Mobile Source Emissions Inventory for Cincinnati PM2.5 Nonattainment Area

Includes a portion of Dearborn County, Indiana, the counties of Boone, Campbell, Kenton in Kentucky, and the counties of Butler, Clermont, Hamilton, and Warren in Ohio. Emission estimates for the Year 2005, 2008, 2011, 2015, 2018, and 2021 developed in support of the PM2.5 State Implementation Plan

August 2010 (text revised Dec 2010)

Prepared for the Indiana Department of Environmental Management, the Kentucky Division for Air Quality and the Ohio Environmental Protection Agency by

OKI Regional Council of Governments

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Acknowledgments

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Abstract This report was prepared for the Indiana Department of Environmental Management, the Kentucky Division for Air Quality and the Ohio Environmental Protection Agency. The Cincinnati PM2.5 nonattainment area includes a portion of Dearborn County Indiana, the counties of Boone, Campbell, Kenton in Kentucky, and the counties of Butler, Clermont, Hamilton, and Warren in Ohio. This report includes emission estimates for the years 2005, 2008, 2011, 2015, 2018 and 2021 was generated to support the attainment SIPs for the annual PM2.5 standard. EPA's Motor Vehicle Emission Simulation (MOVES) 2010 was used to generate the emission rates.

Date August 2010

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MOBILE Source Emissions Inventory for the Cincinnati PM2.5 nonattainment area

This report was prepared for the Indiana Department of Environmental Management, the Kentucky Division for Air Quality and the Ohio Environmental Protection Agency. The Cincinnati PM2.5 nonattainment area includes a portion of Dearborn County Indiana, the counties of Boone, Campbell, Kenton in Kentucky, and the counties of Butler, Clermont, Hamilton, and Warren in Ohio. This report includes emission estimates for the years 2005, 2008, 2011, 2015, 2018 and 2021 was generated to support the attainment SIPs for the annual PM2.5 standard. EPA's Motor Vehicle Emissions Simulator (MOVES) 2010 model was used to generate the vehicle emission rates. In December 2009, MOVES replaced MOBILE6.2 as the EPA's official emission factor model. Technical details on OKI's use of MOVES can be found in the Appendix. The OKI travel demand model version 7.6 was used to generate VMT and speed estimates. MOVES emission rates were generated for direct PM2.5, PM2.5 tirewear, PM2.5 brakewear, NO_x and SO_2.

OKI, as the MPO, is responsible for transportation planning and air quality/transportation conformity. Transportation conformity is a mechanism to ensure that federal funding and approval are given to those transportation activities that are consistent with the air quality goals of the State Implementation Plans (SIPs) for Indiana, Kentucky and Ohio. The SIPs include an inventory of projected emissions from vehicles. One or more of the analysis years in the projected inventory may be designated as the motor vehicle emissions budget (MVEB). This budget establishes a maximum allowable limit on future emissions from vehicles (mobile sources). OKI's transportation plans and programs must be shown to be in conformity with all SIP provisions. The conformity process is a quantitative analysis, using U.S.EPA's vehicle emissions software (currently MOVES), demonstrating that forecasted regional vehicle emissions do not exceed the established budget.

Table 1 shows daily and annual mobile source emissions for the combined Indiana and Ohio portions of the nonattainment area, as well as the Kentucky portion of the nonattainment area. Separate MVEB's are typically designated for these two areas. Although official federal guidance on the use of MOVES for PM2.5 SIP development was not available at the time of this analysis, the Federal Highway Administration (FHWA) along with state and local air quality staff were consulted periodically throughout the development of these emissions. An additional safety margin should be added to the MVEB's due uncertainty with growth assumptions utilized in the OKI travel demand model and uncertainty regarding the use of MOVES. Daily and annual mobile source emissions for each county in the nonattainment area are shown in Table 2.

Table 1. Mobile Source Emissions for the Cincinnati PM2.5 Nonattainment Area (tons)

Year	Pollutant Name	DailyEmissions	AnnualEmissions

Kentucky Portion of NA Area

2005 Vehicle Population: 364,081 Daily VMT: 9,621,110 Annual VMT: 3,289,109,202

Oxides of Nitrogen	39.10	13,496.54
Primary Exhaust PM2.5 - Total	1.36	466.23
Primary PM2.5 - Brakewear Particulate	0.16	54.04
Primary PM2.5 - Tirewear Particulate	0.05	17.52
Sulfur Dioxide (SO2)	0.12	41.46

2008 Vehicle Population: 375,873 Daily VMT: 9,991,179 Annual VMT: 3,425,339,505

Oxides of Nitrogen	37.91	13,114.20
Primary Exhaust PM2.5 - Total	1.64	562.84
Primary PM2.5 - Brakewear Particulate	0.18	62.10
Primary PM2.5 - Tirewear Particulate	0.06	20.70
Sulfur Dioxide (SO2)	0.12	42.74

2011 Vehicle Population: 381,911 Daily VMT: 10,490,143 Annual VMT: 3,587,796,186

Oxides of Nitrogen	29.33	10,141.52
Primary Exhaust PM2.5 - Total	1.19	407.74
Primary PM2.5 - Brakewear Particulate	0.20	68.38
Primary PM2.5 - Tirewear Particulate	0.07	22.68
Sulfur Dioxide (SO2)	0.13	45.36

2015 Vehicle Population: 394,278 Daily VMT: 11,495,496 Annual VMT: 3,931,385,741

Oxides of Nitrogen	20.18	6,996.21
Primary Exhaust PM2.5 - Total	0.78	267.30
Primary PM2.5 - Brakewear Particulate	0.23	77.94
Primary PM2.5 - Tirewear Particulate	0.08	25.88
Sulfur Dioxide (SO2)	0.15	50.50

2018 Vehicle Population: 403,817 Daily VMT: 12,173,549 Annual VMT: 4,163,203,435

Oxides of Nitrogen	15.78	5,480.81
Primary Exhaust PM2.5 - Total	0.59	202.15
Primary PM2.5 - Brakewear Particulate	0.27	91.15
Primary PM2.5 - Tirewear Particulate	0.09	30.09
Sulfur Dioxide (SO2)	0.16	56.28

2021 Vehicle Population: 413,587 Daily VMT: 12,534,236 Annual VMT: 4,286,834,360

Oxides of Nitrogen	12.75	4,435.96
Primary Exhaust PM2.5 - Total	0.43	146.79
Primary PM2.5 - Brakewear Particulate	0.28	96.84
Primary PM2.5 - Tirewear Particulate	0.09	31.74
Sulfur Dioxide (SO2)	0.17	58.63

Year	Pollutant Name	DailyEmissions	AnnualEmissions

Ohio/Indiana Portion of NA Area

2005 Vehicle Population: 1,754,582 Daily VMT: 39,564,030 Annual VMT: 13,541,324,003

Oxides of Nitrogen	168.89	58,423.36
Primary Exhaust PM2.5 - Total	5.74	1,979.63
Primary PM2.5 - Brakewear Particulate	0.65	223.20
Primary PM2.5 - Tirewear Particulate	0.20	69.67
Sulfur Dioxide (SO2)	0.48	165.35

2008 Vehicle Population: 1,811,406 Daily VMT: 40,858,751 Annual VMT: 14,015,754,874

Oxides of Nitrogen	148.02	51,357.02
Primary Exhaust PM2.5 - Total	4.85	1,675.04
Primary PM2.5 - Brakewear Particulate	0.80	273.84
Primary PM2.5 - Tirewear Particulate	0.25	85.37
Sulfur Dioxide (SO2)	0.54	185.13

2011 Vehicle Population: 1,840,505 Daily VMT: 42,044,841 Annual VMT: 14,383,526,419

Oxides of Nitrogen	135.95	47,061.53
Primary Exhaust PM2.5 - Total	5.54	1,904.61
Primary PM2.5 - Brakewear Particulate	0.85	290.00
Primary PM2.5 - Tirewear Particulate	0.27	91.52
Sulfur Dioxide (SO2)	0.53	182.01

2015 Vehicle Population: 1,900,111 Daily VMT: 43,316,281 Annual VMT: 14,830,453,053

Oxides of Nitrogen	89.45	31,064.21
Primary Exhaust PM2.5 - Total	3.57	1,227.86
Primary PM2.5 - Brakewear Particulate	0.82	280.25
Primary PM2.5 - Tirewear Particulate	0.26	90.54
Sulfur Dioxide (SO2)	0.53	182.69

2018 Vehicle Population: 1,946,080 Daily VMT: 45,314,292 Annual VMT: 15,513,701,656

Oxides of Nitrogen	70.34	24,451.43
Primary Exhaust PM2.5 - Total	2.78	958.57
Primary PM2.5 - Brakewear Particulate	0.90	307.39
Primary PM2.5 - Tirewear Particulate	0.29	99.03
Sulfur Dioxide (SO2)	0.57	195.09

2021 Vehicle Population: 1,993,161 Daily VMT: 46,689,707 Annual VMT: 15,521,916,278

Oxides of Nitrogen	55.50	18,911.05
Primary Exhaust PM2.5 - Total	2.10	705.30
Primary PM2.5 - Brakewear Particulate	0.96	320.17
Primary PM2.5 - Tirewear Particulate	0.31	102.89
Sulfur Dioxide (SO2)	0.60	199.14

Table 2. Mobile Source Emissions by County for the Cincinnati PM2.5 Nonattainment Area (tons)

County	Year	Pollutant Name	DailyEmissions	AnnualEmissions

Indiana

Dearborn NA

2005 Vehicle Population: 24,915 Daily VMT: 578,642 Annual VMT: 196,738,031

Oxides of Nitrogen	2.40	865.46
Primary Exhaust PM2.5 - Total	0.08	29.68
Primary PM2.5 - Brakewear Particulate	0.01	3.28
Primary PM2.5 - Tirewear Particulate	0.00	1.02
Sulfur Dioxide (SO2)	0.01	2.45

2008 Vehicle Population: 25,722 Daily VMT: 587,583 Annual VMT: 199,778,078

Oxides of Nitrogen	2.09	748.81
Primary Exhaust PM2.5 - Total	0.07	24.72
Primary PM2.5 - Brakewear Particulate	0.01	3.94
Primary PM2.5 - Tirewear Particulate	0.00	1.23
Sulfur Dioxide (SO2)	0.01	2.69

2011 Vehicle Population: 26,135 Daily VMT: 605,621 Annual VMT: 205,911,005

Oxides of Nitrogen	1.92	685.40
Primary Exhaust PM2.5 - Total	0.08	27.88
Primary PM2.5 - Brakewear Particulate	0.01	4.19
Primary PM2.5 - Tirewear Particulate	0.00	1.32
Sulfur Dioxide (SO2)	0.01	2.65

2015 Vehicle Population: 26,982 Daily VMT: 657,779 Annual VMT: 223,644,622

Oxides of Nitrogen	1.31	482.33
Primary Exhaust PM2.5 - Total	0.05	19.43
Primary PM2.5 - Brakewear Particulate	0.01	4.32
Primary PM2.5 - Tirewear Particulate	0.00	1.39
Sulfur Dioxide (SO2)	0.01	2.87

2018 Vehicle Population: 27,635 Daily VMT: 684,362 Annual VMT: 232,682,971

Oxides of Nitrogen	1.03	376.85
Primary Exhaust PM2.5 - Total	0.04	15.09
Primary PM2.5 - Brakewear Particulate	0.01	4.70
Primary PM2.5 - Tirewear Particulate	0.00	1.51
Sulfur Dioxide (SO2)	0.01	3.04

2021 Vehicle Population: 28,303 Daily VMT: 706,829 Annual VMT: 240,321,759

Oxides of Nitrogen	0.81	297.95
Primary Exhaust PM2.5 - Total	0.03	11.44
Primary PM2.5 - Brakewear Particulate	0.01	5.05
Primary PM2.5 - Tirewear Particulate	0.00	1.62
Sulfur Dioxide (SO2)	0.01	3.19

County	Year	Pollutant Name	DailyEmissions	AnnualEmissions

Kentucky

Boone

2005 Vehicle Population: 129,823 Daily VMT: 3,924,117 Annual VMT: 1,273,226,967

Oxides of Nitrogen	14.94	5,126.88
Primary Exhaust PM2.5 - Total	0.52	177.58
Primary PM2.5 - Brakewear Particulate	0.06	20.86
Primary PM2.5 - Tirewear Particulate	0.02	6.77
Sulfur Dioxide (SO2)	0.05	15.91

2008 Vehicle Population: 134,028 Daily VMT: 4,076,584 Annual VMT: 1,350,001,539

Oxides of Nitrogen	14.73	5,067.94
Primary Exhaust PM2.5 - Total	0.64	219.29
Primary PM2.5 - Brakewear Particulate	0.07	24.42
Primary PM2.5 - Tirewear Particulate	0.02	8.14
Sulfur Dioxide (SO2)	0.05	16.71

2011 Vehicle Population: 136,181 Daily VMT: 4,383,716 Annual VMT: 1,448,879,491

Oxides of Nitrogen	11.61	3,990.01
Primary Exhaust PM2.5 - Total	0.48	162.47
Primary PM2.5 - Brakewear Particulate	0.08	27.55
Primary PM2.5 - Tirewear Particulate	0.03	9.14
Sulfur Dioxide (SO2)	0.05	18.16

2015 Vehicle Population: 140,590 Daily VMT: 4,950,741 Annual VMT: 1,628,041,282

Oxides of Nitrogen	8.11	2,788.45
Primary Exhaust PM2.5 - Total	0.32	108.49
Primary PM2.5 - Brakewear Particulate	0.09	32.17
Primary PM2.5 - Tirewear Particulate	0.03	10.69
Sulfur Dioxide (SO2)	0.06	20.67

2018 Vehicle Population: 143,991 Daily VMT: 5,260,102 Annual VMT: 1,729,595,156

Oxides of Nitrogen	6.34	2,182.28
Primary Exhaust PM2.5 - Total	0.24	82.19
Primary PM2.5 - Brakewear Particulate	0.11	37.76
Primary PM2.5 - Tirewear Particulate	0.04	12.47
Sulfur Dioxide (SO2)	0.07	23.14

2021 Vehicle Population: 147,476 Daily VMT: 5,478,224 Annual VMT: 1,800,571,684

Oxides of Nitrogen	5.14	1,772.72
Primary Exhaust PM2.5 - Total	0.18	60.19
Primary PM2.5 - Brakewear Particulate	0.12	40.56
Primary PM2.5 - Tirewear Particulate	0.04	13.30
Sulfur Dioxide (SO2)	0.07	24.37

County	Year	Pollutant Name	DailyEmissions	AnnualEmissions

Campbell

2005 Vehicle Population: 86,065 Daily VMT: 2,286,217 Annual VMT: 741,790,595

Oxides of Nitrogen	8.87	3,041.21
Primary Exhaust PM2.5 - Total	0.31	104.22
Primary PM2.5 - Brakewear Particulate	0.04	12.14
Primary PM2.5 - Tirewear Particulate	0.01	3.94
Sulfur Dioxide (SO2)	0.03	9.30

2008 Vehicle Population: 88,853 Daily VMT: 2,339,542 Annual VMT: 774,762,718

Oxides of Nitrogen	8.63	2,988.33
Primary Exhaust PM2.5 - Total	0.37	127.73
Primary PM2.5 - Brakewear Particulate	0.04	14.05
Primary PM2.5 - Tirewear Particulate	0.01	4.68
Sulfur Dioxide (SO2)	0.03	9.69

2011 Vehicle Population: 90,279 Daily VMT: 2,421,600 Annual VMT: 800,372,692

Oxides of Nitrogen	6.61	2,287.81
Primary Exhaust PM2.5 - Total	0.27	91.36
Primary PM2.5 - Brakewear Particulate	0.04	15.26
Primary PM2.5 - Tirewear Particulate	0.01	5.06
Sulfur Dioxide (SO2)	0.03	10.15

2015 Vehicle Population: 93,204 Daily VMT: 2,663,159 Annual VMT: 875,774,487

Oxides of Nitrogen	4.55	1,570.14
Primary Exhaust PM2.5 - Total	0.17	59.30
Primary PM2.5 - Brakewear Particulate	0.05	17.31
Primary PM2.5 - Tirewear Particulate	0.02	5.75
Sulfur Dioxide (SO2)	0.03	11.21

