

2002 Periodic Emissions Inventory
for
PM₁₀

for the
Maricopa County, Arizona, Nonattainment Area

June 2004

Revised March 2006

2002 Periodic Emissions Inventory for PM₁₀ for the Maricopa County, Arizona Nonattainment Area

ERRATA

NOTE: All of the corrections described below have been incorporated into a revised electronic version of the 2002 PM₁₀ Periodic Emission Inventory, available at: <http://www.maricopa.gov/aq/ei/reports.aspx>. (The corrected chapters are indicated by the notation “Rev. 3/06” in the footer of each page). The revised emissions totals have also been submitted to the U.S. EPA, and are reflected in the most recent version (February 2006) of the 2002 National Emissions Inventory (NEI).

Chapter 1: Introduction

page 6: Changes to summary Tables 1.6–5 and 1.6–6 result from a significant change in the method used to estimate PM₁₀ and PM_{2.5} emissions from aircraft (described in more detail below).

pages 8, 10–11: The changes to the method used to estimate PM₁₀ and PM_{2.5} emissions from aircraft (described below) also necessitated changes to Figures 1.6–1 and 1.6–2 (pie charts of annual PM₁₀ and PM_{2.5} emissions, by source category) and Figures 1.6–6 and 1.6–7 (pie charts of typical daily PM₁₀ and PM_{2.5} emissions, respectively).

page 13: The above-mentioned changes in aircraft emissions estimates also produced changes in the comparative bar charts in Figures 1.6–11 and 1.6–12.

page 14: Incorrect emissions data for 1994 were inadvertently incorporated in Table 1.6–10. Also, the above mentioned changes in aircraft emissions estimates necessitated changes to 2002 data in Table 1.6–10.

Chapter 4: Nonroad Mobile Sources

pages 108–111: (Section 4.12, Aircraft): A recent review of the calculation methods used to calculate PM₁₀ and PM_{2.5} emissions from aircraft indicated that the prior approach led to a significant overestimate of these emissions from air carriers.

Three airports in Maricopa County reported air carrier activity in 2002: Phoenix Sky Harbor International Airport, Phoenix Goodyear Airport, and Williams Gateway Airport. The FAA’s Emissions and Dispersion Modeling System model (EDMS, version 4.11) was used to estimate annual and average daily emissions for these airports for a number of pollutants; however, the model does not calculate PM emissions for any aircraft type. Thus, based on earlier EPA guidance, PM₁₀ and PM_{2.5} were estimated by applying ratios of NO_x:PM₁₀ and NO_x:PM_{2.5} derived for air taxis. While this approach was used successfully for calculating PM from the air taxi, general aviation, and military aircraft sectors, its application led to unusually large estimates of PM emissions from air carriers.

More recent guidance¹ recommends instead using the following emission factors:

Pollutant	Emission Factor (tons/LTO per engine)
PM ₁₀	0.0002693
PM _{2.5}	0.0002628

¹ “Commercial Aircraft PM Emission Estimates”. Memorandum from R. Billings and R. Chang (ERG) to L. Driver *et al.* (EPA), Sept 21, 2004. Pp. 26–28 in “General Aircraft References”, available at: ftp://ftp.epa.gov/EmisInventory/draftnei2002/mobile/nonroad/documentation/2_aircraft.pdf

**2002 Periodic Emissions Inventory for PM₁₀
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ERRATA (continued)

Based on information supplied by airports reporting air carrier traffic, an average number of engines was determined. The EPA emission factors for PM₁₀ and PM_{2.5} (tons/LTO per engine), the average number of engines and the number of landing and take-off operations (LTOs) per affected airport were used to calculate a lbs/LTO emission factor.

Airport	Average number of engines	LTOs in 2002	PM₁₀ (lbs/LTO)	PM_{2.5} (lbs/LTO)
Phoenix Sky Harbor International Airport (PHX)	2.38	187,125	1.28	1.25
Phoenix Goodyear Airport (GYR)	2.75	131	1.48	1.45
Williams Gateway Airport (IWA)	2	421	1.08	1.05

Applying this new method greatly reduced estimates of PM₁₀ and PM_{2.5} emissions from air carriers. The corrected calculations are now in line with emissions estimates from similar-sized U.S. airports, as well as EPA-calculated national totals.

The following tables summarize the differences in 2002 annual and average daily aircraft emissions from the combined activity categories, for Maricopa County and the PM₁₀ nonattainment area, respectively.

Summary of emission changes for aircraft (all types):

Maricopa County	Annual emissions (tons/yr)		Typical daily emissions (lbs/day)	
	PM₁₀	PM_{2.5}	PM₁₀	PM_{2.5}
Original Calculations	15,987.67	11,030.94	87,603.7	60,443.5
Revised Calculations	1,719.37	1,220.22	9,421.2	6,686.1
Difference	-14,268.30	-9,810.72	-78,182.5	-53,757.4

PM₁₀ Nonattainment Area	Annual emissions (tons/yr)		Typical daily emissions (lbs/day)	
	PM₁₀	PM_{2.5}	PM₁₀	PM_{2.5}
Original Calculations	15,985.12	11,029.19	87,589.7	60,433.9
Revised Calculations	1,716.82	1,218.47	9,407.2	6,676.6
Difference	-14,268.30	-9,810.72	-78,182.5	-53,757.3

Note that totals shown in tables may not equal the sum of individual values due to independent rounding.

page 109: (First paragraph): “EDMS 4.1” should read “EDMS 4.11”.

page 110: Table 4.12–2 has been revised to reflect the corrected PM₁₀ and PM_{2.5} emission factors for air carriers as described above.

page 111: Table 4.12–3 has been revised to reflect the corrected PM₁₀ and PM_{2.5} annual and daily emissions for air carriers.

pages 113–114: The above-mentioned changes in aircraft emissions estimates also produced changes in summary Tables 4.14–1 and 4.14–2.

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1. Introduction

1.1 Overview

This 2002 periodic PM₁₀ emissions inventory was developed to meet requirements set forth in Title I of the Clean Air Act Amendments of 1990 (CAAA). The CAAA require development of a baseline emission inventory and periodic revisions for areas that fail to meet the National Ambient Air Quality Standards (NAAQS). A portion of Maricopa County is classified as serious nonattainment for PM₁₀.

PM₁₀ is defined as particulate matter less than ten micrometers in diameter. This inventory includes primary emissions of PM₁₀ and PM_{2.5} as well as three particulate matter precursors: nitrogen oxides (NO_x), sulfur dioxides (SO_x) and ammonia (NH₃). The inventory provides emission estimates from point, area, nonroad mobile, onroad mobile, and biogenic sources. Note that totals shown in tables may not equal the sum of individual values due to independent rounding.

1.2 Agencies responsible for the emissions inventory

Maricopa County Environmental Services Department (MCESD) has primary responsibility for preparing and submitting the 2002 Periodic PM₁₀ Emissions Inventory for Maricopa County. Point, area, and nonroad mobile source emission estimates for aircraft and locomotives were prepared by MCESD. The remaining nonroad mobile emission estimates were developed by ENVIRON International Corporation (Environ *et al.*, 2003), with additional work conducted by MCESD to develop estimates for the nonattainment area and a typical day. The Maricopa Association of Governments (MAG) prepared the onroad mobile and biogenic emissions estimates. Table 1.2–1 lists those responsible for inventory preparation and quality assurance/quality control activities, which are described in the respective chapters.

Table 1.2–1. Chapter authors and QA/QC contacts.

Chapter	Author(s)	QA/QC contact persons
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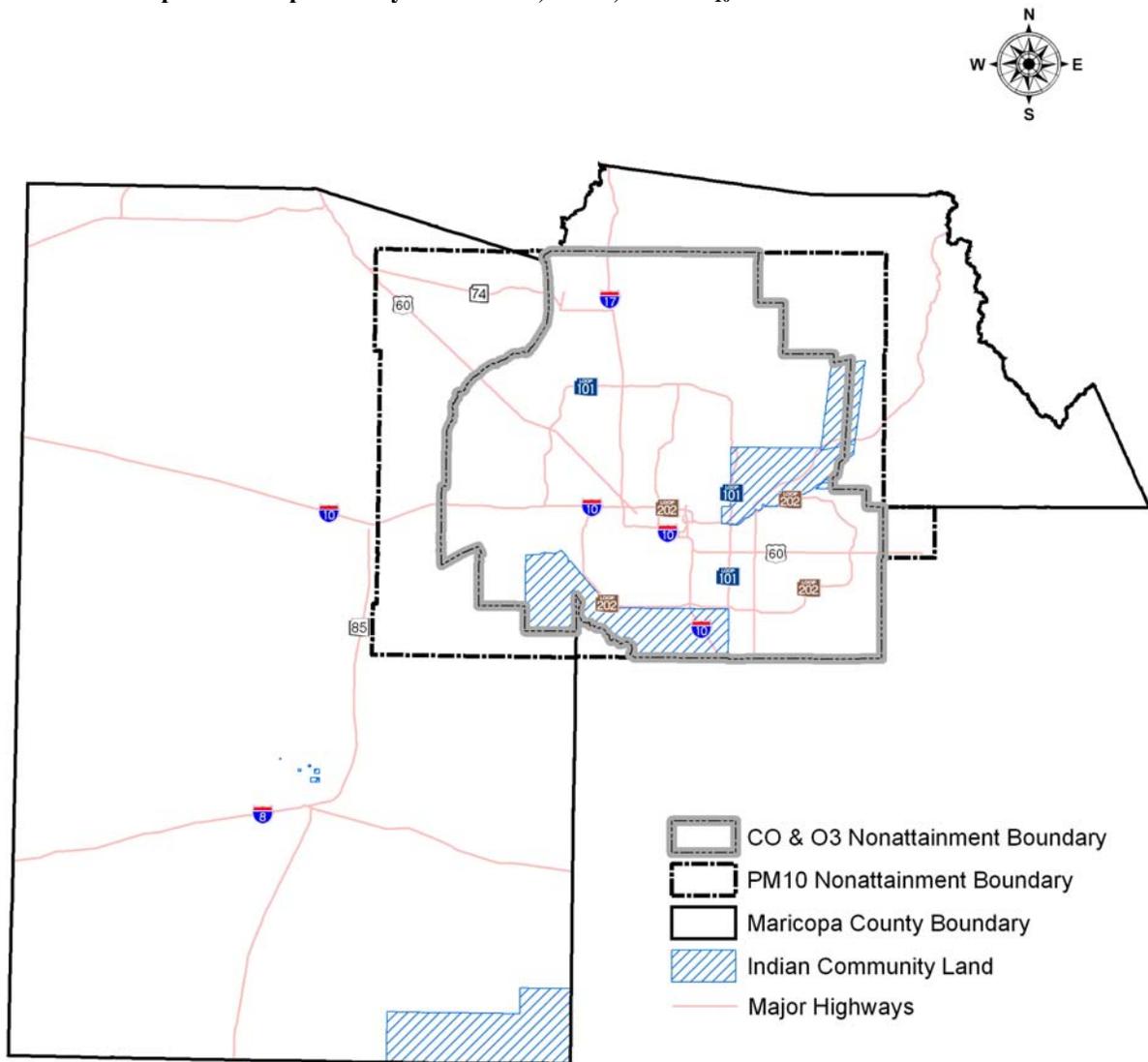
1.3 Temporal scope

