Technical Memorandum
Lima-Allen County Regional Planning Commission (LACRPC)
TCC SIP Inventory
Mobile Emissions Estimate (OZONE)

June 2012

By LACRPC and Ohio Department of Transportation

In Coordination with Lima-Allen County TCC and the Ohio Environmental Protection Agency

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1. Overview

This memorandum is intended to document the air quality analyses and underlying assumptions performed by the Ohio Department of Transportation (ODOT), Division of Transportation System Development-Modeling and Forecasting Section and the Lima-Allen County Regional Planning Commission (LACRPC) for the 8-hour ozone on-road mobile source emission inventories for the Allen County State Implementation Plan (SIP) revision in coordination with the Ohio Environmental Protection Agency (OEPA). Allen County, in north-west Ohio, is designated non-attainment for the 8-hour Ozone Standard. The LACRPC serves as the MPO for the region.

The ODOT Modeling and Forecasting section performed the MOVES runs to generate travel demand model based emission factors as well as the complete air quality analyses for Allen County.

Latest Planning Assumptions

The ozone inventory runs meet the latest planning assumption requirement. As discussed in Section 2 of this report, the modeling process used to develop each MPO emissions is calibrated using the latest population and land use data available and is validated using corresponding traffic count data. Currently, the travel demand models are validated to year 2006 depending on available data.

U.S. EPA's most recent emissions software, MOVES, is used for all mobile source emission analyses with MOVES inputs being established at various interagency consultation meetings between August 2011 and February 2012 (See **Appendix A)**

Finally, the regional emissions analysis includes emissions for Volatile Organic Compounds (VOC) and Nitrogen Oxides (NOX).

On Road Mobile Emission Summary

Tables 1 presents a summary of emissions for Allen County for the required precursors VOC and NOX and the requested scenarios: 2002 base, 2004 attainment, 2009 interim, and 2018 maintenance. Years 2004 and 2018 are established as budget years. The remainder of the document focuses on the assumptions behind the analyses.

Table 1 – July LACRPC Region On-Road Mobile Emissions

YEAR	NOX (tons/day)	VOC (tons/day)	Daily Vehicle Miles Traveled
2002	13.817	7.074	3,469,871
2004	12.227	6.352	3,354,447
2009	9.264	4.684	3,407,692
2018	5.376	2.073	3,521,400

2. Urban Travel Demand Models

The LACRPC has a new travel demand model that combined with the latest planning assumptions was used to generate emissions in Allen County. The new travel demand model now covers all of Allen County and was validated in December 2006, more information is available at http://www.lacrpc.com/pdfs/model_user_guide.pdf. Due to the number of files and complexity, travel demand model run details have not been included in this technical memo.

Networks

The LACRPC modeled networks accurately reflect projects in their respective TIPs and 2040 Long Range Transportation Plans. Project lists can be found online as listed below:

LACRPC
http://www.lacrpc.com/media/85261/modeled_project_list.pdf

Landuse and Socio-economic Data

The LACRPC's socio-economic model variables reflect the current and expected future regional land uses.

LACRPC's 's socio-economic variables were developed for the 2030 LRTP based on the 2000 Census variables, 2000 employment from QCEW, and 2030 population projections from the Ohio Department of Development. Projections were updated for the 2009 Plan update including: school enrollment, hotels, educational and recreational employment, and area type. Independent variables (land use/socio-economic data) as provided by LACRPC are available for every analysis year. These variables are used by ODOT to generate new trip tables for the analysis years: 2002, 2010, 2018, 2020, and 2030.

Table 2 shows a summary of LACRPC's socio-economic data. This summary shows an approximate 3% decline in population, while households and employment show a moderate gain.

Table 2 – LACRPC Socio-Economic Variables

	Area Type (2000)				
	CBD	Urban	Suburban	Rural	**Total**
# of TAZs	28	72	90	10	**172**
2000 Population	1,648	40,161	41,578	26,734	**108,473**
2000 Households	640	15,410	15,653	9,483	**40,546**
2000 Employment	5,073	22,774	24,837	9,080	**56,691**
	Area Type (2030)				
	CBD	Urban	Suburban	Rural	**Total**
# of TAZs	31	103	78	166	**378**
2030 Population	1,526	29,666	45,669	28,144	**105,005**
2030 Households	596	13,042	24,859	14,290	**52,787**
2030 Employment	427	14,663	28,856	18,712	**62,658**

VMT Trends

Figure 2 shows Vehicle Miles Traveled (VMT) trends for each of the analysis years 2004- 2018 for the LACRPC Area.

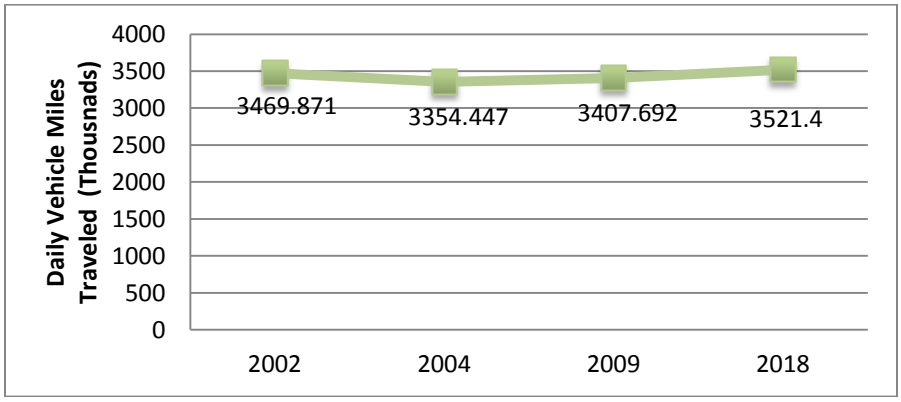

Figure 2 – LACRPC Region VMT Trends

3. Emission Factor Generation

Base and Attainment Years

Using MOVES, emission factor files were generated for base year-2002 and attainment year-2004 to represent the programs being implemented in the Allen County Region. Programs and corresponding MOVES parameters were developed in consultation with OEPA.

Future Years

Emission factors were generated for the future year scenario for 2018. All other assumptions remain the same as those used to generate 2002 emission factors and are further illustrated in this section using year 2002 as an example.

Technical Details

Table 3 summarizes the settings used in the MOVES run specification file and the MOVES County-Data Manager. Further details in specific inputs that are not using default values are provided below.

Parameters used for ozone analyses are similar to those used for PM analyses with the exception of: pollutants, additional profile emissions, analysis month, and the use of consecutive hourly temperature differences for calculation of the vapor venting process.

Instead of using average emission rates for the entire vehicle fleet, total emissions by individual source types will be calculated.