2018 Vehicle Population: 95,458 Daily VMT: 2,771,476 Annual VMT: 911,300,097

Oxides of Nitrogen	3.52	1,216.21
Primary Exhaust PM2.5 - Total	0.13	44.14
Primary PM2.5 - Brakewear Particulate	0.06	19.90
Primary PM2.5 - Tirewear Particulate	0.02	6.57
Sulfur Dioxide (SO2)	0.04	12.28

2021 Vehicle Population: 97,768 Daily VMT: 2,849,127 Annual VMT: 936,445,352

Oxides of Nitrogen	2.84	985.28
Primary Exhaust PM2.5 - Total	0.09	32.07
Primary PM2.5 - Brakewear Particulate	0.06	21.10
Primary PM2.5 - Tirewear Particulate	0.02	6.92
Sulfur Dioxide (SO2)	0.04	12.77

County	Year	Pollutant Name	DailyEmissions	AnnualEmissions
Kenton				
	2005	Vehicle Population: 148,193 Daily VMT: 3,927,743 Annual VMT: 1,274,091,641		
		Oxides of Nitrogen	15.29	5,328.44
		Primary Exhaust PM2.5 - Total	0.53	184.43
		Primary PM2.5 - Brakewear Particulate	0.06	21.04
		Primary PM2.5 - Tirewear Particulate	0.02	6.82
		Sulfur Dioxide (SO2)	0.05	16.24
	2008	Vehicle Population: 152,992 Daily VMT: 3,927,332 Annual VMT: 1,300,575,248		
		Oxides of Nitrogen	14.55	5,057.93
		Primary Exhaust PM2.5 - Total	0.62	215.81
		Primary PM2.5 - Brakewear Particulate	0.07	23.63
		Primary PM2.5 - Tirewear Particulate	0.02	7.87
		Sulfur Dioxide (SO2)	0.05	16.34
	2011	Vehicle Population: 155,451 Daily VMT: 4,049,886 Annual VMT: 1,338,544,003		
		Oxides of Nitrogen	11.11	3,863.70
		Primary Exhaust PM2.5 - Total	0.45	153.90
		Primary PM2.5 - Brakewear Particulate	0.07	25.57
		Primary PM2.5 - Tirewear Particulate	0.02	8.48
		Sulfur Dioxide (SO2)	0.05	17.05
	2015	Vehicle Population: 160,484 Daily VMT: 4,341,124 Annual VMT: 1,427,569,972		
		Oxides of Nitrogen	7.51	2,637.63
		Primary Exhaust PM2.5 - Total	0.29	99.51
		Primary PM2.5 - Brakewear Particulate	0.08	28.45
		Primary PM2.5 - Tirewear Particulate	0.03	9.44
		Sulfur Dioxide (SO2)	0.05	18.62
	2018	Vehicle Population: 164,368 Daily VMT: 4,629,694 Annual VMT: 1,522,308,182		
		Oxides of Nitrogen	5.93	2,082.32
		Primary Exhaust PM2.5 - Total	0.22	75.82
		Primary PM2.5 - Brakewear Particulate	0.10	33.49
		Primary PM2.5 - Tirewear Particulate	0.03	11.04
		Sulfur Dioxide (SO2)	0.06	20.86
	2021	Vehicle Population: 168,343 Daily VMT: 4,715,306 Annual VMT: 1,549,817,325		
		Oxides of Nitrogen	4.76	1,677.96
		Primary Exhaust PM2.5 - Total	0.16	54.53
		Primary PM2.5 - Brakewear Particulate	0.10	35.19
		Primary PM2.5 - Tirewear Particulate	0.03	11.52
		Sulfur Dioxide (SO2)	0.06	21.48

County	Year	Pollutant Name	DailyEmissions	AnnualEmissions

Ohio

Butler

2005 Vehicle Population: 401,759 Daily VMT: 7,452,293 Annual VMT: 2,469,168,490

Oxides of Nitrogen	32.00	10,910.37
Primary Exhaust PM2.5 - Total	1.06	361.06
Primary PM2.5 - Brakewear Particulate	0.12	40.31
Primary PM2.5 - Tirewear Particulate	0.04	12.60
Sulfur Dioxide (SO2)	0.09	30.01

2008 Vehicle Population: 414,771 Daily VMT: 7,745,693 Annual VMT: 2,598,061,793

Oxides of Nitrogen	28.56	9,803.70
Primary Exhaust PM2.5 - Total	0.91	311.45
Primary PM2.5 - Brakewear Particulate	0.15	50.45
Primary PM2.5 - Tirewear Particulate	0.05	15.74
Sulfur Dioxide (SO2)	0.10	34.25

2011 Vehicle Population: 421,434 Daily VMT: 8,050,709 Annual VMT: 2,693,718,927

Oxides of Nitrogen	26.50	9,074.89
Primary Exhaust PM2.5 - Total	1.05	356.91
Primary PM2.5 - Brakewear Particulate	0.16	53.99
Primary PM2.5 - Tirewear Particulate	0.05	17.06
Sulfur Dioxide (SO2)	0.10	34.00

2015 Vehicle Population: 435,082 Daily VMT: 8,361,495 Annual VMT: 2,792,190,918

Oxides of Nitrogen	17.64	6,064.61
Primary Exhaust PM2.5 - Total	0.68	231.78
Primary PM2.5 - Brakewear Particulate	0.16	52.42
Primary PM2.5 - Tirewear Particulate	0.05	16.96
Sulfur Dioxide (SO2)	0.10	34.28

2018 Vehicle Population: 445,608 Daily VMT: 8,806,051 Annual VMT: 2,940,852,857

Oxides of Nitrogen	13.98	4,813.27
Primary Exhaust PM2.5 - Total	0.54	182.29
Primary PM2.5 - Brakewear Particulate	0.17	57.91
Primary PM2.5 - Tirewear Particulate	0.06	18.68
Sulfur Dioxide (SO2)	0.11	36.85

2021 Vehicle Population: 456,389 Daily VMT: 9,150,040 Annual VMT: 2,966,040,396

Oxides of Nitrogen	11.13	3,757.91
Primary Exhaust PM2.5 - Total	0.41	135.39
Primary PM2.5 - Brakewear Particulate	0.19	60.81
Primary PM2.5 - Tirewear Particulate	0.06	19.56
Sulfur Dioxide (SO2)	0.12	37.90

County	Year	Pollutant Name	DailyEmissions	AnnualEmissions
Clermont				
	2005	Vehicle Population: 232,380 Daily VMT: 5,083,336 Annual VMT: 1,684,261,582		
		Oxides of Nitrogen	21.21	7,295.87
		Primary Exhaust PM2.5 - Total	0.72	245.48
		Primary PM2.5 - Brakewear Particulate	0.08	27.67
		Primary PM2.5 - Tirewear Particulate	0.03	8.64
		Sulfur Dioxide (SO2)	0.06	20.51
	2008	Vehicle Population: 239,906 Daily VMT: 5,262,494 Annual VMT: 1,765,146,867		
		Oxides of Nitrogen	18.81	6,516.40
		Primary Exhaust PM2.5 - Total	0.61	211.40
		Primary PM2.5 - Brakewear Particulate	0.10	34.46
		Primary PM2.5 - Tirewear Particulate	0.03	10.74
		Sulfur Dioxide (SO2)	0.07	23.32
	2011	Vehicle Population: 243,760 Daily VMT: 5,489,550 Annual VMT: 1,836,770,645		
		Oxides of Nitrogen	17.48	6,039.51
		Primary Exhaust PM2.5 - Total	0.71	243.25
		Primary PM2.5 - Brakewear Particulate	0.11	37.00
		Primary PM2.5 - Tirewear Particulate	0.03	11.68
		Sulfur Dioxide (SO2)	0.07	23.23
	2015	Vehicle Population: 251,654 Daily VMT: 5,687,704 Annual VMT: 1,899,319,930		
		Oxides of Nitrogen	11.54	3,993.63
		Primary Exhaust PM2.5 - Total	0.46	156.92
		Primary PM2.5 - Brakewear Particulate	0.11	35.82
		Primary PM2.5 - Tirewear Particulate	0.03	11.58
		Sulfur Dioxide (SO2)	0.07	23.34
	2018	Vehicle Population: 257,742 Daily VMT: 5,952,609 Annual VMT: 1,987,922,558		
		Oxides of Nitrogen	9.09	3,146.47
		Primary Exhaust PM2.5 - Total	0.36	122.57
		Primary PM2.5 - Brakewear Particulate	0.12	39.31
		Primary PM2.5 - Tirewear Particulate	0.04	12.67
		Sulfur Dioxide (SO2)	0.07	24.94
	2021	Vehicle Population: 263,978 Daily VMT: 6,186,447 Annual VMT: 2,005,373,961		
		Oxides of Nitrogen	7.22	2,449.31
		Primary Exhaust PM2.5 - Total	0.27	90.84
		Primary PM2.5 - Brakewear Particulate	0.12	41.28
		Primary PM2.5 - Tirewear Particulate	0.04	13.27
		Sulfur Dioxide (SO2)	0.08	25.66

County	Year	Pollutant Name	DailyEmissions	AnnualEmissions

Hamilton

2005 Vehicle Population: 862,422 Daily VMT: 21,859,473 Annual VMT: 7,241,536,812

Oxides of Nitrogen	89.30	31,127.09
Primary Exhaust PM2.5 - Total	3.06	1,064.67
Primary PM2.5 - Brakewear Particulate	0.35	119.94
Primary PM2.5 - Tirewear Particulate	0.11	37.41
Sulfur Dioxide (SO2)	0.26	88.85

2008 Vehicle Population: 890,352 Daily VMT: 22,124,524 Annual VMT: 7,421,012,594

Oxides of Nitrogen	77.45	27,020.93
Primary Exhaust PM2.5 - Total	2.56	889.81
Primary PM2.5 - Brakewear Particulate	0.42	145.42
Primary PM2.5 - Tirewear Particulate	0.13	45.31
Sulfur Dioxide (SO2)	0.28	98.30

2011 Vehicle Population: 904,655 Daily VMT: 22,426,043 Annual VMT: 7,503,619,525

Oxides of Nitrogen	70.18	24,435.59
Primary Exhaust PM2.5 - Total	2.88	997.06
Primary PM2.5 - Brakewear Particulate	0.44	151.73
Primary PM2.5 - Tirewear Particulate	0.14	47.86
Sulfur Dioxide (SO2)	0.28	95.30

2015 Vehicle Population: 933,953 Daily VMT: 22,849,516 Annual VMT: 7,630,239,650

Oxides of Nitrogen	45.58	15,925.19
Primary Exhaust PM2.5 - Total	1.83	634.62
Primary PM2.5 - Brakewear Particulate	0.42	144.67
Primary PM2.5 - Tirewear Particulate	0.14	46.71
Sulfur Dioxide (SO2)	0.27	94.43

2018 Vehicle Population: 956,548 Daily VMT: 23,630,577 Annual VMT: 7,891,625,119

Oxides of Nitrogen	35.51	12,422.37
Primary Exhaust PM2.5 - Total	1.41	490.62
Primary PM2.5 - Brakewear Particulate	0.45	156.90
Primary PM2.5 - Tirewear Particulate	0.15	50.52
Sulfur Dioxide (SO2)	0.29	99.78

2021 Vehicle Population: 979,689 Daily VMT: 24,098,721 Annual VMT: 7,811,745,310

Oxides of Nitrogen	27.80	9,530.16
Primary Exhaust PM2.5 - Total	1.06	357.87
Primary PM2.5 - Brakewear Particulate	0.48	161.69
Primary PM2.5 - Tirewear Particulate	0.15	51.92
Sulfur Dioxide (SO2)	0.30	100.82

County	Year	Pollutant Name	DailyEmissions	AnnualEmissions
Warren				
	2005	Vehicle Population: 233,106 Daily VMT: 5,884,222	Annual VMT:	1,949,619,088
		Oxides of Nitrogen	23.98	8,224.57
		Primary Exhaust PM2.5 - Total	0.82	278.74
		Primary PM2.5 - Brakewear Particulate	0.09	32.00
		Primary PM2.5 - Tirewear Particulate	0.03	10.00
		Sulfur Dioxide (SO2)	0.07	23.54
	2008	Vehicle Population: 240,655 Daily VMT: 6,057,344	Annual VMT:	2,031,755,542
		Oxides of Nitrogen	21.11	7,267.18
		Primary Exhaust PM2.5 - Total	0.69	237.65
		Primary PM2.5 - Brakewear Particulate	0.12	39.57
		Primary PM2.5 - Tirewear Particulate	0.04	12.34
		Sulfur Dioxide (SO2)	0.08	26.57
	2011	Vehicle Population: 244,521 Daily VMT: 6,406,290	Annual VMT:	2,143,506,318
		Oxides of Nitrogen	19.88	6,826.15
		Primary Exhaust PM2.5 - Total	0.82	279.53
		Primary PM2.5 - Brakewear Particulate	0.13	43.09
		Primary PM2.5 - Tirewear Particulate	0.04	13.60
		Sulfur Dioxide (SO2)	0.08	26.83
	2015	Vehicle Population: 252,440 Daily VMT: 6,842,835	Annual VMT:	2,285,057,933
		Oxides of Nitrogen	13.37	4,598.44
		Primary Exhaust PM2.5 - Total	0.54	185.12
		Primary PM2.5 - Brakewear Particulate	0.13	43.02
		Primary PM2.5 - Tirewear Particulate	0.04	13.91
		Sulfur Dioxide (SO2)	0.08	27.77
	2018	Vehicle Population: 258,547 Daily VMT: 7,368,042	Annual VMT:	2,460,618,151
		Oxides of Nitrogen	10.73	3,692.47
		Primary Exhaust PM2.5 - Total	0.43	148.00
		Primary PM2.5 - Brakewear Particulate	0.14	48.57
		Primary PM2.5 - Tirewear Particulate	0.05	15.66
		Sulfur Dioxide (SO2)	0.09	30.49
	2021	Vehicle Population: 264,802 Daily VMT: 7,707,508	Annual VMT:	2,498,434,852
		Oxides of Nitrogen	8.54	2,875.72
		Primary Exhaust PM2.5 - Total	0.33	109.76
		Primary PM2.5 - Brakewear Particulate	0.16	51.34
		Primary PM2.5 - Tirewear Particulate	0.05	16.51
		Sulfur Dioxide (SO2)	0.10	31.58

Mobile Source Emission Forecast Process

Emission Factor Model

OKI's conformity assessment utilized U.S.EPA's emissions model MOVES 2010 to develop emission factors for SO_2, NO_X and PM2.5. Table 3 summarizes the settings used in the MOVES run specification file. Table 4 lists the data used in the MOVES County-Data Manager. Further details on the use of MOVES are found in the Appendix.

Table 3

MOVES RunSpec Parameter	Settings
MOVES Version 2009/05/15, MOVES default database 20100515	
Scale	County, Emission Rates
Time Span	Time aggregation = Hour 1 month representing average annual temperatures All hours of day selected Weekdays only
Geographic Bounds	2 Custom Domains – 4 Ohio counties, 3 Kentucky counties
Vehicles/Equipment	All source types, gasoline and diesel
Road Type	All road types including off-network
Pollutants and Processes	NO_x, All PM2.5 categories, SO_2, Total Energy Consumption
Strategies	Modified AVFT strategy file to reflect 0% CNG buses in the transit fleet
General Output	Units= grams, joules and miles
Output Emissions	Time = hour, Location =county, on-road emission rates by road type and source use type.
Advanced Performance	none

Table 4

County Data Manager	Data Source
Source Type Population	Local and default. Local data (2010) from KYTC and ODOT from motor vehicle registration data. Default data used for source types 41, 61 and 62. In addition , default data for source types 31, 32 and 54 used for KY.
Vehicle Type VMT	Local and default. HPMSVTypeYear VMT=daily VMT from OKI travel demand model with EPA's daily to annual VMT converter applied. monthVMTFraction = default. dayVMTFraction=default, hourVMTFraction=local.
I/M Programs	Default modified to reflect discontinued I/M program

Fuel Formulation	Default
Fuel Supply	Default
Meteorology Data	Local. Kentucky Division for Air Quality.
Ramp Fraction	Local. Ramp emissions calculated outside of MOVES
Road Type Distribution	Local. OKI travel demand model.
Age Distribution	Local and default. Local data (2010) from KYTC and ODOT from motor vehicle registration data. Default data used for source types 41, 61 and 62. In addition , default data for source types 31, 32 and 54 used for KY.
Average Speed Distribution	Local. OKI travel demand model.

