conformity MVEB	**4,157**	**2,251**

Table 4.1.6-2 Nash County MVEB in kilograms per day

	2008	2017
NOx Emissions (kg/day)		
Base Emissions	8,790	3,767
Safety Margin Allocated to MVEB	1,655	2,374
NOx Conformity MVEB	**10,444**	**6,141**

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4.1.7 Speed and VMT provided in January 11, 2006 email from NCDOT

EDGECOMBE COUNTY				
Modeled Area				
Functional Class>Code	**2002**	**2010**	**2020**	**2030**
U-Inter>11	0	0	0	0
Frwy/Exway>12	96,183	132,442	145,217	181,269
U-OtherPrincipal>13	18,434	21,299	23,253	26,477
U-MinorArterial>14	95,164	112,033	150,093	178,359
Collector>15	14,935	17,097	18,254	19,974
U-Local>18	50,229	63,048	72,449	84,957
R-Inter>21	-	-	-	-
R-OtherPrincipal>23	130,368	195,824	249,218	321,288
R-MinorArterial>24	8,061	8,455	9,395	10,339
MajorCollector>26	106,438	85,241	106,833	137,766
MinorCollector>27	60,680	66,977	75,900	100,975
R-Local>28	71,333	87,077	97,925	111,287
Total from Model	**651,825**	**789,495**	**948,535**	**1,172,690**
Rural spreadsheet Portion	851,465	1,042,781	1,249,659	1,456,538
County total	**1,503,290**	**1,832,275**	**2,198,194**	**2,629,229**
County total from Universe file	**1,548,100**	**1,895,942**	**2,272,058**	**2,648,173**

	2002	**2010**	**2020**	**2030**
Rural VMT(Outside MPO)				
Urban Interstate	0.0	0.0	0.0	0.0
Urban Other Freeway	44,399.5	67,744	81,184	94,624
Urban Other PA	53,540.0	65,312	78,270	91,227
Urban Minor Arterial	72,580.5	101,020	121,062	141,103
Urban Collector	8,768.0	11,533	13,822	16,110
Urban Local	40,677.5	50,167	60,120	70,072
Rural Functional Classes				
Rural Interstate	0.0	0.0	-	-
Rural Other PA	196,647.0	235,449	282,160	328,871
Rural Minor Arterial	73,139.0	90,089	107,962	125,834
Rural Major Collector	197,092.5	217,920	261,154	304,387
Rural Minor Collector	104,681.5	131,202	157,232	183,261
Rural Local	59,939.0	72,343	86,695	101,048
Total	**851,464.50**	**1,042,781**	**1,249,659**	**1,456,538**

Edgecombe County	2005	2008, 2011 & 2014	2017		
Year	2002	2010	2020	2030	
Urban Functional Classification					
Interstate	0	0	0	0	
Freeway	65	65	65	65	
Other P-A	35	35	35	35	
Minor Arterial	41	42	42	42	
Collector	40	40	40	40	
Local	37	38	38	38	
Rural Functional Classification					
Interstate	0	0	0	0	
Other P-A	65	65	65	65	
Minor Arterial	51	51	52	53	
Major Collector	53	53	53	58	
Minor Collector	52	52	52	52	
Local	47	47	47	48	
Rural Speeds for Edgecomb County			2008 & 2011	2014 and 2017	
	2002	2005	2010	2020	2030
Urban Interstate	0	0	0	0	0
Other Freeway & Expressway	55	56	55	55	55
Other Principle Arterial	28	29	29	29	28
Minor Arterial	31	32	32	32	31
Urban Collector	31	31	31	31	31
Urban Local	28	30	30	29	28
Rural Interstate	0	0	0	0	0
Other PA	45	45	45	45	45
Minor Arterial	44	44	44	44	44
Rural Major Collector	43	43	43	43	43
Rural Minor Collector	42	42	42	42	42
Rural Local	42	42	42	42	42

NASH COUNTY				
Modeled Area				
Functional Class>Code	2002	2010	2020	2030
No Functional Class>0				
U-Inter>11	25,837	32,264	41,131	54,594
Frwy/Exway>12	314,810	356,275	370,192	482,062
U-OtherPrincipal>13	273,194	276,972	332,563	405,190
U-MinorArterial>14	372,685	470,856	590,758	699,255
Collector>15	57,793	75,711	77,867	95,041
U-Local>18	145,619	170,139	187,176	221,480
R-Inter>21	604,232	768,762	970,708	1,272,578
R-OtherPrincipal>23	183,686	207,006	268,516	364,092
R-MinorArterial>24	59,409	74,969	87,039	103,279
MajorCollector>26	209,675	275,296	410,106	552,903
MinorCollector>27	207,215	274,574	359,359	464,709
R-Local>28	97,386	122,459	143,097	190,190
	2,551,542	3,105,283	3,838,513	4,905,373
Rural part	1,209,732	1,428,551	1,643,229	1,857,906
Sum from model and rural spreadshe	**3,761,274**	**4,533,835**	**5,481,742**	**6,763,279**
County total from Universe file	**3,486,300**	**4,116,843**	**4,735,493**	**5,354,144**