Table 3 – MOVES Inputs

RunSpec Parameter Settings	
MOVES Version	MOVES2010A
Scale	Custom Domain
MOVES Modeling Technique	Emission Factor Method Rates per Profile (grams/vehicle) Rates per Distance (grams/mile) Rates per Vehicle (grams/vehicle)
Time Span	Time Aggregation: Hour 1 Month representing average summer temperatures All hours of day selected 16 speed bins Weekdays only
Geographic Bounds	Allen County
Vehicles/Equipment	All source types, gasoline and diesel
Road Type	All road types including off-network
Pollutants and Processes	Total Gaseous Hydrocarbons, Non-Methane Hydrocarbons, Volitile Organic Compounds, NO_x, NO, NO_2, Total Energy Consumption

Strategies	Default values
General Output	Units = grams, joules and miles
Output Emissions	Time = hour, Location = custom area, on-road emission rates by road type and source use type.
Advance Performance	None

County Data Manager Sources	
Source Type Population	Combination of local and default data Local data (2010) ODOT from motor vehicle registration Default data used for source types 41, 51, 54, 61, and 62 Future year growth rate based on MPO model Household growth rate.
Vehicle Type VMT	Combination of local and default data HPMSVTypeYear VMT = daily VMT from travel demand model monthVMTFraction = default dayVMTFraction=default hourVMTFraction=local
I/M Program	None
Fuel Formulation	Default
Fuel Supply	Default
Metereology Data	Local data obtained from NOAA National Climatic Data Center. Data will consist of monthly high and low temperatures and daily relative humidity for 2002.
Ramp Fraction	Using the base year travel demand model for VHT fractions. Future fractions will be assumed constant
Road Type Distribution	Use ODOT county summary VMT categorized by federal functional classes
Age Distribution	Combination of local and default data. Local data (2010) ODOT from motor vehicle registration Default data used for source types 41, 51, 54, 61, and 62 The same age distribution will be used for all analysis years
Average Speed Distribution	Default
Alternative Fuel Type	Default

Temperature and Relative Humidity

Temperatures used for the single season approach are representative of July 2002 based on NOAA data from the National Climate Data Center webiste. Data for Lima Municipal Airport was used because it was the most complete compared to the nearest airports with the same latitude for the non-attainment area. To get the correct fomat for MOVES, the data was entered into a spreadsheet provided by EPA which was designed to convert Mobile6 data to MOVES. The average July hourly temperature and relative humidity distribution profile can be seen in Table 4.

Table 4 – Temperature and Relative Humidity Data

Hour	Average Temperature	Average Relative Humidity
1	60.8	82
2	57.2	93
3	57.2	93
4	60.8	82
5	60.8	87
6	62.6	82
7	62.6	82
8	64.4	77
9	66.2	72
10	66.2	72
11	68	68
12	69.8	64
13	69.8	64
14	71.6	60
15	69.8	60
16	69.8	60
17	69.8	64
18	66.2	68
19	66.2	63
20	66.2	68
21	66.2	68
22	64.4	72
23	64.4	72
24	60.8	82

Ramp Fraction

Ramp fractions were derived using the base year travel demand model VHT fractions. Ramp fractions can be seen in Table 5. Base year fractions were assumed to apply to future years.

Table 5 – Ramp Fractions

roadTypeID	roadDesc	rampFraction
2	Rural Restricted Access	0.06
4	Urban Restricted Access	0.50

Source Type Population

Source type population is based on a combination of local and MOVES default data. Local data was provided by ODOT based on 2010 motor vehicle registration. Default data is used for source types 41, 51, 54, 61, and 62. Future year growth rate is based on MPO model household growth rate which is 0% in LACRPC. In Allen County cars are an independent variable to the travel demand model. The base year (2000) and the LP year (2040) are used to interpolate the number of cars for the needed analysis years in Allen County. Table 6 shows source type population for the analyzed counties in 2004.

Table 6 – Source Type Population for year 2004

sourceTypeID	sourceTypeName	Allen
11	MotorCycle	6,995
21	Passenger Car	53,875
31	Passenger Truck	32,360
32	Light Commercial Truck	836
41	Intercity Bus	54
42	Transit Bus	19
43	School Bus	251
51	Refuse truck	34
52	Single Unit Short-haul Truck	36
53	Single Unit Long-haul Truck	263
54	Motor Home	164
61	Comb Short-haul Truck	558
62	Comb Long-haul Truck	642

Vehicle Age Distribution

Vehicle age distribution information was derived using Ohio Bureau of Motor Vehicle registration data for year 2010. The data was given to OEPA who supplied a VIN decoder that allowed ODOT to create correctly formatted MOVES inputs. MOVES default data is used for source types 41, 51, 54, 61, and 62. The registration data for all of Allen County in the non-attainment area were combined to create a regional vehicle age distribution file, see Table 7. The same age distribution will be used for all analysis years.

Table 7 – Vehicle Age Distribution

yearid	sourcetypeid	ageid	ageFraction	sourcetypeid	ageid	ageFraction	sourcetypeid	ageid	ageFraction
2004	11	0	0.0018	21	17	0.0364	32	3	0.0708
2004	11	1	0.0214	21	18	0.033	32	4	0.0678
2004	11	2	0.0551	21	19	0.0256	32	5	0.0341
2004	11	3	0.0702	21	20	0.0211	32	6	0.0268
2004	11	4	0.0831	21	21	0.0174	32	7	0.033
2004	11	5	0.0782	21	22	0.0133	32	8	0.0332
2004	11	6	0.0617	21	23	0.0098	32	9	0.0367
2004	11	7	0.0775	21	24	0.0087	32	10	0.0497
2004	11	8	0.0569	21	25	0.0067	32	11	0.0525
2004	11	9	0.0506	21	26	0.0051	32	12	0.0406
2004	11	10	0.0429	21	27	0.0026	32	13	0.0411
2004	11	11	0.0328	21	28	0.0016	32	14	0.0348
2004	11	12	0.0241	21	29	0.0015	32	15	0.0745
2004	11	13	0.0205	21	30	0.0444	32	16	0.0526
2004	11	14	0.0215	31	0	0.0062	32	17	0.0408
2004	11	15	0.0164	31	1	0.0255	32	18	0.0354
2004	11	16	0.0136	31	2	0.0463	32	19	0.0267
2004	11	17	0.0124	31	3	0.0558	32	20	0.0215
2004	11	18	0.0089	31	4	0.065	32	21	0.0245
2004	11	19	0.0082	31	5	0.0782	32	22	0.0156
2004	11	20	0.0079	31	6	0.0722	32	23	0.0135
2004	11	21	0.0086	31	7	0.0708	32	24	0.0102
2004	11	22	0.0091	31	8	0.0674	32	25	0.0107
2004	11	23	0.0125	31	9	0.0545	32	26	0.0066
2004	11	24	0.0186	31	10	0.0579	32	27	0.0039
2004	11	25	0.0172	31	11	0.0569	32	28	0.0014
2004	11	26	0.0147	31	12	0.0507	32	29	0.0007
2004	11	27	0.0169	31	13	0.0452	32	30	0.0094
2004	11	28	0.0249	31	14	0.0407	41	0	0
2004	11	29	0.0168	31	15	0.0424	41	1	0.0282
2004	11	30	0.095	31	16	0.035	41	2	0.0466
2004	21	0	0.0063	31	17	0.0298	41	3	0.0791
2004	21	1	0.0237	31	18	0.0215	41	4	0.0819
2004	21	2	0.0347	31	19	0.0166	41	5	0.0819
2004	21	3	0.0428	31	20	0.0123	41	6	0.0636
2004	21	4	0.0439	31	21	0.0114	41	7	0.0734