OKI Travel Demand Model

Transportation system performance was estimated using the OKI Travel Demand Model Version 7.6. The OKI Travel Demand Model is composed of TRANPLAN programs, CUBE Voyager programs and a series of FORTRAN programs written by OKI. It is a state of the practice model that uses the standard 4 phase sequential modeling approach of trip generation, distribution, modal choice and assignment. The model uses demographic and land use data and capacity and free-flow speed characteristics for each roadway segment in the network to produce a "loaded" highway network with forecasted traffic volumes with revised speeds based on specified speed/capacity relationships.

Travel analysis zones are the basic geographic unit for estimating travel in the OKI model. The OKI region is subdivided into 1608 traffic analysis zones to permit detail as well as manageability. A variety of socioeconomic data items are used in the OKI transportation planning process. These data are used primarily to forecast future travel patterns by serving as independent variables in OKI trip generation equations. The following categories of planning data are utilized:

- Population (household and group quarter)
- Households
- Household vehicles
- Employment (by employment category and zone of work)
- Labor force participation (by zone of residence)
- Area type

The principal data requirements of the OKI travel demand forecasting model are population and employment. From these variables, other characteristics including households, labor force, and personal vehicles may be derived. Chapter 5 of *OKI 2030 Regional Transportation Plan 2008 Update* provides a complete demographic overview of the region.

OKI utilizes both base year (2005) and future year data (2010, 2020 and 2030) in the planning process. Planning data are maintained at the Traffic Analysis Zone (TAZ) level, and originate in the 2000 Census of Population and Housing. Base year 2005 and future year data for each variable are developed through various methods. More detailed explanation of base year and future year data generation for each of the above-mentioned categories of planning data follows. All of the variables represent the latest OKI planning assumptions.

Population

Base and Future Year Data: Population data for base year 2005 and future years 2010, 2020 and 2030 originate with the 2000 Census of Population and Housing. Utilizing ArcView GIS, population data at the zonal level for 2000 was derived from the area proportion allocation of block level population.

As a tri-state regional planning agency, OKI uses county level projections as prepared by the respective state data centers (Ohio Department of Development Office of Strategic Research, Kentucky State Data Center and Indiana Business Research Center) as control totals. The most current projections (years 2005 to 2030) were released by the Ohio and Indiana state data centers in 2003 and the Kentucky State Data Center in 2004. Population projections at the zonal level are calculated by multiplying household size by the projected zonal households. Household size is factored so that, in each county, the sum of the zonal populations equals the control total.

Households

Base Year Data: Household data for base year 2005 originates with the 2000 Census of Population and Housing. Utilizing the geographic information system ArcMap, household data at the zonal level for 2000 was derived from the area proportion allocation of block level households. Year 2000 household data was updated to 2005 with residential building permits issued between January 2000 and December 2004. The residential building locations were geo-coded in ArcMap, then aggregated to the TAZs. The housing unit totals for each TAZ were converted to households by applying a vacancy rate, an adjustment for permitted but unbuilt units, and subtracting demolitions (where data was available). These households were then added to the year Census 2000 zonal household total to arrive at 2005 households for each TAZ.

Future Year Data: The preparation of household projections was accomplished by calculating the number of households for a projected county population using ratios of householders to total population by age specific cohorts derived from the 2000 Census for each analysis year. Disaggregation to TAZs was determined by historical trends, existing and future land use, topography, flood plain information, availability of land, local knowledge and other factors.

Household Vehicles

Base and Future Year Data: Base and future year household vehicle data were obtained from the 2000 Census of Population and Housing. The 2000 Census is the only source of household vehicle data available at the block group level. Average vehicles per household were calculated for block groups then applied to the TAZs associated with each block group. The 2005, 2010, 2020 and 2030 vehicles per household level was held at the 2000 level based on the fact that, since 2002, the number of vehicles per household has exceeded the number of drivers per household.

Labor Force

Base and Future Year Data: The OKI labor force is a function of the population as determined by a labor force participation ratio (the number of employed persons in the labor force per persons 16 and over). Household data for base year 2005 originates with the 2000 Census of Population and Housing. Utilizing the geographic information system ArcMap, household data at the zonal level for 2000 was derived from the area proportion allocation of block group level employed labor force. The labor force projections for 2005, 2010, 2020 and 2030 were based on the most recent projections of national labor force participation rates by age and sex cohorts from the U.S. Department of Labor, Bureau of Labor Statistics for each of those years. These rates were then applied to the projected county age/sex cohorts and adjusted to eliminate the unemployed to arrive at a county employed labor force control total. Employed labor force at the zonal level is calculated by multiplying the labor force participation rate by the zonal population. The labor force participation rate is adjusted so that, in each county, the sum of the zonal labor force counts equals the control total.

Employment

Base Year Data: Quarterly Census of Employment and Wages (QCEW or ES202) data for 2005 was utilized as the primary tool to calculate employment at the zonal level. Individual business records containing physical location, number of employees and SIC code were geocoded through ArcMap and aggregated to the TAZ level. This data set was supplemented by other sources of data to complete the commuting employment picture in the OKI region. Each zone's employment was divided according to the SIC code into three classes (retail, office, industrial) based upon the potential for generating trips.

Future Year Data: For future year employment projection, calculation was first made of the employment at the regional level. At the regional level, employment is a calculation of the region's employed labor force minus workers who live in the region but commute out to work, plus workers who live outside the region but commute in to work. The regional total was disaggregated first to the county level based on historic trends and expected changes in the county's share of the region's employment and then to the TAZ level. Disaggregation to TAZs was determined by historical trends, existing and future land use, topography, flood plain information, availability of land, local knowledge and other factors.

Area Type

Base and Future Year Data: For each analysis year, each TAZ is assigned an area type designation as CBD, Urban, Suburban or Rural based on population and employment densities.

Model Calibration

OKI's Travel Demand Model has been validated to observed traffic volumes for the model base year 2005. The modeling network encompasses the entire ozone nonattainment area with the exception of Clinton County, Ohio. The modeling network also includes Greene, Miami and Montgomery counties in Ohio and the remainder of Dearborn County Indiana. The difference between estimated vehicle miles traveled (VMT) and 2005 observed VMT is less than 1%. A highway screenline analysis compares the screenline observed and simulated traffic volume discrepancies with the ODOT standard of maximum desirable deviation. The comparison shows that the model performs at a satisfactory level and all the errors were under the ODOT curve. Further information can be found in OKI's 2007 report, "*OKI/MVRPC Travel Demand Model Methodology/ Validation Report*". For the calibration, OKI used over 3000 traffic counts collected through 2006 by the Ohio Department of Transportation (ODOT), the Kentucky Transportation Cabinet, many county and local governments, transportation engineering consultants, and OKI. These traffic counts cover nearly 50% percent of the links in the OKI portion of the modeling network. The methodology provides consistency with past emission inventory and conformity analysis work performed by OKI.

Local Inputs and Post-Model Processing

OKI incorporates a variety of sources of local data to both improve and confirm the accuracy of VMT, as well as other travel-related parameters. Free flow speeds used on the highway and transit networks are based on travel time studies performed locally. The OKI post-processing program, IMPACT, uses the loaded highway network to generate VMT by hour, VMT by speed distribution and VMT by facility type. These tables are then included as input into MOVES. Two separate sets of VMT tables are generated: one for the four Ohio counties plus Dearborn County Indiana, and a second for the three Kentucky counties. The VMT by hour tables utilize hourly traffic distribution and directional split factors for different roadway types as developed by OKI. The main source of the data was the permanent traffic counting stations located throughout the OKI region for the years of 2004-2006. This data was supplemented with data collected at coverage count stations (locations with counts taken on only one-two days). The stations were classified by area type: urban and rural, and functional classification: freeway, arterial and collector. Speeds representing various "loaded" conditions (with traffic volumes) are estimated using techniques from the 1997 Highway Capacity Manual. This permits the estimation of speeds as conditions vary from hour to hour on the different facility types throughout the region. The IMPACT program performs the appropriate summation by area and roadway type as well as regional totals. OKI has also developed seasonal conversion factors to adjust traffic volumes to summer conditions. The factors were derived from local data collected at permanent traffic counting stations during 1994-1997 utilizing the average daily traffic monthly conversion factors for June, July and August. Further information on OKI's IMPACT program is documented in the report, *"Travel Demand Model Summary Reporting and Impact Summary Reporting: OKI/MVRPC Travel Demand Model User's Guide", OKI 2003.*

APPENDIX

OKI Technical Documentation for Using EPA Motor Vehicle Emission Simulator (MOVES) 2010 to develop mobile Source Emissions

August 2010

1. Using MOVES

To determine specific emission profiles and inventory, user has to define the input data like area, time span, type of vehicles, road types, fuel types, emission producing processes etc. These data are stored in a run specification (RunSpec) XML file. Using graphical user interface, the user can modify all these attributes of the RunSpec. In the following sections, how input data is entered and modified is explained. All these input options are found in the navigation panel of Graphical User Interface of MOVES software.

1.1 Description

The description text box is useful to list the specifications of the RunSpec and to distinguish between the RunSpecs. We can provide a brief overview of the particular RunSpec. In all of our current RunSpecs, we have details such as analysis years, area and pollutants analyzed.

1.2 Scale/Calculation Type

In this option, we need to specify about the Domain/Scale and Calculation type. The Domain specifies the level of default data we need to use for analysis and also the scale of the analysis. We have used the County scale. The county scale requires user supplied local data for most inputs. We have selected "Emission Rates" as the calculation type.

1.3 Time Spans

This input panel has different time-related input data like time aggregation level, year of analysis, month of analysis, whether analysis day is weekday or weekend, and hours of analysis. In all of our runs, time aggregation level is considered as hour, which is the most disaggregated level possible in MOVES and it is also specified in EPA's technical guidance for all SIP runs. In In consultation with the states, the analysis years of 2005, 2008, 2011, 2015, 2018, and 2021 were selected. Each analysis year requires a separate MOVES run. We have used the month of April for analysis. Annual analysis uses one 24-hour set of average annual temperatures. The annual average minimum temperature, maximum temperature and humidity values for each hour were calculated and assigned the April month ID. The annual average temperature profile was used for the PM2.5 SIP inventory. Weekdays only, and all hours were selected.

1.4 Geographic Bounds

In this input screen, we need to specify the region of analysis (eg. Nation, State, Custom Domain). We have created a two separate input database through combining the four OKI Ohio counties (Hamilton, Butler, Clermont, and Warren) and the three OKI Kentucky counties (Boone, Campbell, and Kenton). Upon selecting the custom domain, MOVES will consider this region as separate generic County. The state ID is fixed as 99 and we have assigned an arbitrary CountyID of 390 for Ohio, and 210 for Kentucky to distinguish between the two states (39 and

21 are used in post-processing as state id's). The user also needs to provide a fraction geographic phase in area. In this case we do not have any phase in area fraction and we also provided average barometric pressure (MOVES default value for Hamilton County Ohio) to identify whether it is low altitude area or high altitude area. Since we do not have I/M program in the region the refueling program adjustment fraction and refueling spill program adjustment fractions are assigned as 0.00. In this input panel we also need to specify the Domain Input Databases. For all of our runs we have defined different input databases for each year.

1.5 Vehicles/Equipment

In MOVES, the user also needs to provide the different type of vehicles considered for analysis in the region. MOVES provide us with 13 different types of vehicles or equipment and four different fuel types and we need to select appropriate fuel and vehicle combinations. In MOVES, vehicle types are called SourceUseTypes . We have considered all possible types of fuel/vehicle type combinations.

1.6 Road Type

There are five road types available in MOVES. All five road types are selected in the RunSpecs, however OKI travel demand model does not predict the off-network vehicle miles traveled. The off-network road type in MOVES is used to assign activity for vehicle starts and for evaporative emissions while vehicles are parked. The other four road types are relatively simple and are based on area type, whether it is urban or rural. All expressways and freeways are considered as restricted roadways and all other road types are considered as unrestricted roadways.

1.7 Pollutants and Processes

There are different pollutants and corresponding processes are available in MOVES. A separate panel is available for selecting different pollutants and processes. In consultation with the states, PM2.5, NO_x, SO_2 were selected. To perform calculation of PM2.5 it is also required to select total energy consumption, elemental carbon, organic carbon, and sulfate particulate. In addition, brake wear and tire wear are also selected.

1.8 Miscellaneous

Information about present and future alternative vehicle fuels & technologies, on-road retrofit and rate of progress information can be input with the MOVES Strategies section of the RunSpec. If we do not specify future Alternative Vehicle Fuel & Technologies, MOVES is going to assume default alternative fuels. The default AVFT strategy file was modified to reflect 0% CNG buses in the transit fleet (default is 6%). MOVES also provides options whether we would like to save the MOVESactivityoutput and MOVESOutput databases or not. We did not select these options, although these were selected in subsequent runs as an error checking method, and to obtain values utilized in the post-processing.

Table 1.8 : Alternative Vehicle and Fueling Technology used in all RunSpecs

sourceTypeID	modelYearID	fuelTypeID	engTechID	fuelEngFraction
42	1960	2	1	1
42	1961	2	1	1
42	1962	2	1	1
42	1963	2	1	1
42	1964	2	1	1
42	1965	2	1	1
42	1966	2	1	1
42	1967	2	1	1
42	1968	2	1	1
42	1969	2	1	1
42	1970	2	1	1
42	1971	2	1	1
42	1972	2	1	1
42	1973	2	1	1
42	1974	2	1	1
42	1975	2	1	1
42	1976	2	1	1
42	1977	2	1	1
42	1978	2	1	1
42	1979	2	1	1
42	1980	2	1	1
42	1981	2	1	1
42	1982	2	1	1
42	1983	2	1	1
42	1984	2	1	1
42	1985	2	1	1
42	1986	2	1	1
42	1987	2	1	1
42	1988	2	1	1
42	1989	2	1	1
42	1990	2	1	1
42	1991	2	1	1
42	1992	2	1	1
42	1993	2	1	1
42	1994	2	1	1
42	1995	2	1	1
42	1996	2	1	1
42	1997	2	1	1
42	1998	2	1	1
42	1999	2	1	1
42	2000	2	1	1
42	2001	2	1	1
42	2002	2	1	1
42	2003	2	1	1

42	2004	2	1	1
42	2005	2	1	1
42	2006	2	1	1
42	2007	2	1	1
42	2008	2	1	1
42	2009	2	1	1
42	2010	2	1	1
42	2011	2	1	1
42	2012	2	1	1
42	2013	2	1	1
42	2014	2	1	1
42	2015	2	1	1
42	2016	2	1	1
42	2017	2	1	1
42	2018	2	1	1
42	2019	2	1	1
42	2020	2	1	1
42	2021	2	1	1
42	2022	2	1	1
42	2023	2	1	1
42	2024	2	1	1
42	2025	2	1	1
42	2026	2	1	1
42	2027	2	1	1
42	2028	2	1	1
42	2029	2	1	1
42	2030	2	1	1
42	2031	2	1	1
42	2032	2	1	1
42	2033	2	1	1
42	2034	2	1	1
42	2035	2	1	1
42	2036	2	1	1
42	2037	2	1	1
42	2038	2	1	1
42	2039	2	1	1
42	2040	2	1	1
42	2041	2	1	1
42	2042	2	1	1
42	2043	2	1	1
42	2044	2	1	1
42	2045	2	1	1
42	2046	2	1	1
42	2047	2	1	1
42	2048	2	1	1
42	2049	2	1	1
42	2050	2	1	1

1.9 Output

The MOVES output section requires the designation of an output database. A new database was created for each new RunSpec. Output units selected for mass, energy and distance were grams, joules and miles. Activity output was not selected. The second output screen requires further selection for data aggregation and data options. Hour was selected for Time, and County was selected for Location. Road Type and Source Type were also selected.

2. Data Importers

In order to enter local data into RunSpec, we need to use pre processing option in the MOVES. We can select either Data Importer or County Importer for Custom Domain option. These Importers convert the data in excel format to MySQL tables. This is the preferred input format of MOVES software.

2.1 Meteorology Data Importer

In this type of Importer, meteorology data is converted to a MOVES input format. This dataset has different data items like month ID, Zone ID, hour ID, Temperature and Relative Humidity. The Ohio and Kentucky custom domains use the identical temperature data obtained from the Kentucky Division for Air Quality (KDAQ). Even though ODOT has provided the temperature data (collected from local airports), KDAQ data appeared to be more applicable. A portion of the KDAQ temperature file is shown in Table 2.1. As previously discussed, annual average minimum and maximum temperatures and humidity values were calculated and used in the PM2.5 analysis.