	2002	**2010**	**2020**	**2030**
Rural VMT(Outside MPO)				
Urban Interstate	0.0	0.0	0.0	0.0
Urban Other Freeway	60,759.7	76,372	87,849	99,326
Urban Other PA	109,884.5	141,334	162,574	183,813
Urban Minor Arterial	89,536.4	109,910	126,427	142,944
Urban Collector	25,442.0	31,004	35,663	40,322
Urban Local	26,927.2	31,026	35,689	40,351
Rural Functional Classes				
Rural Interstate	302,382.7	346,403.6	398,460	450,516
Rural Other PA	216,302.5	241,278	277,536	313,795
Rural Minor Arterial	34,068.5	43,096	49,572	56,048
Rural Major Collector	177,903.4	214,263	246,462	278,661
Rural Minor Collector	119,215.3	141,119	162,325	183,532
Rural Local	47,310.0	52,745	60,671	68,597
Total	**1,209,732.22**	**1,428,551**	**1,643,229**	**1,857,906**

Model Speed for Urban area (MPO covered by TDM)					
NASH County	2005	2008, 2011 & 2014	2017		
Year	2002	2010	2020	2030	
Urban Functional Classification					
Interstate	65	65	65	65	
Freeway	65	65	65	65	
Other P-A	46	45	45	44	
Minor Arterial	44	44	44	45	
Collector	39	39	40	40	
Local	34	34	35	35	
Rural Functional Classification					
Interstate	65	65	65	65	
Other P-A	60	61	61	61	
Minor Arterial	53	53	53	53	
Major Collector	52	52	52	52	
Minor Collector	50	50	50	51	
Local	41	42	42	42	
Rural Speeds for Nash County			2008 & 2011	2014 and 2017	
	2002	2005	2010	2020	2030
Urban Interstate	0	0	0	0	0
Other Freeway & Expressway	55	56	56	56	56
Other Principle Arterial	28	29	29	29	29
Minor Arterial	31	32	32	32	32
Urban Collector	31	31	31	31	31
Urban Local	26	30	30	30	30
Rural Interstate	65	66	66	65	65
Other PA	47	47	47	47	47
Minor Arterial	43	44	44	44	44
Rural Major Collector	43	43	43	43	43
Rural Minor Collector	42	42	42	42	42
Rural Local	42	42	42	42	42

4.2 NON-HIGHWAY MOBILE SOURCES

Off-road mobile sources are those sources that can move but do not use the highway system. Examples include lawn mowers, agricultural equipment, construction equipment, aircraft engines and railroad locomotives. All but the aircraft engine and railroad locomotive emissions are estimated using the USEPA off-road mobile model NONROAD2005a, which was released February 10, 2006. The emissions from aircraft engines are estimated using the FAA model EDMS and the emissions from railroad locomotives are estimated in a more traditional way of using activity levels and emission factors. The methodology used to calculate the emissions from these off-road mobile sources are described in detail in the subsections that follow. Table 4.2-1 summarize the total VOC and NOx emissions from all off-road mobile source categories.

Table 4.2-1 Off-Road Mobile Source VOC Emissions by County

County	2005	2008	2011	2014	2017
VOC Emissions					
Edgecombe	0.95	0.78	0.70	0.68	0.65
Nash	1.39	1.17	1.07	1.05	1.08
Total	2.34	1.95	1.77	1.73	1.73
NOx Emissions					
Edgecombe	2.35	2.10	1.82	1.60	1.40
Nash	2.10	1.90	1.69	1.48	1.29
Total	4.45	4.00	3.51	3.08	2.69

4.2.1 NONROAD Model Mobile Sources

The nonroad mobile source category includes a diverse collection of equipment such as lawn mowers, chain saws, tractors, all terrain vehicles, fork lifts and construction equipment. The USEPA included more than 80 different types of equipment in the NONROAD2005a model. To facilitate analysis and reporting, the USEPA grouped the equipment types into ten equipment categories. These include:

Agricultural equipment	Lawn and garden equipment
Airport ground support equipment	Logging equipment
Commercial equipment	Railroad maintenance equipment
Construction equipment	Recreational marine equipment
Industrial equipment	Recreational equipment

Additionally, the emissions are broken out by five different engine types. These include: 2-stroke and 4-stroke spark engines, diesel engines, liquid propane gas and compressed natural gas fueled engines.