yearid	sourcetypeid	ageid	ageFraction	sourcetypeid	ageid	ageFraction	sourcetypeid	ageid	ageFraction
2004	21	5	0.0478	31	22	0.0096	41	8	0.0381
2004	21	6	0.0504	31	23	0.0072	41	9	0.0678
2004	21	7	0.0527	31	24	0.0057	41	10	0.0664
2004	21	8	0.0548	31	25	0.0038	41	11	0.0438
2004	21	9	0.0523	31	26	0.0026	41	12	0.0297
2004	21	10	0.0571	31	27	0.0016	41	13	0.0226
2004	21	11	0.057	31	28	0.0006	41	14	0.0212
2004	21	12	0.0519	31	29	0.0004	41	15	0.048
2004	21	13	0.0518	31	30	0.0062	41	16	0.0367
2004	21	14	0.0489	32	0	0.0063	41	17	0.0155
2004	21	15	0.0535	32	1	0.0418	41	18	0.0071
2004	21	16	0.0432	32	2	0.0828	41	19	0.0353
2004	41	20	0.0226	43	6	0.0595	51	23	0.0086
2004	41	21	0.0056	43	7	0.0584	51	24	0.0086
2004	41	22	0.0056	43	8	0.0623	51	25	0
2004	41	23	0.0071	43	9	0.0639	51	26	0.0086
2004	41	24	0.0085	43	10	0.0611	51	27	0.0043
2004	41	25	0.0155	43	11	0.0823	51	28	0
2004	41	26	0.0127	43	12	0.0656	51	29	0
2004	41	27	0.0014	43	13	0.0506	51	30	0.0385
2004	41	28	0.0056	43	14	0.0183	52	0	0.0043
2004	41	29	0.0042	43	15	0.0222	52	1	0.0343
2004	41	30	0.0243	43	16	0.0183	52	2	0.0343
2004	42	0	0.0103	43	17	0.0167	52	3	0.1159
2004	42	1	0	43	18	0.0178	52	4	0.073
2004	42	2	0.0515	43	19	0.0178	52	5	0.0472
2004	42	3	0.0412	43	20	0.0167	52	6	0.0472
2004	42	4	0.0309	43	21	0.0156	52	7	0.0815
2004	42	5	0.0928	43	22	0.0117	52	8	0.1373
2004	42	6	0.0309	43	23	0.0133	52	9	0.0429
2004	42	7	0.0412	43	24	0.0117	52	10	0.0386
2004	42	8	0.0412	43	25	0.0078	52	11	0.0472
2004	42	9	0.1237	43	26	0.0044	52	12	0.0386
2004	42	10	0.0412	43	27	0.0061	52	13	0.0343
2004	42	11	0.0412	43	28	0.0006	52	14	0.0129
2004	42	12	0.0515	43	29	0.0028	52	15	0.0258
2004	42	13	0.0515	43	30	0.0093	52	16	0.0258

yearid	sourcetypeid	ageid	ageFraction	sourcetypeid	ageid	ageFraction	sourcetypeid	ageid	ageFraction
2004	42	14	0.0515	51	0	0.0043	52	17	0.0172
2004	42	15	0.0412	51	1	0.0343	52	18	0.0258
2004	42	16	0.0412	51	2	0.0343	52	19	0.0258
2004	42	17	0.0103	51	3	0.1159	52	20	0.0129
2004	42	18	0.0412	51	4	0.073	52	21	0.0043
2004	42	19	0.0515	51	5	0.0472	52	22	0.0043
2004	42	20	0.0206	51	6	0.0472	52	23	0.0086
2004	42	21	0	51	7	0.0815	52	24	0.0086
2004	42	22	0.0309	51	8	0.1373	52	25	0
2004	42	23	0.0103	51	9	0.0429	52	26	0.0086
2004	42	24	0.0106	51	10	0.0386	52	27	0.0043
2004	42	25	0.0103	51	11	0.0472	52	28	0
2004	42	26	0.0103	51	12	0.0386	52	29	0
2004	42	27	0	51	13	0.0343	52	30	0.0385
2004	42	28	0.0103	51	14	0.0129	53	0	0.0043
2004	42	29	0	51	15	0.0258	53	1	0.0343
2004	42	30	0.0107	51	16	0.0258	53	2	0.0343
2004	43	0	0.0534	51	17	0.0172	53	3	0.1159
2004	43	1	0.0361	51	18	0.0258	53	4	0.073
2004	43	2	0.04	51	19	0.0258	53	5	0.0472
2004	43	3	0.0539	51	20	0.0129	53	6	0.0472
2004	43	4	0.0523	51	21	0.0043	53	7	0.0815
2004	43	5	0.0495	51	22	0.0043	53	8	0.1373
2004	53	10	0.0386	54	26	0.0226	62	11	0.0716
2004	53	11	0.0472	54	27	0.0151	62	12	0.0508
2004	53	12	0.0386	54	28	0.0108	62	13	0.0339
2004	53	13	0.0343	54	29	0.0064	62	14	0.0329
2004	53	14	0.0129	54	30	0.1363	62	15	0.0277
2004	53	15	0.0258	61	0	0.0015	62	16	0.0195
2004	53	16	0.0258	61	1	0.0124	62	17	0.0102
2004	53	17	0.0172	61	2	0.027	62	18	0.008
2004	53	18	0.0258	61	3	0.0335	62	19	0.0052
2004	53	19	0.0258	61	4	0.0436	62	20	0.0058
2004	53	20	0.0129	61	5	0.046	62	21	0.0056
2004	53	21	0.0043	61	6	0.055	62	22	0.0026
2004	53	22	0.0043	61	7	0.0601	62	23	0.0009
2004	53	23	0.0086	61	8	0.0536	62	24	0.0017