Annual and typical daily emissions were estimated for the year 2002, for Maricopa County and the Maricopa County PM₁₀ nonattainment area (NAA).

1.4 Geographic scope

This inventory includes emission estimates for Maricopa County and for the Maricopa County PM₁₀ nonattainment area. Maricopa County encompasses approximately 9,223 square miles of land area, while the Maricopa County PM₁₀ nonattainment area is approximately 2,880 square miles or approximately 31 percent of the Maricopa County land area. A map of Maricopa County and the PM₁₀ nonattainment area is provided in Figure 1.4–1.

Figure 1.4–1. Map of Maricopa County and the CO, ozone, and PM₁₀ nonattainment areas.



1.5 Overview of local demographic and land-use data

Many of the emissions estimates generated in this report were calculated using demographic and land-use data provided by the Maricopa Association of Governments (MAG). These data were used to apportion and/or scale Maricopa County emissions estimates to the nonattainment area and vice versa. (For example, county-level emissions from residential natural gas usage in Maricopa County was apportioned to the nonattainment area using the ratio of occupied households in each area). Detailed explanations of how emission estimates were apportioned or scaled are presented in each of the following chapters, along with the data sources used.

1.5.1 Demographic profile

The demographic data provided by MAG included population, housing and employment data for calendar year 2002, for Maricopa County and the nonattainment area. Table 1.5–1 provides an overview of the demographic data used in this report.

Table 1.5–1. Demographic profile of Maricopa County and the PM₁₀ nonattainment area.

Demographic variable	Maricopa County	Within PM₁₀ NAA	Percent within PM₁₀ NAA
Total resident population	3,296,250	3,267,804	99.14%
Total non-resident population	253,443	251,484	99.23%
Total population:	3,549,693	3,519,288	99.14%
Occupied resident housing units	1,215,173	1,205,176	99.18%
Total non-resident households	146,664	145,541	99.23%
Total occupied households:	1,361,837	1,350,717	99.18%
Retail employment	438,674	434,263	98.99%
Office employment	392,383	391,819	99.86%
Industrial employment	383,938	379,757	98.91%
Public employment	221,676	214,954	96.97%
Other employment	232,614	230,547	99.11%
Total employment:	1,669,285	1,651,340	98.92%

1.5.2 Land-use data

The most recent land-use data available from MAG was for the year 2000. The 2000 land-use data was assumed to be representative of 2002. Table 1.5–2 presents a summary of the land-use categories and acreage used to develop emission estimates for this inventory. Note that the land-use data used to model emissions from biogenic sources is different from the land-use data discussed here. See Chapter 6 for a discussion of the biogenic land-use data.

Table 1.5–2. Land-use categories used to apportion emissions.

Description	Acreage in Maricopa County	Acreage within PM ₁₀ NAA	Percent within PM ₁₀ NAA
Active open space (e.g., parks)	127,792	121,231	94.87%
Passive open space (e.g., mountain preserves)	2,057,048	175,487	8.53%
General open space (not elsewhere classified)	849	849	100.00%
Golf courses	22,922	22,844	99.66%
Water	110,940	53,565	48.28%
Agriculture	415,473	222,124	53.46%
Vacant (e.g., developable land)	2,653,351	749,516	28.25%

1.6 Emissions overview by source category

1.6.1 Point sources

The point source category includes those stationary sources that emit a significant amount of pollution into the air such as power plants, industrial processes and large manufacturing facilities. As Maricopa County has an established annual reporting program for sources with air quality permits, the thresholds for defining a point source are lower than the minimums required by the US EPA. For the purposes of this inventory, a point source is a stationary operation within Maricopa County or within 25 miles of the PM₁₀ nonattainment area, which in 2002 emitted:

- 25 English (short) tons or more of carbon monoxide (CO); or
- 10 tons or more of volatile organic compounds (VOC), oxides of nitrogen (NO_x), or sulfur oxides (SO_x); or
- 5 tons or more of particulate matter less than 10 microns (PM₁₀) or ammonia compounds (NH_x).

Tables 1.6–1 and 1.6–2 summarize annual and typical daily emissions from point sources in Maricopa County and the PM₁₀ nonattainment area, respectively. A detailed breakdown of emissions calculations for all point sources is contained in Chapter 2.

Table 1.6–1. Summary of annual and typical daily emissions from point sources in Maricopa County.

Source category	Annual (tons/yr)					Typical day (lbs/day)				
	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
Electricity generation	243.38	243.38	2,783.19	23.97	93.78	1,351.5	1,351.5	15,336.5	133.0	515.7
Comm./Inst. fuel combustion	4.88	4.72	103.90	3.38	0.23	34.9	33.4	769.9	24.6	1.3
Industrial fuel combustion	77.57	55.58	481.08	84.59	6.13	487.0	355.6	3,260.1	571.5	49.8
Food/agriculture	60.89	7.16				353.6	42.4			
Industrial processes	696.92	257.81	60.74	59.05	17.22	4,328.5	1,613.2	342.0	371.2	159.2
Manufacturing processes	157.06	124.15	65.13	18.24	5.74	1,154.7	915.4	466.1	139.7	34.5
Waste disposal	42.51	39.51	27.51	29.88		233.7	217.2	155.5	164.3	
All point sources:	1,283.19	732.31	3,521.55	219.10	123.10	7,943.9	4,528.7	20,330.2	1,404.3	760.5

Table 1.6–2. Summary of annual and typical daily emissions from point sources in the PM₁₀ NAA.

Source category	Annual (tons/yr)					Typical day (lbs/day)				
	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
Electricity generation	120.24	120.24	2,560.30	11.94	44.42	660.7	660.7	14,067.6	65.6	244.1
Comm./Inst. fuel combustion	4.88	4.72	103.90	3.38	0.23	34.9	33.4	769.9	24.6	1.3
Industrial fuel combustion	75.57	53.78	416.42	83.31	6.13	474.8	344.6	2,887.6	563.3	49.8
Food/agriculture	28.00	3.60				154.7	20.3			
Industrial processes	611.48	194.21	60.74	59.05	6.35	3,811.2	1,233.5	342.0	371.2	34.9
Manufacturing processes	154.48	121.57	52.24	17.05	5.74	1,134.9	895.5	366.9	130.6	34.5
Waste disposal	41.96	39.14	26.24	29.38		230.7	215.2	148.5	161.6	
All point sources:	1,036.60	537.26	3,219.83	204.10	62.86	6,501.8	3,403.2	18,582.5	1,316.9	364.5

1.6.2 Area sources

Area sources are facilities or activities whose individual emissions do not qualify them as point sources. Area sources represent numerous facilities or activities that individually release small amounts of a given pollutant, but collectively they can release significant amounts of a pollutant. Stationary sources with annual emissions lower than the point source thresholds described in Section 1.6.1 were included in the area source inventory. Examples of area source categories include residential wood burning, commercial cooking, waste incineration and wildfires.

Tables 1.6–3 and 1.6–4 summarize annual and season-day emissions of the chief area source categories, for Maricopa County and the PM₁₀ nonattainment area, respectively. A detailed breakdown of emissions calculations for each area source category is contained in Chapter 3.

Table 1.6–3. Summary of annual and typical daily emissions from area sources in Maricopa County.

Category	Annual emissions (tons/yr)					Typical daily emissions (lbs/day)				
	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
Fuel combustion	743.52	712.72	4,560.90	238.60	13.65	6,749.6	6,409.2	28,675.4	1,550.0	87.5
Industrial processes	19,974.43	4,683.60	589.86	157.46	1,672.79	152,018.5	34,546.4	5,318.0	1,265.4	10,722.2
Waste treatmt/disposal	111.58	109.76	67.36	2.67	1,230.86	938.8	927.5	519.3	15.4	6,744.4
Misc. area sources	28,855.85	6,365.39	95.36	18.22	6,476.27	334,886.8	177,457.1	36,603.3	9,971.5	43,028.9
All area sources:	49,685.38	11,871.47	5,313.47	416.94	9,393.56	494,593.6	219,340.2	71,116.0	12,802.3	60,582.9

Table 1.6–4. Summary of annual and typical daily emissions from area sources in the PM₁₀ NAA.