The NONROAD2005a model version was used to estimate emissions for the 8-hour ozone maintenance plan. This latest version of the model was released to the public on February 10, 2006.

NONROAD2005a is the latest final release of the USEPA NONROAD model that was first released in June 2000, and incorporates many revisions to improve the model's predictive ability. The final version of the model also incorporates all the USEPA final nonroad engine emission standards, including the recreational and large spark-ingintion engines rules that were published in the Federal Register in November 2002. Although this model is considered to be a final model, an updated version is planned that may incorporate revised inputs for the small spark iginition (SI) (<19 kW) and recreational marine SI categories in conjunction with additional promulgated nonroad engine standards.

One of the default input files was edited to reflect North Carolina specific information. In the "SEASON.DAT" file, the region representative of North Carolina was changed from Mid-Atlantic to Southeast. A copy of the revised seasonality input data file is in Section 5.

The options files used in the NONROAD2005a model were tailored to reflect North Carolina specific information also. Copies of the options input files are in Section 5. Default data was used for the remaining input files used in the NONROAD model.

For reporting purposes, the resulting emissions from the NONROAD2005a model were totaled for each equipment category by county. The model generates VOC and NOx emissions directly. The results for most of the equipment categories by county indicate a reduction in emissions with time into the out-years. These reduced emisson projections are influenced by several factors, including expected future changes in emission factors and activity levels. These future emission factors and activity levels are accounted for in the model.

Future changes in emission factors are primarily the result of future regulations. With the latest final version of the model, the USEPA has incorporated the final nonroad engine emission standards, including the recreational and large spark-ingintion engines rules that were published in the Federal Register in November 2002. Future changes in activity levels are the result of estimated engine populations, which are based on growth rates and scrappage functions of the equipment.

The summary of these results are tabulated in Tables 4.2.1-1 through 4.2.1-10. In Table 4.2.1-11 summaries of the NONROAD model categories emissions for each county within the nonattainment area.

Table 4.2.1-1 Agricultural Equipment Emissions by County

County	2005	2008	2011	2014	2017
VOC Emissions					
Edgecombe	0.08	0.07	0.06	0.05	0.04
Nash	0.07	0.06	0.05	0.04	0.04
Total	0.15	0.13	0.11	0.09	0.08
NOx Emissions					
Edgecombe	0.59	0.55	0.50	0.44	0.37
Nash	0.53	0.49	0.45	0.39	0.33
Total	1.12	1.04	0.95	0.83	0.70

Table 4.2.1-2 Airport Ground Support Equipment Emissions by County

County	2005	2008	2011	2014	2017
VOC Emissions					
Edgecombe	0.0000	0.0000	0.0000	0.0000	0.0000
Nash	0.0008	0.0007	0.0005	0.0005	0.0004
Total	0.001	0.001	0.001	0.001	0.000
NOx Emissions					
Edgecombe	0.0000	0.0000	0.0000	0.0000	0.0000
Nash	0.0079	0.0074	0.0060	0.0050	0.0038
Total	0.008	0.007	0.006	0.005	0.004

Table 4.2.1-3 Commercial Equipment Emissions by County

County	2005	2008	2011	2014	2017
VOC Emissions					
Edgecombe	0.05	0.05	0.04	0.05	0.05
Nash	0.18	0.16	0.15	0.16	0.17
Total	0.23	0.21	0.19	0.21	0.22
NOx Emissions					
Edgecombe	0.03	0.03	0.03	0.03	0.02
Nash	0.10	0.10	0.09	0.09	0.08
Total	0.13	0.13	0.12	0.12	0.10

Table 4.2.1-4 Construction Equipment Emissions by County

County	2005	2008	2011	2014	2017
VOC Emissions					
Edgecombe	0.03	0.02	0.02	0.02	0.01
Nash	0.08	0.06	0.06	0.05	0.04
Total	0.11	0.08	0.08	0.07	0.05
NOx Emissions					
Edgecombe	0.15	0.14	0.12	0.10	0.08
Nash	0.47	0.43	0.38	0.31	0.23
Total	0.62	0.57	0.50	0.41	0.31

Table 4.2.1-5 Industrial Equipment Emissions by County

County	2005	2008	2011	2014	2017
VOC Emissions					
Edgecombe	0.13	0.09	0.06	0.03	0.02
Nash	0.05	0.04	0.02	0.01	0.01
Total	0.18	0.13	0.08	0.04	0.03
NOx Emissions					
Edgecombe	0.53	0.40	0.27	0.17	0.12
Nash	0.23	0.18	0.13	0.09	0.07
Total	0.76	0.58	0.40	0.26	0.19