yearid	sourcetypeid	ageid	ageFraction	sourcetypeid	ageid	ageFraction	sourcetypeid	ageid	ageFraction
2004	53	24	0.0086	61	9	0.0496	62	25	0.0017
2004	53	25	0	61	10	0.0533	62	26	0.0013
2004	53	26	0.0086	61	11	0.0527	62	27	0.0002
2004	53	27	0.0043	61	12	0.0453	62	28	0.0004
2004	53	28	0	61	13	0.0489	62	29	0.0002
2004	53	29	0	61	14	0.0407	62	30	0.0013
2004	53	30	0.0385	61	15	0.0439			
2004	54	0	0.0048	61	16	0.0443			
2004	54	1	0.0148	61	17	0.0315			
2004	54	2	0.0268	61	18	0.0307			
2004	54	3	0.0365	61	19	0.0282			
2004	54	4	0.0423	61	20	0.0237			
2004	54	5	0.0482	61	21	0.0273			
2004	54	6	0.0504	61	22	0.0278			
2004	54	7	0.0431	61	23	0.0179			
2004	54	8	0.0413	61	24	0.0183			
2004	54	9	0.0418	61	25	0.013			
2004	54	10	0.0499	61	26	0.0096			
2004	54	11	0.0487	61	27	0.0056			
2004	54	12	0.0454	61	28	0.0046			
2004	54	13	0.0336	61	29	0.0034			
2004	54	14	0.0355	61	30	0.047			
2004	54	15	0.0381	62	0	0.0045			
2004	54	16	0.0292	62	1	0.0448			
2004	54	17	0.0235	62	2	0.0074			
2004	54	18	0.0171	62	3	0.1062			
2004	54	19	0.0148	62	4	0.1088			
2004	54	20	0.0169	62	5	0.1557			
2004	54	21	0.0209	62	6	0.0692			
2004	54	22	0.0234	62	7	0.0424			
2004	54	23	0.023	62	8	0.0478			
2004	54	24	0.02	62	9	0.0504			
2004	54	25	0.0188	62	10	0.0813			

Road Type Distribution

Road type distribution is based on the 2008 ODOT, county summary, HPMS VMT data categorized by federal functional class for the three county non-attainment area. Road type distribution can be seen in Table 8.

Table 8 – Road Type Distribution

sourceTypeID	roadTypeID	roadTypeVMTFraction		sourceTypeID	roadTypeID	roadTypeVMTFraction
11	1	0		43	4	0.29
11	2	0.06		43	5	0.52
11	3	0.13		51	1	0
11	4	0.29		51	2	0.06
11	5	0.52		51	3	0.13
21	1	0		51	4	0.29
21	2	0.06		51	5	0.52
21	3	0.13		52	1	0
21	4	0.29		52	2	0.06
21	5	0.52		52	3	0.13
31	1	0		52	4	0.29
31	2	0.06		52	5	0.52
31	3	0.13		53	1	0
31	4	0.29		53	2	0.06
31	5	0.52		53	3	0.13
32	1	0		53	4	0.29
32	2	0.06		53	5	0.52
32	3	0.13		54	1	0
32	4	0.29		54	2	0.06
32	5	0.52		54	3	0.13
41	1	0		54	4	0.29
41	2	0.06		54	5	0.52
41	3	0.13		61	1	0
41	4	0.29		61	2	0.06
41	5	0.52		61	3	0.13
42	1	0		61	4	0.29
42	2	0.06		61	5	0.52
42	3	0.13		62	1	0
42	4	0.29		62	2	0.06
42	5	0.52		62	3	0.13
43	1	0		62	4	0.29
43	2	0.06		62	5	0.52
43	3	0.13				

Vehicle Type VMT and VMT Fractions

The first component of the VMT inputs is the Yearly HPMS VMT, but the travel demand model was used instead of ODOT's HMPS data since it was felt that the model would better predict future year VMT. ODOT's CMS post-processor was run for each year to generate congestion reports, which includes total daily VMT. The vehicle type percentages of the total VMT were based on ODOT's weigh-in-motion (WIM) data. Since there are not enough WIM stations for lower class facilties in the non-attainment area, a statewide average of all ODOT WIM data collectors was used. Daily VMT was then converted to yearly. Yearly HPMS VMT for 2004 can be seen in Table 9. The same method was to generate all other analysis years

Table 9 – Yearly HPMS VMT for 2004

HPMSVtypeID	yearID	HPMSBaseYearVMT	baseYearOffNetVMT
10	2004	4,547,051	0
20	2004	810,930,735	0
30	2004	250,210,894	0
40	2004	2,557,488	0
50	2004	18,906,400	0
60	2004	44,887,267	0

Monthly and daily VMT fractions used MOVES default data. The hourly VMT fractions were derived from ODOT WIM data. Hourly VMT fractions vary for each of the five MOVES road types but do not change for each of the 16 MOVES source types. A representative sample of the hour VMT fraction input file can be seen in Table 10, the entire file is too large to include in this document.

Table 10 – Hourly VMT Fractions

sourceTypeID	roadTypeID	dayID	hourID	hourVMTFraction
11	1	2	1	0.0089
11	1	2	2	0.00564
11	1	2	3	0.00424
11	1	2	4	0.00427
11	1	2	5	0.00695
11	1	2	6	0.01798
11	1	2	7	0.03806
11	1	2	8	0.057
11	1	2	9	0.05773
11	1	2	10	0.05538
11	1	2	11	0.05554
11	1	2	12	0.05558
11	1	2	13	0.05584
11	1	2	14	0.06051
11	1	2	15	0.06765
11	1	2	16	0.07755
11	1	2	17	0.08428

sourceTypeID	roadTypeID	dayID	hourID	hourVMTFraction
11	1	2	18	0.0797
11	1	2	19	0.06012
11	1	2	20	0.04522
11	1	2	21	0.03646
11	1	2	22	0.02912
11	1	2	23	0.02142
11	1	2	24	0.01486
11	2	2	1	0.0089
11	2	2	2	0.00564
11	2	2	3	0.00424
11	2	2	4	0.00427
11	2	2	5	0.00695
11	2	2	6	0.01798
11	2	2	7	0.03806
11	2	2	8	0.057
11	2	2	9	0.05773
11	2	2	10	0.05538
11	2	2	11	0.05554
11	2	2	12	0.05558
11	2	2	13	0.05584
11	2	2	14	0.06051
11	2	2	15	0.06765
11	2	2	16	0.07755
11	2	2	17	0.08428
11	2	2	18	0.0797
11	2	2	19	0.06012
11	2	2	20	0.04522
11	2	2	21	0.03646
11	2	2	22	0.02912
11	2	2	23	0.02142
11	2	2	24	0.01486
11	3	2	1	0.00655
11	3	2	2	0.0037
11	3	2	3	0.00304
11	3	2	4	0.00363
11	3	2	5	0.00792
11	3	2	6	0.02343
11	3	2	7	0.04899
11	3	2	8	0.06319
11	3	2	9	0.05402

