Appendix C

Emissions Inventory Documentation

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LIST OF TABLES

List of Acronyms

Acronym	Definition
AST	Aboveground Storage Tank
FHWA	Federal Highway Administration
GSMNP	Great Smoky Mountains National Park
HDDV	Heavy duty diesel vehicles
HDGV	Heavy duty gas vehicles
HDV2	Heavy duty vehicle 2; medium truck classification in GSMNP
kW	Killowatts, power rating for generators
kW/hr-yr	Killowatt per hour per year, generator annual output
LDDT	Light duty diesel trucks
LDDT1	Light duty diesel trucks 1
LDDT2	Light duty diesel trucks 2
LDDV	Light duty diesel vehicles
LDGT1	Light duty gas trucks 1
LDGT2	Light duty gas trucks 2
LDGV	Light duty gas vehicles
MC	Motorcycles
mph	Miles per hour
NAAQS	National Ambient Air Quality Standard
NBB	National Biodiesel Board
NCDAQ	North Carolina Division of Air Quality
NCDOT	North Carolina Department of Transportation
NOx	Nitrogen Oxides
NPS	National Park Service
QA	Quality Assurance
RVP	Reid Vapor Pressure
USEPA	U.S. Environmental Protection Agency
VMT	Vehicle Miles Traveled
VOC	Volatile Organic Compounds

1.0 INTRODUCTION AND SCOPE

The Great Smoky Mountains National Park (GSMNP) is located in partially in North Carolina and partially in Tennessee. The North Carolina portion is located in Haywood and Swain Counties. For the purpose of the redesignation demonstration and maintenance plan, only the emissions on the North Carolina side of the GSMNP will be estimated and all emissions will be reported on a ton per summer day basis. Emission estimates will be made for the two main pollutants of concern for ozone, volatile organic compounds (VOCs) and nitrogen oxides (NOx).

The types of emission sources in the GSMNP are significantly different than what is in a typical urban 8-hour ozone nonattainment area. For this reason, the North Carolina Division of Air Quality (NCDAQ) contacted the National Park Service (NPS) for a list of emission sources. The NPS provided the NCDAQ with an emissions inventory for 2000 that had been prepared by EA Engineering, Science, and Technology, Inc. in October 2002 (See Appendix B).

According to the NPS 2000 emissions inventory, there are only three manmade emission inventory source classifications: (1) area sources, (2) off-road mobile sources and (3) highway mobile sources.

Area sources represent a collection of many small, unidentified points of air pollution emissions within a specified geographical area, emitting less than the minimum level prescribed for point sources. These sources are too small and/or too numerous to be surveyed and characterized individually, therefore, all area source activities are collectively estimated. Off-road mobile sources are those sources that can move but do not use the highway system. Examples of off-road mobile sources within the GSMNP include lawn mowers and construction equipment. Highway mobile sources are considered those vehicles that travel on the roadways.

The emissions inventories detailed in this Appendix have been developed for the North Carolina GSMNP 8-hour ozone nonattainment area as part of the process of redesignating the area from nonattainment to attainment/maintenance for the 8-hour ozone standard.

2.0 OVERALL METHODOLOGY

2.1 SOURCE CATEGORY IDENTIFICATION

The area and off-road mobile source categories were identified the NPS's *2000 Air Emissions Inventory* report (Appendix B). Highway mobile sources were identified from the U. S. Environmental Protection Agency (USEPA) highway mobile model MOBILE6.2.

2.2 EMISSION ESTIMATION APPROACH

Area source emissions are estimated by multiplying an emission factor by some known indicator of collective activity for each source category within the inventory area. An indicator is any parameter associated with the activity level of a source that can be correlated with the air pollutant emissions from that source, such as number of camp fires, number of acres burned or gallons of fuel used. This data was provided by the NPS's *2000 Air Emissions Inventory* report. Based on information from the NPS, the area source activity levels generally remain the same from year-to-year and recommended using the 2000 activity data for all years in the maintenance plan.

Off-road mobile emissions were estimated by using emission factors obtained from the USEPA's off-road mobile model, NONROAD2005c, and activity level data obtained from the NPS's *2000 Air Emissions Inventory* report. Similar to the area sources, the NPS reported that the off-road equipment activity levels generally remain the same from year-to-year and recommended using the 2000 activity data for all years in the maintenance plan.

The highway mobile source emissions are estimated by the methodologies suggested in the USEPA's document *Technical Guidance on the Use of MOBILE6.2 for Emission Inventory Preparation*, Office of Transportation and Air Quality EPA420-R-04-013, August 2004. The estimation of emissions from mobile sources involves multiplying an activity level, vehicle miles traveled (VMT), by an emission factor. The emission factors were generated using the USEPA mobile model MOBILE6.2 and the VMT data was obtained from the North Carolina Department of Transportation (NCDOT).

3.0 QUALITY ASSURANCE MEASURES

The quality assurance (QA) procedures for the area and off-road mobile source categories were conducted in the same manner. 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 is detailed in the paragraphs below.

The speed and VMT information is acquired from the NCDOT and the NPS, and then the speed information is checked for reasonableness. Once comfortable with the speeds, the 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), min/max temperature, inspection and maintenance program, anti-tampering program, calendar year, evaluation month, the vehicle mix per road type and the vehicle age distribution. All input files are printed and checked by hand against a "key" with the original source of the information. A person other than the one who generated the files always performs this QA step. If any discrepancies are found, they are marked on the hard copy and given to the person who generated the input files for correction.

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 comparing the summary tables containing emission factors to the other MOBILE6.2 output file (referred to as the "text output").

The 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 person who generated the file, to ensure no errors were introduced.

4.0 DISCUSSION OF AREA SOURCES

Area sources represent a collection of many small, unidentified points of air pollution emissions within a specified geographical area, emitting less than the minimum level prescribed for permitted sources. The types of area sources found in the North Carolina GSMNP nonattainment area were identified from the NPS's *2000 Air Emissions Inventory* report. The subsections below describe each source category and the emission estimation procedures.

4.1 ABOVEGROUND FUEL STORAGE TANKS

The area source emissions attributed to this category are associated with various operations related to gasoline fuel handling. In 2000, the GSMNP had eight aboveground gasoline storage tanks (AST), with only one AST being located in the North Carolina GSMNP nonattainment area. The area source emissions are derived for each of the following operations: 1) working losses from storage tank emptying and refilling, 2) storage tank breathing losses and 3) as the vehicle is refueled.

Working losses from emptying the tank occur from the vaporization of fuel as the levels in the tank are decreased and air is drawn into the tank. Storage tank filling losses occurs as the fuel vapor releases to the air during the process of refilling the tank. Breathing losses describe those tank emissions from the vaporization of the fuel in the AST due to changes in ambient temperatures. The emissions from vehicle refueling are captured in the mobile source inventory in the emission factors produced by the USEPA's MOBILE6.2 model and therefore are not estimated as part of the area source inventory.

As part of the air toxics program, Stage I controls for gasoline dispensing facilities was adopted by the State, effective May 1990 with final compliance by January 1, 1994. Stage I is the vapor recovery technology on the underground storage tanks and reduces the emissions during the tank filling operations at service stations. According to the NPS's *2000 Air Emissions Inventory* report, the AST at Ocanaluftee maintenance yard is equipped with Stage I vapor controls.