Category	Annual emissions (tons/yr)					Typical daily emissions (lbs/day)				
	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
Fuel combustion	736.81	706.26	4,513.93	236.06	13.50	6,690.3	6,352.7	28,379.0	1,533.5	86.5
Industrial processes	19,149.15	4,511.99	589.67	157.45	1,654.64	145,691.2	33,240.8	5,316.9	1,265.4	10,605.8
Waste treatmt/disposal	43.56	41.74	49.13	2.67	1,220.31	373.5	362.2	367.9	15.4	6,686.6
Misc. area sources	13,661.81	2,958.31	32.22	3.30	3,902.06	81,136.1	17,469.6	285.4	26.5	21,381.1
All area sources:	33,591.32	8,218.30	5,184.95	399.48	6,790.51	233,890.9	57,425.4	34,349.2	2,840.8	38,760.2

1.6.3 Nonroad mobile sources

Nonroad mobile sources include off-highway vehicles and engines that move or are moved within a 12-month period. Tables 1.6–5 and 1.6–6 summarize annual and season-day emissions from nonroad mobile sources, for Maricopa County and the PM₁₀ nonattainment area, respectively. A detailed breakdown of emissions calculations for each source category is contained in Chapter 4.

Table 1.6–5. Annual and typical daily emissions from nonroad mobile sources in Maricopa County.

Category	Annual emissions (tons/yr)					Typical daily emissions (lbs/day)				
	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
Agricultural	56.90	52.35	477.46	6.59	0.96	364.8	335.7	3,060.7	42.3	6.1
Airport ground support	4.67	4.31	147.09	1.67	3.41	25.7	23.7	808.1	9.2	18.7
Commercial	120.50	110.95	1,319.44	19.28	21.68	772.4	711.1	8,457.9	123.5	139.0
Construction & mining	859.34	790.60	9,834.69	154.05	19.47	5,508.6	5,067.9	63,042.9	987.6	124.9
Industrial	107.22	99.38	3,174.80	22.45	77.69	687.6	637.1	20,351.3	143.9	498.0
Lawn & garden	141.59	130.27	695.48	15.20	17.54	974.6	896.7	4,286.3	108.4	128.8
Logging	3.25	2.99	38.74	0.71	0.09	20.8	19.1	248.3	4.6	0.6
Pleasure craft	27.23	25.06	43.01	0.88	1.02	366.5	337.2	579.1	11.7	13.7
Railway maintenance	3.05	2.81	20.35	0.27	0.05	21.1	19.5	140.9	1.9	0.3
Recreational	4.53	4.17	63.35	2.29	1.92	38.8	35.7	541.4	19.6	16.5
Aircraft	1,719.37	1,220.22	4,187.66	295.81	0.00	9,421.2	6,686.1	22,946.1	1,620.9	0.0
Locomotives	86.76	76.16	3,444.32	201.30	5.31	475.4	417.3	18,873.0	1,103.0	29.1
All nonroad mobile sources:	3,134.41	2,519.27	23,446.39	720.50	149.14	18,677.5	15,187.1	143,336.0	4,176.6	975.7

Table 1.6–6. Annual and typical daily emissions from all nonroad mobile sources in the PM₁₀ NAA.

Category	Annual emissions (tons/yr)					Typical daily emissions (lbs/day)				
	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
Agricultural	30.42	27.99	255.25	3.52	0.51	195.0	179.4	1,636.2	22.6	3.2
Airport ground support	4.55	4.20	143.42	1.63	3.33	25.1	23.1	787.9	9.0	18.2
Commercial	119.17	109.74	1,305.06	19.07	21.46	763.9	703.4	8,365.7	122.2	267.6
Construction & mining	851.95	783.80	9,750.12	152.73	19.31	5,461.2	5,024.4	62,500.8	979.1	123.9
Industrial	106.05	98.30	3,140.20	22.19	76.84	680.1	630.1	20,129.5	142.4	492.6
Lawn & garden	140.43	129.20	689.78	15.07	17.40	966.7	889.3	4,251.2	107.5	127.8
Logging	3.22	2.96	38.40	0.70	0.09	20.7	19.0	246.2	4.6	0.6
Pleasure craft	13.15	12.10	20.77	0.42	0.49	177.0	162.8	279.6	5.7	6.6
Railway maintenance	3.02	2.79	20.18	0.27	0.05	20.9	19.3	139.7	1.9	0.3
Recreational	0.91	0.83	12.68	0.46	0.39	7.8	7.2	108.4	3.9	3.3
Aircraft	1,716.82	1,218.47	4,186.89	295.66	0.00	9,407.2	6,676.6	22,941.9	1,620.1	0.0
Locomotives	44.85	39.83	1,781.60	100.70	2.66	245.7	218.2	9,762.2	551.8	14.6
All nonroad mobile sources:	3,034.54	2,430.21	21,344.35	612.42	142.53	17,971.3	14,552.8	131,149.3	3,570.8	1,058.7

1.6.4 Onroad mobile sources

Emission from onroad mobile sources were calculated for the PM₁₀ nonattainment area located primarily within Maricopa County, as well as for Maricopa County as a whole. A detailed breakdown of emissions calculations for each area source category is contained in Chapter 5.

Tables 1.6–7 and 1.6–8 summarize annual and typical daily emissions from onroad mobile sources in Maricopa County and the PM₁₀ nonattainment area, respectively.

Table 1.6–7. Annual and typical daily emissions from all onroad mobile sources in Maricopa County.

Category	Annual emissions (tons/yr)					Typical daily emissions (lbs/day)				
	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
Exhaust	1,285	1,176	79,572	1,183	2,544	7,039	6,446	436,006	6,479	13,937
Paved road fugitive dust	20,046	2,374				109,838	13,007			
Unpaved road fugitive dust	9,562	1,432				52,392	7,846			
Tire wear		287	71			1,574	390			
Brake wear		370	157			2,028	860			
All onroad mobile sources:	31,550	5,210	79,572	1,183	2,544	172,872	28,550	436,006	6,479	13,937

Table 1.6–8. Annual and typical daily emissions from all onroad mobile sources in the PM₁₀ NAA.

Category	Annual emissions (tons/yr)					Typical daily emissions (lbs/day)				
	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
Exhaust	1,223	1,120	75,307	1,125	2,418	6,700	6,135	412,639	6,166	13,250
Paved road fugitive dust	19,241	2,276				105,431	12,474			
Unpaved road fugitive dust	9,142	1,369				50,093	7,502			
Tire wear	273	68				1,497	370			
Brake wear	352	149				1,929	818			
All onroad mobile sources:	30,231	4,982	75,307	1,125	2,418	165,649	27,300	412,639	6,166	13,250

1.6.5 Biogenic sources

The biogenic source category includes emissions from all vegetation (e.g., crops, indigenous vegetation, landscaping, etc.) in Maricopa County and the PM₁₀ nonattainment area. Emissions were estimated through MAG-BEIS2, a local computer model developed by the Maricopa Association of Governments (MAG) that is based on the US EPA model UAM-BEIS2, but which uses county-specific land-use and temperature data. Annual and daily NO_x emissions from biogenic sources are shown in Table 1.6–9 for Maricopa County and the PM₁₀ nonattainment area.

Table 1.6–9. Annual and season-day NO_x emissions from biogenic sources.

Geographic area	Annual emissions (tons/yr)	Typical daily emissions (lbs/day)
Maricopa County	8,327	45,626
PM ₁₀ NAA	2,447	13,408

1.6.6 Summary of emissions by source category

Figures 1.6–1 through 1.6–10 provide a graphical overview of the relative contributions of the major source categories (point, area, nonroad, onroad and biogenic) to emissions in the PM₁₀ nonattainment area, on an annual and season-day basis, respectively.

Figure 1.6–1. Annual PM₁₀ emissions in the PM₁₀ nonattainment area, by source category (tons/yr).

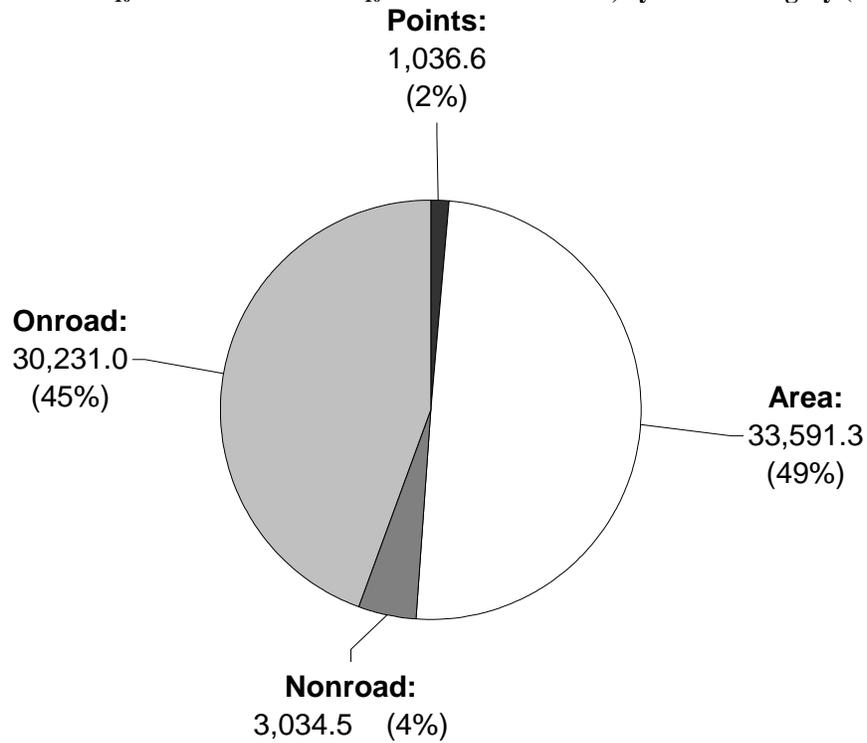


Figure 1.6–2. Annual PM_{2.5} emissions in the PM₁₀ nonattainment area, by source category (tons/yr).