Table 2.1 : Meteorology Data

monthID	zoneID	hourID	temperature	relHumidity
1	993900	1	23.2	100
1	993900	2	22.2	100
1	993900	3	21.4	100
1	993900	4	20.9	100
1	993900	5	20.4	100
1	993900	6	19.9	100
1	993900	7	19.5	100
1	993900	8	19.9	100
1	993900	9	22	100
1	993900	10	25.4	100
1	993900	11	28.9	87.6

1	993900	12	31.9	77.5
1	993900	13	34.5	69.7
1	993900	14	36	65.9
1	993900	15	36.5	64.6
1	993900	16	36.6	64.2
1	993900	17	36.2	65.1
1	993900	18	35.2	67.8
1	993900	19	33.5	72.6
1	993900	20	31.3	79.3
1	993900	21	29.1	86.8
1	993900	22	27.2	93.9
1	993900	23	25.8	99.4
1	993900	24	24.5	100

2.2 Source Type Population Importer

The source type population importer converts vehicle type, and registered vehicle population in into MOVES database format. ODOT has provided us with the registered vehicle population in each county in the Ohio portion of the region for 13 MOVES vehicle types. KYTC has provided registered vehicle population by county for 6 HPMS vehicle types. The KYTC data was converted to the 13 MOVES vehicle types based on the Ohio distribution. Same vehicle population was used for all analysis years. As per suggestions made by FHWA, the source type population has been forecasted for future years with +0.8 % per year. Similarly, the source type populations has been estimated for past years. The MOVES default source type population for intercity bus, refuse trucks, motor homes and combination trucks was used. In addition, MOVES default source type population for passenger trucks and light commercial trucks was used for Kentucky. The MOVES default source type population was acquired from the MOVES activity output tables from county-level inventory runs.

Table 2.21: Ohio Source Type Population (acquired from ODOT and default)

yearID	sourceTypeID	sourceTypePopulation
2008	11	68559
2008	21	1191067
2008	31	482420
2008	32	15817
2008	41	454
2008	42	81
2008	43	3651
2008	51	409
2008	52	366
2008	53	361
2008	54	4888
2008	61	4839

2008	62	5548

Table 2.22: Kentucky Source Type population (acquired from KYTC and default)

yearID	sourceTypeID	sourceTypePopulation
2008	11	7975
2008	21	197009
2008	31	120518
2008	32	40263
2008	41	127
2008	42	21
2008	43	977
2008	51	115
2008	52	761
2008	53	751
2008	54	1379
2008	61	1580
2008	62	1811

2.3 Age Distribution Importer

For emission calculation, MOVES requires vehicle Age Distribution by Source Type. Vehicle Age Distribution is divided into 30 years based on vehicle model years. For each vehicle type, the distribution sum adds up to one. ODOT has obtained vehicle registration data from the Ohio Bureau of Motor Vehicles for all the counties in Ohio and processed them to convert into MOVES Age Distribution for 13 vehicle types. KYTC also provided vehicle registration data. We have used the same Age Distribution for all year runs. All the vehicles older than 30 years are considered as 30-years old. Identical age distribution is used for all analysis years. KYTC also provided similar information, but for the 6 HPMS types only. For Kentucky, identical age distributions are used within each HPMS vehicle type.

Table 2.3: Ohio Custom Domain Age distribution

Source TypeID	yearID	ageID	ageFraction
11	2008	0	0.0019
11	2008	1	0.0191
11	2008	2	0.0531
11	2008	3	0.0688
11	2008	4	0.0773
11	2008	5	0.0737
11	2008	6	0.0611
11	2008	7	0.0780
11	2008	8	0.0636
11	2008	9	0.0537
11	2008	10	0.0435
11	2008	11	0.0359
11	2008	12	0.0282
11	2008	13	0.0230
11	2008	14	0.0220
11	2008	15	0.0183
11	2008	16	0.0160
11	2008	17	0.0146
11	2008	18	0.0097
11	2008	19	0.0080
11	2008	20	0.0072
11	2008	21	0.0086

11	2008	22	0.0084
11	2008	23	0.0121
11	2008	24	0.0171
11	2008	25	0.0179
11	2008	26	0.0137
11	2008	27	0.0171
11	2008	28	0.0249
11	2008	29	0.0172
11	2008	30	0.0862
21	2008	0	0.0121
21	2008	1	0.0331
21	2008	2	0.0440
21	2008	3	0.0528
21	2008	4	0.0534
21	2008	5	0.0566
21	2008	6	0.0570
21	2008	7	0.0592
21	2008	8	0.0591
21	2008	9	0.0542
21	2008	10	0.0590
21	2008	11	0.0568
21	2008	12	0.0507
21	2008	13	0.0499
21	2008	14	0.0438
21	2008	15	0.0453
21	2008	16	0.0368
21	2008	17	0.0308
21	2008	18	0.0261
21	2008	19	0.0207
21	2008	20	0.0165
21	2008	21	0.0132
21	2008	22	0.0095
21	2008	23	0.0073
21	2008	24	0.0059
21	2008	25	0.0043
21	2008	26	0.0033
21	2008	27	0.0017
21	2008	28	0.0011
21	2008	29	0.0010
21	2008	30	0.0346
31	2008	0	0.0103
31	2008	1	0.0279
31	2008	2	0.0502
31	2008	3	0.0570
31	2008	4	0.0659
31	2008	5	0.0806
31	2008	6	0.0796
31	2008	7	0.0733
31	2008	8	0.0727

31	2008	9	0.0599
31	2008	10	0.0625
31	2008	11	0.0603
31	2008	12	0.0516
31	2008	13	0.0432
31	2008	14	0.0380
31	2008	15	0.0386
31	2008	16	0.0302
31	2008	17	0.0260
31	2008	18	0.0165
31	2008	19	0.0125
31	2008	20	0.0093
31	2008	21	0.0084
31	2008	22	0.0067
31	2008	23	0.0051
31	2008	24	0.0037
31	2008	25	0.0025
31	2008	26	0.0017
31	2008	27	0.0009
31	2008	28	0.0004
31	2008	29	0.0002
31	2008	30	0.0041
32	2008	0	0.0178
32	2008	1	0.0459
32	2008	2	0.0871
32	2008	3	0.0699
32	2008	4	0.0707
32	2008	5	0.0357
32	2008	6	0.0355
32	2008	7	0.0369
32	2008	8	0.0366
32	2008	9	0.0407
32	2008	10	0.0491
32	2008	11	0.0547
32	2008	12	0.0427
32	2008	13	0.0413
32	2008	14	0.0383
32	2008	15	0.0602
32	2008	16	0.0476
32	2008	17	0.0381
32	2008	18	0.0304
32	2008	19	0.0181
32	2008	20	0.0212
32	2008	21	0.0184
32	2008	22	0.0135
32	2008	23	0.0134
32	2008	24	0.0095
32	2008	25	0.0070
32	2008	26	0.0054

32	2008	27	0.0021
32	2008	28	0.0014
32	2008	29	0.0008
32	2008	30	0.0100
41	2008	0	0.0000
41	2008	1	0.0309
41	2008	2	0.0884
41	2008	3	0.0890
41	2008	4	0.0768
41	2008	5	0.0746
41	2008	6	0.0967
41	2008	7	0.0635
41	2008	8	0.0486
41	2008	9	0.0801
41	2008	10	0.0751
41	2008	11	0.0624
41	2008	12	0.0254
41	2008	13	0.0271
41	2008	14	0.0188
41	2008	15	0.0193
41	2008	16	0.0133
41	2008	17	0.0177
41	2008	18	0.0094
41	2008	19	0.0177
41	2008	20	0.0171
41	2008	21	0.0099
41	2008	22	0.0039
41	2008	23	0.0055
41	2008	24	0.0061
41	2008	25	0.0011
41	2008	26	0.0033
41	2008	27	0.0033
41	2008	28	0.0028
41	2008	29	0.0017
41	2008	30	0.0105
42	2008	0	0.0000
42	2008	1	0.0366
42	2008	2	0.1098
42	2008	3	0.0366
42	2008	4	0.1585
42	2008	5	0.0366
42	2008	6	0.0610
42	2008	7	0.0610
42	2008	8	0.0244
42	2008	9	0.1098
42	2008	10	0.0366
42	2008	11	0.0976
42	2008	12	0.0366
42	2008	13	0.0244

42	2008	14	0.0244
42	2008	15	0.0122
42	2008	16	0.0244
42	2008	17	0.0244
42	2008	18	0.0366
42	2008	19	0.0000
42	2008	20	0.0000
42	2008	21	0.0122
42	2008	22	0.0000
42	2008	23	0.0000
42	2008	24	0.0000
42	2008	25	0.0000
42	2008	26	0.0122
42	2008	27	0.0000
42	2008	28	0.0000
42	2008	29	0.0122
42	2008	30	0.0122
43	2008	0	0.0905
43	2008	1	0.0302
43	2008	2	0.0549
43	2008	3	0.0467
43	2008	4	0.0592
43	2008	5	0.0723
43	2008	6	0.0481
43	2008	7	0.0334
43	2008	8	0.0668
43	2008	9	0.0647
43	2008	10	0.0842
43	2008	11	0.0864
43	2008	12	0.0473
43	2008	13	0.0500
43	2008	14	0.0242
43	2008	15	0.0185
43	2008	16	0.0106
43	2008	17	0.0228
43	2008	18	0.0109
43	2008	19	0.0130
43	2008	20	0.0125
43	2008	21	0.0092
43	2008	22	0.0062
43	2008	23	0.0079
43	2008	24	0.0090
43	2008	25	0.0035
43	2008	26	0.0030
43	2008	27	0.0011
43	2008	28	0.0027
43	2008	29	0.0016
43	2008	30	0.0087
51	2008	0	0.0054

51	2008	1	0.0488
51	2008	2	0.0623
51	2008	3	0.0705
51	2008	4	0.0867
51	2008	5	0.0434
51	2008	6	0.0434
51	2008	7	0.0542
51	2008	8	0.0542
51	2008	9	0.0759
51	2008	10	0.0217
51	2008	11	0.0407
51	2008	12	0.0786
51	2008	13	0.0542
51	2008	14	0.0515
51	2008	15	0.0678
51	2008	16	0.0325
51	2008	17	0.0081
51	2008	18	0.0163
51	2008	19	0.0027
51	2008	20	0.0081
51	2008	21	0.0000
51	2008	22	0.0027
51	2008	23	0.0027
51	2008	24	0.0136
51	2008	25	0.0000
51	2008	26	0.0000
51	2008	27	0.0000
51	2008	28	0.0027
51	2008	29	0.0000
51	2008	30	0.0515
52	2008	0	0.0054
52	2008	1	0.0488
52	2008	2	0.0623
52	2008	3	0.0705
52	2008	4	0.0867
52	2008	5	0.0434
52	2008	6	0.0434
52	2008	7	0.0542
52	2008	8	0.0542
52	2008	9	0.0759
52	2008	10	0.0217
52	2008	11	0.0407
52	2008	12	0.0786
52	2008	13	0.0542
52	2008	14	0.0515
52	2008	15	0.0678
52	2008	16	0.0325
52	2008	17	0.0081
52	2008	18	0.0163

52	2008	19	0.0027
52	2008	20	0.0081
52	2008	21	0.0000
52	2008	22	0.0027
52	2008	23	0.0027
52	2008	24	0.0136
52	2008	25	0.0000
52	2008	26	0.0000
52	2008	27	0.0000
52	2008	28	0.0027
52	2008	29	0.0000
52	2008	30	0.0515
53	2008	0	0.0000
53	2008	1	0.0062
53	2008	2	0.0373
53	2008	3	0.0093
53	2008	4	0.0280
53	2008	5	0.0342
53	2008	6	0.0186
53	2008	7	0.0186
53	2008	8	0.0124
53	2008	9	0.0155
53	2008	10	0.0217
53	2008	11	0.0373
53	2008	12	0.0093
53	2008	13	0.0311
53	2008	14	0.0217
53	2008	15	0.0373
53	2008	16	0.0217
53	2008	17	0.0342
53	2008	18	0.0124
53	2008	19	0.0186
53	2008	20	0.0248
53	2008	21	0.0373
53	2008	22	0.0186
53	2008	23	0.0248
53	2008	24	0.0062
53	2008	25	0.0373
53	2008	26	0.0155
53	2008	27	0.0186
53	2008	28	0.0217
53	2008	29	0.0186
53	2008	30	0.3509
54	2008	0	0.0077
54	2008	1	0.0170
54	2008	2	0.0377
54	2008	3	0.0424
54	2008	4	0.0471
54	2008	5	0.0579

54	2008	6	0.0552
54	2008	7	0.0485
54	2008	8	0.0406
54	2008	9	0.0439
54	2008	10	0.0505
54	2008	11	0.0539
54	2008	12	0.0435
54	2008	13	0.0360
54	2008	14	0.0348
54	2008	15	0.0375
54	2008	16	0.0303
54	2008	17	0.0231
54	2008	18	0.0196
54	2008	19	0.0150
54	2008	20	0.0183
54	2008	21	0.0208
54	2008	22	0.0218
54	2008	23	0.0217
54	2008	24	0.0186
54	2008	25	0.0173
54	2008	26	0.0163
54	2008	27	0.0118
54	2008	28	0.0084
54	2008	29	0.0059
54	2008	30	0.0968
61	2008	0	0.0030
61	2008	1	0.0167
61	2008	2	0.0334
61	2008	3	0.0393
61	2008	4	0.0506
61	2008	5	0.0530
61	2008	6	0.0620
61	2008	7	0.0625
61	2008	8	0.0562
61	2008	9	0.0551
61	2008	10	0.0595
61	2008	11	0.0569
61	2008	12	0.0458
61	2008	13	0.0493
61	2008	14	0.0380
61	2008	15	0.0435
61	2008	16	0.0425
61	2008	17	0.0312
61	2008	18	0.0262
61	2008	19	0.0235
61	2008	20	0.0201
61	2008	21	0.0225
61	2008	22	0.0212
61	2008	23	0.0141
61	2008	24	0.0137
61	2008	25	0.0096
61	2008	26	0.0069
61	2008	27	0.0039
61	2008	28	0.0030
61	2008	29	0.0027
61	2008	30	0.0343
62	2008	0	0.0078
62	2008	1	0.0232
62	2008	2	0.0307
62	2008	3	0.0907
62	2008	4	0.0721
62	2008	5	0.0808
62	2008	6	0.0564
62	2008	7	0.0520
62	2008	8	0.0360
62	2008	9	0.0552
62	2008	10	0.1019
62	2008	11	0.0813
62	2008	12	0.0603
62	2008	13	0.0425
62	2008	14	0.0439
62	2008	15	0.0442
62	2008	16	0.0273
62	2008	17	0.0202
62	2008	18	0.0122
62	2008	19	0.0101
62	2008	20	0.0103
62	2008	21	0.0080
62	2008	22	0.0079
62	2008	23	0.0058
62	2008	24	0.0050
62	2008	25	0.0036
62	2008	26	0.0038
62	2008	27	0.0001
62	2008	28	0.0012
62	2008	29	0.0010
62	2008	30	0.0046

Table 2 : Kentucky Custom Domain Age distribution

Source TypeID	yearID	ageID	ageFraction
11	2008	0	0.0020
11	2008	1	0.0323
11	2008	2	0.0606
11	2008	3	0.0826
11	2008	4	0.0831
11	2008	5	0.0774
11	2008	6	0.0667
11	2008	7	0.0830
11	2008	8	0.0650
11	2008	9	0.0495
11	2008	10	0.0424
11	2008	11	0.0345
11	2008	12	0.0287
11	2008	13	0.0214
11	2008	14	0.0240
11	2008	15	0.0208
11	2008	16	0.0138
11	2008	17	0.0129
11	2008	18	0.0092
11	2008	19	0.0051
11	2008	20	0.0052
11	2008	21	0.0058
11	2008	22	0.0078
11	2008	23	0.0108
11	2008	24	0.0153
11	2008	25	0.0168
11	2008	26	0.0124
11	2008	27	0.0160
11	2008	28	0.0228
11	2008	29	0.0152
11	2008	30	0.0568
21	2008	0	0.0118
21	2008	1	0.0665
21	2008	2	0.0596
21	2008	3	0.0642
21	2008	4	0.0611
21	2008	5	0.0705
21	2008	6	0.0694
21	2008	7	0.0699
21	2008	8	0.0719
21	2008	9	0.0619
21	2008	10	0.0633
21	2008	11	0.0591
21	2008	12	0.0490
21	2008	13	0.0442
21	2008	14	0.0348
21	2008	15	0.0318
21	2008	16	0.0241
21	2008	17	0.0191
21	2008	18	0.0142
21	2008	19	0.0111
21	2008	20	0.0088
21	2008	21	0.0066
21	2008	22	0.0049
21	2008	23	0.0039
21	2008	24	0.0028
21	2008	25	0.0024
21	2008	26	0.0018
21	2008	27	0.0009
21	2008	28	0.0005
21	2008	29	0.0005
21	2008	30	0.0094
31	2008	0	0.0000
31	2008	1	0.0000
31	2008	2	0.0000
31	2008	3	0.0000
31	2008	4	0.0238
31	2008	5	0.0119
31	2008	6	0.0119
31	2008	7	0.0119
31	2008	8	0.0119
31	2008	9	0.0000
31	2008	10	0.0238
31	2008	11	0.0357
31	2008	12	0.0119
31	2008	13	0.0952
31	2008	14	0.0833
31	2008	15	0.0595
31	2008	16	0.1071
31	2008	17	0.0357
31	2008	18	0.0357
31	2008	19	0.0357
31	2008	20	0.0119
31	2008	21	0.0476
31	2008	22	0.0238
31	2008	23	0.0119
31	2008	24	0.0119
31	2008	25	0.0595