As mentioned earlier, the NPS has indicated that the area source activity levels generally remain the same year-to-year and no changes in activity levels are expected through the maintenance period. Therefore, the AST data provided in the NPS's *2000 Air Emissions Inventory* report was used to estimate the base year (2005) and future year emissions from storage tank breathing and working losses.

In the North Carolina GSMNP nonattainment area, there was one AST located in the Ocanaluftee Maintenance Yard. The storage tank breathing and working loss emissions were calculated for the using the latest USEPA's TANKS 4.0.9d model and the VOC emission factor used was 0.022 lb VOC per gallon used. To be conservative, the AST was assumed to be used only during the ozone-forecasting season (May through September) or 153 days per year. The emissions from the AST were calculated using the following formula:

$$EM = \frac{(EF) \times (Throughput)}{(2000\ lb/ton) \times (153\ days/year)}$$

where, EM = emissions for source category tons/day
EF = emission factor for source category, (lbs VOC/gallon of fuel)
Throughput = gallons of fuel used per year

The AST fuel storage throughput and the VOC emissions are summarized in the table below. The VOC emission estimates are reported in tons per year and tons per summer day.

Table 4.1-1 AST Throughput Data and VOC Emissions

Location	Type	Throughput (gal)	Emission Factor (lb VOC/gallon)	Annual VOC Emissions	Daily VOC Emissions
Oconaluftee maintenance yard	AST	30,613	0.022	0.34	0.00

4.2 PRESCRIBED BURNING AND WILDLAND FIRES

The NPS's *2000 Air Emissions Inventory* report discussed two types of forest fires; wildland fires, which are accidental or felonious fires and prescribed burns, which are intentionally set for the purpose of forest and/or grassland management practice. Wildland fires are may be ignited naturally, usually by lightning, or by man through carelessness or felonious intent. These types of fires are typically suppressed. Prescribed fires are ignited intentionally in order to achieve fire management objectives. Prescribed burning is a land treatment process to accomplish natural resource management objectives, including reducing the potential for destructive wildfires, eliminating excessive fuel buildup, controlling insects and disease, improving wildlife habitat and forage production, maintaining natural succession of plant communities, and restoring natural

Although prescribed fires occurred in the GSMNP during 2000, none of the prescribed burns occurred in the North Carolina GSMNP nonattainment area. Further discussions with the NPS determined that prescribed burns occur in March – April and October – November time periods, which are both outside of the peak ozone season period of June through August. Therefore, no emissions from prescribed burning were estimated for the maintenance plan.

4.3 GENERATORS

According to the NPS's *2000 Air Emissions Inventory* report, there are two propane-powered generators used within the GSMNP. The NPS recommended assuming one of the generators was used within the North Carolina GSMNP nonattainment area. The generator is rated at 45 kilowatts (kW) and operates 3,650 hours per year for an output of 164,250 kilowatt-hours per year (kW-hr/yr).

Emissions were calculated by multiplying the unit rating (kW) of the generators by an estimated annual run time (hours/year) to obtain the output (kW-hr/yr). Afterwards, the appropriate VOC and NOx emission factors were then multiplied by the output. The VOC and NOx emission factors were obtain from Table 3.1-1 of USEPA's *AP-42 Compilation of Air Pollutant Emissions Factors*, Section 3.1, Stationary Gas Turbines. The VOC and NOx emission factors used were 1.92 E-04 lbs/hp-hr and 3.53 E-03 lbs/hp-hr, respectively. To estimate the daily emissions, a conservative estimate of 153 days per year was used. This would assume that the generator only ran during the ozone-forecasting season, May through September.

Again, the usage of this generator is expected to remain constant throughout the maintenance plan period. Therefore the base year (2005) and the future year emissions are expected to be at the same level as reported in the NPS's *2000 Air Emissions Inventory* report.

The emissions for the base and future years were calculated using equation below.

$$EM = \frac{(EF) \times (1.34\ hp/kW) \times (Power\ Rating) \times Run\ Time}{(2000\ lb/tons) \times (153\ days/year)}$$

where,

	EM	=	emissions for source category tons/day
	EF	=	emission factor for source category, (lbs/hp-hr)
	Power Rating	=	power rating of generator, (kW)
	Run Time	=	hours of operation, (hrs/yr)

The VOC and NOx emissions estimates from the one generator located in the North Carolina GSMNP nonattainment area are tabulated in the table below. Since the emissions are so small, both the annual and the daily emissions are displayed and are in tons per year and tons per day, respectively.

Table 4.3-1 Emission Estimates for Generators

Location	VOC		NOx	
	Annual	Daily	Annual	Daily
Water plant generator	0.02	0.00	0.39	0.00

4.4 CAMPFIRES

In 2000, the entire GSMNP had ten front country campgrounds with about 900 campsites and about 100 campsites in the backcountry. Within the North Carolina GSMNP nonattainment area, there were five front country campgrounds. These sites were occupied between 153 to 365 days per year, and it was estimated that approximately 50 percent had an evening or morning campfire at each site. Campground sites are used more often during summertime months. Thus, annual campfire emissions were assumed to occur over the 153-day ozone-forecasting season (May through September) as a conservative estimate.

According to the NPS's *2000 Air Emissions Inventory* report, each campfire site consumes approximately 10 lbs of wood per campfire. The amount of campfire wood burned in tons per year from each campground location is listed in Table 4.4-1. The VOC and NOx emission factors for the combustion of wood were obtain from Table 1.9-1 of USEPA's *AP-42 Compilation of Air Pollutant Emissions Factors*, Section 1.9, Residential Fireplaces. The emission factors are 229.0 lbs. VOC per ton of wood and 2.6 lbs. NOx per ton of wood.

Again, the usage of the campsites and the number of campfires is expected to remain constant throughout the maintenance plan period. Therefore the base year (2005) and the future year emissions are expected to be at the same level as reported in the NPS's *2000 Air Emissions Inventory* report.

The VOC and NOx emissions estimates from the campfires located in the North Carolina GSMNP nonattainment area are tabulated in the table below. Since the emissions are so small, both the annual and the daily emissions are displayed and are in tons per year and tons per day, respectively.

Table 4.4-1 Tons Of Wood Burned From Campfires

Location	Campfires	Wood Burned (tons/yr)	VOC		NOx	
			Annual	Daily	Annual	Daily
Balsam Mountain	3,450	17	1.95	0.01	0.02	0.00
Big Creek	1,350	7	0.80	0.01	0.01	0.00
Cataloochee	3,038	15	1.72	0.01	0.02	0.00
Deep Creek	9,660	48	5.50	0.04	0.06	0.00
Smokemont	25,915	130	14.89	0.10	0.17	0.00
Total	43,413	217	24.86	0.17	0.28	0.00

4.5 OTHER MANMADE AREA SOURCES

Other man made area sources include space and water heating equipment, woodstoves and fireplaces, and miscellaneous area sources.

