REDESIGNATION INVENTORIES
FOR THE
8-HOUR OZONE NAAQS
FOR THE
NORTHEAST OHIO
MODERATE OZONE NONATTAINMENT AREA

METHODOLOGY AND RESULTS

(Revised 2/4/09)

January 2009

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TABLE OF CONTENTS

Introduction

The United States Environmental Protection Agency (USEPA) published final rules for the implementation of the 8-Hour Ozone National Ambient Air Quality Standard (8-Hour Ozone NAAQS) in the Federal Register on November 29, 2005 (70 FR 71612). These rules identify the required actions for areas designated under the 8-Hour Ozone NAAQS by USEPA during 2004 (69 FR 23858). USEPA designated the counties of Ashtabula, Cuyahoga, Geauga, Lake, Lorain, Medina, Portage and Summit as a moderate nonattainment area in that action.

Ohio EPA is seeking redesignation of the area to attainment for the referenced standard based on current monitor data that shows attainment. It asked its air quality planning partners to assist in this effort by developing inventories necessary to that request. These inventories include the years 2002, 2006, 2012, and 2020.

The following report summarizes the development of these inventories. These inventories will become part of the Ohio Environmental Protection Agency's (Ohio EPA) State Implementation Plan (SIP) redesignation submittal for Ohio under the 8-Hour Ozone NAAQS. These inventories are part of the process laid out by the Clean Air Act Amendments of 1990 (CAAA) and resultant regulation to achieve and maintain attainment of the identified NAAQS.

Ohio EPA is the lead agency for coordinating development of SIPs in Ohio. The Ohio Department of Transportation (ODOT), the Metropolitan Planning Organizations (MPOs), and the Local Air Agencies (LAAs) participate in the development of the SIPs as necessary.

The NEOMONA is a challenging area for which to prepare SIPs. Its geography is defined by the monitored extent of the 8-Hr Ozone problem. This area includes the counties of Ashtabula, Cuyahoga, Geauga, Lake, Lorain, Medina, Portage and Summit. A single planning agency does not exist for the area however.

- ODOT conducts large-scale transportation and emission modeling in Ashtabula County.
- The Akron Metropolitan Area Transportation Study (AMATS), which is the Akron metropolitan area's MPO, works in conjunction with ODOT to accomplish transportation and emissions modeling for Summit and Portage counties.
- The Northeast Ohio Areawide Coordinating Agency (NOACA), which is the MPO for Cuyahoga, Geauga, Lake, Lorain and Medina counties, conducts transportation modeling and emission modeling efforts for these areas.

All three agencies participate with Ohio EPA and USEPA in determining the best methods and practices for conducting emissions modeling efforts for the region. The methodology and results described below are the result of the ongoing cooperative efforts between these planning partners.

Methodology

The general methodology for mobile source inventory preparation involves three steps:

1) Development of vehicle miles of travel (VMT) estimates for the required analysis years and transportation system networks;
2) Development of hydrocarbon and NO_X emission factors corresponding to the required analysis year; and
3) Multiplication of emission factors by VMT to calculate estimated pollutant emissions from mobile sources in the required analysis years.

1. Vehicle Miles of Travel (VMT)

As noted previously, the nonattainment area contains three distinct planning areas. NOACA uses a travel demand model, TRANPLAN, to model VMT in its five counties. AMATS and ODOT cooperatively use a travel demand model, Cube Voyager, to develop VMT for Summit and Portage counties. Ashtabula County is not covered by a travel demand model. ODOT develops VMT for Ashtabula's transportation system by factoring Highway Performance Monitoring System (HPMS) counts.

The transportation networks and socio-economic data used within the models were modified to reflect year 2002, 2006, 2012, and 2020 conditions. The models use a modified four step – trip generation, trip distribution, mode choice, and assignment – process to generate VMT. Reiteration and other features improve the validity of the modeled outcomes in these high-tech models.