sourceTypeID	roadTypeID	dayID	hourID	hourVMTFraction
11	3	2	10	0.05121
11	3	2	11	0.0528
11	3	2	12	0.05608
11	3	2	13	0.05814
11	3	2	14	0.05875
11	3	2	15	0.06676
11	3	2	16	0.07812
11	3	2	17	0.08469
11	3	2	18	0.08152
11	3	2	19	0.05852
11	3	2	20	0.04343
11	3	2	21	0.03606
11	3	2	22	0.02829
11	3	2	23	0.01883
11	3	2	24	0.01233
11	4	2	1	0.00752
11	4	2	2	0.0044
11	4	2	3	0.00354
11	4	2	4	0.00374
11	4	2	5	0.00705
11	4	2	6	0.02123
11	4	2	7	0.054
11	4	2	8	0.0768
11	4	2	9	0.06545
11	4	2	10	0.05114
11	4	2	11	0.04692
11	4	2	12	0.04916
11	4	2	13	0.05112
11	4	2	14	0.0534
11	4	2	15	0.06105
11	4	2	16	0.07421
11	4	2	17	0.08321
11	4	2	18	0.08385
11	4	2	19	0.06062
11	4	2	20	0.04229
11	4	2	21	0.03442
11	4	2	22	0.0292
11	4	2	23	0.02137
11	4	2	24	0.01431
11	5	2	1	0.00678

sourceTypeID	roadTypeID	dayID	hourID	hourVMTFraction
11	5	2	2	0.00378
11	5	2	3	0.00295
11	5	2	4	0.0029
11	5	2	5	0.00498
11	5	2	6	0.01422
11	5	2	7	0.03449
11	5	2	8	0.05728
11	5	2	9	0.05435
11	5	2	10	0.04991
11	5	2	11	0.05261
11	5	2	12	0.06098
11	5	2	13	0.06457
11	5	2	14	0.06387
11	5	2	15	0.06812
11	5	2	16	0.07672
11	5	2	17	0.08274
11	5	2	18	0.08284
11	5	2	19	0.06344
11	5	2	20	0.04866
11	5	2	21	0.0407
11	5	2	22	0.03083
11	5	2	23	0.01966
11	5	2	24	0.01262

Output Emission Factors

Table 11 shows the first record in a MOVES sample output (rate per distance) emission file for year 2004. For any given month, day of week, hour of the day, pollutant, and source type; the rate per distance varies by road type and speed bin. Rates per distance emissions are applied to link and intrazonal VMT.

Table 11 – Sample Emission File (Rate per Distance) for year 2004

Heading:	MOVESScenarioID	MOVESRunID	yearID	monthID	dayID	hourID
Record:			2004	7	5	1
Heading:	linkID	pollutantID	processID	sourceTypeID	SCC	fuelTypeID
Record:		87	0	1		0
Heading:	modelYearID	roadTypeID	avgSpeedBinID	temperature	relHumidity	ratePerDistance
Record:	0	2	1			8.113212

Table 12 shows the first record in a MOVES sample output (rate per vehicle) emission file for year 2004. The rate per vehicle varies for any combinations of month, day of week, hour of the day, pollutant, and process. Rates per vehicle emissions are applied to the vehicle source type population.

Table 12 – Sample Emission File (Rate per Vehicle) for year 2004

Heading:	MOVESScenarioID	MOVESRunID	yearID	monthID	dayID
Record:			2004	7	5
Heading:	hourID	zoneID	pollutantID	processID	sourceTypeID
Record:	1		87		1
Heading:	SCC	fuelTypeID	modelYearID	temperature	ratePerVehicle
Record:		0	0		0.300037

Table 13 shows the first record in a MOVES sample output (rate per profile) emission file for year 2004. The rate per vehicle varies for any combinations of month, day of week, hour of the day, pollutant, and process. Rates per profile emissions are applied to the vehicle souce type population.

Table 13 – Sample Emission File (Rate per Profile) for year 2004

Heading:	MOVESScenarioID	MOVESRunID	yearID	monthID	dayID
Record:			2004	0	5
Heading:	hourID	zoneID	pollutantID	processID	sourceTypeID
Record:	1		87	0	1
Heading:	SCC	fuelTypeID	modelYearID	temperature	ratePerVehicle
Record:		0	0		0.01838

4. Post Processing

Total emissions were computed with the aid of several custom programs by ODOT. The process uses data on daily and directional traffic distributions as well as more up to date volume/delay functions from the 2000 Highway Capacity Manual (HCM). This process, described below and illustrated in Figure 4, also uses rewritten code able to handle the newer model network formats and MOVES generated emission factors.

The first step in the the process involves running postcms.exe to calculate hourly link volumes based on the percentage of the daily volume (travel demand model output) determined by a link's facility and area type. Link speeds from the travel demand model are not used in the analysis. The speeds are estimated as a post-process to the model based on HCM methods using a link's volume-to-capacity ratio and link group code. The daily to hourly volume conversion percentages and speed tables can be seen in **Appendix B.1.**

The second step (movesnet.exe) uses a combination of the MOVES emission factors and the hourly link volumes that are output of the postcms.exe program. The hourly volumes are multiplied by the MOVES emission factor for the corresponding hour of day, speed bin, and roadtype to calculate emissions for every network link for each hour. The final link on road vehicle emissions for the area is the sum of all individual link-hour emissions.

The third step, (movesveh.exe), calculates vehicle-based emissions (using a combination of the Rate per Distance and Rate per Profile files) for each source type for each hour of the day. The vehicle source type is based on a combination of local and default data. The final vehicle emissions for each county are the sum of all individual hourly emissions for all vehicle types.

Intrazonal trips do not get loaded onto the network, so the fourth step in the process requires a separate method to account for those trips that use local roads to travel within a zone. The movesintra.exe program uses intrazonal trips to estimate VMT using the area in square miles and intrazonal trips of each zone. The zone is assumed circular and the radius of the circle is used as the average trip length for these intrazonal trips. Intrazonal emissions are then calculated by combining MOVES generated emissions with estimated intrazonal VMT. The emission rates are the same as those used to calculated link based emissions.