Space and Water Heating Equipment

According to the NPS's *2000 Air Emissions Inventory* report, there are space and water heating units that use No. 2 fuel oil and propane. In discussions with the NPS, it was determined that all of these units are located in the Tennessee part of the GSMNP. Therefore, there were no emissions estimated for this source category in this maintenance plan.

Woodstoves and Fireplaces

According to the NPS's *2000 Air Emissions Inventory* report, there are no woodstoves or fireplaces in GSMNP. Therefore, no emission estimates were calculated for this source category.

Miscallaneous Area Sources

According to the NPS's *2000 Air Emissions Inventory* report, miscellaneous area sources include food preparation, degreasers, paints and other surface coatings, lighter fluid consumption, consumer solvents, propane use by visitors in recreational vehicles, and highway maintenance, such as paving materials. Little data was available on these activities and products. The NPS's *2000 Air Emissions Inventory* report did not estimate emissions for these sources.

4.6 BIOGENIC EMISSIONS

Biogenic emissions are primarily VOC emissions from vegetation and are kept constant through all years when modeling ozone. Since the redesignation and maintenance plan is a comparison of future year to base year emissions and the biogenic emissions are kept constant, the biogenic emissions do not play a part in the redesignation demonstration. Upon discussions with the USEPA Region 4, it was agreed that the biogenic emissions did not need to be estimated for the redesignation and maintenance plan.

4.7 SUMMARY OF AREA SOURCE EMISSIONS

The base year and future years estimated emissions are held constant for area sources. Table 4.7-1 below summarizes the area source emissions the North Carolina GSMNP nonattainment area. The annual emissions are in tons per year and the daily emissions are in tons per day.

Table 4.7-1 Total Area Source Emissions

Source	VOC Emissions		NOx Emissions	
	Annual	Daily	Annual	Daily
Aboveground storage tank	0.34	0.00	0.00	0.00
Prescribed burns	0.00	0.00	0.00	0.00
Generators	0.02	0.00	0.39	0.00
Campfires	24.86	0.17	0.28	0.00
Other Sources	0.00	0.00	0.00	0.00
Total	25.22	0.17	0.67	0.00

4.8 EMAIL VERIFICATION FROM NPS ON GROWTH ASSUMPTIONS

Subject: Re: emissions growth for the park
From: Jim_Renfro@nps.gov
Date: Wed, 21 Mar 2007 14:59:01 -0400
To: "Laura.Boothe" <Laura.Boothe@ncmail.net>

Laura: I do not expect any significant activity levels or growth for "Area" or "Off-Road Mobile" emission sources in Great Smoky Mountains National Park between 2000 (base-year) and future years during the Maintenance Plan for the Great Smoky Mountains National Park 8-hour ozone non-attainment area.

Jim Renfro, Air Quality Program Manager
Great Smoky Moutains National Park
Resource Mgt & Science Division
1314 Cherokee Orchard Rd
Gatlinburg, TN 37738
Ph: 865/436-1708 Fx: 865/430-4753
Email: jim_renfro@nps.gov
http://www2.nature.nps.gov/air/WebCams/parks/grsmcam/grsmcam.htm

5.0 DISCUSSION OF OFF-ROAD MOBILE SOURCES

Off-road mobile sources are those sources that can move but do not use the highway system. In a typical off-road mobile source emissions inventory, examples would include lawn mowers, agricultural equipment, construction equipment, aircraft engines and railroad locomotives. The NPS's *2000 Air Emissions Inventory* report was used to identify the types of off-road equipment used in the GSMNP. The off-road mobile sources used within the Park include tractors, backhoes, graders, sweepers, forklifts, a roller/compactor, utility vehicles, riding mowers, a bobcat, a dozer and chippers.

Since diesel equipment tend to have higher emission rates than gasoline equipment, all of the off-road equipment was assumed to use diesel to be conservative. Biodiesel is currently used in off-road mobile source equipment within the Tennessee portions of GSMNP, but will not be available in the North Carolina portions of the GSMNP until a later time. For the purpose of calculating emissions, the NPS suggested assuming that biodiesel would be used in off-road equipment in 2008 and all future years.

In order to adequately quantify future year emissions, the use of off-road mobile source emission factors for equipment operating with biodiesel would yield the most accurate emission values. Several U.S. research projects are currently underway, which look at the effects on emissions of using biodiesel in nonroad mobile equipment. One of these is a study being conducted by the NCDOT entitled "Real World Duty Cycles and Utilization for Construction Equipment in North Carolina". This study aims to develop emissions estimates for construction equipment of various types, and to develop a model of overall NCDOT construction equipment emissions. Another study entitled "York Technical College Nonroad Diesel Retrofit Demonstration Project" is being conducted by York Technical College in South Carolina. The goal of this program is to promote statewide the use of diesel oxidation catalysts and B-20 biodiesel for all nonroad vehicles used by both public and private operators. In each case, the studies are underway and no prelimary results were available, which provide information about biodiesel emission factors for nonroad equipment.

The National Biodiesel Board (NBB) has concluded that when comparing biodiesel to traditional diesel, hydrocarbon emissions are reduced when using biodiesel. Also, NOx emissions can increase or decrease slightly when using B-20 biodiesel. This fluctuation depends upon the engine family tested and the testing procedures. Since emissions factors for biodiesel could not be found and the NBB concluded that biodiesel tends to have lower emissions than diesel, diesel emission factors, obtained from the reporting utility of the USEPA's NONROAD2005c model

released March 21, 2006, were used to provide a conservative estimate the emissions from off-road mobile sources.

The NPS's *2000 Air Emissions Inventory* report also included the annual usage rates for the off-road equipment. The NPS was contacted to determine which equipment was used in the North Carolina GSMNP nonattainment area. According to the NPS, all of the equipment was used in North Carolina about 30% of the time.

Table 5-1 contains a list of the off-road equipment, the annual usage data and the VOC and NOx emission factors used to calculate the emissions for the North Carolina GSMNP nonattainment area.

Table 5-1 Off-Road Mobile Data Used in Estimating Emissions

Equipment Type	Number of Units	Annual Usage (Hrs/yr/unit)	Power Rating (Hp)	Load (%)	VOC EF (grams/hp-hr)	NOx EF (grams/hp-hr)
Utility Vehicles	11	100	15	55	1.93	8.37
Tractors	13	100	42.35	68	1.93	8.37
Backhoes	9	100	77	55	1.93	8.37
Riding Mowers	7	100	15	55	1.46	7.40
Bobcat	1	100	15	55	1.93	8.37
Dozer	1	100	77	55	1.93	8.37
Graders	4	100	172	61	0.48	6.14
Sweepers	4	100	30	68	0.62	6.49
Forklifts	3	100	172	61	0.55	5.55
Roller/Compactor	1	100	30	55	0.70	6.34
Chippers	3	100	30	55	0.80	7.10

According to the NPS, the activity level of the off-road equipment remains generally the same year-to-year. Their recommendation was not to grow the emissions, rather keep the emissions constant out into the future. As a conservative estimate, it was assumed that the equipment was only used during the ozone-forecasting season, May through September (i.e., 153 days).