31	2008	26	0.0357
31	2008	27	0.0000
31	2008	28	0.0238
31	2008	29	0.0238
31	2008	30	0.1548
32	2008	0	0.0000
32	2008	1	0.0000
32	2008	2	0.0000
32	2008	3	0.0000
32	2008	4	0.0238
32	2008	5	0.0119
32	2008	6	0.0119
32	2008	7	0.0119
32	2008	8	0.0119
32	2008	9	0.0000
32	2008	10	0.0238
32	2008	11	0.0357
32	2008	12	0.0119
32	2008	13	0.0952
32	2008	14	0.0833
32	2008	15	0.0595
32	2008	16	0.1071
32	2008	17	0.0357
32	2008	18	0.0357
32	2008	19	0.0357
32	2008	20	0.0119
32	2008	21	0.0476
32	2008	22	0.0238
32	2008	23	0.0119
32	2008	24	0.0119
32	2008	25	0.0595
32	2008	26	0.0357
32	2008	27	0.0000
32	2008	28	0.0238
32	2008	29	0.0238
32	2008	30	0.1548
41	2008	0	0.0455
41	2008	1	0.1136
41	2008	2	0.0000
41	2008	3	0.0114
41	2008	4	0.0227
41	2008	5	0.0000
41	2008	6	0.0000
41	2008	7	0.0114
41	2008	8	0.0114
41	2008	9	0.0227
41	2008	10	0.0114
41	2008	11	0.0568
41	2008	12	0.1250
41	2008	13	0.0227
41	2008	14	0.0000
41	2008	15	0.0341
41	2008	16	0.0341
41	2008	17	0.0682
41	2008	18	0.0455
41	2008	19	0.0909
41	2008	20	0.0568
41	2008	21	0.0455
41	2008	22	0.0341
41	2008	23	0.0455
41	2008	24	0.0227
41	2008	25	0.0227
41	2008	26	0.0114
41	2008	27	0.0000
41	2008	28	0.0227
41	2008	29	0.0000
41	2008	30	0.0114
42	2008	0	0.0455
42	2008	1	0.1136
42	2008	2	0.0000
42	2008	3	0.0114
42	2008	4	0.0227
42	2008	5	0.0000
42	2008	6	0.0000
42	2008	7	0.0114
42	2008	8	0.0114
42	2008	9	0.0227
42	2008	10	0.0114
42	2008	11	0.0568
42	2008	12	0.1250
42	2008	13	0.0227
42	2008	14	0.0000
42	2008	15	0.0341
42	2008	16	0.0341
42	2008	17	0.0682
42	2008	18	0.0455
42	2008	19	0.0909
42	2008	20	0.0568
42	2008	21	0.0455
42	2008	22	0.0341
42	2008	23	0.0455
42	2008	24	0.0227
42	2008	25	0.0227
42	2008	26	0.0114
42	2008	27	0.0000
42	2008	28	0.0227
42	2008	29	0.0000
42	2008	30	0.0114

43	2008	0	0.0455
43	2008	1	0.1136
43	2008	2	0.0000
43	2008	3	0.0114
43	2008	4	0.0227
43	2008	5	0.0000
43	2008	6	0.0000
43	2008	7	0.0114
43	2008	8	0.0114
43	2008	9	0.0227
43	2008	10	0.0114
43	2008	11	0.0568
43	2008	12	0.1250
43	2008	13	0.0227
43	2008	14	0.0000
43	2008	15	0.0341
43	2008	16	0.0341
43	2008	17	0.0682
43	2008	18	0.0455
43	2008	19	0.0909
43	2008	20	0.0568
43	2008	21	0.0455
43	2008	22	0.0341
43	2008	23	0.0455
43	2008	24	0.0227
43	2008	25	0.0227
43	2008	26	0.0114
43	2008	27	0.0000
43	2008	28	0.0227
43	2008	29	0.0000
43	2008	30	0.0114
51	2008	0	0.0025
51	2008	1	0.0200
51	2008	2	0.0386
51	2008	3	0.0436
51	2008	4	0.0495
51	2008	5	0.0579
51	2008	6	0.0667
51	2008	7	0.0698
51	2008	8	0.0620
51	2008	9	0.0611
51	2008	10	0.0675
51	2008	11	0.0619
51	2008	12	0.0508
51	2008	13	0.0529
51	2008	14	0.0397
51	2008	15	0.0397
51	2008	16	0.0375
51	2008	17	0.0276
51	2008	18	0.0204
51	2008	19	0.0184
51	2008	20	0.0158
51	2008	21	0.0174
51	2008	22	0.0152
51	2008	23	0.0108
51	2008	24	0.0108
51	2008	25	0.0071
51	2008	26	0.0052
51	2008	27	0.0031
51	2008	28	0.0021
51	2008	29	0.0021
51	2008	30	0.0220
52	2008	0	0.0025
52	2008	1	0.0200
52	2008	2	0.0386
52	2008	3	0.0436
52	2008	4	0.0495
52	2008	5	0.0579
52	2008	6	0.0667
52	2008	7	0.0698
52	2008	8	0.0620
52	2008	9	0.0611
52	2008	10	0.0675
52	2008	11	0.0619
52	2008	12	0.0508
52	2008	13	0.0529
52	2008	14	0.0397
52	2008	15	0.0397
52	2008	16	0.0375
52	2008	17	0.0276
52	2008	18	0.0204
52	2008	19	0.0184
52	2008	20	0.0158
52	2008	21	0.0174
52	2008	22	0.0152
52	2008	23	0.0108
52	2008	24	0.0108
52	2008	25	0.0071
52	2008	26	0.0052
52	2008	27	0.0031
52	2008	28	0.0021
52	2008	29	0.0021
52	2008	30	0.0220
53	2008	0	0.0025
53	2008	1	0.0200
53	2008	2	0.0386
53	2008	3	0.0436
53	2008	4	0.0495

53	2008	5	0.0579
53	2008	6	0.0667
53	2008	7	0.0698
53	2008	8	0.0620
53	2008	9	0.0611
53	2008	10	0.0675
53	2008	11	0.0619
53	2008	12	0.0508
53	2008	13	0.0529
53	2008	14	0.0397
53	2008	15	0.0397
53	2008	16	0.0375
53	2008	17	0.0276
53	2008	18	0.0204
53	2008	19	0.0184
53	2008	20	0.0158
53	2008	21	0.0174
53	2008	22	0.0152
53	2008	23	0.0108
53	2008	24	0.0108
53	2008	25	0.0071
53	2008	26	0.0052
53	2008	27	0.0031
53	2008	28	0.0021
53	2008	29	0.0021
53	2008	30	0.0220
54	2008	0	0.0025
54	2008	1	0.0200
54	2008	2	0.0386
54	2008	3	0.0436
54	2008	4	0.0495
54	2008	5	0.0579
54	2008	6	0.0667
54	2008	7	0.0698
54	2008	8	0.0620
54	2008	9	0.0611
54	2008	10	0.0675
54	2008	11	0.0619
54	2008	12	0.0508
54	2008	13	0.0529
54	2008	14	0.0397
54	2008	15	0.0397
54	2008	16	0.0375
54	2008	17	0.0276
54	2008	18	0.0204
54	2008	19	0.0184
54	2008	20	0.0158
54	2008	21	0.0174
54	2008	22	0.0152
54	2008	23	0.0108
54	2008	24	0.0108
54	2008	25	0.0071
54	2008	26	0.0052
54	2008	27	0.0031
54	2008	28	0.0021
54	2008	29	0.0021
54	2008	30	0.0220
61	2008	0	0.0000
61	2008	1	0.0064
61	2008	2	0.0295
61	2008	3	0.0205
61	2008	4	0.0321
61	2008	5	0.0346
61	2008	6	0.0423
61	2008	7	0.0308
61	2008	8	0.0269
61	2008	9	0.0179
61	2008	10	0.0462
61	2008	11	0.0410
61	2008	12	0.0359
61	2008	13	0.0513
61	2008	14	0.0333
61	2008	15	0.0359
61	2008	16	0.0423
61	2008	17	0.0269
61	2008	18	0.0295
61	2008	19	0.0231
61	2008	20	0.0385
61	2008	21	0.0397
61	2008	22	0.0333
61	2008	23	0.0346
61	2008	24	0.0295
61	2008	25	0.0192
61	2008	26	0.0346
61	2008	27	0.0128
61	2008	28	0.0141
61	2008	29	0.0128
61	2008	30	0.1244
62	2008	0	0.0000
62	2008	1	0.0064
62	2008	2	0.0295
62	2008	3	0.0205
62	2008	4	0.0321
62	2008	5	0.0346
62	2008	6	0.0423
62	2008	7	0.0308
62	2008	8	0.0269
62	2008	9	0.0179

62	2008	10	0.0462
62	2008	11	0.0410
62	2008	12	0.0359
62	2008	13	0.0513
62	2008	14	0.0333
62	2008	15	0.0359
62	2008	16	0.0423
62	2008	17	0.0269
62	2008	18	0.0295
62	2008	19	0.0231
62	2008	20	0.0385
62	2008	21	0.0397
62	2008	22	0.0333
62	2008	23	0.0346
62	2008	24	0.0295
62	2008	25	0.0192
62	2008	26	0.0346
62	2008	27	0.0128
62	2008	28	0.0141
62	2008	29	0.0128
62	2008	30	0.1244

2.4 Vehicle Type VMT and VMT Fractions

This option is useful to import the annual VMT by source type into MOVES format. It has input option as HPMS Base Year VMT, for which we can either use HPMS data or the Travel Demand Model output. We have used daily VMT from the OKI Regional Travel Demand Model and converted to annual VMT using the VMT converter. Options include Month VMT fraction, Day VMT fraction and Hour VMT fraction, which are useful for calculating emissions for different time periods. We have used default Monthly VMT distribution factors provided in the VMT Converter provided by EPA. Hourly distribution factors are developed from traffic count data collected in the region from 2004-2006 and the same set of hourly distribution factors are used for all vehicle types and road types. OKI model could only predict VMT of two different vehicle types' autos and trucks. So, we have distributed total Annual VMT based on vehicle population in the region.

Table 2.41 : Annual VMT for Ohio Custom Domain from OKI travel demand model for 2005

HPMSVtypeID	yearID	HPMSBaseYearVMT	baseYearOffNetVMT
10	2005	67065022	0
20	2005	7405961237	0
30	2005	4943917030	0
40	2005	24512225	0
50	2005	334351024	0
60	2005	567810955	0

Table 2.41a :Annual VMT for Kentucky Custom Domain from OKI travel demand model for 2005

HPMSVtypeID	yearID	HPMSBaseYearVMT	baseYearOffNetVMT
10	2005	16658465	0
20	2005	1815341688	0
30	2005	1209494070	0
40	2005	5968488	0
50	2005	82065068	0
60	2005	160708291	0

Table 2.42: Annual VMT for Ohio Custom Domain from OKI travel demand model for 2008

HPMSVtypeID	yearID	HPMSBaseYearVMT	baseYearOffNetVMT
10	2008	69438850	0
20	2008	7668102136	0
30	2008	5118911580	0
40	2008	25379858	0
50	2008	346185690	0
60	2008	587909153	0

Table 2.42a : Annual VMT for Kentucky Custom Domain from OKI travel demand model for 2008

HPMSVtypeID	yearID	HPMSBaseYearVMT	baseYearOffNetVMT
10	2008	17342291	0
20	2008	1889861055	0
30	2008	1259143528	0
40	2008	6213493	0
50	2008	85433821	0
60	2008	167305330	0

Table 2.43: Annual VMT for Ohio Custom Domain from OKI travel demand model for 2011

HPMSVtypeID	yearID	HPMSBaseYearVMT	baseYearOffNetVMT
10	2008	69438850.44	0
20	2008	7668102136	0
30	2008	5118911580	0
40	2008	25379858.39	0
50	2008	346185689.5	0
60	2008	587909153	0

Table2.43a: Annual VMT for Kentucky Custom Domain from OKI travel demand model for 2011

HPMSVtypeID	yearID	HPMSBaseYearVMT	baseYearOffNetVMT
10	2011	18163152	0
20	2011	1979313603	0
30	2011	1318742406	0
40	2011	6507596	0
50	2011	89477649	0
60	2011	175224371	0

Table 2.44 : Annual VMT for Ohio Custom Domain from OKI travel demand model for 2015

HPMSVtypeID	yearID	HPMSBaseYearVMT	baseYearOffNetVMT
10	2015	73413634	0
20	2015	8107035747	0
30	2015	5411925719	0
40	2015	26832639	0
50	2015	366001875	0
60	2015	621561950	0

Table 2.44a: Annual VMT for Kentucky Custom Domain from OKI travel demand model for 2015

HPMSVtypeID	yearID	HPMSBaseYearVMT	baseYearOffNetVMT
10	2015	19903870	0

20	2015	2169006811	0
30	2015	1445127874	0
40	2015	7131270	0
50	2015	98052996	0
60	2015	192017502	0

Table 2.45: Annual VMT for Kentucky Custom Domain from OKI travel demand model for 2018

HPMSVtypeID	yearID	HPMSBaseYearVMT	baseYearOffNetVMT
10	2018	76802311	0
20	2018	8481245879	0
30	2018	5661733109	0
40	2018	28071199	0
50	2018	382896041	0
60	2018	650252434	0

Table 2.45a: Annual VMT for Kentucky Custom Domain from OKI travel demand model for 2018

HPMSVtypeID	yearID	HPMSBaseYearVMT	baseYearOffNetVMT
10	2018	21077884	0
20	2018	2296944011	0
30	2018	1530367631	0
40	2018	7551902	0
50	2018	103836577	0
60	2018	203343507	0

Table 2.46 : Annual VMT for Ohio Custom Domain from OKI travel demand model for 2021

HPMSVtypeID	yearID	HPMSBaseYearVMT	baseYearOffNetVMT
10	2021	79128218	0
20	2021	8738094842	0
30	2021	5833194979	0
40	2021	28921317	0
50	2021	394491797	0
60	2021	669944902	0

Table 2.46a : Annual VMT for Kentucky Custom Domain from OKI travel demand model for 2021

HPMSVtypeID	yearID	HPMSBaseYearVMT	baseYearOffNetVMT
10	2021	21702396	0
20	2021	2364999583	0
30	2021	1575710506	0
40	2021	7775656	0
50	2021	106913124	0
60	2021	209368320	0

Table 2.47 : Day VMT Fractions used in all RunSpecs

sourceTypeID	monthID	roadTypeID	dayID	dayVMTFraction
11	1	1	2	0.237635
11	1	1	5	0.762365
11	1	2	2	0.237635
11	1	2	5	0.762365
11	1	3	2	0.237635
11	1	3	5	0.762365
11	1	4	2	0.237635
11	1	4	5	0.762365
11	1	5	2	0.237635
11	1	5	5	0.762365

Table 2.48: Hour VMT Fractions used in all RunSpecs

sourceTypeID	roadTypeID	dayID	hourID	hourVMTFraction
11	1	2	1	0.021474
11	1	2	2	0.014443
11	1	2	3	0.010968
11	1	2	4	0.007495
11	1	2	5	0.006839
11	1	2	6	0.010359
11	1	2	7	0.01843
11	1	2	8	0.026812
11	1	2	9	0.036385
11	1	2	10	0.047541
11	1	2	11	0.057466
11	1	2	12	0.065079
11	1	2	13	0.071323
11	1	2	14	0.071492
11	1	2	15	0.071723
11	1	2	16	0.072006
11	1	2	17	0.071149
11	1	2	18	0.067887
11	1	2	19	0.061772
11	1	2	20	0.051688
11	1	2	21	0.042866
11	1	2	22	0.03803
11	1	2	23	0.032207
11	1	2	24	0.024568

2.5 Average Speed Distribution Importer

This importer allows the user to input average speed data specific to vehicle type, road type, and time of day/ type of day. The MOVES model defines 16 “speed bins” which describe the average driving speed on each road type. Unlike MOBILE 6.2 model, which uses VMT-based speed distribution, MOVES uses fraction of driving time in each speed bin for each vehicle type, for each road type, and for each hour. Thus, for each combination of vehicle type, road type, and hour/day type, the fractions will add to one. This importer was not used for the PM2.5 analysis. OKI utilized a FORTRAN program to post-process OKI Travel Demand Model results into VHT distribution by the MOVES 16 average speed bins.