The final step is to summarize link, vehicle, and intrazonal emissions for each county, pollutant, and analyzed year. Daily summary emissions for each pollutant, county, and scenario year in the Lima-Allen County Region can be found in **Appendix B.2.**

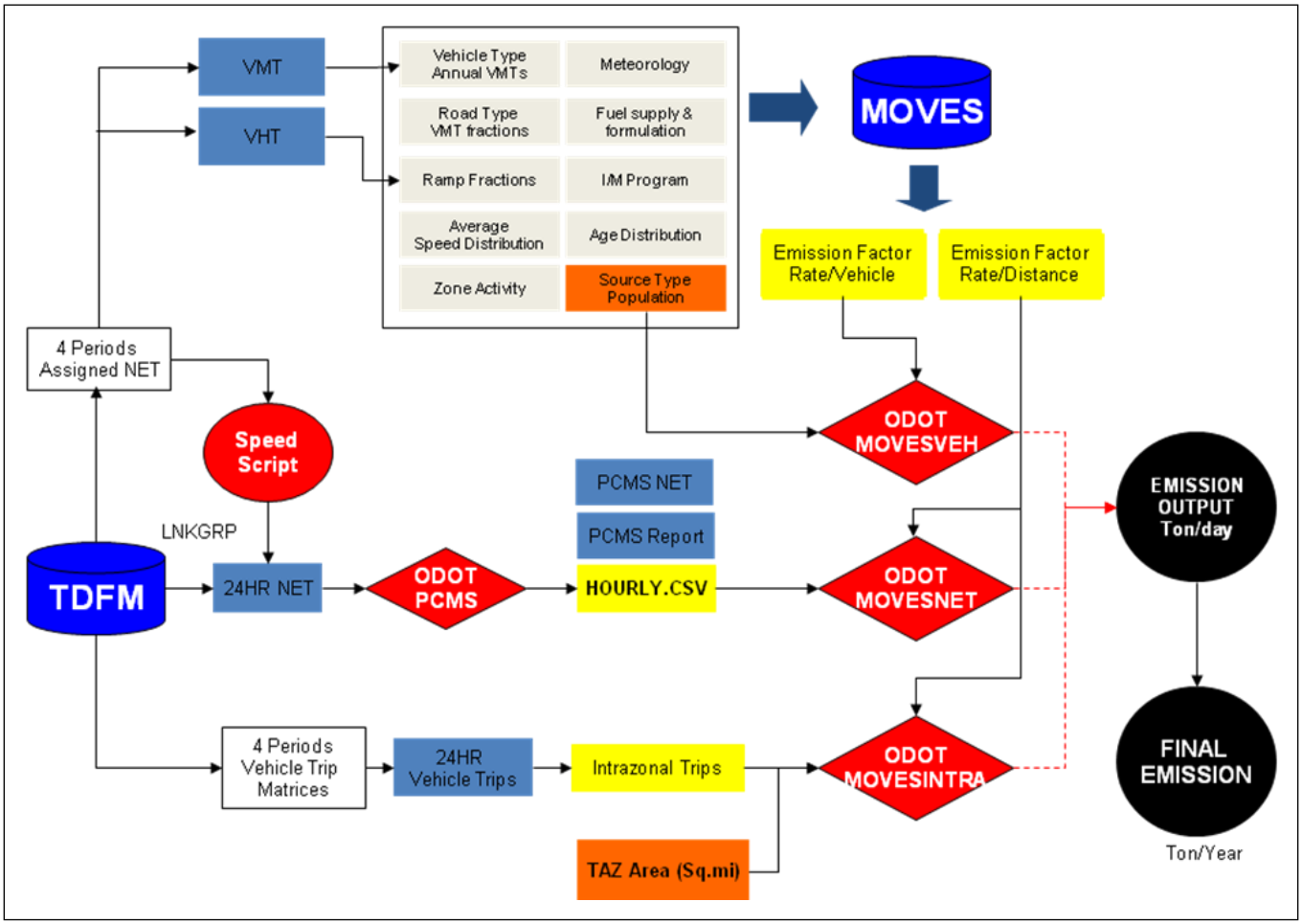

Figure 3 – Emission Calculation Process

5. Coordination Issues

LACRPC, ODOT, and OEPA have a long history of working together in air quality issues, the Memorandum of Understanding, listed below, documents these working relationships. The document is in the process of being signed by all parties involved.

- Memorandum of Understanding among the LACRPC, the OEPA, the ODOT, the US EPA-Region 5, the FHWA-Ohio Division, and the FTA-Region 5.

Appendix A

Interagency Consultation Documentation

NOTE: Lima-Allen County MPO was not included in the Interagency Consulatation. The results of this meeting recorded below were applied to the Lima Allen County MPO.

Dayton-Springfield Ozone SIP MOVES Update
Minutes 8/24/2011

Attending: ODOT employees Dave Moore, Monica Drake, Mark Byram, Nino Brunello, and Andrew Shepler, Jennifer Hunter - OEPA, Pat Morris – US EPA, Ana Ramirez – MVRPC, Scott Schmidt – CCSTCC, Lamar Daniel – CCSTCC.

This air quality interagency consultation conference call was held to coordinate development of revision to the Dayton/Springfield 8-Hour Ozone SIP Maintenance Plan. The SIP revision will update the mobile source HC and NOx budgets to reflect US EPA's new MOVES software emission results. The SIP revision will be reviewed and approved via the federal register process.

Pat Morris confirmed that a full SIP revision is needed. She also confirmed that only the mobile source emissions will be updated, not point, area, etc.
Analysis years will be consistent with the existing Ozone SIP:

- 2002 - base year
- 2005 - attainment and budget year
- 2009 - interim non-budget analysis year
- 2018 - out year budget

Pat Morris confirmed that these four years are acceptable. When asked about using fewer years, Pat stated that it is helpful to have the runs for all four years.

Temperature and humidity inputs for the Ozone SIP Update will be consistent with the existing Ozone SIP, reflecting an average day in July. The existing SIP reflected temperature data from the ten hottest days of summer, 2002. Temperature minimum and maximum were provided by OEPA, correspondence is on file at ODOT and included in technical MPO memos. For MOBILE6 runs, hourly temperatures were established based on a daily profile ODOT developed from NOAA data. The MOBILE to MOVES translator applies a daily temperature profile in a similar manner and will be used for this SIP update.

Ana Ramirez asked Nino Brunello to prepare a protocol document recording the analysis input parameters to use as a guide for the technical documentation that MVRPC will produce. Nino agreed to transmit the document the week of August 29.

Latest Planning Assumptions:
Latest land use and population assumptions will be used. Therefore, 2018 forecasts will reflect the latest socio-economic conditions based on the 2010 Census and current Transportation Plan.

Emissions parameters will be consistent with the MOBILE based SIP runs, as follows:
2002 & 2005 will reflect E-check
2009 & 2018 will reflected RVP 7.8

A safety margin was not included in 2005. Pat Morris said that a safety margin could be added in future years if necessary. It was determined that the safety margins would be added if necessary after the runs are completed. 2005 will also be looked at prior to submission of the SIP.

Nino requested that for Ozone emissions, MOVES emission factors by source type (ie vehicle class) be used instead of the aggregated emission factors that have been used for PM2.5 analyses. This is a more detailed approach which should produce more accurate results, more defensible results. This request was approved. MVRPC agreed contingent on the results of comparisons between aggregate versus disaggregate emission factor methods. To insure deadlines are met, Nino will run the aggregate methodology first in case he runs into problems with the more detailed disaggregate methodology.

The schedule was discussed.

1) Emission factors will be provided to MVRPC by ODOT by mid-September.
2) Information would need to be submitted to OEPA & US EPA by mid-November.
3) The deadline for approved budgets is mid-February. OEPA will need three months to process.
4) US EPA will complete as much as possible concurrently with OEPA. Pat Morris stated that she will need 90 days and will need approval by OPEA to complete the budgets for approval.
5) The conformity finding needs to be complete by August 1, 2012.