The emissions for the base and future years were calculated using equation 5-1.

$$EM = \frac{EF \times (\text{No. Of Units}) \times \text{Usage} \times (\text{Power Rating}) \times \text{Load} \times (\text{Fraction in NC})}{(453.6 \text{ grams/lb}) \times (2000 \text{ lb/tons}) \times (153 \text{ days/year})} \quad 5\text{-}1$$

where, EM = emissions for source category, tons/day
EF = emission factor for source category, grams/hp-hr
No. of Units = the number of units within the specific equipment type
Usage = the number of hours one unit operates per year
Power Rating = power rating of equipment, hp
Load = operating load, %
Fraction in NC = the fraction of usage within the nonattainment area (0.30)

The VOC and NOx emission estimates from off-road equipment used in the North Carolina GSMNP nonattainment area are tabulated in the table below. Since the emissions are so small, both the annual and the daily emissions are displayed and are in tons per year and tons per day, respectively.

Table 5.-2 Total Off-Road Mobile Source Emissions

Source	VOC Emissions		NOx Emissions	
	Annual	Daily	Annual	Daily
Utility Vehicles	0.004	0.00	0.016	0.00
Tractors	0.016	0.00	0.068	0.00
Backhoes	0.016	0.00	0.069	0.00
Riding Mowers	0.002	0.00	0.009	0.00
Bobcat	0.000	0.00	0.001	0.00
Dozer	0.002	0.00	0.008	0.00
Graders	0.004	0.00	0.056	0.00
Sweepers	0.001	0.00	0.011	0.00
Forklifts	0.004	0.00	0.038	0.00
Roller/Compactor	0.000	0.00	0.002	0.00
Chippers	0.001	0.00	0.008	0.00
Total	0.05	0.00	0.29	0.00

6.0 DISCUSSION OF HIGHWAY MOBILE SOURCES

6.1 INTRODUCTION

Highway mobile sources are considered those vehicles that travel on the roadways. Mobile sources comprise over 50 percent of the emissions of NOx emissions for most of North Carolina. However, in GSMNP, nearly all of the man-made NOx comes from mobile sources. Emissions of these pollutants are estimated in the mobile source inventory required for the maintenance plan. In Section 7 are copies of the data used in the calculation of the estimated emissions, such as the MOBILE6.2 mobile model input and output files.

All of these GSMNP 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 and the NPS, 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 transportation partners involved in the North Carolina GSMNP redesignation interagency consultation process included: NCDAQ, NCDOT, USEPA, Federal Highway Administration (FHWA), and the NPS. Specifically, the NPS was consulted for input data such as vehicle mix, speeds, and VMT. Also, an interagency consultation conference call was held to discuss some of the specific details on the MOBILE 6.2 modeling. During the final stages of the update to the redesignation and maintenance plan preparation, the interagency partners were again consulted (February 2009), the parameters and assumptions of the modeling were reiterated and comments were solicited since NCDAQ was adding the final year as 2020 and developing budgets for the years 2011 and 2020.

6.2 MOBILE6.2 INPUT ASSUMPTIONS

The MOBILE6.2 input files and output files used in the development of the highway mobile source emissions for the maintenance plan are compiled in Section 7.

Speed Assumptions

The MOBILE6.2 command "AVERAGE SPEED" was used to enter the daily speeds provided by NPS. 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, NPS, and NCDOT follow the USEPA's *Technical Guidance on the Use of MOBILE6.2 for Emission Inventory Preparation* to match FHWA roadways to MOBILE6.2 driving cycles.

Emissions from motor vehicles vary with the manner in which the vehicle is operated. Vehicles traveling at 25 miles per hour (mph) emit a very different mix of pollutants than the car that is traveling at 65 mph on an interstate highway. In order to estimate emissions from vehicles for a typical day, the NPS provided speeds for the Park.

For the North Carolina GSMNP nonattainment area, the latest speeds were obtained from the NPS at the Interagency Consultation Conference Call/Meeting for the Great Smoky Mountains National Park on May 26, 2006. The speeds provided are based on a daily average. The MOBILE6.2 model was utilized to generate emission factors for the North Carolina GSMNP nonattainment area. The same speed, 25 mph, was provided for all of the years in the maintenance plan. The average speed of 25 mph is constant for all years due to the lower speed limit, relatively constant volume of vehicles over the years, limited infrastructure, and limited access to the park . The arterial road type was used in the modeling.

Vehicle Age Distribution

The vehicle age distribution comes from annual registration data for North Carolina from the NCDOT. For this analysis, the latest available data was for 2004. The NCDOT provided the latest available count data based on the number of vehicle types per year from 1982 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 MOBILE5 format and does not correlate to the USEPA's MOBILE6.2 model vehicle types. In order to convert the data provided by the NCDOT into the MOBILE6.2 model format, the NCDAQ used a 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 park vehicle age distribution is somewhat unique in composition due to it being a tourist destination. The consensus best judgment of NPS, NCDOT, and NCDAQ was to use the age distribution for the entire state of North Carolina.

Development of the GSMNP Vehicle Mix

The vehicle mix refers to the percentage of different vehicle types on the road. It is critical for estimating mobile emissions in an area to use data that accurately reflects the vehicles types traveling on the road. The NPS provided the breakdown of the percent of vehicle types that use the Park roadways (Table 6.2-1).

Table 6.2-1 Percentage of Each Vehicle Type

Vehicle Type	Percentage
Passenger Cars	92.07%
Light Duty Trucks	3.39%
Motorcycles	2.63%
Recreational Vehicles	0.55%
Vehicles/RV Pulling Trailers	1.24%
Transit/Shuttle Buses	0.02%
Tour Buses	0.08%
Heavy Duty Trucks	0.00%

Using the *Technical Guidance on the Use of MOBILE6.2 for Emission Inventory Preparation*, Section 4.1.5, the percentage of vehicle types were mapped to the 16 MOBILE6.2 vehicle classes. Based on this methodology, the GSMNP 2004 count data from Table 6.2-1 was aggregated into the general categories as shown below:

Table 6.2-2 Aggregation of GSMNP Count Data

GSMNP Count Category	General Category
Passenger Cars, Light Duty Trucks	Passenger Car (LDV)+Light Duty Trucks (LDT1, LDT2, LDT3, LDT4)
Motorcycle	Motorcycle (MC)
Recreational Vehicles, RV	Medium Trucks (HDV2, HDV3, HDV4, HDV5, HDV6)
Tour, Transit and Shuttle Buses	Buses (HDBT, HDBS)
Heavy Duty Trucks	Heavy Duty Trucks (HDV7, HDV8)

The GSMNP count categories were grouped into general categories and the percentages for each subcategory was determined as follows:

Light Duty Vehciles+Light Duty Trucks	=	95.48%
Motorcycles	=	2.63%
Medium Trucks	=	1.79%
Buses	=	0.10%
Heavy Duty Vehicles	=	0.00%

For the motorcycles, medium trucks, buses and heavy duty vehicles, the fraction from the GSMNP count data was matched one-for-one with a corresponding vehicle type. The medium truck fraction was matched to the heavy duty diesel 2 (HDV2) vehicle type since there is no access to the GSMNP for the other types of medium trucks listed in Table 6.2-2. The NPS does have a few larger medium duty trucks in the Park, however, these were not counted as they are predominantly on the Tennessee side and the limited North Carolina VMT data was not available.