NOACA generates average daily VMT and then aggregates it into 5 mph speed range increments for freeway, major arterial, minor arterial, local and toll road classifications in preparation for pairing with emission factors. For ozone season analyses, average daily VMT is expanded by 8% to reflect the higher proportion of travel that occurs during the ozone season. AMATS/ODOT prepare VMT and associated speeds for each link within their models for each hour of the day and pair these with emission factors within the congestion mitigation/air quality (CMAQ) process they have developed. ODOT uses HPMS data to identify rural and urban portions of VMT across 12 different classes (rural interstate, rural principal arterial, rural minor arterial, rural major collector, rural minor collector, rural local, urban interstate, urban freeway/expressway, urban principal arterial, urban minor arterial, urban collector, and urban local) in preparation for pairing them with emission factors for those geographies not covered by a travel demand model.

2. Emission Factors

NOACA, AMATS and ODOT utilize the USEPA-developed and required MOBILE6.2 emission factor model to develop emission factors for pairing with the VMT generated in step one. USEPA and Ohio EPA provide policy and technical guidance in the preparation of input files of the model runs.

NOACA runs the MOBILE6.2 model separately and pairs the resulting emission factors with the VMT from its travel demand model in Excel spreadsheets. ODOT does similarly for Ashtabula County. ODOT's CMAQ process generates MOBILE6.2 emission factors and pairs them with VMT from its

models in a dynamic programmed process for the AMATS area. A summary of the emissions calculated by the process is printed out at its conclusion.

Similar to previous MOBILE versions, the input files are divided into three sections: the header section, the run section, and the scenario section. The header section contains information pertinent to all runs and scenarios within the input file. It appears once at the beginning of the input file regardless of how many runs or scenarios are contained in it.

The run section includes information and data elements that customize the analysis to the local area. All scenarios in the input file generally use the inputs within this section. However, some of these inputs could be replaced with other values in the scenario section if modeling needs called for it.

The scenario section includes information pertinent to only a given scenario, such as the calendar year or VMT distribution. Many inputs can be placed in either the run or the scenario section. The user determines the appropriate location based upon the desired impact, local or global, of the input. The inputs used in this analysis are described below. The inputs were discussed and agreed upon by the planning partners during a series of meetings, phone calls, teleconferences and e-mails during spring 2006. Where inputs are different between portions of the nonattainment area and those differences will impact the emission factor output, they will be pointed out. In the absence of that clarification, the specified input is representative of the entire eight county area.

Inputs are in regular text. "xxxxx" represents information that can vary between different input files and agencies. Explanations are in italic text. Note: inputs are not printed here in the required MOBILE input format.

Header Section

MOBILE6.2 INPUT FILE:	*This tells MOBILE6.2 that the file is a normal input file as opposed to a batch file.*
> xxxxx > xxxxx	*These are comment lines that provide the user with information regarding the run.*
REPORT FILE: xxxxx	*This provides a user supplied name for the traditional output file.*
SPREADSHEET:	*This asks for spreadsheet output in addition to the traditional output file.*
POLLUTANTS: xxxxx	*This tells the model which pollutants to produce emission factors for.*
RUN DATA:	*This indicates the end of the header section and the beginning of the run section.*

Run Section

MIN/MAX TEMPERATURE: xxxxx	*This tells the model the minimum and maximum daily temperatures to use in generating emission factors. NOACA uses 62 and 89 currently. These are the inputs for the NOACA and Ashtabula County areas. The inputs for the AMATS area are 62 and 88 degrees. These inputs were developed by averaging the minimum and*

maximum temperatures for the nearest National Weather Service (NWS) climate data monitor to the subarea being modeled. The ODOT methodology, which is conducted at an hourly basis, actually assigns a different temperature to each hour of the day that results in the spread from 62 to 88 being covered by the accumulation of the individual hours emissions.