2.6 Road Type Distribution Importer

VHT distribution by the fives MOVES roadway types is provided from the OKI Travel Demand Model thru the use of post-processing FORTRAN program. OKI travel demand model can calculate the VMT or VHT distribution by functional class, which is further processed to obtain road type VMT/VHT distribution. But, our model could not predict off network VMT, which is assumed as zero.

2.7 Ramp Fraction Importer

This option allows the user to modify the fraction of ramp driving time on selected road types. But, in the current version of MOVES model (MOVES2010), the emission rates for ramps are erroneously calculated. To circumvent this problem, FHWA has suggested a temporary solution. This solution discussed in the Section 3.

2.8 Fuel Formulation Importer and Fuel Supply Importer

The Fuel formulation importer allows the user to select an existing fuel in the MOVES database and change its properties, or create a new fuel formulation with different fuel properties. But we have used only default fuels available in MOVES default database. The default values were verified by ODOT and KDAQ. Fuel supply importer allows the user to assign existing fuels to counties, months, and years, and the associated market share for each fuel. We have used default fuel supply from MOVES default database. The same type of fuel is used for the entire custom domain.

Table 2.81 : Fuel supply data for Ohio Custom Domain (same for all years)

countyID	fuelYearID	monthGroupID	fuelFormulationID	marketShare	marketShareCV
99390	2008	1	3982	1	
99390	2008	1	20011	1	

99390	2008	2	3982	1	
99390	2008	2	20011	1	
99390	2008	3	3982	1	
99390	2008	3	20011	1	
99390	2008	4	3982	1	
99390	2008	4	20011	1	
99390	2008	5	3982	1	
99390	2008	5	20011	1	
99390	2008	6	3982	1	
99390	2008	6	20011	1	
99390	2008	7	3982	1	
99390	2008	7	20011	1	
99390	2008	8	3982	1	
99390	2008	8	20011	1	
99390	2008	9	3982	1	
99390	2008	9	20011	1	
99390	2008	10	3982	1	
99390	2008	10	20011	1	
99390	2008	11	3982	1	
99390	2008	11	20011	1	
99390	2008	12	3982	1	
99390	2008	12	20011	1	

Table2.82: Fuel supply data for Kentucky Custom Domain (same for all years)

countyID	fuelYearID	monthGroupID	fuelFormulationID	marketShare	marketShareCV
99210	2012	1	3982	1	
99210	2012	1	20011	1	
99210	2012	2	3982	1	
99210	2012	2	20011	1	
99210	2012	3	3982	1	
99210	2012	3	20011	1	
99210	2012	4	3982	1	
99210	2012	4	20011	1	
99210	2012	5	3982	1	
99210	2012	5	20011	1	
99210	2012	6	3982	1	
99210	2012	6	20011	1	
99210	2012	7	3982	1	
99210	2012	7	20011	1	
99210	2012	8	3982	1	
99210	2012	8	20011	1	
99210	2012	9	3982	1	
99210	2012	9	20011	1	
99210	2012	10	3982	1	
99210	2012	10	20011	1	
99210	2012	11	3982	1	

99210	2012	11	20011	1
99210	2012	12	3982	1
99210	2012	12	20011	1

2.9 Inspection and Maintenance (I/M) Importer

The I/M Importer allows the user to import information describing the inspection and maintenance programs. The MOVES default database includes an I/M program for this regional although it was suspended in 2005. The default I/M program was turned "off" for all analysis years 2008 and later, by inserting "N" in the "useIMyn" field.

2.10 Zone Road Activity Importer

The Zone Road Activity Importer is used only if the Custom Domain option is chosen in the County Domain Manager. We have used value 1 for SHOallocfactor for each road type which means that all of the VMT input by the users is assigned to custom domain.

Table 2.11 : Kentucky Custom Domain Zone road activity data (same for all years)

zoneID	roadTypeID	SHOAllocFactor
992100	1	1
992100	2	1
992100	3	1
992100	4	1
992100	5	1

Table 2.12 : Ohio Custom Domain Zone road activity data (same for all years)

zoneID	roadTypeID	SHOAllocFactor
993900	1	1
993900	2	1
993900	3	1
993900	4	1
993900	5	1

3. Ramp Inventory Runs

As discussed earlier, current version of the MOVES (MOVES2010) model cannot calculate Emission Rates for Ramps. To deal with this problem, FHWA has suggested an approach. The steps involved in this method are: (a) Calculating Emission Inventory for Urban Restricted and Rural Restricted road types keeping Ramp fraction as 1 (b) Finding out total VMT of Urban Restricted and Rural Restricted road types using MOVESactivityoutput option (c) Calculation

Emission Rates for Ramps through dividing Emission Inventory with VMT (d) Finally, using the Emission Rates in post processing for calculating regional Emission Inventory.

Table 3.1 :Ramp fraction Input

roadTypeID	rampFraction
2	1
4	1

4. Post-Processing of MOVES Output

4.1 Linking SQL tables to Microsoft Access

Microsoft Access 2007 was used for the post-processing. An ODBC connection with the MOVES output directory was established. Information on how to link or import SQL tables to Access can be found in the MOVES Users Guide.

4.2 Creating Emission Rate Lookup Tables

The ratepervehicle and rateperdistance SQL tables, one set for each state (Kentucky and Ohio) and analysis year, were imported into Access. Ohio emission rates are used for the nonattainment portion of Dearborn County Indiana. Rateperprofile output was not generated by MOVES because evaporative output was not selected (i.e. VOC). Tables were renamed with state and analysis year in the format OH_20xxrateperdistance. All rateperdistance tables were merged with a Union query. The SQL commands are shown in Figure 4.21. ratepervehicle tables were merged in the same manner.

Table 4.21 :Rateperdistance Union Query

```
SELECT *
FROM OH_2008rateperdistance
WHERE MOVESRunID = (select max (MOVESRunID) from OH_2008rateperdistance) AND
pollutantID = 3 Or MOVESRunID =  (select max (MOVESRunID) from
OH_2008rateperdistance) AND pollutantID=110 Or MOVESRunID =  (select max
(MOVESRunID) from OH_2008rateperdistance) AND pollutantID=116 Or MOVESRunID =
(select max (MOVESRunID) from OH_2008rateperdistance) AND pollutantID=117 Or
MOVESRunID = (select max (MOVESRunID) from OH_2008rateperdistance) AND
pollutantID = 31
UNION ALL select *
FROM OH_2011rateperdistance
WHERE ….. (repeated for each file)
```

"Rateperdistance_state" and "Ratepervehicle_state" tables were created from the union query output using a Make Table query. Emission rates for each process were summed by pollutant and a stateID field is created. The SQL commands for creating the "Rateperdistance_state" table are shown in Table 4.22. Unique index fields were identified for each of the two tables. Indexes facilitate more efficient data processing.

Table 4.22: Rateperdistance_State Query

```
SELECT Val(Mid([LinkID],3,2)) AS StateID, Union_rateperdistance_state.yearID,
Union_rateperdistance_state.monthID, Union_rateperdistance_state.linkID,
Union_rateperdistance_state.hourID, Union_rateperdistance_state.sourceTypeID,
Union_rateperdistance_state.roadTypeID,
Union_rateperdistance_state.avgSpeedBinID,
Union_rateperdistance_state.pollutantID,
Sum(Union_rateperdistance_state.ratePerDistance) AS SumOfratePerDistance INTO
rateperdistance_state
```

```
FROM Union_rateperdistance_state
GROUP BY Val(Mid([LinkID],3,2)), Union_rateperdistance_state.yearID,
Union_rateperdistance_state.monthID, Union_rateperdistance_state.linkID,
Union_rateperdistance_state.hourID, Union_rateperdistance_state.sourceTypeID,
Union_rateperdistance_state.roadTypeID,
Union_rateperdistance_state.avgSpeedBinID,
Union_rateperdistance_state.pollutantID
ORDER BY Union_rateperdistance_state.linkID,
Union_rateperdistance_state.hourID, Union_rateperdistance_state.pollutantID;
```

4.3 Creating a VMT Table by County

The VMT table includes Daily VMT by county by analysis year from the OKI Travel Demand Model (TDM). Summer factors and applied by functional class to create Summer VMT. Seasonal factors by functional class are contained in the report, "OKI Travel Demand Forecasting Model, Update of Hourly and Seasonal Factors as Used in Air Quality Impact Calculations", September 2001. Annual VMT is calculated by using EPA's VMT converter to grow daily VMT to annual VMT. In order to accommodate an error in MOVES 2010, all VMT values are exclusive of ramp VMT. Ramp VMT and emission are added in later in the process. In order to apply the emission rates, it is necessary to factor the county VMT by source type, hour, road type and speed bin.

Table 4.3 : VMT and Source Type Population by County and Year

County	Daily VMT	Summer VMT	Annual VMT	yearID	SourceType Population	stateID
Boone	3924117	4186006	1273226984	2005	129823	21
Boone	4076584	4355527	1350001557	2008	134028	21
Boone	4383716	4681593	1448879510	2011	136181	21
Boone	4950741	5276742	1628041303	2015	140590	21
Boone	5260102	5597287	1729595179	2018	143991	21
Boone	5478224	5826768	1800571708	2021	147476	21
Campbell	2286217	2437698	741790605	2005	86065	21
Campbell	2339542	2495174	774762729	2008	88853	21
Campbell	2421600	2582758	800372702	2011	90279	21
Campbell	2663159	2844504	875774499	2015	93204	21
Campbell	2771476	2958827	911300109	2018	95458	21
Campbell	2849127	3041704	936445364	2021	97768	21
Kenton	3927743	4182042	1274091658	2005	148193	21
Kenton	3927332	4185652	1300575265	2008	152992	21
Kenton	4049886	4327836	1338544021	2011	155451	21
Kenton	4341124	4614242	1427569992	2015	160484	21
Kenton	4629694	4880614	1522308203	2018	164368	21
Kenton	4715306	5006383	1549817345	2021	168343	21
Butler	578641	7804476	196737836	2005	24915	39

Butler	587582	8133554	199777880	2008	25722	39
Butler	605620	8454053	205910800	2011	26135	39
Butler	657778	8768598	223644400	2015	26982	39
Butler	684361	9232457	232682740	2018	27635	39
Butler	706828	9592567	240321520	2021	28303	39
Clermont	7452286	5391578	2469166037	2005	401759	39
Clermont	7745685	5599530	2598059212	2008	414771	39
Clermont	8050701	5841102	2693716250	2011	421434	39
Clermont	8361487	6035155	2792188144	2015	435082	39
Clermont	8806042	6314640	2940849935	2018	445608	39
Clermont	9150031	6562428	2966037449	2021	456389	39
Dearborn NA	5083331	599761	1684259908	2005	232380	39
Dearborn NA	5262489	613027	1765145113	2008	239906	39
Dearborn NA	5489545	631914	1836768820	2011	243760	39
Dearborn NA	5687698	685272	1899318043	2015	251654	39
Dearborn NA	5952603	712461	1987920583	2018	257742	39
Dearborn NA	6186441	735862	2005371969	2021	263978	39
Hamilton	21859452	23170766	7241529618	2005	862422	39
Hamilton	22124503	23447460	7421005221	2008	890352	39
Hamilton	22426021	23803187	7503612070	2011	904655	39
Hamilton	22849494	24259554	7630232069	2015	933953	39
Hamilton	23630554	25096560	7891617279	2018	956548	39
Hamilton	24098698	25596996	7811737549	2021	979689	39
Warren	5884216	6263010	1949617151	2005	233106	39
Warren	6057338	6464217	2031753523	2008	240655	39
Warren	6406284	6835660	2143504189	2011	244521	39
Warren	6842828	7279441	2285055662	2015	252440	39
Warren	7368035	7836746	2460615706	2018	258547	39
Warren	7707500	8194596	2498432370	2021	264802	39

4.4 Source type population and source type VMT distribution

A combination of local and MOVES default data were used for the source type populations. The source type VMT fractions are based on the ratio of MOVES default source type population and MOVES default source type VMT. It is assumed that the growth rate of source type populations is equal to the regional annual household growth rate of 0.8%. Source type VMT fractions are the same for all analysis years.

Table 4.4: Base Year Source Type Population and VMT Fraction

stateID	sourceTypeID	sourceType Population	sourceTypeFraction	sourceTypeVMTFraction
39	11	69121	0.038559	0.005026
39	21	1200827	0.669872	0.555019
39	31	486373	0.271319	0.277725
39	32	15947	0.008896	0.092783
39	41	458	0.000255	0.000754
39	42	82	0.000046	0.000225
39	43	3681	0.002053	0.000858
39	51	0	0.000000	0.000644
39	52	369	0.000206	0.020527
39	53	364	0.000203	0.002663
39	54	4928	0.002749	0.001224
39	61	4879	0.002722	0.017977
39	62	5593	0.003120	0.024576
21	11	8040	0.021370	0.005063
21	21	198623	0.527931	0.551736
21	31	121506	0.322958	0.275546
21	32	40593	0.107894	0.092055
21	41	128	0.000340	0.000745
21	42	21	0.000056	0.000222
21	43	985	0.002618	0.000847
21	51	0	0.000000	0.000641
21	52	767	0.002039	0.020433
21	53	757	0.002012	0.002650
21	54	1390	0.003695	0.001218
21	61	1593	0.004234	0.020634
21	62	1826	0.004853	0.028210

4.5 Hourly distribution

Hourly distribution factors were derived from OKI's traffic count database using 2004-2006 counts.

4.6 Road type distribution

Road type VMT fractions by source type are default values, except for passenger cars (source type 21) and passenger trucks (source type 31). VMT fractions from the OKI TDM are used for passenger cars and passenger trucks.

Table 4.6: Base Year Source Type Population and VMT Fraction

sourceTypeID	roadTypeID	roadTypeVMTFraction	stateID
21	1	0	21
21	2	0.0952	21
21	3	0.0818	21
21	4	0.4741	21
21	5	0.3489	21
31	1	0	21
31	2	0.0952	21
31	3	0.0818	21
31	4	0.4741	21
31	5	0.3489	21
21	1	0	39
21	2	0.0436	39
21	3	0.1256	39
21	4	0.4143	39
21	5	0.4165	39
31	1	0	39
31	2	0.0436	39
31	3	0.1256	39
31	4	0.4143	39
31	5	0.4165	39

4.7 Average speed distribution

Average speed fractions for each of the 16 speed bins are provided by the OKI TDM. The average speed fractions vary by state, year, road type and hour.