For passenger cars and light duty trucks, the GSMNP count data had to be expanded into the five MOBILE6.2 vehicle types. To create the 2005 GSMNP vehicle mix for this group, the total 2004 State fractions for this group was used, since the GSMNP count data was for 2004, along with the State vehicle type fractions for 2005. The calculation for the 2005 passenger cars and light duty trucks vehicle mix for the GSMNP is illustrated below.

The total 2004 State passenger cars and light duty trucks fraction was 0.8774. The 2005 State vehicle mix for passenger cars and light duty trucks is:

Vehicle Type		Fraction
LDV	=	0.4247
LDT1	=	0.0777
LDT2	=	0.2587
LDT3	=	0.0797
LDT4	=	0.0366

The GSMNP 2005 vehicle mix for each type of passenger cars and light duty trucks was calculated using the following formula:

$$\text{Vehicle Type} = \frac{(\text{2005 State VMT fraction for vehicle}) \times (\text{2004 GSMNP total fraction for group})}{(\text{2004 State total fraction for group})}$$

Table 6.2-3 displays the calculation for each vehicle type for the 2005 GSMNP vehicle mix. The vehicle mix is adjusted to make only the vehicles allowed into GSMNP equal 100%.

Table 6.2-3 Calculation of 2005 GSMNP Rural Minor Arterial Vehicle Mix

Vehicle Type		Calculation		New 2005 Mix
Passenger Cars and Light Duty Trucks				
LDV	=	0.4247 x (0.9548/0.8774)	=	0.4622
LDT1	=	0.0777 x (0.9548/0.8774)	=	0.0846
LDT2	=	0.2587 x (0.9548/0.8774)	=	0.2815
LDT3	=	0.0797 x (0.9548/0.8774)	=	0.0867
LDT4	=	0.0366 x (0.9548/0.8774)	=	0.0398
Other vehicle types				
Motorcycles		actual GSMNP count fraction	=	0.0263
Medium Truck (HDV2)		actual GSMNP count fraction	=	0.0179
Buses		actual GSMNP count fraction	=	0.0010
Heavy Duty Vehicles		(Park access regulations)	=	0.0000
Total				1.0000

Temperature, and Altitude Assumptions

The MOBILE6.2 command "MIN/MAX TEMPERATURES" was used to enter temperatures to estimate mobile source emissions. This command requires the command name followed by the average minimum and maximum temperatures in the data field in the RUN SECTION of the mobile input files. For the North Carolina GSMNP nonattainment area, mobile source emission estimates, the NCDAQ used average July 2005 temperature profile from the Oconaluftee CO-OP Meteorological Station located just within the southern border of the the GSMMP. The minimum and maximum temperatures used in this analysis are 57.8ºF and 85.5ºF.

The ALTITUDE command requires the command name followed by the flag value of "1" or "2", where "1" represents 500 feet above sea level and "2" represents altitude 5500 feet above sea level. Based on discussions with the NPS, the "2" flag was determined to better represent the Park altitude that averages approximately 4000 feet.

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. Although Haywood County is subject to the OBDII program, most vehicles in the Park are visitors from all over and their vehicles may or may not be subject to an inspection and maintenance program. Therefore, to be on the conservative side, the benefits of OBD II were not calculated for the Park. However, all counties in North Carolina have a vehicle safety inspection program. Inspection stations are required to administer an anti-tampering check to ensure that emissions control equipment on any vehicle, less than 35 model years old, has not been altered. Since many of the visitors to the Park are from North Carolina, this benefit was used in the model.

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 Park and the rural North Carolina area. Lower RVP leads to lower VOC emissions from gasoline handling and lowers vapor losses from motor vehicles.

6.3 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 North Carolina GSMNP nonattainment area was provided by NCDOT and approved by the NPS via e-mail on September 20, 2006. This VMT data was developed in conjunction with a transportation conformity analysis for the North Carolina GSMNP nonattainment area. Although the NPS has stated that the number of visitors to the Park is not expected to increase, a modest growth in VMT was applied to provide a conservative estimate. The VMT used for the maintenance plan are listed in Table 6.3-1.

Table 6.3-1 Vehicle Miles Traveled for GSMNP

Road Type	2005	2008	2011	2014	2017	2020
Arterial	200,830	212,277	223,725	235,172	246,619	258,067

6.4 ESTIMATED EMISSIONS FROM MOBILE SOURCES

A summary of the highway mobile source emissions in tons per day is provided in Tables 6.4-1 for VOC and NOx emissions.

Table 6.4-1 Highway Mobile Source Emissions (tons/day)

Pollutant	2005	2008	2011	2014	2017	2020
VOC emissions	0.41	0.36	0.32	0.27	0.24	0.22
NOx emissions	0.26	0.23	0.20	0.17	0.15	0.14

6.5 EMAIL VERIFICATION FROM NPS ON GROWTH ASSUMPTIONS

Subject: Re: GSMNP Redesignation and Maintenance
From: Jim_Renfro@nps.gov
Date: 1/26/2009
To: Janice Godfrey <Janice.godfrey@ncmail.net>

Janice; based on visitation data, and projections, I think the speed limits will be the same as well as visitation (VMT). What do you think?

Jim Renfro, Air Quality Specialist
Great Smoky Mountains NP
1316 Cherokee Orchard Rd
Gatlinburg, TN 37738
865.436.1708
http://www.nature.nps.gov/air/WebCams/parks/grsmcam/grsmcam.cfm

7.0 MOBILE DATA USED

7.1 INPUT FILES

GSM05N.IN

```
MOBILE6 INPUT FILE :

> GSMNP(NC Side) O3 Non I/M Redignation Analysis for 2005
POLLUTANTS          : HC NOX
SPREADSHEET         : GSMNP
RUN DATA            :

***************** RUN SECTION  **********
FUEL RVP            : 9.0

MIN/MAX TEMPERATURE: 57.8 85.5

REG DIST            : NCage04.prn

ANTI-TAMP PROG      :
91 68 50 22222 22222222 2 11 095. 22212222

************  SCENARIO SECTION ********
SCENARIO RECORD     : Arterial-GSMNP
CALENDAR YEAR       : 2005
EVALUATION MONTH    : 7

> Arterial mix and speeds

VMT FRACTIONS       :
0.4622    0.0846   0.2815    0.0867   0.0398    0.0179    0.0000    0.0000
0.0000    0.0000   0.0000    0.0000   0.0000    0.0000    0.0010    0.0263

AVERAGE SPEED       : 25 Arterial 100.0 0.0 0.0 0.0

ALTITUDE            : 2

END OF RUN          :
```