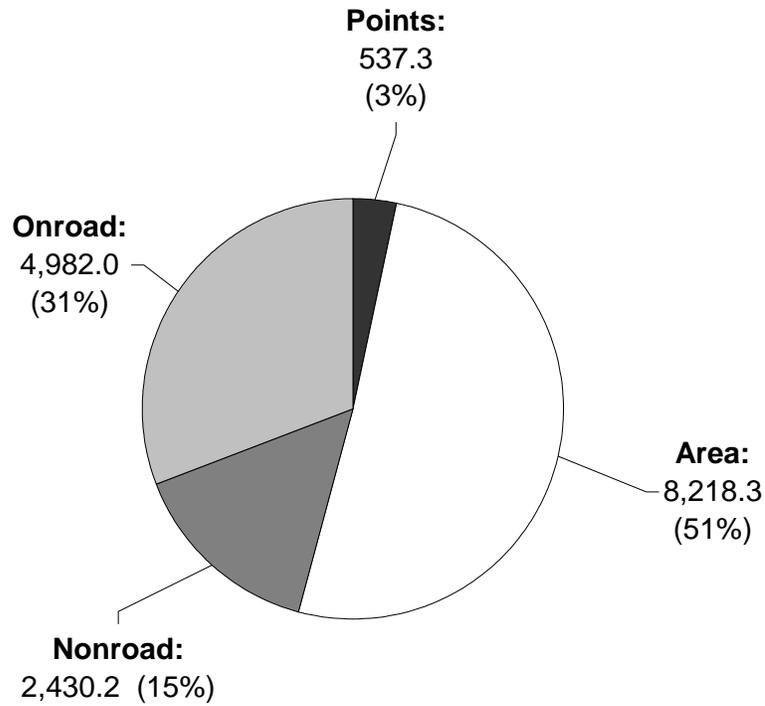


Figure 1.6-3. Annual NO_x emissions in the PM₁₀ nonattainment area, by source category (tons/yr).

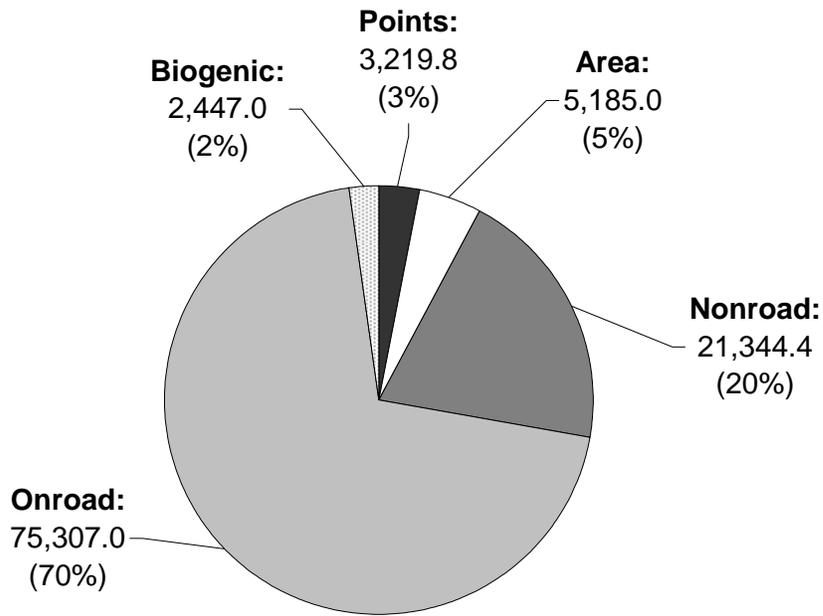


Figure 1.6-4. Annual SO_x emissions in the PM₁₀ nonattainment area, by source category (tons/yr).

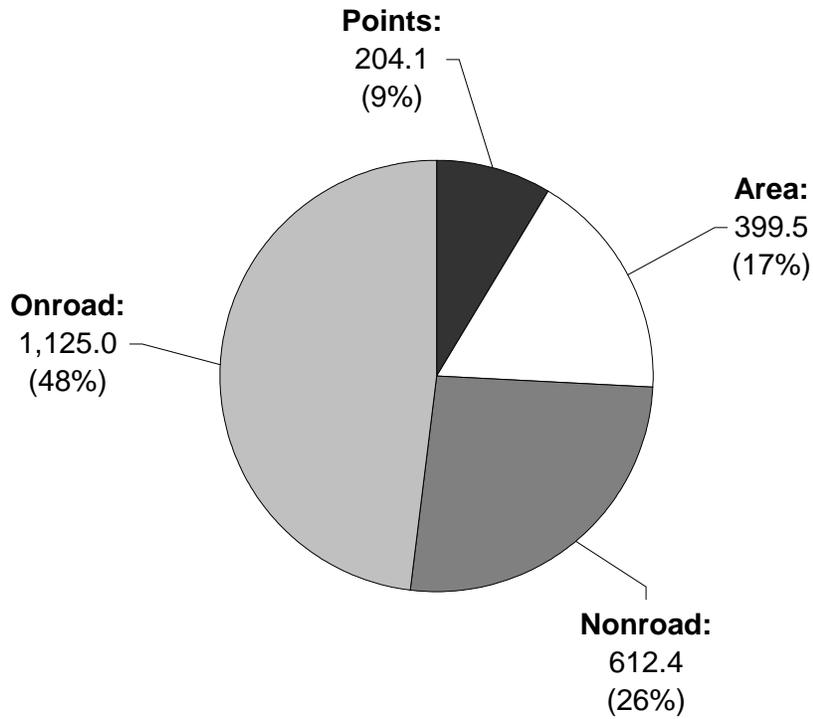


Figure 1.6-5. Annual NH₃ emissions in the PM₁₀ nonattainment area, by source category (tons/yr).

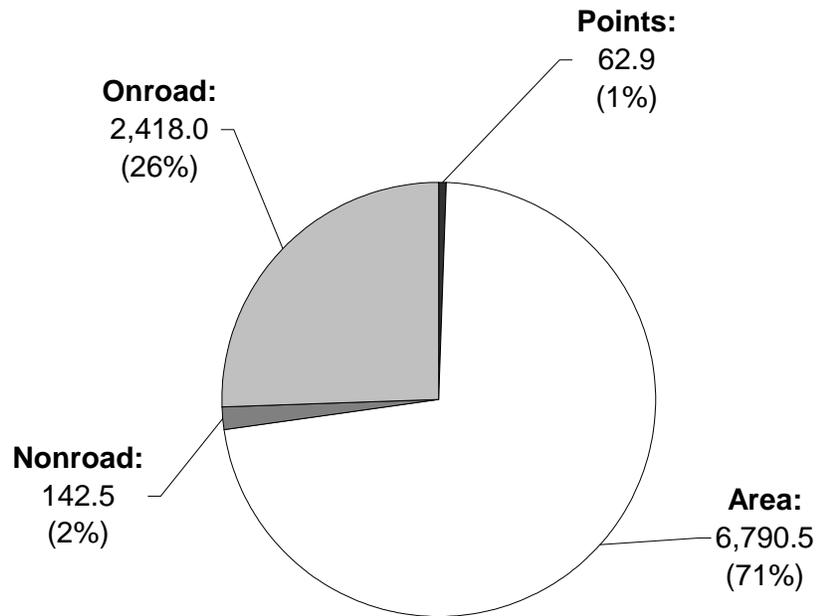


Figure 1.6-6. Typical daily PM₁₀ emissions in the PM₁₀ nonattainment area, by source category (lbs/day).

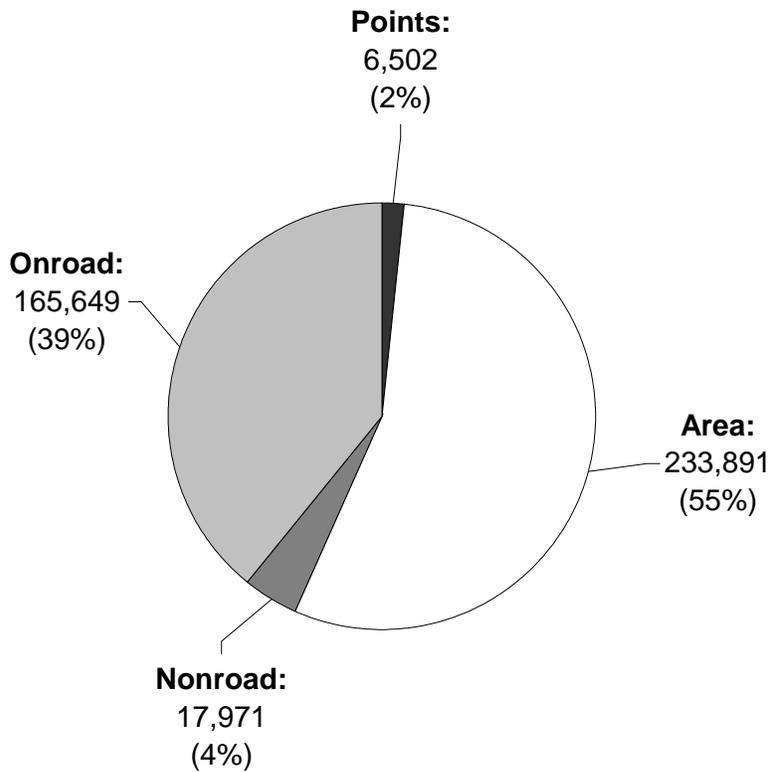


Figure 1.6–7. Typical daily PM_{2.5} emissions in the PM₁₀ nonattainment area, by source category (lbs/day).