Table 4.7: Average Speed Distribution (Example: only road type 2, year 2011, Ohio values shown)

roadTypeID	hourID	avgSpeedBinID	avgSpeedFraction	YearID	stateID
2	1	1	0.00000000	2011	39
2	1	2	0.00000000	2011	39
2	1	3	0.00000000	2011	39
2	1	4	0.00000000	2011	39
2	1	5	0.00000000	2011	39
2	1	6	0.00000000	2011	39
2	1	7	0.00000000	2011	39
2	1	8	0.00000000	2011	39

2	1	9	0.00000000	2011	39
2	1	10	0.11922233	2011	39
2	1	11	0.12547629	2011	39
2	1	12	0.19752816	2011	39
2	1	13	0.00589550	2011	39
2	1	14	0.00000000	2011	39
2	1	15	0.55187773	2011	39
2	1	16	0.00000000	2011	39
2	2	1	0.00000000	2011	39
2	2	2	0.00000000	2011	39
2	2	3	0.00000000	2011	39
2	2	4	0.00000000	2011	39
2	2	5	0.00000000	2011	39
2	2	6	0.00000000	2011	39
2	2	7	0.00000000	2011	39
2	2	8	0.00000000	2011	39
2	2	9	0.00000000	2011	39
2	2	10	0.11922233	2011	39
2	2	11	0.12547629	2011	39
2	2	12	0.19752816	2011	39
2	2	13	0.00589550	2011	39
2	2	14	0.00000000	2011	39
2	2	15	0.55187773	2011	39
2	2	16	0.00000000	2011	39
2	3	1	0.00000000	2011	39
2	3	2	0.00000000	2011	39
2	3	3	0.00000000	2011	39
2	3	4	0.00000000	2011	39
2	3	5	0.00000000	2011	39
2	3	6	0.00000000	2011	39
2	3	7	0.00000000	2011	39
2	3	8	0.00000000	2011	39
2	3	9	0.00000000	2011	39
2	3	10	0.11922233	2011	39
2	3	11	0.12547629	2011	39
2	3	12	0.19752816	2011	39
2	3	13	0.00589550	2011	39
2	3	14	0.06436270	2011	39

2	3	15	0.48751503	2011	39
2	3	16	0.00000000	2011	39
2	4	1	0.00000000	2011	39
2	4	2	0.00000000	2011	39
2	4	3	0.00000000	2011	39
2	4	4	0.00000000	2011	39
2	4	5	0.00000000	2011	39
2	4	6	0.00000000	2011	39
2	4	7	0.00000000	2011	39
2	4	8	0.00000000	2011	39
2	4	9	0.00000000	2011	39
2	4	10	0.11922233	2011	39
2	4	11	0.12547629	2011	39
2	4	12	0.19752816	2011	39
2	4	13	0.00589550	2011	39
2	4	14	0.12369152	2011	39
2	4	15	0.42818621	2011	39
2	4	16	0.00000000	2011	39
2	5	1	0.00000000	2011	39
2	5	2	0.00000000	2011	39
2	5	3	0.00000000	2011	39
2	5	4	0.00000000	2011	39
2	5	5	0.00000000	2011	39
2	5	6	0.00000000	2011	39
2	5	7	0.00000000	2011	39
2	5	8	0.00000000	2011	39
2	5	9	0.00000000	2011	39
2	5	10	0.11922233	2011	39
2	5	11	0.12547629	2011	39
2	5	12	0.26189086	2011	39
2	5	13	0.09782827	2011	39
2	5	14	0.06250896	2011	39
2	5	15	0.33307330	2011	39
2	5	16	0.00000000	2011	39
2	6	1	0.00000000	2011	39
2	6	2	0.12369152	2011	39
2	6	3	0.03260396	2011	39
2	6	4	0.03085494	2011	39

2	6	5	0.01601927	2011	39
2	6	6	0.01563475	2011	39
2	6	7	0.00000000	2011	39
2	6	8	0.00000000	2011	39
2	6	9	0.00000000	2011	39
2	6	10	0.11922233	2011	39
2	6	11	0.12547629	2011	39
2	6	12	0.19752816	2011	39
2	6	13	0.00589550	2011	39
2	6	14	0.00278921	2011	39
2	6	15	0.33028409	2011	39
2	6	16	0.00000000	2011	39
2	7	1	0.21880443	2011	39
2	7	2	0.00000000	2011	39
2	7	3	0.00278921	2011	39
2	7	4	0.00000000	2011	39
2	7	5	0.01131028	2011	39
2	7	6	0.03548550	2011	39
2	7	7	0.03519436	2011	39
2	7	8	0.03514937	2011	39
2	7	9	0.00617093	2011	39
2	7	10	0.08564905	2011	39
2	7	11	0.14691446	2011	39
2	7	12	0.13064235	2011	39
2	7	13	0.00589550	2011	39
2	7	14	0.14352342	2011	39
2	7	15	0.14247115	2011	39
2	7	16	0.00000000	2011	39
2	8	1	0.21880443	2011	39
2	8	2	0.00278921	2011	39
2	8	3	0.01131028	2011	39
2	8	4	0.01356074	2011	39
2	8	5	0.05711912	2011	39
2	8	6	0.03514937	2011	39
2	8	7	0.02902228	2011	39
2	8	8	0.01193860	2011	39
2	8	9	0.07229727	2011	39
2	8	10	0.05473480	2011	39

2	8	11	0.08493157	2011	39
2	8	12	0.11645227	2011	39
2	8	13	0.04360641	2011	39
2	8	14	0.20648097	2011	39
2	8	15	0.04180267	2011	39
2	8	16	0.00000000	2011	39
2	9	1	0.21880443	2011	39
2	9	2	0.00000000	2011	39
2	9	3	0.00000000	2011	39
2	9	4	0.00000000	2011	39
2	9	5	0.00000000	2011	39
2	9	6	0.00278921	2011	39
2	9	7	0.00000000	2011	39
2	9	8	0.04679577	2011	39
2	9	9	0.03519436	2011	39
2	9	10	0.08369185	2011	39
2	9	11	0.14590244	2011	39
2	9	12	0.15349370	2011	39
2	9	13	0.02733367	2011	39
2	9	14	0.03771092	2011	39
2	9	15	0.24828365	2011	39
2	9	16	0.00000000	2011	39
2	10	1	0.15629548	2011	39
2	10	2	0.04687421	2011	39
2	10	3	0.01563475	2011	39
2	10	4	0.00000000	2011	39
2	10	5	0.00000000	2011	39
2	10	6	0.00000000	2011	39
2	10	7	0.00000000	2011	39
2	10	8	0.00000000	2011	39
2	10	9	0.00000000	2011	39
2	10	10	0.11922233	2011	39
2	10	11	0.13957578	2011	39
2	10	12	0.18621788	2011	39
2	10	13	0.00589550	2011	39
2	10	14	0.04428952	2011	39
2	10	15	0.28599457	2011	39
2	10	16	0.00000000	2011	39

2	11	1	0.06436270	2011	39
2	11	2	0.12278771	2011	39
2	11	3	0.01601927	2011	39
2	11	4	0.01563475	2011	39
2	11	5	0.00000000	2011	39
2	11	6	0.00000000	2011	39
2	11	7	0.00000000	2011	39
2	11	8	0.00000000	2011	39
2	11	9	0.00000000	2011	39
2	11	10	0.11922233	2011	39
2	11	11	0.13678656	2011	39
2	11	12	0.18900709	2011	39
2	11	13	0.00589550	2011	39
2	11	14	0.02285135	2011	39
2	11	15	0.30743274	2011	39
2	11	16	0.00000000	2011	39
2	12	1	0.06436270	2011	39
2	12	2	0.09193278	2011	39
2	12	3	0.04687421	2011	39
2	12	4	0.01563475	2011	39
2	12	5	0.00000000	2011	39
2	12	6	0.00000000	2011	39
2	12	7	0.00000000	2011	39
2	12	8	0.00000000	2011	39
2	12	9	0.00000000	2011	39
2	12	10	0.11922233	2011	39
2	12	11	0.12547629	2011	39
2	12	12	0.20031737	2011	39
2	12	13	0.00589550	2011	39
2	12	14	0.02285135	2011	39
2	12	15	0.30743274	2011	39
2	12	16	0.00000000	2011	39
2	13	1	0.06436270	2011	39
2	13	2	0.09193278	2011	39
2	13	3	0.04687421	2011	39
2	13	4	0.01563475	2011	39
2	13	5	0.00000000	2011	39
2	13	6	0.00000000	2011	39

2	13	7	0.00000000	2011	39
2	13	8	0.00000000	2011	39
2	13	9	0.00000000	2011	39
2	13	10	0.11922233	2011	39
2	13	11	0.12547629	2011	39
2	13	12	0.19752816	2011	39
2	13	13	0.00868471	2011	39
2	13	14	0.00000000	2011	39
2	13	15	0.33028409	2011	39
2	13	16	0.00000000	2011	39
2	14	1	0.06436270	2011	39
2	14	2	0.09193278	2011	39
2	14	3	0.03085494	2011	39
2	14	4	0.03165402	2011	39
2	14	5	0.00000000	2011	39
2	14	6	0.00000000	2011	39
2	14	7	0.00000000	2011	39
2	14	8	0.00000000	2011	39
2	14	9	0.00000000	2011	39
2	14	10	0.11922233	2011	39
2	14	11	0.12547629	2011	39
2	14	12	0.19752816	2011	39
2	14	13	0.00868471	2011	39
2	14	14	0.00000000	2011	39
2	14	15	0.33028409	2011	39
2	14	16	0.00000000	2011	39
2	15	1	0.06436270	2011	39
2	15	2	0.09193278	2011	39
2	15	3	0.04687421	2011	39
2	15	4	0.01563475	2011	39
2	15	5	0.00000000	2011	39
2	15	6	0.00000000	2011	39
2	15	7	0.00000000	2011	39
2	15	8	0.00000000	2011	39
2	15	9	0.00000000	2011	39
2	15	10	0.11922233	2011	39
2	15	11	0.12547629	2011	39
2	15	12	0.19752816	2011	39

2	15	13	0.00868471	2011	39
2	15	14	0.02285135	2011	39
2	15	15	0.30743274	2011	39
2	15	16	0.00000000	2011	39
2	16	1	0.12369152	2011	39
2	16	2	0.07947816	2011	39
2	16	3	0.01563475	2011	39
2	16	4	0.00000000	2011	39
2	16	5	0.00000000	2011	39
2	16	6	0.00000000	2011	39
2	16	7	0.00000000	2011	39
2	16	8	0.00000000	2011	39
2	16	9	0.00000000	2011	39
2	16	10	0.11922233	2011	39
2	16	11	0.13957578	2011	39
2	16	12	0.18621788	2011	39
2	16	13	0.00589550	2011	39
2	16	14	0.04428952	2011	39
2	16	15	0.28599457	2011	39
2	16	16	0.00000000	2011	39
2	17	1	0.20316968	2011	39
2	17	2	0.01563475	2011	39
2	17	3	0.00000000	2011	39
2	17	4	0.00000000	2011	39
2	17	5	0.00000000	2011	39
2	17	6	0.00000000	2011	39
2	17	7	0.00278921	2011	39
2	17	8	0.02487101	2011	39
2	17	9	0.05711912	2011	39
2	17	10	0.05722137	2011	39
2	17	11	0.15811770	2011	39
2	17	12	0.14489757	2011	39
2	17	13	0.05018502	2011	39
2	17	14	0.00000000	2011	39
2	17	15	0.28599457	2011	39
2	17	16	0.00000000	2011	39
2	18	1	0.15629548	2011	39
2	18	2	0.04687421	2011	39

2	18	3	0.01563475	2011	39
2	18	4	0.00000000	2011	39
2	18	5	0.00000000	2011	39
2	18	6	0.00000000	2011	39
2	18	7	0.00000000	2011	39
2	18	8	0.00000000	2011	39
2	18	9	0.00000000	2011	39
2	18	10	0.11922233	2011	39
2	18	11	0.13957578	2011	39
2	18	12	0.18621788	2011	39
2	18	13	0.00589550	2011	39
2	18	14	0.04428952	2011	39
2	18	15	0.28599457	2011	39
2	18	16	0.00000000	2011	39
2	19	1	0.00000000	2011	39
2	19	2	0.00000000	2011	39
2	19	3	0.00000000	2011	39
2	19	4	0.00000000	2011	39
2	19	5	0.06436270	2011	39
2	19	6	0.00000000	2011	39
2	19	7	0.05932882	2011	39
2	19	8	0.03260396	2011	39
2	19	9	0.00000000	2011	39
2	19	10	0.15007727	2011	39
2	19	11	0.14149556	2011	39
2	19	12	0.21316291	2011	39
2	19	13	0.00589550	2011	39
2	19	14	0.00000000	2011	39
2	19	15	0.33307330	2011	39
2	19	16	0.00000000	2011	39
2	20	1	0.00000000	2011	39
2	20	2	0.00000000	2011	39
2	20	3	0.00000000	2011	39
2	20	4	0.00000000	2011	39
2	20	5	0.00000000	2011	39
2	20	6	0.00000000	2011	39
2	20	7	0.00000000	2011	39
2	20	8	0.00000000	2011	39

2	20	9	0.00000000	2011	39
2	20	10	0.11922233	2011	39
2	20	11	0.12547629	2011	39
2	20	12	0.19752816	2011	39
2	20	13	0.00589550	2011	39
2	20	14	0.15629548	2011	39
2	20	15	0.39558226	2011	39
2	20	16	0.00000000	2011	39
2	21	1	0.00000000	2011	39
2	21	2	0.00000000	2011	39
2	21	3	0.00000000	2011	39
2	21	4	0.00000000	2011	39
2	21	5	0.00000000	2011	39
2	21	6	0.00000000	2011	39
2	21	7	0.00000000	2011	39
2	21	8	0.00000000	2011	39
2	21	9	0.00000000	2011	39
2	21	10	0.11922233	2011	39
2	21	11	0.12547629	2011	39
2	21	12	0.19752816	2011	39
2	21	13	0.00589550	2011	39
2	21	14	0.00000000	2011	39
2	21	15	0.55187773	2011	39
2	21	16	0.00000000	2011	39
2	22	1	0.00000000	2011	39
2	22	2	0.00000000	2011	39
2	22	3	0.00000000	2011	39
2	22	4	0.00000000	2011	39
2	22	5	0.00000000	2011	39
2	22	6	0.00000000	2011	39
2	22	7	0.00000000	2011	39
2	22	8	0.00000000	2011	39
2	22	9	0.00000000	2011	39
2	22	10	0.11922233	2011	39
2	22	11	0.12547629	2011	39
2	22	12	0.19752816	2011	39
2	22	13	0.00589550	2011	39
2	22	14	0.00000000	2011	39

2	22	15	0.55187773	2011	39
2	22	16	0.00000000	2011	39
2	23	1	0.00000000	2011	39
2	23	2	0.00000000	2011	39
2	23	3	0.00000000	2011	39
2	23	4	0.00000000	2011	39
2	23	5	0.00000000	2011	39
2	23	6	0.00000000	2011	39
2	23	7	0.00000000	2011	39
2	23	8	0.00000000	2011	39
2	23	9	0.00000000	2011	39
2	23	10	0.11922233	2011	39
2	23	11	0.12547629	2011	39
2	23	12	0.19752816	2011	39
2	23	13	0.00589550	2011	39
2	23	14	0.00000000	2011	39
2	23	15	0.55187773	2011	39
2	23	16	0.00000000	2011	39
2	24	1	0.00000000	2011	39
2	24	2	0.00000000	2011	39
2	24	3	0.00000000	2011	39
2	24	4	0.00000000	2011	39
2	24	5	0.00000000	2011	39
2	24	6	0.00000000	2011	39
2	24	7	0.00000000	2011	39
2	24	8	0.00000000	2011	39
2	24	9	0.00000000	2011	39
2	24	10	0.11922233	2011	39
2	24	11	0.12547629	2011	39
2	24	12	0.19752816	2011	39
2	24	13	0.00589550	2011	39
2	24	14	0.00000000	2011	39
2	24	15	0.55187773	2011	39
2	24	16	0.00000000	2011	39

4.8 Creating a VMT Table by State, Year, Source Type, Hour, Road Type, and Average Speed Bin

The 'StateVMT_MakeTableQuery' query creates a VMT Table by state, source type, hour, road type and average speed utilizing the VMT distribution factors described in 4.4, 4.5, 4.6 and 4.7. The SQL commands for this query are shown in Table 4.8.