GSM08N.IN

```
MOBILE6 INPUT FILE :

> GSMNP(NC Side) O3 Non I/M Redignation Analysis for 2008
POLLUTANTS          : HC NOX
SPREADSHEET         : GSMNP
RUN DATA            :

***************** RUN SECTION  **********
FUEL RVP            : 9.0

MIN/MAX TEMPERATURE: 57.8 85.5

REG DIST            : NCage04.prn

ANTI-TAMP PROG      :
91 68 50 22222 22222222 2 11 095. 22212222

************  SCENARIO SECTION ********
SCENARIO RECORD     : Arterial-GSMNP
CALENDAR YEAR       : 2008
EVALUATION MONTH    : 7

> Arterial mix and speeds

VMT FRACTIONS       :
0.4159    0.0925   0.3079    0.0949   0.0436    0.0179    0.0000    0.0000
0.0000    0.0000   0.0000    0.0000   0.0000    0.0000    0.0010    0.0263

AVERAGE SPEED       : 25 Arterial 100.0 0.0 0.0 0.0

ALTITUDE            : 2

END OF RUN          :
```

GSM11N.IN

```
MOBILE6 INPUT FILE :

> GSMNP(NC Side) O3 Non I/M Redignation Analysis for 2011
POLLUTANTS          : HC NOX
SPREADSHEET         : GSMNP
RUN DATA            :

***************** RUN SECTION  **********
FUEL RVP            : 9.0

MIN/MAX TEMPERATURE: 57.8 85.5

REG DIST            : NCage04.prn

ANTI-TAMP PROG      :
91 68 50 22222 22222222 2 11 095. 22212222

************  SCENARIO SECTION ********
SCENARIO RECORD     : Arterial-GSMNP
CALENDAR YEAR       : 2011
EVALUATION MONTH    : 7

> Arterial mix and speeds

VMT FRACTIONS       :
0.3744    0.0997   0.3315    0.1022   0.0470    0.0179    0.0000    0.0000
0.0000    0.0000   0.0000    0.0000   0.0000    0.0000    0.0010    0.0263

AVERAGE SPEED       : 25 Arterial 100.0 0.0 0.0 0.0

ALTITUDE            : 2

END OF RUN          :
```

GSM14N.IN

```
MOBILE6 INPUT FILE :

> GSMNP(NC Side) O3 Non I/M Redignation Analysis for 2014
POLLUTANTS          : HC NOX
SPREADSHEET         : GSMNP
RUN DATA            :

***************** RUN SECTION  **********
FUEL RVP            : 9.0

MIN/MAX TEMPERATURE: 57.8 85.5

REG DIST            : NCage04.prn

ANTI-TAMP PROG      :
91 68 50 22222 22222222 2 11 095. 22212222

************  SCENARIO SECTION ********
SCENARIO RECORD     : Arterial-GSMNP
CALENDAR YEAR       : 2014
EVALUATION MONTH    : 7

> Arterial mix and speeds

VMT FRACTIONS       :
0.3437    0.1049    0.3492    0.1075    0.0495    0.0179    0.0000    0.0000
0.0000    0.0000    0.0000    0.0000    0.0000    0.0000    0.0010    0.0263

AVERAGE SPEED       : 25 Arterial 100.0 0.0 0.0 0.0

ALTITUDE            : 2

END OF RUN          :
```

GSM17N.IN

```
MOBILE6 INPUT FILE :

> GSMNP(NC Side) O3 Non I/M Redignation Analysis for 2017
POLLUTANTS          : HC NOX
SPREADSHEET         : GSMNP
RUN DATA            :

***************** RUN SECTION  **********
FUEL RVP            : 9.0

MIN/MAX TEMPERATURE: 57.8 85.5

REG DIST            : NCage04.prn

ANTI-TAMP PROG      :
91 68 50 22222 22222222 2 11 095. 22212222

************  SCENARIO SECTION ********
SCENARIO RECORD     : Arterial-GSMNP
CALENDAR YEAR       : 2017
EVALUATION MONTH    : 7

> Arterial mix and speeds

VMT FRACTIONS       :
0.3218    0.1086   0.3617    0.1114   0.0513    0.0179    0.0000    0.0000
0.0000    0.0000   0.0000    0.0000   0.0000    0.0000    0.0010    0.0263

AVERAGE SPEED       : 25 Arterial 100.0 0.0 0.0 0.0

ALTITUDE            : 2

END OF RUN          :
```

GSM20N.IN

```
MOBILE6 INPUT FILE :

> GSMNP(NC Side) O3 Non I/M Redignation Analysis for 2020
POLLUTANTS          : HC NOX
SPREADSHEET         : GSMNP
RUN DATA            :

***************** RUN SECTION  **********
FUEL RVP            : 9.0

MIN/MAX TEMPERATURE: 57.8 85.5

REG DIST            : NCage04.prn

ANTI-TAMP PROG      :
91 68 50 22222 22222222 2 11 095. 22212222

************  SCENARIO SECTION ********
SCENARIO RECORD     : Arterial-GSMNP
CALENDAR YEAR       : 2020
EVALUATION MONTH    : 7

> Arterial mix and speeds

VMT FRACTIONS       :
0.3056    0.1114   0.3709   0.1143   0.0526    0.0179    0.0000   0.0000
0.0000    0.0000   0.0000   0.0000   0.0000    0.0000    0.0010   0.0263

AVERAGE SPEED       : 25 Arterial 100.0 0.0 0.0 0.0

ALTITUDE            : 2

END OF RUN          :
```

7.2 MOBILE6.2 OUTPUT DATA

```
***************************************************************************
* MOBILE6.2.03 (24-Sep-2003)                                              *
* Input file: GSM05N.IN (file 1, run 1).                                  *
***************************************************************************

* Reading Registration Distributions from the following external
* data file: NCAGE04.PRN
  M 49 Warning:
                 1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.999     MYR sum not = 1. (will normalize)
  M 49 Warning:
                 1.00     MYR sum not = 1. (will normalize)

* # # # # # # # # # # # # # # # # # # # # # # # # #
* Arterial-GSMNP
* File 1, Run 1, Scenario 1.
* # # # # # # # # # # # # # # # # # # # # # # # # #
* Arterial mix and speeds
  M615 Comment:
                User supplied VMT mix.
  M583 Warning:
             The user supplied arterial average speed of 25.0
             will be used for all hours of the day.  100% of VMT
             has been assigned to the arterial/collector roadway
             type for all hours of the day and all vehicle types.
  M 48 Warning:
               there are no sales for vehicle class HDGV8b

                     Calendar Year:  2005
                             Month:  July
                          Altitude:  High
               Minimum Temperature:  57.8 (F)
               Maximum Temperature:  85.5 (F)
                 Absolute Humidity:   75. grains/lb
                  Nominal Fuel RVP:   9.0 psi
                     Weathered RVP:   8.8 psi
               Fuel Sulfur Content:   92. ppm

               Exhaust I/M Program:  No
                  Evap I/M Program:  No
                       ATP Program:  Yes
                  Reformulated Gas:  No
```