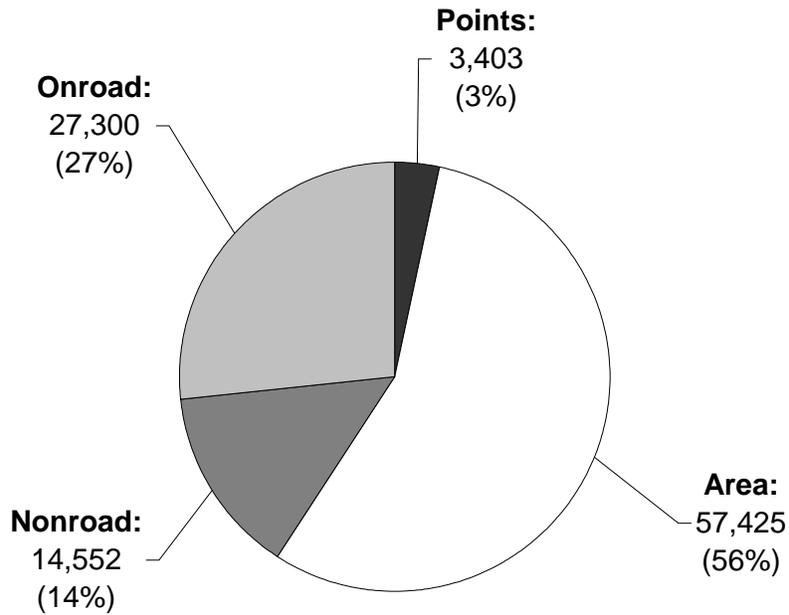


Figure 1.6–8. Typical daily NO_x emissions in the PM₁₀ nonattainment area, by source category (lbs/day).

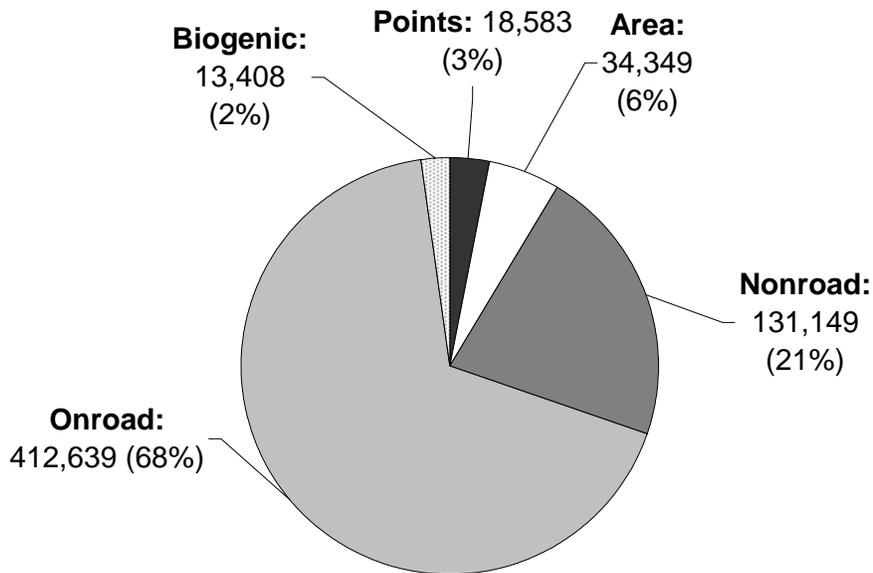


Figure 1.6–9. Typical daily SO_x emissions in the PM₁₀ nonattainment area, by source category (lbs/day).

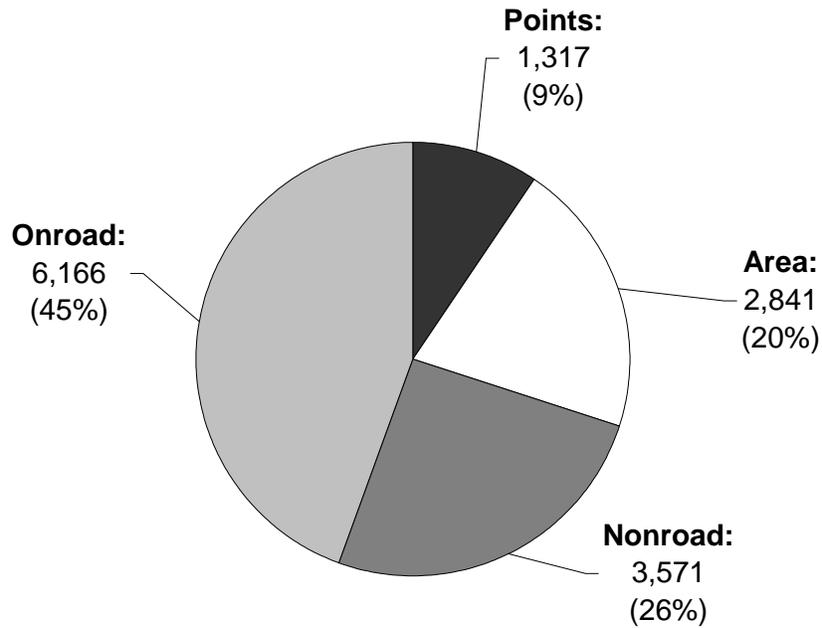
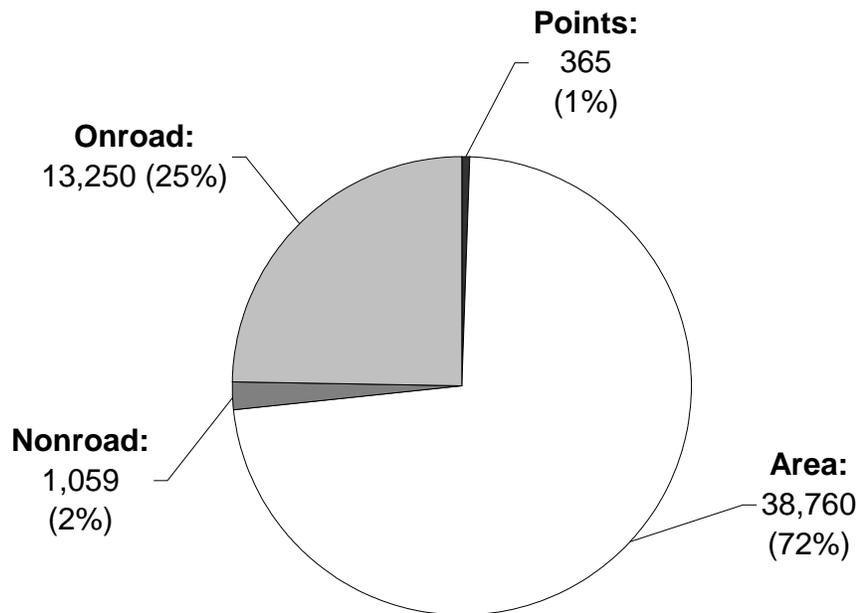


Figure 1.6–10. Typical daily NH₃ emissions in the PM₁₀ nonattainment area, by source category (lbs/day).



Figures 1.6–11 and 1.6–12 show the relative contributions of each source category for each pollutant on an annual and season-day basis, respectively.

Figure 1.6–11. Annual emissions in the PM₁₀ nonattainment area, by source category (TPY).

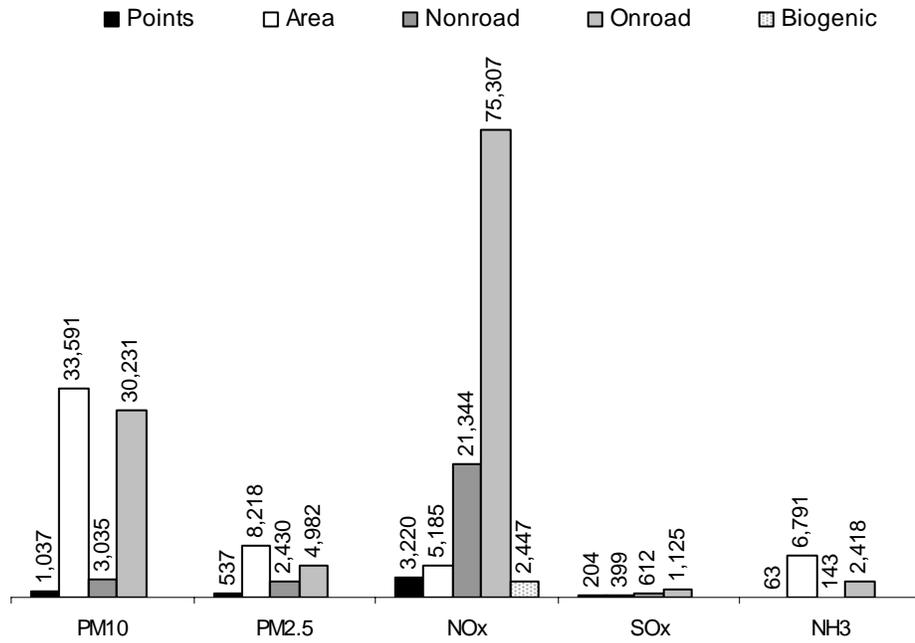


Figure 1.6–12. Typical daily emissions in the PM₁₀ nonattainment area, by source category (lb/day).