Table 4.8 :State VMT Table Query

```
SELECT VMT_byBudgetArea.yearID, VMT_byBudgetArea.stateID,
VMT_byBudgetArea.budgetID, roadtypedistribution1.sourceTypeID,
hourvmtfraction.hourID, roadtypedistribution1.roadTypeID,
avgSpeedDistribution.avgSpeedBinID,
sourecetypepopulation.sourceTypeVMTFraction, hourvmtfraction.hourVMTFraction,
roadtypedistribution1.roadTypeVMTFraction,
avgSpeedDistribution.avgSpeedFraction, First(VMT_byBudgetArea.[Annual VMT])
AS [FirstOfAnnual VMT], First(VMT_byBudgetArea.[Daily VMT]) AS [FirstOfDaily
VMT], [FirstOfDaily
VMT]*[hourVMTFraction]*[sourceTypeVMTFraction]*[roadTypeVMTFraction]*[avgSpee
dFraction] AS DailyVMT, [FirstOfAnnual
VMT]*[sourceTypeVMTFraction]*[hourVMTFraction]*[roadTypeVMTFraction]*[avgSpee
dFraction] AS AnnualizedVMT INTO StateVMT_Table
FROM VMT_byBudgetArea INNER JOIN (((avgSpeedDistribution INNER JOIN
hourvmtfraction ON (avgSpeedDistribution.hourDayID = hourvmtfraction.hourID)
AND (avgSpeedDistribution.roadTypeID = hourvmtfraction.roadTypeID) AND
(avgSpeedDistribution.sourceTypeID = hourvmtfraction.sourceTypeID)) INNER
JOIN roadtypedistribution1 ON (avgSpeedDistribution.stateID =
roadtypedistribution1.stateID) AND (avgSpeedDistribution.roadTypeID =
roadtypedistribution1.roadTypeID) AND (avgSpeedDistribution.sourceTypeID =
roadtypedistribution1.sourceTypeID)) INNER JOIN sourecetypepopulation ON
(avgSpeedDistribution.sourceTypeID = sourecetypepopulation.sourceTypeID) AND
(avgSpeedDistribution.stateID = sourecetypepopulation.stateID)) ON
(VMT_byBudgetArea.yearID = avgSpeedDistribution.YearID) AND
(VMT_byBudgetArea.stateID = avgSpeedDistribution.stateID)
GROUP BY VMT_byBudgetArea.yearID, VMT_byBudgetArea.stateID,
VMT_byBudgetArea.budgetID, roadtypedistribution1.sourceTypeID,
hourvmtfraction.hourID, roadtypedistribution1.roadTypeID,
avgSpeedDistribution.avgSpeedBinID,
sourecetypepopulation.sourceTypeVMTFraction, hourvmtfraction.hourVMTFraction,
roadtypedistribution1.roadTypeVMTFraction,
avgSpeedDistribution.avgSpeedFraction
HAVING (((avgSpeedDistribution.avgSpeedFraction)>0))
ORDER BY VMT_byBudgetArea.yearID, VMT_byBudgetArea.stateID,
hourvmtfraction.hourID;
```

5. Combining VMT and Emission Rates; Calculating Total Emissions

5.1 Summarizing Distance-based Emissions by Source Type

The daily VMT and annual VMT in each state, year, hour, source type, road type, and speed bin is multiplied by the appropriate rate per distance for each pollutant. This query is shown in Table 5.1.

Table 5.1 :Emissions distance Query

```
SELECT StateVMT_Table.stateID, StateVMT_Table.budgetID,
StateVMT_Table.yearID, rateperdistance_state.monthID, StateVMT_Table.hourID,
StateVMT_Table.sourceTypeID, StateVMT_Table.roadTypeID,
StateVMT_Table.avgSpeedBinID, rateperdistance_state.pollutantID,
StateVMT_Table.DailyVMT, StateVMT_Table.AnnualizedVMT,
rateperdistance_state.SumOfratePerDistance, [DailyVMT]*[SumOfratePerDistance]
AS EmissionsDist, [AnnualizedVMT]*[SumOfratePerDistance] AS
AnnualEmissionsDist
FROM StateVMT_Table INNER JOIN rateperdistance_state ON
(StateVMT_Table.stateID = rateperdistance_state.StateID) AND
(StateVMT_Table.yearID = rateperdistance_state.yearID) AND
(StateVMT_Table.sourceTypeID = rateperdistance_state.sourceTypeID) AND
(StateVMT_Table.hourID = rateperdistance_state.hourID) AND
(StateVMT_Table.roadTypeID = rateperdistance_state.roadTypeID) AND
(StateVMT_Table.avgSpeedBinID = rateperdistance_state.avgSpeedBinID)
GROUP BY StateVMT_Table.stateID, StateVMT_Table.budgetID,
StateVMT_Table.yearID, rateperdistance_state.monthID, StateVMT_Table.hourID,
StateVMT_Table.sourceTypeID, StateVMT_Table.roadTypeID,
StateVMT_Table.avgSpeedBinID, rateperdistance_state.pollutantID,
StateVMT_Table.DailyVMT, StateVMT_Table.AnnualizedVMT,
rateperdistance_state.SumOfratePerDistance;
```

A second query further summarizes the emissions by source type. This is necessary in order to combine with vehicle-based emissions that are independent of road type and speed.

5.2 Summarizing Vehicle-based Emissions by Source type

The source population for each county, year, hour, and source type is multiplied by the rate per vehicle for each pollutant. This query is shown in Table 5.2.

Table 5.2: Emissions Vehicle Query

```
SELECT VMT_byBudgetArea.budgetID, VMT_byBudgetArea.stateID,
ratepervehicle_state.yearID, ratepervehicle_state.monthID,
ratepervehicle_state.hourID, ratepervehicle_state.sourceTypeID,
sourecetypepopulation.sourceTypeFraction,
VMT_byBudgetArea.SourceTypePopulation, ratepervehicle_state.pollutantID,
ratepervehicle_state.SumOfratePerVehicle,
((Nz([VMT_byBudgetArea]!sourceTypePopulation*[sourceTypeFraction],0)/24)) AS
STPop, Nz([VMT_byBudgetArea]!sourceTypePopulation*[sourceTypeFraction],0) AS
STPop2,
Nz([VMT_byBudgetArea]!sourceTypePopulation*[sourceTypeFraction]*[SumOfratePer
Vehicle],0) AS emissionsVehicle,
Nz(([VMT_byBudgetArea]!sourceTypePopulation*[sourceTypeFraction]*[SumOfratePe
rVehicle])*365,0) AS AnnualemissionsVehicle
FROM (sourecetypepopulation INNER JOIN ratepervehicle_state ON
(sourecetypepopulation.sourceTypeID = ratepervehicle_state.sourceTypeID) AND
(sourecetypepopulation.stateID = ratepervehicle_state.StateID)) INNER JOIN
VMT_byBudgetArea ON (ratepervehicle_state.StateID = VMT_byBudgetArea.stateID)
AND (ratepervehicle_state.yearID = VMT_byBudgetArea.yearID)
GROUP BY VMT_byBudgetArea.budgetID, VMT_byBudgetArea.stateID,
ratepervehicle_state.yearID, ratepervehicle_state.monthID,
ratepervehicle_state.hourID, ratepervehicle_state.sourceTypeID,
sourecetypepopulation.sourceTypeFraction,
VMT_byBudgetArea.SourceTypePopulation, ratepervehicle_state.pollutantID,
ratepervehicle_state.SumOfratePerVehicle;
```

5.3 Ramp Emissions

Ramp emission rates, calculated as discussed in Section 3, are multiplied by ramp VMT in each state, year and source type. This query is shown in Table 5.3.

Table 5.3: Ramp Emissions Query

```
SELECT VMT_byBudgetArea.stateID, VMT_byBudgetArea.yearID,
hourvmtfraction.hourID, hourvmtfraction.sourceTypeID,
hourvmtfraction.hourVMTFraction, ramp_rate.pollutantID,
VMT_byBudgetArea.[Ramp VMT], ([Ramp VMT]*[hourVMTFraction])/13 AS
HourlyRampVMT, ramp_rate.ramprate, [HourlyRampVMT]*[ramprate] AS
RampEmissions, ([HourlyRampVMT]*[ramprate])*340 AS RampEmissionsAnnual
FROM (hourvmtfraction INNER JOIN ramp_rate ON hourvmtfraction.hourID =
ramp_rate.hourID) INNER JOIN VMT_byBudgetArea ON (ramp_rate.yearID =
VMT_byBudgetArea.yearID) AND (ramp_rate.StateID = VMT_byBudgetArea.stateID)
WHERE (((hourvmtfraction.roadTypeID)=4))
ORDER BY VMT_byBudgetArea.stateID, VMT_byBudgetArea.yearID,
hourvmtfraction.hourID, hourvmtfraction.sourceTypeID, ramp_rate.pollutantID;
```

5.4 Summarizing Results

Distance-based emissions by source type, vehicle-based emissions by source type, and ramp emissions by source type are summed by state, year and pollutant. This query is shown below. This is also where criteria may be set for limiting the results. A sum of VMT and source type population is also useful as a verification that all steps were run properly. The appropriate monthID criteria should be set here. The annual average temperature profile is contained in April (monthID=4).

Table 5.41:Results by State Query

```
SELECT EmissionsDistance_bySourceType_State.stateID,
EmissionsDistance_bySourceType_State.budgetID, EmissionsDistance_bySourceType_State.yearID,
EmissionsDistance_bySourceType_State.pollutantName,
Sum(EmissionsDistance_bySourceType_State.SumOfDailyVMT) AS SumOfSumOfDailyVMT,
Sum(RampEmissions_Query_State.HourlyRampVMT) AS SumOfHourlyRampVMT1,
Sum(EmissionsDistance_bySourceType_State.SumOfAnnualizedVMT) AS SumOfSumOfAnnualizedVMT,
First(EmissionsVehicle_Query_State.SourceTypePopulation) AS FirstOfSourceTypePopulation,
Sum(EmissionsVehicle_Query_State.SourceTypePopulation) AS SumOfSourceTypePopulation,
Sum(EmissionsDistance_bySourceType_State.SumOfEmissionsDist) AS SumOfSumOfEmissionsDist,
Sum(EmissionsDistance_bySourceType_State.SumOfAnnualEmissionsDist) AS
SumOfSumOfAnnualEmissionsDist, Sum(Nz([emissionsVehicle],0)) AS EmissionsVeh,
Sum(Nz([AnnualemissionsVehicle],0)) AS AnnualEmissionsVeh,
Sum(RampEmissions_Query_State.RampEmissions) AS SumOfRampEmissions,
Sum(RampEmissions_Query_State.RampEmissionsAnnual) AS SumOfRampEmissionsAnnual,
(([SumOfSumOfEmissionsDist]+[EmissionsVeh]+[SumOfRampEmissions])/1000)*0.001102 AS
DailyEmissionsTONS,
(([SumOfSumOfAnnualEmissionsDist]+[AnnualEmissionsVeh]+[SumOfRampEmissionsAnnual])/1000)*0.0
01102 AS AnnualEmissionsTONS
FROM (EmissionsDistance_bySourceType_State LEFT JOIN EmissionsVehicle_Query_State ON
```

```
(EmissionsDistance_bySourceType_State.yearID = EmissionsVehicle_Query_State.yearID) AND
(EmissionsDistance_bySourceType_State.stateID = EmissionsVehicle_Query_State.stateID) AND
(EmissionsDistance_bySourceType_State.monthID = EmissionsVehicle_Query_State.monthID) AND
(EmissionsDistance_bySourceType_State.hourID = EmissionsVehicle_Query_State.hourID) AND
(EmissionsDistance_bySourceType_State.sourceTypeID = EmissionsVehicle_Query_State.sourceTypeID)
AND (EmissionsDistance_bySourceType_State.pollutantID = EmissionsVehicle_Query_State.pollutantID))
INNER JOIN RampEmissions_Query_State ON (EmissionsDistance_bySourceType_State.stateID =
RampEmissions_Query_State.stateID) AND (EmissionsDistance_bySourceType_State.yearID =
RampEmissions_Query_State.yearID) AND (EmissionsDistance_bySourceType_State.sourceTypeID =
RampEmissions_Query_State.sourceTypeID) AND (EmissionsDistance_bySourceType_State.pollutantID =
RampEmissions_Query_State.pollutantID) AND (EmissionsDistance_bySourceType_State.hourID =
RampEmissions_Query_State.hourID)
GROUP BY EmissionsDistance_bySourceType_State.stateID,
EmissionsDistance_bySourceType_State.budgetID, EmissionsDistance_bySourceType_State.yearID,
EmissionsDistance_bySourceType_State.pollutantName,
EmissionsDistance_bySourceType_State.monthID, EmissionsDistance_bySourceType_State.pollutantID
HAVING (((EmissionsDistance_bySourceType_State.monthID)=4));
```

County-level emissions are also calculated based on county VMT, as reported by the OKI Travel Demand Model. Table 5.42 shows the query for calculating the county level results.

Table 5.42:Results by County Query

```
SELECT VMT.State, VMT.County, EmissionsDistance_bySourceType_State.stateID,
EmissionsDistance_bySourceType_State.budgetID, EmissionsDistance_bySourceType_State.yearID,
EmissionsDistance_bySourceType_State.pollutantName, VMT.SourceTypePopulation, VMT.[Daily VMT],
VMT.[Annual VMT], VMT.[All Daily VMT], [Daily VMT]/[SumOfSumOfDailyVMT] AS CountyFraction,
Sum(EmissionsDistance_bySourceType_State.SumOfDailyVMT) AS SumOfSumOfDailyVMT,
Sum(RampEmissions_Query_State.HourlyRampVMT) AS SumOfHourlyRampVMT1,
Sum(EmissionsDistance_bySourceType_State.SumOfAnnualizedVMT) AS SumOfSumOfAnnualizedVMT,
First(EmissionsVehicle_Query_State.SourceTypePopulation) AS FirstOfSourceTypePopulation,
Sum(EmissionsVehicle_Query_State.SourceTypePopulation) AS SumOfSourceTypePopulation,
Sum(EmissionsDistance_bySourceType_State.SumOfEmissionsDist) AS SumOfSumOfEmissionsDist,
Sum(EmissionsDistance_bySourceType_State.SumOfAnnualEmissionsDist) AS
SumOfSumOfAnnualEmissionsDist, Sum(Nz([emissionsVehicle],0)) AS EmissionsVeh,
Sum(Nz([AnnualemissionsVehicle],0)) AS AnnualEmissionsVeh,
Sum(RampEmissions_Query_State.RampEmissions) AS SumOfRampEmissions,
Sum(RampEmissions_Query_State.RampEmissionsAnnual) AS SumOfRampEmissionsAnnual,
(([SumOfSumOfEmissionsDist]+[EmissionsVeh]+[SumOfRampEmissions])/1000)*0.001102 AS
DailyEmissionsTONS,
(([SumOfSumOfAnnualEmissionsDist]+[AnnualEmissionsVeh]+[SumOfRampEmissionsAnnual])/1000)*0.0
01102 AS AnnualEmissionsTONS, [DailyEmissionsTONS]*[CountyFraction] AS CountyDailyEmissions,
[AnnualEmissionsTONS]*[CountyFraction] AS CountyAnnualEmissions
FROM VMT INNER JOIN ((EmissionsDistance_bySourceType_State LEFT JOIN
EmissionsVehicle_Query_State ON (EmissionsDistance_bySourceType_State.pollutantID =
EmissionsVehicle_Query_State.pollutantID) AND (EmissionsDistance_bySourceType_State.sourceTypeID
= EmissionsVehicle_Query_State.sourceTypeID) AND (EmissionsDistance_bySourceType_State.hourID =
```

```
EmissionsVehicle_Query_State.hourID) AND (EmissionsDistance_bySourceType_State.monthID =
EmissionsVehicle_Query_State.monthID) AND (EmissionsDistance_bySourceType_State.stateID =
EmissionsVehicle_Query_State.stateID) AND (EmissionsDistance_bySourceType_State.yearID =
EmissionsVehicle_Query_State.yearID)) INNER JOIN RampEmissions_Query_State ON
(EmissionsDistance_bySourceType_State.hourID = RampEmissions_Query_State.hourID) AND
(EmissionsDistance_bySourceType_State.pollutantID = RampEmissions_Query_State.pollutantID) AND
(EmissionsDistance_bySourceType_State.sourceTypeID = RampEmissions_Query_State.sourceTypeID)
AND (EmissionsDistance_bySourceType_State.yearID = RampEmissions_Query_State.yearID) AND
(EmissionsDistance_bySourceType_State.stateID = RampEmissions_Query_State.stateID)) ON
(VMT.yearID = EmissionsDistance_bySourceType_State.yearID) AND (VMT.stateID =
EmissionsDistance_bySourceType_State.stateID)
GROUP BY VMT.State, VMT.County, EmissionsDistance_bySourceType_State.stateID,
EmissionsDistance_bySourceType_State.budgetID, EmissionsDistance_bySourceType_State.yearID,
EmissionsDistance_bySourceType_State.pollutantName, VMT.SourceTypePopulation, VMT.[Daily VMT],
VMT.[Annual VMT], VMT.[All Daily VMT], EmissionsDistance_bySourceType_State.monthID,
EmissionsDistance_bySourceType_State.pollutantID
HAVING (((EmissionsDistance_bySourceType_State.monthID)=4));
```