REG DIST: xxxxx

This identifies the use of an alternative, local registration distribution and provides its file name. This file contains a local registration distribution for five classes of light-duty vehicles. It identifies the percentage of on-road vehicles in each of 25 model years. This file differs for each of the subareas. The inputs for each subarea are listed below. The inputs were derived from a vehicle identification number (VIN) decoding project Ohio EPA conducted with funding from USEPA. VINs contain information about the type of vehicle being registered with the Bureau of Motor Vehicles (BMV). Processing of VIN data acquired from the BMV can provide a snapshot of the registration distribution in an area. Ohio EPA did this for each of the state's counties for the five light duty vehicle classes. These include light duty vehicles (passenger cars) and four size ranges of light duty trucks.

```
REG DIST (for NOACA Counties)
* LDV Counties 18,28,43,47,52
 1 0.0345 0.0460 0.0544 0.0482 0.0970 0.1020
   0.0919 0.0907 0.0708 0.0700 0.0589 0.0503
   0.0412 0.0328 0.0282 0.0214 0.0156 0.0097
   0.0081 0.0057 0.0038 0.0020 0.0012 0.0009 0.0147
* LDT1 Counties 18,28,43,47,52
 2 0.0423 0.0564 0.0670 0.0333 0.0497 0.0581
   0.0642 0.0578 0.0793 0.0690 0.0929 0.0649
   0.0422 0.0517 0.0428 0.0382 0.0235 0.0212
   0.0173 0.0089 0.0050 0.0025 0.0014 0.0014 0.0090
* LDT2 Counties 18,28,43,47,52
 3 0.0464 0.0619 0.0736 0.0597 0.1222 0.1260
   0.1176 0.1009 0.0693 0.0568 0.0524 0.0402
   0.0251 0.0146 0.0103 0.0074 0.0070 0.0015
   0.0017 0.0012 0.0011 0.0007 0.0003 0.0002 0.0019
* LDT3 Counties 18,28,43,47,52
 4 0.0354 0.0472 0.0564 0.0449 0.0996 0.1256
   0.0646 0.0642 0.0662 0.0740 0.0678 0.0521
   0.0387 0.0253 0.0301 0.0249 0.0207 0.0135
   0.0118 0.0076 0.0056 0.0030 0.0016 0.0006 0.0186
* LDT4 Counties 18,28,43,47,52
 5 0.0365 0.0487 0.0576 0.0556 0.1179 0.1793
   0.1075 0.1075 0.0845 0.0571 0.0725 0.0133
   0.0114 0.0057 0.0079 0.0045 0.0048 0.0017
   0.0043 0.0033 0.0014 0.0003 0.0005 0.0002 0.0160
```

```
REG DIST (AMATS Counties)
*LDV County 77
1 0.0303 0.0403 0.0477 0.0453 0.0932 0.1003
  0.0893 0.0942 0.0752 0.0751 0.0608 0.0515
  0.0435 0.0333 0.0291 0.0227 0.0156 0.0106
  0.0088 0.0058 0.0051 0.0021 0.0013 0.0011 0.0177
*LDT1 County 77
2 0.029 0.0387 0.0458 0.0265 0.045 0.0542
  0.0576 0.0667 0.0883 0.0774 0.1105 0.0776
  0.0431 0.0554 0.0418 0.0403 0.0256 0.0213
  0.0203 0.0101 0.004 0.0041 0.0021 0.0021 0.0124
*LDT2 County 77
3 0.0381 0.0508 0.0601 0.0534 0.128 0.1273
  0.1205 0.1038 0.07 0.0634 0.0547 0.0416
  0.029 0.0181 0.0109 0.0084 0.009 0.002
  0.003 0.0019 0.0015 0.0011 0.0003 0.0001 0.003
*LDT3 County 77
4 0.0274 0.0366 0.0433 0.0359 0.0916 0.1227
  0.0683 0.0677 0.0769 0.075 0.0717 0.0528
  0.051 0.0254 0.0326 0.0277 0.0199 0.0167
  0.011 0.0105 0.0055 0.0033 0.0022 0.0012 0.0231
*LDT4 County 77
5 0.0312 0.0416 0.0494 0.056 0.1091 0.1759
  0.1163 0.1235 0.0825 0.0615 0.0747 0.0133
  0.0121 0.006 0.006 0.0024 0.006 0.003
  0.0048 0.0042 0.0012 0.0012 0.0018 0 0.0163
```

```
REG DIST (for Ashtabula County)
* LDV County 04
 1 0.0266 0.0355 0.0415 0.0425 0.0766 0.0877
   0.0829 0.0884 0.0742 0.0751 0.0637 0.0618
   0.0502 0.0414 0.0346 0.0302 0.0200 0.0144
   0.0112 0.0093 0.0061 0.0035 0.0020 0.0021 0.0183
* LDT1 County 04
 2 0.0209 0.0279 0.0327 0.0222 0.0357 0.0592
   0.0758 0.0579 0.0797 0.0753 0.0984 0.0601
   0.0527 0.0588 0.0401 0.0440 0.0287 0.0331
   0.0283 0.0231 0.0100 0.0048 0.0061 0.0052 0.0192
* LDT2 County 04
   3 0.0309 0.0412 0.0480 0.0485 0.0955 0.1066
   0.1285 0.1054 0.0767 0.0626 0.0616 0.0539
   0.0381 0.0212 0.0195 0.0181 0.0184 0.0040
   0.0059 0.0035 0.0035 0.0026 0.0012 0.0005 0.0042
* LDT3 County 04
 4 0.0216 0.0288 0.0338 0.0338 0.0799 0.0926
   0.0735 0.0730 0.0744 0.0730 0.0748 0.0534
   0.0402 0.0310 0.0310 0.0319 0.0242 0.0183
   0.0187 0.0205 0.0100 0.0064 0.0046 0.0037 0.0470
* LDT4 County 04
 5 0.0321 0.0428 0.0508 0.0455 0.0882 0.1604
   0.0989 0.1310 0.0561 0.0561 0.0989 0.0214
   0.0107 0.0160 0.0160 0.0027 0.0107 0.0053
   0.0027 0.0107 0.0000 0.0027 0.0000 0.0000 0.0401
```