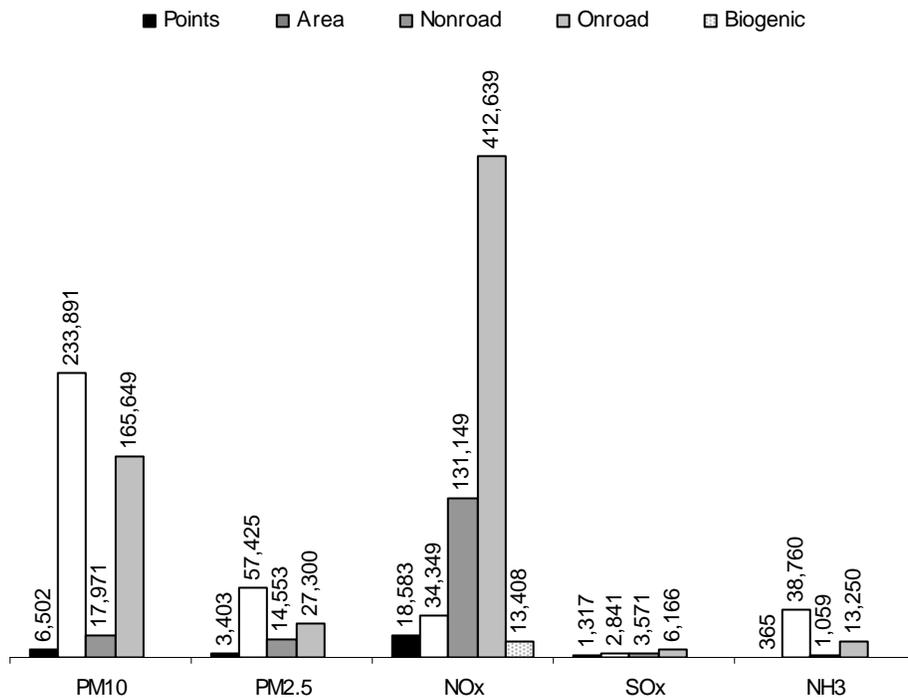


Table 1.6–10 provides a comparison between this inventory and earlier periodic PM emissions inventories for the PM₁₀ nonattainment area. Note that figures may not be directly comparable as calculation methods, emission factors, and source category definitions (e.g., point vs. area sources) may have changed over time. Prior-year inventories that did not include annual totals for a specific source category are denoted by “n/c”, for not calculated.

Table 1.6–10. Summary of annual emissions by source category, 1994–2002 (tons/yr).

Category	Inventory year 1994					Inventory year 2002				
	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
Points	1,238	684	5,538	610	7	1,037	537	3,220	204	63
Area	3,474	2,304	4,100	535	5,677	33,591	8,218	5,185	399	6,791
Nonroad	15,064	7,010	37,814	3,082	n/c	3,035	2,430	21,344	612	143
Onroad	37,014	13,049	63,372	217	n/c	30,231	4,982	75,307	1,125	2,418
Biogenic	29	26	1,792	n/c	n/c	n/c	n/c	2,447	n/c	n/c
Totals:	56,819	23,073	112,616	4,445	5,684	67,893	16,168	107,503	2,341	9,415

1.7 References

ENVIRON *et al.*, 2003. Maricopa County 2002 Comprehensive Emission Inventory for the Cap and Trade Oversight Committee, Final Rep. prepared for Arizona Dept. of Environmental Quality, October 9, 2003.

2. Point Sources

2.1 Introduction and scope

This inventory of PM₁₀ and related pollutants is one of a number of emission inventories being prepared to meet US EPA reporting requirements. In addition to preparing periodic emissions inventories for the PM₁₀ nonattainment area (NAA) as a commitment under the current PM₁₀ State Implementation Plan (SIP), the federal Consolidated Emission Reporting Rule (CERR) requires that state and local agencies prepare emissions estimates on a county basis, and submit data electronically to the US EPA for inclusion in the National Emission Inventory (NEI) for 2002. This inventory is being developed concurrently with similar inventories for CO and ozone precursors (VOC, NO_x, and CO), as part of Maricopa County's requirements under the respective SIPs.

In order to provide consistency among all these inventories, it was decided to standardize the definition of a "point source". While EPA has defined minimum point source reporting thresholds for various pollutants, EPA guidance also notes that:

... we encourage organizations to provide facility-specific emissions data for all point sources, regardless of size, where they are already included in the S/L/T [state/local/tribal] emission inventory. (US EPA, 2003)

As Maricopa County has an established annual reporting program for sources with air quality permits, the thresholds for defining a point source are lower than the minimums required by EPA. For the purposes of this inventory, a point source is a stationary operation within Maricopa County or within 25 miles of the PM₁₀ nonattainment area, which in 2002 emitted:

- 25 English (short) tons or more of carbon monoxide (CO); or
- 10 tons or more of volatile organic compounds (VOC), oxides of nitrogen (NO_x), or sulfur oxides (SO_x); or
- 5 tons or more of particulate matter less than 10 microns (PM₁₀) or ammonia compounds (NH_x).

While the above approach results in some anomalies (e.g., a facility treated as a point source may have very low, or no, emissions of a certain pollutant), a uniform definition of "point source" ensures that all data sets, which are prepared for a variety of purposes, will be comparable.

PM₁₀ is defined as particulate matter less than ten micrometers in diameter. This inventory includes primary emissions of PM₁₀ and PM_{2.5} as well as three particulate matter precursors: nitrogen oxides (NO_x), sulfur dioxides (SO_x) and ammonia (NH₃). This point source inventory includes actual emissions of PM₁₀, PM_{2.5}, NO_x, SO_x, and NH₃ for the year 2002 as well as a typical day. A description and map of the nonattainment area are provided in Chapter 1. Questions concerning point source emissions may be directed to Bob Downing of MCESD at (602) 506-6790.

Several tables have been constructed to provide the point source emissions and category totals. Table 2.2–1 summarizes all point sources by location and permitting authority. Table 2.2–2 provides an alphabetical list of all point sources and their location. Table 2.4–1 shows the 2002 annual and typical day emissions of PM₁₀, PM_{2.5}, SO_x, NO_x and NH₃ for those point sources which reported emissions of any of these pollutants broken out by facility, while Table 2.4–2 lists the 2002 annual and PM typical day emissions broken out by individual process types. Table 2.6–1 summarizes point source emissions by source category. Note that totals shown in the tables may not equal the sum of individual values due to independent rounding.

2.2 Identification of point sources

Maricopa County Environmental Services Department (MCESD) identified point sources within Maricopa County through its permit system database and the 2002 annual emissions reports submitted to the department. In addition, the permit system was reviewed to locate new installations that were not included in the previous emission inventory, and to identify sources that have ceased operations since the 1999 periodic inventory was compiled.

A total of 172 stationary point sources were identified using the emission thresholds described in Section 2.1. Of these 172 sources, 143 MCESD-permitted sources reported emissions of PM, NO_x, SO_x, and/or ammonia – 133 within the PM₁₀ nonattainment area, and 10 outside the PM₁₀ NAA. There are 2 additional point sources (Hexcel Corp. and SRP Desert Basin Generating Station) within the 25-mile boundary around the PM₁₀ nonattainment area, with permits issued the Pinal County Air Quality Control District (PCAQCD). While the Arizona Department of Environmental Quality (ADEQ) retains permitting authority for a limited number of industrial source categories in Maricopa County, no ADEQ-permitted facilities are considered point sources, and are addressed instead as area sources.

Table 2.2–1. Number of stationary point sources by location and permitting authority.

Location	Total no. of facilities	Facilities reporting emissions of PM, NO_x, SO_x, and/or NH₃
Within the PM₁₀ nonattainment area:		
– Maricopa County-permitted sites	160	133
Outside the PM₁₀ nonattainment area:		
– Maricopa County-permitted sites	10	10
– Pinal County-permitted sites	2	2
Total outside NAA:	12	12
Grand total:	172	145

Table 2.2–2 contains an alphabetical list of all point sources, including a unique business identification number, NAICS industry classification code, business name (including any changes from the 1999 periodic inventory), and physical address.

Table 2.2–2. Name and location of all point sources.

Within the PM₁₀ nonattainment area:

ID #	NAICS	Business name	Address	City	ZIP
1074	22132	23rd Ave. Wastewater Treatment Plant (formerly <i>City of Phoenix 23rd Ave. WWTP</i>)	2470 S. 22nd Ave.	Phoenix	85009
1075	22132	91st Ave. Wastewater Treatment Plant	5615 S. 91st Ave.	Tolleson	85353
245	337122	A. F. Lorts Company Inc.	8120 W. Harrison St.	Tolleson	85353
1952	811121	Adesa Phoenix LLC	400 N. Beck Ave.	Chandler	85226
1239	332321	AG Products	2525 W. Broadway Rd.	Phoenix	85041
1874	212321	Alleco Stone LLC	10401 S. Miller Rd.	Buckeye	85326
35541	33121	Allied Tube & Conduit Corp.	2525 N. 27th Ave.	Phoenix	85009
31643	562212	Allied Waste Industries Inc. Southwest Regional Facility	24427 S. Hwy 85	Buckeye	85326
199	327332	Ameron Intl. Water Transmission Group (formerly <i>Ameron Pipe</i>)	2325 S. 7th St.	Phoenix	85034
292	325412	Anabolic Laboratories Inc. (formerly <i>Health Factors International Inc.</i>)	429 S. Siesta Ln.	Tempe	85281
31637	115111	Anderson Clayton Corp. Valencia Gin	25500 W. Southern Ave.	Buckeye	85326
3313	221112	APS West Phoenix Power Plant	4606 W. Hadley St.	Phoenix	85043
3938	332812	Arizona Galvanizing Inc.	15775 Elwood St.	Goodyear	85338
4364	61131	Arizona State University	1551 S. Rural Rd.	Tempe	85287
36485	54185	Billboard Poster Company Inc.	3940 W. Montecito Ave.	Phoenix	85019
43124	313230	Bonded Logic Inc.	411 E. Ray Rd.	Chandler	85225
3441	42471	BP West Coast Products LLC	5333 W. Van Buren St.	Phoenix	85043
458	32191	Bryant Industries Inc.	788 W. Illini St.	Phoenix	85041
217	327123	Building Products Co.	4850 W. Buckeye Rd	Phoenix	85043
3442	493190	Caljet (formerly <i>Caljet/Williams</i>)	125 N. 53rd Ave.	Phoenix	85043
60598	337211	Case Furniture & Design LLC	4645 W. Polk St.	Phoenix	85043
1317	321991	Cavco Industries LLC (35th Ave.)	2602 S. 35th Ave.	Phoenix	85009
1318	321991	Cavco Industries LLC (Litchfield Rd.)	1366 S. Litchfield Rd.	Goodyear	85338
1316	321991	Cavco Industries LLC (Durango Plant)	2502 W. Durango St.	Phoenix	85009
4145	61111	Cave Creek School District	33606 N. 60th St.	Cave Creek	85331
1267	32732	Cemex Mesa Plants #61 & #71	1901 N. Alma School Rd.	Mesa	85201
1266	212321	Cemex USA (Phoenix)	11701 W. Indian School	Phoenix	85063
1268	212321	Cemex USA (Sun City)	24004 N. 107th Ave.	Sun City	85373
1310	32311	Century Graphics LLC	2960 Grand Ave.	Phoenix	85017
1426	32311	Cesar Color Inc.	3433 E. Wood St.	Phoenix	85040
4401	32732	Chandler Ready Mix Inc.	6500 N. 115th Ave.	Glendale	85323
51073	52312	Charles Schwab & Co. Inc.	2121 S. Price Rd.	Chandler	85248
3297	42471	Chevron USA Inc.	5110 W. Madison St.	Phoenix	85043
3976	33711	Cholla Custom Cabinets Inc.	1727 E. Deer Valley Dr.	Phoenix	85024
4083	32191	Chris Fischer Productions Inc.	4741 W. Polk St.	Phoenix	85043
399	32739	Coreslab Structures (Ariz) Inc.	5026 S. 43rd Ave.	Phoenix	85041
1198	32311	Courier Graphics Corp.	2621 S. 37th St.	Phoenix	85034
4368	32191	Craftsmen in Wood Mfg.	5441 W. Hadley St.	Phoenix	85043
4023	321918	Creative Shutters Inc.	2009 W. Ironwood Dr.	Phoenix	85021
1389	541380	DaimlerChrysler AZ Proving Grounds	33040 N. 203rd Ave.	Wittmann	85361
3744	325991	Desert Sun Fiberglass	21412 N. 14th Ave.	Phoenix	85027
130	331512	Dolphin Inc.	740 S. 59th Ave.	Phoenix	85043
508	337122	Eagle Industries LLC (formerly <i>Samuel Lawrence Furniture Co.</i>)	601 S. 65th Ave.	Phoenix	85043
45493	811121	Earnhardt Ford	7300 W. Orchid Ln.	Chandler	85226
3305	311812	Earthgrains Baking Companies Inc.	738 W. Van Buren St.	Phoenix	85007
26	423810	Empire Machinery Co.	1725 S. Country Club Dr.	Mesa	85210

Table 2.2–2. Name and location of all point sources (continued).

ID #	NAICS	Business name	Address	City	ZIP
1505	32191	Executive Door	3939 W. Clarendon Ave.	Phoenix	85019
544	321991	Fleetwood Homes of Arizona Inc. #21	6112 N. 56th Ave.	Glendale	85311
27728	334413	FlipChip International LLC (formerly <i>Flip Chip Technologies</i>)	3701 E. University Dr.	Phoenix	85034
41751	326212	GCR Truck Tire Center	2815 N. 32nd Ave.	Phoenix	85009
4050	311812	General Mills (formerly <i>Pillsbury Bakeries & Food Service</i>)	1120 W. Fairmont Dr.	Tempe	85282
4173	562212	Glendale Municipal Sanitary Landfill	11480 W. Glendale Ave.	Glendale	85301
781	62211	Good Samaritan Regional Medical Center	1111 E. McDowell Rd.	Phoenix	85006
1418	326299	Goodrich Aircraft Interior Products (formerly <i>BF Goodrich Aircraft Evacuation Sys.</i>)	3414 S. 5th St.	Phoenix	85040
36772	212321	GTI Capital Holdings LLC	3636 S. 43rd Ave.	Phoenix	85009
699	212321	Hanson Aggregates of Arizona	4002 S. 51st Ave.	Phoenix	85043
31565	32614	Henry Products Inc.	302 S. 23rd Ave.	Phoenix	85009
529	32614	Highland Products Inc.	43 N. 48th Ave.	Phoenix	85043
3536	311812	Holsum Bakery Inc.	2322 W. Lincoln St.	Phoenix	85009
3802	311812	Holsum Bakery Tempe	710 W. Geneva Dr.	Tempe	85252
1059	336412	Honeywell Engines Systems & Service (formerly <i>Honeywell Aerospace Services</i>)	1944 E. Sky Harbor Cir.	Phoenix	85034
355	336412	Honeywell International Inc.	111 S. 34th St.	Phoenix	85034
354	331314	Imsamet of Arizona	3829 S. Estrella Pkwy.	Goodyear	85338
777	32614	Insulfoam	3401 W. Cocopah St.	Phoenix	85009
3966	334413	Intel Corp. Ocotillo Campus (Fab 12 & 22) (formerly <i>Intel Corp. Ocotillo Campus Fab 12</i>)	4500 S. Dobson Rd.	Chandler	85248
983	334419	Isola Laminate Systems Corp.	165 S. Price Rd.	Chandler	85224
725	212321	Kilauea Crushers Inc.	Hwy 74	Wickenburg	85358
3317	221112	Kyrene Generating Station (formerly <i>SRP Kyrene Steam Plant</i>)	7005 S. Kyrene Rd.	Tempe	85283
341	325991	L & M Laminates & Marble	813 E. University Dr.	Phoenix	85034
4182	337122	Legends Furniture Inc.	5555 N. 51st Ave.	Glendale	85301
857	334412	Litton Electro-Optical Systems	1215 S. 52nd St.	Tempe	85281
3300	92811	Luke Air Force Base	14002 W. Marauder St.	Glendale	85309
744	3325	M. E. Global Inc. (formerly <i>M. E. West Castings Inc.</i>)	5857 S. Kyrene Rd.	Tempe	85283
1248	325991	Maax Spas	25605 S. Arizona Ave.	Chandler	85248
31261	21231	Madison Granite Supplies	30600 N. 23rd Ave.	Phoenix	85027
4111	337121	Magic Woods Inc.	4210 N. 39th Ave.	Phoenix	85019
205	322232	Mail-Well Envelope	221 N. 48th Ave.	Phoenix	85043
353	326199	Marlam Industries Inc.	834 E. Hammond Ln.	Phoenix	85034
61268	327390	Master Block Inc.	12620 W. Butler Dr.	El Mirage	85335
62	33711	Mastercraft Cabinets Inc.	305 S. Brooks	Mesa	85202
1414	212321	Mesa Materials Inc. (Mesa)	3410 N. Higley Rd.	Mesa	85205
1415	212321	Mesa Materials Inc. (Phoenix)	7845 W. Broadway Rd.	Phoenix	85043
29474	423930	Metal Management Arizona Inc.	3640 S. 35th Ave.	Phoenix	85009
1203	334413	Microchip Technology Inc. (Chandler)	2355 W. Chandler Blvd.	Chandler	85224
1875	334413	Microchip Technology Inc. (Tempe)	1200 S. 52nd St.	Tempe	85281
226	32739	Monier Lifetile LLC	1832 S. 51st Ave.	Phoenix	85043
882	311942	Morton Salt Glendale Facility	13000 W. Glendale Ave.	Glendale	85307
881	334413	Motorola Inc.	1300 N. Alma School Rd.	Chandler	85224
223	333112	MTD Southwest Inc.	550 N. 54th St.	Chandler	85226
693	333415	Munters Corp.	802 S. 59th Ave.	Phoenix	85043
34197	327420	National Gypsum Co.	1414 E. Hadley St.	Phoenix	85034
948	32614	Nesco Manufacturing Inc.	1510 W. Drake Dr.	Tempe	85283
1309	337122	New Directions Inc.	2940 W. Willetta St.	Phoenix	85009

Table 2.2–2. Name and location of all point sources (continued).