Vehicle Type:	LDGV	LDGT12	LDGT34	LDGT	HDGV	LDDV	LDDT	HDDV	MC	All Veh
GVWR:	<6000	>6000	(All)							
VMT Distribution:	0.4613	0.3656	0.1247		0.0138	0.0009	0.0023	0.0051	0.0263	1.0000
Composite Emission Factors (g/mi):										
Composite VOC:	1.396	2.132	2.188	2.147	2.614	1.065	1.351	0.676	4.60	1.861
Composite NOX:	0.961	1.295	1.441	1.332	2.974	1.401	1.330	5.724	0.80	1.192

```
***************************************************************************
* MOBILE6.2.03 (24-Sep-2003)                                              *
* Input file: GSM08N.IN (file 2, run 1).                                  *
***************************************************************************
* Reading Registration Distributions from the following external
* data file: NCAGE04.PRN
  M 49 Warning:
                 1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.999     MYR sum not = 1. (will normalize)
  M 49 Warning:
                 1.00     MYR sum not = 1. (will normalize)
* # # # # # # # # # # # # # # # # # # # # # # # # #
* Arterial-GSMNP
* File 2, Run 1, Scenario 1.
* # # # # # # # # # # # # # # # # # # # # # # # # #
* Arterial mix and speeds
  M615 Comment:
               User supplied VMT mix.
  M583 Warning:
            The user supplied arterial average speed of 25.0
            will be used for all hours of the day.  100% of VMT
            has been assigned to the arterial/collector roadway
            type for all hours of the day and all vehicle types.
  M 48 Warning:
              there are no sales for vehicle class HDGV8b

                    Calendar Year:  2008
                            Month:  July
                         Altitude:  High
              Minimum Temperature:  57.8 (F)
              Maximum Temperature:  85.5 (F)
                Absolute Humidity:   75. grains/lb
                 Nominal Fuel RVP:   9.0 psi
                    Weathered RVP:   8.8 psi
              Fuel Sulfur Content:   30. ppm

              Exhaust I/M Program:  No
                 Evap I/M Program:  No
                      ATP Program:  Yes
                 Reformulated Gas:  No

Vehicle Type:     LDGV   LDGT12  LDGT34    LDGT   HDGV     LDDV    LDDT    HDDV      MC   All Veh
      GVWR:      <6000   >6000   (All)
                 ------  ------  ------  ------  ------  ------  ------  ------  ------  ------
VMT Distribution:0.4155  0.4003  0.1365          0.0137  0.0004  0.0021  0.0052  0.0263  1.0000
------------------------------------------------------------------------------------------
 Composite Emission Factors (g/mi):
Composite VOC:    1.105   1.700   1.717   1.704   2.023    0.438   0.708   0.580    4.49   1.524
Composite NOX:    0.718   1.064   1.237   1.108   2.218    0.782   0.881   4.586    0.80   0.971
------------------------------------------------------------------------------------------
```

```
***************************************************************************
* MOBILE6.2.03 (24-Sep-2003)                                              *
* Input file: GSM11N.IN (file 3, run 1).                                  *
***************************************************************************
* Reading Registration Distributions from the following external
* data file: NCAGE04.PRN
  M 49 Warning:
                 1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.999     MYR sum not = 1. (will normalize)
  M 49 Warning:
                 1.00     MYR sum not = 1. (will normalize)
* # # # # # # # # # # # # # # # # # # # # # # # # #
* Arterial-GSMNP
* File 3, Run 1, Scenario 1.
* # # # # # # # # # # # # # # # # # # # # # # # # #
* Arterial mix and speeds
  M615 Comment:
               User supplied VMT mix.
  M583 Warning:
            The user supplied arterial average speed of 25.0
            will be used for all hours of the day.  100% of VMT
            has been assigned to the arterial/collector roadway
            type for all hours of the day and all vehicle types.
  M 48 Warning:
              there are no sales for vehicle class HDGV8b

                    Calendar Year:  2011
                            Month:  July
                         Altitude:  High
              Minimum Temperature:  57.8 (F)
              Maximum Temperature:  85.5 (F)
                Absolute Humidity:   75. grains/lb
                 Nominal Fuel RVP:   9.0 psi
                    Weathered RVP:   8.8 psi
              Fuel Sulfur Content:   30. ppm

              Exhaust I/M Program:  No
                 Evap I/M Program:  No
                      ATP Program:  Yes
                 Reformulated Gas:  No

Vehicle Type:    LDGV   LDGT12  LDGT34    LDGT   HDGV     LDDV    LDDT    HDDV      MC   All Veh
      GVWR:     <6000   >6000   (All)
                 ------  ------  ------  ------  ------  ------  ------  ------  ------  ------
VMT Distribution:0.3741  0.4312  0.1471           0.0138  0.0003  0.0021  0.0051  0.0263  1.0000
-------------------------------------------------------------------------------------------
 Composite Emission Factors (g/mi):
Composite VOC:     0.854   1.433   1.466   1.441   1.547    0.207   0.452   0.454    4.40   1.293
Composite NOX:     0.556   0.884   1.038   0.923   1.652    0.337   0.559   3.275    0.80   0.804
-------------------------------------------------------------------------------------------
```

```
***********************************************************************
* MOBILE6.2.03 (24-Sep-2003)                                          *
* Input file: GSM14N.IN (file 4, run 1).                              *
***********************************************************************

* Reading Registration Distributions from the following external
* data file: NCAGE04.PRN
  M 49 Warning:
                1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
               0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
               0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
               0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
               0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
               0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
               0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
               0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
               0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
               0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
               0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
               0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
               0.999     MYR sum not = 1. (will normalize)
  M 49 Warning:
                1.00     MYR sum not = 1. (will normalize)

* # # # # # # # # # # # # # # # # # # # # # # # # #
* Arterial-GSMNP
* File 4, Run 1, Scenario 1.
* # # # # # # # # # # # # # # # # # # # # # # # # #
* Arterial mix and speeds
  M615 Comment:
               User supplied VMT mix.
  M583 Warning:
            The user supplied arterial average speed of 25.0
            will be used for all hours of the day.  100% of VMT
            has been assigned to the arterial/collector roadway
            type for all hours of the day and all vehicle types.
  M 48 Warning:
              there are no sales for vehicle class HDGV8b
  M 48 Warning:
              there are no sales for vehicle class LDDT12

                    Calendar Year:  2014
                            Month:  July
                         Altitude:  High
              Minimum Temperature:  57.8 (F)
              Maximum Temperature:  85.5 (F)
                Absolute Humidity:   75. grains/lb
                 Nominal Fuel RVP:   9.0 psi
                    Weathered RVP:   8.8 psi
              Fuel Sulfur Content:   30. ppm

              Exhaust I/M Program:  No
                 Evap I/M Program:  No
                      ATP Program:  Yes
                 Reformulated Gas:  No
```