Table 4.2.1-6 Lawn and Garden Equipment Emissions by County

County	2005	2008	2011	2014	2017
VOC Emissions					
Edgecombe	0.55	0.45	0.42	0.43	0.44
Nash	0.87	0.72	0.67	0.68	0.70
Total	1.42	1.17	1.09	1.11	1.14
NOx Emissions					
Edgecombe	0.07	0.07	0.06	0.06	0.06
Nash	0.11	0.11	0.10	0.10	0.10
Total	0.18	0.18	0.16	0.16	0.16

Table 4.2.1-7 Logging Equipment Emissions by County

County	2005	2008	2011	2014	2017
VOC Emissions					
Edgecombe	0.01	0.01	0.01	0.01	0.01
Nash	0.02	0.02	0.02	0.02	0.02
Total	0.03	0.03	0.03	0.03	0.03
NOx Emissions					
Edgecombe	0.02	0.02	0.01	0.01	0.00
Nash	0.04	0.03	0.02	0.01	0.01
Total	0.06	0.05	0.03	0.02	0.01

Table 4.2.1-8 Railroad Maintenance Equipment Emissions by County

County	2005	2008	2011	2014	2017
VOC Emissions					
Edgecombe	0.0004	0.0005	0.0005	0.0005	0.0006
Nash	0.0007	0.0008	0.0008	0.0009	0.0010
Total	0.001	0.001	0.001	0.001	0.002
NOx Emissions					
Edgecombe	0.0019	0.0020	0.0021	0.0023	0.0025
Nash	0.0031	0.0033	0.0035	0.0038	0.0041
Total	0.005	0.005	0.006	0.006	0.007

Table 4.2.1-9 Recreational Equipment Emissions by County

County	2005	2008	2011	2014	2017
VOC Emissions					
Edgecombe	0.01	0.01	0.02	0.02	0.02
Nash	0.02	0.02	0.02	0.02	0.02
Total	0.03	0.03	0.04	0.04	0.04
NOx Emissions					
Edgecombe	0.003	0.003	0.003	0.003	0.004
Nash	0.004	0.004	0.004	0.004	0.004
Total	0.01	0.01	0.01	0.01	0.01

Table 4.2.1-10 Recreational Marine Equipment Emissions by County

County	2005	2008	2011	2014	2017
VOC Emissions					
Edgecombe	0.05	0.05	0.04	0.04	0.03
Nash	0.08	0.07	0.06	0.05	0.05
Total	0.13	0.12	0.10	0.09	0.08
NOx Emissions					
Edgecombe	0.00	0.00	0.01	0.01	0.01
Nash	0.01	0.01	0.01	0.01	0.01
Total	0.01	0.01	0.02	0.02	0.02

Table 4.2.1-11 Total NONROAD2005a Model Engine Emissions by County

County	2005	2008	2011	2014	2017
VOC Emissions					
Edgecombe	0.91	0.75	0.67	0.65	0.62
Nash	1.37	1.15	1.05	1.03	1.05
Total	2.28	1.90	1.72	1.68	1.67
NOx Emissions					
Edgecombe	1.39	1.22	1.01	0.83	0.67
Nash	1.51	1.36	1.19	1.01	0.84
Total	2.90	2.58	2.20	1.84	1.51

4.2.2 Aircraft Engines

Aircraft engines, like other engines, emit pollutants whenever the engines are in operation. However, the only emissions that are of concern for this inventory are the portion of the operation that occurs below the mixing layer. This is because the emissions tend to disperse whenever the aircraft is above the mixing layer and therefore has little or no effect on ground level ozone.

The aircraft operations of interest are termed the landing and takeoff (LTO) cycle. The cycle begins when the aircraft approaches the airport, descending below the mixing layer, lands and taxis to the gate. It continues as the aircraft idles at the gate and then taxis back out to the runway for the subsequent takeoff and climbout as it heads back to cruising altitudes, above the mixing layer.

Aircrafts can be categorized by use into four classifications: commercial, air taxis, general aviation and military. Commercial aircraft include those used for scheduled service transporting passengers, freight or both. Air taxis, or commuter aircraft, also fly scheduled service carrying passengers and/or freight but usually are smaller aircraft and operate on a more limited basis than commercial carriers. General aviation include all other non-military aircraft used for recreational flying, personal transportation, and various other activities. Military aircraft cover a wide range of sizes, uses and operating missions. The military aircraft are treated as a separate classification since the LTO operations reported at the airports group all military aircraft together.