The meeting concluded following the schedule discussion.

MOVES Ozone Inputs Technical Details

The summaries and the settings used in the MOVES run specification file and the MOVES County-Data Manager are shown below. Further details in specific inputs that are not using default values are provided below.

Parameters used for ozone analyses are similar to those used for PM analyses with the exception of: pollutants, additional profile emissions, analysis month, and the use of consecutive hourly temperature differences for calculation of the vapor venting process.

Instead of using average emission rates for the entire vehicle fleet, total emissions by individual source types will be calculated.

RunSpec Parameter Settings	
MOVES Version	MOVES2010A
Scale	Custom Domain
MOVES Modeling Technique	Emission Factor Method Rates per Profile (grams/vehicle) Rates per Distance (grams/mile) Rates per Vehicle (grams/vehicle)
Time Span	Time Aggregation: Hour 1 Month representing average summer temperatures All hours of day selected 16 speed bins Weekdays only
Geographic Bounds	Clark, Greene, Miami, and Montgomery Counties
Vehicles/Equipment	All source types, gasoline and diesel
Road Type	All road types including off-network
Pollutants and Processes	Total Gaseous Hydrocarbons, Non-Methane Hydrocarbons, Volitile Organic Compounds, NO_x, NO, NO_2, Total Energy Consumption
Strategies	None
General Output	Units = grams, joules and miles
Output Emissions	Time = hour, Location = custom area, on-road emission rates by road type and source use type.
Advance Performance	None

County Data Manager Sources	
Source Type Population	Combination of local and default data Local data (2010) ODOT from motor vehicle registration Default data used for source types 41, 51, 54, 61, and 62 Future year growth rate based on MPO model Household growth rate.
Vehicle Type VMT	Combination of local and default data HPMSVTypeYear VMT = daily VMT from travel demand model monthVMTFraction = default dayVMTFraction=default hourVMTFraction=local
I/M Program	I/M program information applied for 2002/2005 where applicable for all counties except Miami (Miami Co. is never had an I/M program)
Fuel Formulation	Default
Fuel Supply	Reformulated gas (RVP) for summer analyses
Metereology Data	Local data obtained from NOAA National Climatic Data Center. Data will consist of monthly high and low temperatures and daily relative humidity for 2002.
Ramp Fraction	Using the base year travel demand model for VHT fractions. Future fractions will be assumed constant
Road Type Distribution	Use ODOT county summary VMT categorized by federal functional classes
Age Distribution	Combination of local and default data. Local data (2010) ODOT from motor vehicle registration Default data used for source types 41, 51, 54, 61, and 62 The same age distribution will be used for all analysis years
Average Speed Distribution	Default
Alternative Fuel Type	Default

Appendix B

Appendix B.1

Post Processing Default Distributions

HOUR	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
PCTADT																								
URB FWY	0.9	0.6	0.5	0.6	0.9	2.2	5.2	7.3	6.4	5.2	4.9	5.1	5.3	5.5	6.1	7.2	8.0	7.9	5.8	4.2	3.4	2.9	2.2	1.5
URB ART	0.7	0.4	0.3	0.3	0.6	1.5	3.5	5.7	5.5	5.1	5.3	6.2	6.5	6.4	6.8	7.6	8.2	8.1	6.2	4.8	4.0	3.0	1.9	1.3
RUR FWY	1.4	1.1	0.9	1.0	1.3	2.2	3.7	5.2	5.4	5.4	5.6	5.6	5.7	6.0	6.5	7.1	7.5	7.0	5.6	4.5	3.8	3.2	2.5	2.0
RUR ART	0.8	0.5	0.4	0.5	1.0	2.4	4.8	6.2	5.5	5.3	5.5	5.8	6.0	6.0	6.7	7.6	8.1	7.7	5.6	4.2	3.5	2.8	1.9	1.3
PCTADT TRK																								
URB FWY	2.1	1.9	1.8	2.0	2.4	3.0	3.9	4.6	5.3	6.0	6.3	6.4	6.4	6.4	6.3	5.8	5.2	4.6	4.1	3.7	3.4	3.1	2.8	2.4
URB ART	1.1	0.9	1.0	1.2	1.6	2.3	3.9	5.9	6.9	6.7	7.1	7.6	7.4	7.2	7.4	7.2	6.0	5.0	3.7	2.8	2.3	1.9	1.5	1.3
RUR FWY	2.6	2.2	2.1	2.3	2.6	3.1	3.5	4.0	4.5	5.1	5.6	5.8	5.8	5.8	5.8	5.6	5.3	4.9	4.6	4.3	4.0	3.8	3.5	3.1
RUR ART	1.5	1.3	1.4	1.6	2.2	3.0	4.2	5.3	6.1	6.7	7.0	7.1	7.0	6.9	6.8	6.3	5.5	4.6	3.8	3.1	2.6	2.3	2.1	1.7
PCTDIR																								
URB FWY	38	40	40	46	56	64	70	70	68	62	58	52	52	52	50	46	38	38	46	52	46	42	42	40
URB ART	44	46	44	48	54	62	66	68	64	56	54	52	50	50	50	46	40	38	46	52	48	46	46	46
RUR FWY	44	46	48	54	60	68	68	64	58	54	52	50	50	52	52	48	42	40	44	48	48	44	46	44
RUR ART	40	42	44	48	58	66	72	68	60	56	54	50	50	50	50	46	40	38	46	50	46	44	44	44