Vehicle Type:	LDGV	LDGT12	LDGT34	LDGT	HDGV	LDDV	LDDT	HDDV	MC	All Veh
GVWR:	<6000	>6000	(All)							
VMT Distribution:	0.3434	0.4541	0.1547		0.0138	0.0003	0.0023	0.0051	0.0263	1.0000
Composite Emission Factors (g/mi):										
Composite VOC:	0.654	1.141	1.174	1.149	1.215	0.127	0.348	0.386	4.35	1.058
Composite NOX:	0.432	0.750	0.873	0.781	1.031	0.177	0.385	2.138	0.80	0.671

```
***************************************************************************
* MOBILE6.2.03 (24-Sep-2003)                                              *
* Input file: GSM17N.IN (file 5, run 1).                                  *
***************************************************************************

* Reading Registration Distributions from the following external
* data file: NCAGE04.PRN
  M 49 Warning:
                 1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
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                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.999     MYR sum not = 1. (will normalize)
  M 49 Warning:
                 1.00     MYR sum not = 1. (will normalize)

* # # # # # # # # # # # # # # # # # # # # # # # # #
* Arterial-GSMNP
* File 5, Run 1, Scenario 1.
* # # # # # # # # # # # # # # # # # # # # # # # # #
* Arterial mix and speeds
  M615 Comment:
               User supplied VMT mix.
  M583 Warning:
            The user supplied arterial average speed of 25.0
            will be used for all hours of the day.  100% of VMT
            has been assigned to the arterial/collector roadway
            type for all hours of the day and all vehicle types.
  M 48 Warning:
              there are no sales for vehicle class HDGV8b
  M 48 Warning:
              there are no sales for vehicle class LDDT12

                    Calendar Year:  2017
                            Month:  July
                         Altitude:  High
              Minimum Temperature:  57.8 (F)
              Maximum Temperature:  85.5 (F)
                Absolute Humidity:   75. grains/lb
                 Nominal Fuel RVP:   9.0 psi
                    Weathered RVP:   8.8 psi
              Fuel Sulfur Content:   30. ppm

              Exhaust I/M Program:  No
                 Evap I/M Program:  No
                      ATP Program:  Yes
                 Reformulated Gas:  No
```

Vehicle Type:	LDGV	LDGT12	LDGT34	LDGT	HDGV	LDDV	LDDT	HDDV	MC	All Veh
GVWR:	<6000	>6000	(All)							
VMT Distribution:	0.3215	0.4703	0.1603		0.0138	0.0003	0.0024	0.0051	0.0263	1.0000
Composite Emission Factors (g/mi):										
Composite VOC:	0.538	0.933	1.000	0.950	0.972	0.094	0.305	0.363	4.27	0.900
Composite NOX:	0.347	0.625	0.754	0.658	0.735	0.098	0.309	1.419	0.80	0.566

```
****************************************************************************
* MOBILE6.2.03 (24-Sep-2003)                                               *
* Input file: GSM20N.IN (file 1, run 1).                                   *
****************************************************************************

* Reading Registration Distributions from the following external
* data file: NCAGE04.PRN
  M 49 Warning:
                 1.00     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.998     MYR sum not = 1. (will normalize)
  M 49 Warning:
                0.999     MYR sum not = 1. (will normalize)
  M 49 Warning:
                 1.00     MYR sum not = 1. (will normalize)

* # # # # # # # # # # # # # # # # # # # # # # # # # #
* Arterial-GSMNP
* File 1, Run 1, Scenario 1.
* # # # # # # # # # # # # # # # # # # # # # # # # # #
* Arterial mix and speeds
  M615 Comment:
               User supplied VMT mix.
  M583 Warning:
            The user supplied arterial average speed of 25.0
            will be used for all hours of the day.  100% of VMT
            has been assigned to the arterial/collector roadway
            type for all hours of the day and all vehicle types.
  M 48 Warning:
              there are no sales for vehicle class HDGV8b
  M 48 Warning:
              there are no sales for vehicle class LDDT12

                    Calendar Year:  2020
                            Month:  July
                         Altitude:  High
              Minimum Temperature:  57.8 (F)
              Maximum Temperature:  85.5 (F)
                Absolute Humidity:   75. grains/lb
                 Nominal Fuel RVP:   9.0 psi
                    Weathered RVP:   8.8 psi
              Fuel Sulfur Content:   30. ppm

              Exhaust I/M Program:  No
                 Evap I/M Program:  No
                      ATP Program:  Yes
                 Reformulated Gas:  No

Vehicle Type:    LDGV    LDGT12    LDGT34    LDGT    HDGV    LDDV    LDDT    HDDV    MC   All Veh
        GVWR:   <6000     >6000     (All)
 ------    ------    ------    ------    ------    ------    ------    ------    ------    ------
VMT Distribution:0.3053  0.4823    0.1645   0.0139  0.0003   0.0024    0.0050    0.0263    1.0000
```

```
-------------------------------------------------------------------------------------------------
Composite Emission Factors (g/mi):
Composite VOC :   0.463   0.774   0.836   0.790   0.831  0.079   0.232   0.332    4.16    0.776
Composite NOX :   0.292   0.542   0.656   0.571   0.563  0.069   0.227   0.926    0.80    0.492
-------------------------------------------------------------------------------------------------
```

7.3 VEHICLE MIX

2005 GSMNP Vehicle Mix

Rural							
LDV	**LDT1**	**LDT2**	**LDT3**	**LDT4**	**HDV2B**	**HDV3**	**HDV4**
HDV5	**HDV6**	**HDV7**	**HDV8a**	**HDV8b**	**HDBS**	**HDBT**	**MC**
Minor Art.							
0.4622	0.0846	0.2815	0.0867	0.0398	0.0179	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0010	0.0263

2008 GSMNP Vehicle Mix

Rural							
LDV	**LDT1**	**LDT2**	**LDT3**	**LDT4**	**HDV2B**	**HDV3**	**HDV4**
HDV5	**HDV6**	**HDV7**	**HDV8a**	**HDV8b**	**HDBS**	**HDBT**	**MC**
Minor Art.							
0.4159	0.0925	0.3079	0.0949	0.0436	0.0179	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0010	0.0263

2011 GSMNP Vehicle Mix

Rural							
LDV	**LDT1**	**LDT2**	**LDT3**	**LDT4**	**HDV2B**	**HDV3**	**HDV4**
HDV5	**HDV6**	**HDV7**	**HDV8a**	**HDV8b**	**HDBS**	**HDBT**	**MC**
Minor Art.							
0.3744	0.0997	0.3315	0.1022	0.0470	0.0179	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0010	0.0263

2014 GSMNP Vehicle Mix

Rural							
LDV	**LDT1**	**LDT2**	**LDT3**	**LDT4**	**HDV2B**	**HDV3**	**HDV4**
HDV5	**HDV6**	**HDV7**	**HDV8a**	**HDV8b**	**HDBS**	**HDBT**	**MC**
Minor Art.							
0.3437	0.1049	0.3492	0.1075	0.0495	0.0179	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0010	0.0263

2017 GSMNP Vehicle Mix

Rural							
LDV	**LDT1**	**LDT2**	**LDT3**	**LDT4**	**HDV2B**	**HDV3**	**HDV4**
HDV5	**HDV6**	**HDV7**	**HDV8a**	**HDV8b**	**HDBS**	**HDBT**	**MC**
Minor Art.							
0.3218	0.1086	0.3617	0.1114	0.0513	0.0179	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0010	0.0263

2020 GSMNP Vehicle Mix

Rural							
LDV	**LDT1**	**LDT2**	**LDT3**	**LDT4**	**HDV2B**	**HDV3**	**HDV4**
HDV5	**HDV6**	**HDV7**	**HDV8a**	**HDV8b**	**HDBS**	**HDBT**	**MC**
Minor Art.							
0.3056	0.1114	0.3709	0.1143	0.0526	0.0179	0.0000	0.0000
0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0010	0.0263