Base year 2005 emissions for aircraft engines were projected from the 2002 Base F emissions inventory prepared for the southeast regional haze planning organization Visibility Improvement State and Tribal Association of the Southeast (VISTAS). The projection from 2002 to 2005 was made using growth factors generated from the Economic Growth Analysis System Version 5.0 Beta (E-GAS 5.0).

For 2002 aircraft emissions, VISTAS used 1999 emission estimates developed for the USEPA's 1999 National Emission Inventory (NEI) Version 2 as base year estimates for the VISTAS region. VISTAS then projected the revised 1999 inventory to 2002 using surrogate growth indicators. For the aircraft category, 1999 and 2002 approach operations by airport and aircraft type were compiled by VISTAS from the Federal Aviation Administration's Air Traffic Activity Data System (ATADS).The airport-level LTOs were assigned to counties and summed for the county. For counties with aircraft emissions without a county match in ATADS, state-average growth factors were calculated and applied.

Table 4.2.2-1 summarizes the VOC and NOx emissions for aircraft engines.

Table 4.2.2-1 Aircraft Engine Emissions by County

County	2005	2008	2011	2014	2017
VOC Emissions					
Edgecombe	0.0012	0.0013	0.0015	0.0016	0.0017
Nash	0.0036	0.0040	0.0044	0.0048	0.0051
Total	0.005	0.005	0.006	0.006	0.007
NOx Emissions					
Edgecombe	0.0002	0.0002	0.0002	0.0002	0.0002
Nash	0.0005	0.0005	0.0006	0.0006	0.0007
Total	0.001	0.001	0.001	0.001	0.001

4.2.3 Railroad Locomotives

Railroads are categorized by size (Class I, Class 2) and passenger service (Amtrak and NCDOT Rail Division). Class I railroads are long haul operations, consisting of Norfolk Southern Corporation and CSX Corporation. Class II and Class III railroads are short lines, serving localized markets. Passenger service is provided by Amtrak and the NCDOT Rail Division. These entities lease trackage from Class I railroads. Base year 2005 emissions for railroad locomotive engines were projected from the 2002 VISTAS Base F emissions inventory. The projection from 2002 to 2005 was made using growth factors generated from the E-GAS 5.0.

For 2002 railroad locomotive engine emissions, VISTAS used 1999 emission estimates developed for the USEPA’s 1999 NEI Version 2 as base year estimates for the VISTAS region. Projected emissions for 2002 were developed in two steps as described below. For 1999 to 2001, State-level rail fuel consumption was obtained from the Department of Energy, Energy Information Administration’s (EIA’s) *Fuel Oil and Kerosene Sales.* For 2001 to 2002, VISTAS applied national growth factors developed from fuel consumption projections in EIA’s *Annual Energy Outlook.* A growth factor of 1.4 was used for locomotives and applied to 1999 emissions to first develop 2001 emissions. Table 4.2.3.1 lists the growth factors used to generate 2002 emissions.

Table 4.2.3-1 2002 National Rail Transportation Energy Use by Fuel Type (Trillion BTU)

	2001	**2002**	**Growth Factor (GF)**
Intercity Rail (Electric)	10.17	10.40	1.0226
Intercity Rail (Diesel)	16.60	16.88	1.0169
Transit Rail (Electric)	46.36	47.40	1.0224
Intercity/Transit Rail Average (SCC 2285002008)			**1.0206**
Commuter Rail (Electric)	16.13	16.49	1.0223
Commuter Rail (Diesel)	26.31	26.76	1.0171
Commuter Rail Average (SCC 2285002009)			**1.0197**
Freight Rail (Distillate) (SCCs 2285002000, 2285002005, 2285002006, 2285002007, 2285002010)	512.81	492.32	0.9600

Source: Department of Energy, Energy Information Administration, Annual Energy Outlook 2003: Table 34. Transportation Sector Energy Use by Fuel Type Within a Mode

The summary of emissions from all railroad locomotives in each county are in Table 4.2.3-2.

Table 4.2.3-2 Railroad Locomotive Engine Emissions by County

County	2005	2008	2011	2014	2017
VOC Emissions					
Edgecombe	0.04	0.03	0.03	0.03	0.03
Nash	0.02	0.02	0.02	0.02	0.02
Total	0.06	0.05	0.05	0.05	0.05
NOx Emissions					
Edgecombe	0.96	0.88	0.81	0.77	0.73
Nash	0.59	0.54	0.50	0.47	0.45
Total	1.55	1.42	1.31	1.24	1.18