LOS E VC	0	0.625	1.25	1.875	2.5	3.125	3.75	4.375	5	5.625	6.25	6.875	7.5	8.125	8.75	9.375	10	10.625	11.25	11.875	12.5	13.125	13.75	14.375
SPEEDVC																								
curve1	75	75	75	75	75	75	74.9	74.8	74.6	74.2	73.5	72.3	70.5	67.8	64.2	59.5	54	47.7	41.2	34.9	28.9	23.7	19.2	15.5
curve2	70	70	70	70	70	70	70	69.9	69.8	69.6	69.2	68.4	67.1	65.1	62.2	58.2	53	47	40.5	33.9	27.7	22.2	17.6	13.8
curve3	65	65	65	65	65	65	65	65	65	64.9	64.8	64.4	63.8	62.6	60.5	57	52	45.4	37.8	29.9	22.7	16.7	12.1	8.6
curve4	60	60	60	60	60	60	60	60	60	59.9	59.8	59.6	59.1	58.2	56.7	54.3	50.8	46.1	40.3	33.8	27.3	21.3	16.2	12.2
curve5	55	55	55	55	55	55	55	55	55	55	55	54.9	54.7	54.3	53.6	52.3	50	46.5	41.5	35.3	28.5	21.9	16.1	11.5
curve6	60	60	60	60	60	60	60	60	59.9	59.8	59.7	59.4	59.1	58.5	57.7	56.5	55	53.1	50.7	47.9	44.7	41.1	37.3	33.4
curve7	55	55	55	55	55	55	55	55	54.9	54.9	54.7	54.5	54.2	53.8	53.1	52.2	50.9	49.3	47.3	44.9	42.1	39	35.7	32.2
curve8	50	50	50	50	50	50	50	50	49.9	49.9	49.8	49.6	49.4	49	48.5	47.7	46.7	45.4	43.8	41.8	39.5	36.8	33.9	30.9
curve9	45	45	45	45	45	45	45	45	45	44.9	44.8	44.7	44.4	44.1	43.6	43	42.1	40.9	39.4	37.6	35.5	33.1	30.5	27.8
curve10	50	50	50	50	49.9	49.8	49.7	49.4	49	48.4	47.5	46.5	45.1	43.5	41.7	39.6	37.3	34.9	32.4	29.8	27.3	24.9	22.6	20.4
curve11	50	50	50	50	50	49.9	49.7	49.4	48.9	48	46.7	44.9	42.5	39.6	36.2	32.6	28.7	25	21.4	18.2	15.3	12.9	10.8	9
curve12	50	50	50	50	50	49.9	49.8	49.6	49.1	48.2	46.8	44.5	41.4	37.5	32.9	28	23.1	18.7	14.9	11.8	9.2	7.2	5.7	4.5
curve13	40	40	40	40	40	40	39.9	39.8	39.5	39.2	38.6	37.8	36.7	35.3	33.5	31.4	29	26.4	23.7	21.1	18.5	16.1	13.9	12
curve14	40	40	40	40	40	39.9	39.8	39.6	39.1	38.5	37.5	36.1	34.3	32.1	29.4	26.5	23.5	20.5	17.7	15.1	12.8	10.7	9	7.6
curve15	40	40	40	40	40	39.9	39.7	39.4	38.8	37.9	36.5	34.7	32.3	29.5	26.4	23.2	20	17	14.3	11.9	9.9	8.2	6.8	5.6
curve16	35	35	35	35	35	34.9	34.8	34.5	34	33.2	32.1	30.5	28.5	26.1	23.5	20.6	17.9	15.2	12.8	10.7	8.9	7.4	6.1	5.1
curve17	35	35	35	35	35	34.9	34.7	34.4	33.9	33.1	32	30.3	28.3	25.8	23.1	20.3	17.5	14.9	12.5	10.4	8.6	7.2	5.9	4.9
curve18	35	35	35	35	35	34.9	34.6	34.2	33.5	32.4	30.9	28.8	26.3	23.4	20.4	17.4	14.6	12.1	9.9	8.1	6.6	5.4	4.4	3.6
curve19	30	30	30	30	30	29.9	29.8	29.5	29	28.2	27.1	25.6	23.7	21.5	19.1	16.6	14.2	12	10	8.3	6.8	5.6	4.6	3.8
curve20	30	30	30	30	30	29.9	29.7	29.4	28.9	28.1	26.9	25.3	23.4	21.1	18.6	16.1	13.6	11.4	9.5	7.8	6.4	5.3	4.3	3.6
curve21	30	30	30	30	30	29.9	29.7	29.3	28.7	27.7	26.2	24.4	22.1	19.6	17	14.4	12	9.9	8.1	6.6	5.4	4.4	3.6	2.9

VC RATIO TO LOS CONVERSION (VALUE SHOWN IS LOWER LIMIT FOR THAT LOS)(URBAN ROADS USE SPEED BREAKS BELOW FOR LOS DETERMINATION) (ALL USE THE BASE VC'S TO DETERMINE EXCEEDANCE)

	BASE	RUR2	FWY
A	0.00	0.00	0.00
B	0.30	0.00	0.25
C	0.50	0.10	0.40
D	0.70	0.30	0.60
E	0.90	0.50	0.80

F 1.00 1.00 1.00
F+ 1.10 1.10 1.10
F++ 1.30 1.30 1.30

SPEED VC RATIO BREAKS FOR URBAN STREETS (HIGHEST SPEED FOR GIVEN LOS & FF SPEED)

FFS	B	C	D	E	F
>47	42.	34.	27.	21.	16.
>37	35.	28.	22.	17.	13.
>32	30.	24.	18.	14.	10.
<33	25.	19.	13.	9.	7.

LEVEL OF SERVICE THRESHOLD BY AREA

NUM	LOS	DEFINITION
1	F	CINCINNATI,CLEVELAND,COLUMBUS CENTRAL MPO COUNTIES (CUY,FRA,HAM)
2	E	OTHER TMA MPOS (AKRON,CANTON,DAYTON,TOLEDO,YOUNGSTOWN + NON-CENTRAL COUNTIES FROM 1)
3	E	OTHER MPOS & PARTS OF AREAS 1 & 2 OUTSIDE URBANIZED AREA
4	E	RURAL NON MPO COUNTIES

PEAK SPREADING MODEL INFO (SET MAX ITERATIONS TO 0 TO DISABLE PEAK SPREADING)
MAX VC RATIO FWY: 1.30
MAX VC RATIO ART: 1.30
MAX ITERATIONS : 1000

TRUCK PCE: 2.00

AQ SEASON FACTOR: 1.08

MODEL CLASS PARAMETERS (MAX 4 CLASSES, HOURS 0-23 W/ NO OVERLAP IN CLASS, ALLOCATE ENTIRE CLASS AS TRUCK(1) OR NOT(0))

CLS TRK	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CLS BEG	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CLS END	23	23	0	0	0	0	0	0	0	0	0	0	0	0	0	0
CLS NUM	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix B.2

Ozone EmissionSummaries

LACRPC Region Daily Summary
July

2002 (No I/M)		
ALLEN	**NOX (tons/day)**	**VOC (tons/day)**
Link Emissions	12.029	3.451
Vehicle Emissions	1.740	3.604
Intrazonal Emissions	0.048	0.019
TOTAL	**13.817**	**7.074**

2004 (No I/M)		
ALLEN	**NOX (tons/day)**	**VOC (tons/day)**
Link Emissions	10.347	2.815
Vehicle Emissions	1.836	3.521
Intrazonal Emissions	0.044	0.017
TOTAL	**12.227**	**6.352**

2009 (No I/M)		
ALLEN	**NOX (tons/day)**	**VOC (tons/day)**
Link Emissions	7.449	1.687
Vehicle Emissions	1.781	2.987
Intrazonal Emissions	0.034	0.011
TOTAL	**9.264**	**4.684**

2018 (No I/M)		
ALLEN	**NOX (tons/day)**	**VOC (tons/day)**
Link Emissions	4.343	0.638
Vehicle Emissions	1.022	1.431
Intrazonal Emissions	0.012	0.003
TOTAL	**5.376**	**2.073**