STAGE II REFUELING: 93 3 086 086

This input provides the model with specifications for modeling the impacts of the Stage II vapor recovery program for the area. It indicates that the program started in 1993; that it was phased in over three years; that it is 86 percent efficient for Light Duty Gasoline Vehicles (LDGVs) and Light Duty Gasoline Trucks (LDGTs); and that it is 86 percent efficient for Heavy Duty Gasoline Vehicles (HDGVs).

OXYGENATED FUELS: 0.00 0.42 0.00 0.036 2

This input provides information on the use of oxygenated fuels in the area. Oxygenates impact emissions. The inputs provide: the ether blend market share; the alcohol blend market share; the average oxygen content of ether blend fuels; the average oxygen content of alcohol blend fuels, and that a Reid Vapor Pressure (RVP) waiver has been granted. The elimination of MTBE as a viable fuel additive is responsible for the absence of an ether blend market share at this time.

ANTI-TAMP PROG:
96 75 50 22222 21111111 1 12 098. 12111112

This input provides the model with information on the anti-tampering programs in use for the model run. The inputs provide the following information: the year the program began; the first model year covered by the program; the last model year covered by the program; the vehicle types covered by the program (14 total entries, 1 = not covered, 2 = covered); 1; program frequency(1=annual; 2=biennial); the program compliance rate; and the tampering inspections covered by the program (8 entries, 1 = not tested, 2 =tested). This input is principally historic since the presence of an I/M program in the input leads the model to ignore it because anti-tampering is covered as part of the I/M process.

There is no anti-tampering program and/or I/M program in Ashtabula County, and this input line is not used in its analysis.

```
I/M PROGRAM       : 1 2001 2003 2 T/O ASM 2525 PHASE-IN
I/M MODEL YEARS   : 1 1996 2003
I/M VEHICLES      : 1 22222 21111111 1
I/M STRINGENCY    : 1 30.0
I/M COMPLIANCE    : 1 98.0
I/M WAIVER RATES  : 1 3.0 1.0
I/M EXEMPTION AGE : 1 25
I/M GRACE PERIOD  : 1 2

I/M PROGRAM       : 2 2001 2050 2 T/O ASM 2525 PHASE-IN
I/M MODEL YEARS   : 2 1975 1995
I/M VEHICLES      : 2 22222 21111111 1
I/M STRINGENCY    : 2 30.0
I/M COMPLIANCE    : 2 98.0
I/M WAIVER RATES  : 2 3.0 1.0
I/M EXEMPTION AGE : 2 25
I/M GRACE PERIOD  : 2 4

I/M PROGRAM       : 3 1996 1997 2 T/O IM240
I/M MODEL YEARS   : 3 1975 1997
I/M VEHICLES      : 3 22222 21111111 1
I/M STRINGENCY    : 3 30.0
I/M COMPLIANCE    : 3 98.0
I/M WAIVER RATES  : 3 3.0 1.0
I/M EXEMPTION AGE : 3 25
I/M CUTPOINTS     : 3 CUTPOINT.D
I/M GRACE PERIOD  : 3 2

I/M PROGRAM       : 4 1996 2050 2 T/O GC
I/M MODEL YEARS   : 4 1975 1995
I/M VEHICLES      : 4 22222 21111111 1
I/M COMPLIANCE    : 4 98.0
I/M WAIVER RATES  : 4 3.0 1.0
I/M EXEMPTION AGE : 4 25
I/M GRACE PERIOD  : 4 2

I/M PROGRAM       : 5 2004 2050 2 T/O OBD I/M
I/M MODEL YEARS   : 5 1996 2050
I/M VEHICLES      : 5 22222 21111111 1
I/M STRINGENCY    : 5 30
I/M COMPLIANCE    : 5 98
I/M WAIVER RATES  : 5 1 1
I/M EXEMPTION AGE : 5 25
I/M GRACE PERIOD  : 5 4

I/M PROGRAM       : 6 2004 2050 2 T/O EVAP OBD & GC
I/M MODEL YEARS   : 6 1996 2050
I/M VEHICLES      : 6 22222 11111111 1
I/M COMPLIANCE    : 6 98
I/M WAIVER RATES  : 6 1 1
I/M EXEMPTION AGE : 6 25
I/M GRACE PERIOD  : 6 4
```

The set of Inspection and Maintenance (I/M) Program inputs appears in the box above. These inputs are used for NOACA and AMATS areas. Ashtabula County does not have an I/M program. The

parameters for the 2002 program were based on actual performance as provided by Ohio EPA. The following discussion generally describes the meaning of the various inputs.

I/M PROGRAM:	*This input provides the following: the I/M program number; the program start year; the program end year, the inspection frequency (1=annual, 2=biennial), the program type (T/O is test only); and the I/M program inspection type which is one of 15 possible types.*
I/M MODEL YEARS:	*This input provides: the I/M program number; the first model year covered by that program; and the last model year covered by that program.*
I/M VEHICLES:	*This input provides: the I/M program number; the vehicle types (14 types) covered by the program (1=not covered, 2 = covered).*
I/M STRINGENCY:	*This input provides: the I/M program number; the expected exhaust inspection failure rate for pre-1981 vehicles covered by the program.*
I/M COMPLIANCE:	*This input provides: the I/M program number; the expected percentage of covered vehicles that will comply with the inspection requirement.*
I/M WAIVER RATES:	*This input provides: the I/M program number; the percentage of pre-1981 vehicles that are expected to receive a waiver; the percentage of 1981 and later vehicles that are expected to receive a waiver.*
I/M EXEMPTION AGE:	*This input provides the age at which vehicles are no longer subject to the test.*
I/M CUTPOINTS:	*This input provides the cut points for passing or failing the test for the tested pollutants.*
I/M GRACE PERIOD:	*This input provides: the I/M program number, and the age at which vehicles first become subject to the program*

Scenario Section

Since there are many scenarios in a single run and since scenarios differ between the participating agencies, only a single representative scenario will be discussed here.

SCENARIO RECORD: xxxxx…	*This input indicates the beginning of a scenario section and allows the user to provide a scenario name that is included with the output files.*
CALENDAR YEAR: xxxxx	*This input provides the calendar year for which the model is generating emission factors.*
EVALUATION MONTH: 7	*This input provides the evaluation month for which the model is being run. Two choices are possible. 1 is January. 7 is July.*

FUEL RVP: 9	*This input provides the fuel Reid Vapor Pressure (RVP) for fuel used in the area. RVP is a measure of how easily a fuel evaporates. The lower the RVP the lower the fuel's evaporation rate under a consistent set of conditions.*
AVERAGE SPEED: 05.0 FREEWAY	*This input instructs the model to generate emissions for the scenario at a single user provided speed (in this case 5 miles per hour on a Freeway). MOBILE6.2 unlike its predecessors utilizes different speed and emission profiles for different facility types. The user can choose between non-ramp, Freeway, Arterial, and Areawide types. As noted previously speeds are determined differently for the three areas. Generally speaking, there are enough scenarios to cover the total number of unique speed/facility type combinations required for the subarea's modeling methods.*

This concludes the summary of MOBILE6.2 input parameters used for inventory preparation.

3. Emissions

Once the previously discussed modeling efforts have been completed, the vehicle miles of travel (VMT) are paired with the emission factors generated for them to develop emissions. Emission factors are in grams per mile. When paired with VMT for a day, the result is grams per day. For ease of reporting these results are converted to tons/day. The results of the inventory development process appear below.

Year 2002 EMISSIONS (TONS/DAY)			
COUNTY	**VOC**	**NOx**	**VMT**
ASHTABULA	5.78	9.6	2,941,440
CUYAHOGA	43.68	90.55	30,948,810
GEAUGA	3.62	6.80	2,509,051
LAKE	8.20	17.65	5,826,638
LORAIN	9.54	20.33	6,868,952
MEDINA	7.58	16.31	5,446,155
PORTAGE	6.61	14.56	4,424,158
SUMMIT	24.48	50.37	14,641,537
TOTAL	**109.50**	**226.16**	**73,606,741**

Year 2006 EMISSIONS (TONS/DAY)			
COUNTY	**VOC**	**NOx**	**VMT**
ASHTABULA	4.00	7.01	2,959,540
CUYAHOGA	27.64	64.40	31,199,284
GEAUGA	2.41	5.06	2,641,636
LAKE	5.33	13.00	6,065,299
LORAIN	6.17	14.88	7,083,878
MEDINA	5.05	12.32	5,797,646
PORTAGE	4.30	10.79	4,799,450
SUMMIT	14.18	34.28	15,031,043
TOTAL	**69.08**	**161.74**	**75,577,776**

Year 2012 EMISSIONS (TONS/DAY)			
COUNTY	**VOC**	**NOx**	**VMT**
ASHTABULA	2.49	4.12	3,120,712
CUYAHOGA	15.08	31.52	31,395,908
GEAUGA	1.38	2.61	2,796,371
LAKE	3.03	6.61	6,329,046
LORAIN	3.46	7.45	7,294,998
MEDINA	2.98	6.48	6,268,845
PORTAGE	2.85	5.94	5,108,060
SUMMIT	9.29	18.65	15,612,531
TOTAL	**40.56**	**83.38**	**77,926,471**

Year 2020 EMISSIONS (TONS/DAY)			
COUNTY	**VOC**	**NOx**	**VMT**
ASHTABULA	1.68	1.99	3,335,613
CUYAHOGA	10.50	14.48	35,342,881
GEAUGA	0.95	1.15	3,090,956
LAKE	2.17	3.04	7,227,239
LORAIN	2.46	3.32	8,238,155
MEDINA	2.25	3.12	7,564,982
PORTAGE	1.75	2.47	5,499,263
SUMMIT	5.62	7.59	16,443,663
TOTAL	**27.37**	**37.17**	**86,742,752**

Conclusion

These inventories of ozone precursors for 2002, 2006, 2012, and 2020 were developed in an effort to aid Ohio-EPA with a redesignation effort for northeast Ohio's ozone non-attainment area. They provide evidence that the area's mobile sources emissions will continue to decrease and therefore support ongoing attainment of the standard.