ID #	NAICS	Business name	Address	City	ZIP
1879	562212	Northwest Regional Landfill	19401 W. Deer Valley Rd	Surprise	85374
1331	337122	Oak Canyon Manufacturing Inc. (formerly <i>Aspen II</i>)	3021 N. 29th Dr.	Phoenix	85017
3953	33711	Oakcraft Inc.	7733 W. Olive Ave.	Peoria	85345
27925	337122	Oasis Bedroom Co.	2022 N. 22nd Ave.	Phoenix	85009
52382	221112	Ocotillo Power Plant	1500 E. University Dr.	Tempe	85281
3982	32311	O'Neil Printing Inc.	366 N. 2nd Ave.	Phoenix	85003
3970	337122	Pacific Designs	2425 W. Sherman St.	Phoenix	85043
1344	321991	Palm Harbor Homes Inc.	309 S. Perry Ln.	Tempe	85281
733	811412	Pan-Glo West	2401 W. Sherman St.	Phoenix	85009
419	336412	Parker Hannifin GTFSD	7777 N. Glen Harbor Bd.	Glendale	85307
1341	33992	Penn Racquet Sports Inc.	306 S. 45th Ave.	Phoenix	85043
1014	327121	Phoenix Brick Yard	1814 S. 7th Ave.	Phoenix	85007
562	51111	Phoenix Newspapers Inc.	22600 N. 19th Ave.	Phoenix	85027
148	331528	Presto Casting Co.	5440 W. Missouri Ave.	Glendale	85301
60889	326212	Purcell's Western States Tire	420 S. 35th Ave.	Phoenix	85009
1030	32311	Quebecor World Phoenix Division	1850 E. Watkins St.	Phoenix	85034
44182	332312	Quincy Joist Company	22253 W. Southern Ave.	Buckeye	85326
537	327999	Red Mountain Mining Inc.	4250 N. Bush Hwy.	Mesa	85215
1503	321991	Redman Homes Inc.	400 E. Ray Rd.	Chandler	85225
303	332431	Rexam Beverage Can Company	211 N. 51st Ave.	Phoenix	85043
4318	32732	River Ranch Plant	5159 N. El Mirage Rd.	Litchfield Pk	85340
759	32613	Rogers Corp. Advanced Circuit Materials	100 S. Roosevelt Ave.	Chandler	85226
1437	334412	Sanmina Phoenix Division (formerly <i>Hadco Phoenix Inc./Sanmina Phx. Div.</i>)	5020 S. 36th St.	Phoenix	85040
3315	221112	Santan Generating Station (formerly <i>Santan Generating Plant</i>)	1005 S. Val Vista Rd.	Gilbert	85296
266	332312	Schuff Steel Co.	420 S. 19th Ave.	Phoenix	85009
246	321991	Schult Homes	231 N. Apache Rd.	Buckeye	85326
42636	62211	Scottsdale Health Care Hospital	7400 E. Osborn Rd.	Scottsdale	85251
4175	493190	SFPP LP	49 N. 53rd Ave.	Phoenix	85043
70634	42471	Shell Oil Phoenix Terminal (formerly <i>Texaco Phoenix Terminal</i>)	5325 W. Van Buren St.	Phoenix	85043
27933	562212	Skunk Creek Landfill	3165 W. Happy Valley Rd	Phoenix	85027
4471	332311	Skyline Steel Inc.	631 W. Commerce Ave.	Gilbert	85233
31627	115111	South Mountain Gin	6411 S. 51st Ave.	Laveen	85339
3316	221112	SRP Agua Fria	7302 W. Northern Ave.	Glendale	85303
4131	334413	ST Microelectronics	1000 E. Bell Rd.	Phoenix	85022
1444	327123	Staco Architectural Roof Tile	3530 E. Elwood St.	Phoenix	85040
582	337122	Stone Creek Inc.	4221 E. Raymond St.	Phoenix	85040
281	212321	Sun State Rock & Materials	11500 W. Beardsley Rd.	Sun City	85373
101	31161	Sunland Beef Co.	651 S. 91st Ave.	Tolleson	85353
52471	325188	Superior Lime & Chemical	320 S. 27th Ave.	Phoenix	85009
3978	337122	Team Two Design Assoc Inc.	310 S. 43rd Ave.	Phoenix	85009
249	336411	The Boeing Company	5000 E. McDowell Rd.	Mesa	85215
937	336211	The Heil Company	1500 S. 7th St.	Phoenix	85034
232	72111	The Phoenician Resort	6000 E. Camelback Rd.	Scottsdale	85251
1102	325412	The Procter & Gamble Mfg. Co.	2050 S. 35th Ave.	Phoenix	85009
552	337122	Thornwood Furniture Mfg.	5125 E. Madison St.	Phoenix	85034
363	337122	Thunderbird Furniture	7501 E. Redfield Rd.	Scottsdale	85260
56	32739	TPAC: A Division of Kiewit Western Co.	3052 S. 19th Ave.	Phoenix	85009
1210	337122	Trendwood Inc. (15th Ave.)	2402 S. 15th Ave.	Phoenix	85007
1211	337122	Trendwood Inc. (University Dr.)	261 E. University Dr.	Phoenix	85004
819	336399	TRW Vehicle Safety Systems Inc.	11202 E. Germann Rd.	Queen Creek	85242

Table 2.2–2. Name and location of all point sources (continued).

ID #	NAICS	Business name	Address	City	ZIP
169	811111	U Haul Intl. Technical Center	11298 S. Priest Dr.	Tempe	85284
1228	325991	Ultra Installations Inc.	245 S. Mulberry	Mesa	85202
234	311514	United Dairymen of Arizona	2008 S. Hardy Dr.	Tempe	85282
260	212321	United Metro Plant #11	3640 S. 19th Ave.	Phoenix	85009
213	212321	United Metro Plant #12	11920 W. Glendale Ave.	Glendale	85307
403	331316	VAW of America	249 S. 51st Ave.	Phoenix	85043
2	32412	Vulcan Materials Co. (El Mirage)	14521 N. 115th Ave.	El Mirage	85335
90	32732	Vulcan Materials Co. (Phoenix)	4830 S. 43rd Ave.	Phoenix	85041
174	325998	W. R. Meadows of AZ Inc.	2636 S. Sarival Ave.	Goodyear	85338
141	424910	Western Organics Inc.	2807 S. 27th Ave.	Phoenix	85009
4384	321918	Western Shutter LLC	4038 E. Madison St.	Phoenix	85034
2703	42471	Western States Petroleum	450 S. 15th Ave.	Phoenix	85007
20706	32614	Wincup Holdings Inc.	7980 W. Buckeye Rd.	Phoenix	85043
1382	33711	Woodcase Fine Cabinetry Inc. (formerly <i>McCarthy Cabinet Co.</i>)	3255 W. Osborn Rd.	Phoenix	85017
72	337122	Woodstuff Manufacturing Inc.	1635 S. 43rd Ave.	Phoenix	85009

The following point sources are **outside** the PM₁₀ nonattainment area:

ID #	NAICS	Business name	Address	City	ZIP
31606	115111	Acme Gin Co. Inc.	7401 S. Wilson Rd.	Buckeye	85326
1218	562212	Butterfield Station	40404 S. 99th Ave.	Mobile	85239
43063	221112	Duke Energy Arlington Valley LLC	39027 W. Elliot Rd.	Arlington	85322
1488	115111	Farmers Gin Inc.	8400 S. Turner St.	Buckeye	85326
10211		Hexcel Corp. †	1214 W. Gila Bend Hwy.	Casa Grande	85222
725	212321	Kilauea Crushers Inc.	Hwy 74	Wickenburg	85358
98	221113	Palo Verde Nuclear Generating Station	5801 S. Wintersburg Rd.	Tonopah	85354
428	115111	Paloma Gin Properties LLC	I-8	Gila Bend	85337
289	115111	Phoenix Agro Invest Inc.	51040 W. Valley Rd.	Aguila	85320
42956	221112	Pinnacle West Energy Corp.	11600 S. 363rd Ave.	Arlington	85322
10469	221112	SRP Desert Basin Generating Station †	1872 N. Burris Rd.	Casa Grande	85222
398	212321	Wickenburg Facility	44605 Grand Ave.	Wickenburg	85390

† Source is located in Pinal County.

2.3 Procedures for estimating emissions from point sources

2.3.1 Sources with air quality permits issued by Maricopa County Environmental Services Department (MCESD)

Annual and typical daily emission estimates were determined from annual source emission reports, MCESD investigation reports, permit files and logs, or telephone contacts with sources. For most of the sources, material balance methods were used for determining emissions. Emissions were estimated using the emission factors from AP-42, source tests, engineering calculations, or manufacturers' specifications.

MCESD distributes annual emissions survey forms to nearly all facilities for which MCESD has issued an operating permit. Facilities are required to report detailed information on stacks, control devices, operating schedules, and process-level information concerning their annual activities. (See Appendix 2.1 for a copy of the instructions to complete the emissions inventory.) These instructions include examples and explanations on how to complete the annual emissions reporting forms that facilities must submit to MCESD.

After a facility has submitted an annual emissions report to MCESD, emissions inventory staff check all reports for missing and questionable data, and check the accuracy and reasonableness of all emissions calculations with AP-42, the Factor Information and REtrieval (FIRE) software, and other EPA documentation. Control efficiencies are determined by source tests when available, or by AP-42 factors, engineering calculations, or manufacturers' specifications. MCESD has conducted annual emissions surveys for permitted facilities since 1988, and the department's database system, EMS, contains numerous automated quality assurance/quality control checks for data input and processing.

2.3.1.1 Calculation of PM_{2.5} emissions

For all county-permitted sources that submitted an annual emission inventory report, all process-level emissions for PM₁₀, NO_x, SO_x, and NH₃ were calculated for each facility. Actual emissions for these pollutants were calculated using reported emission factors (from AP-42 or source test results) and reflecting any control devices installed. PM_{2.5} was calculated using a variety of methods, depending on the Source Classification Code (SCC) of the process reported:

1. For those SCC's and control device combinations included in EPA's "PM_{2.5} Calculator", this software program was used to calculate PM_{2.5}, using EPA-recommended emission factors and typical control efficiencies.
2. For processes with no PM₁₀ controls, a PM_{2.5}: PM₁₀ ratio was calculated using EPA's software. This ratio was then applied to reported PM₁₀ emissions to calculate PM_{2.5}.
3. For SCCs not included in EPA's PM_{2.5} Calculator, emission factors for PM_{2.5} published by the California Air Resources Board (CARB, 2004) were used where available.
4. For all other processes (where none of the above resources provided guidance), PM_{2.5} was assumed equal to PM₁₀ as a conservative estimate.

2.3.1.2 Application of rule effectiveness

Rule effectiveness reflects the actual ability of a regulatory program to achieve the emission reductions required by regulation. The concept of applying rule effectiveness in a SIP emission inventory has evolved from the observation that regulatory programs may be less than 100 percent effective for some source categories. Rule effectiveness (RE) is applied to those sources affected by a regulation and for which emissions are determined by means of emission factors and control efficiency estimates. As a default, a rule effectiveness of 80 percent has been applied to those sources that calculated NO_x emissions using control device capture and control estimates. Following EPA guidance (US EPA, 2003b), rule effectiveness was not considered for processes that produce PM.

The following sections illustrate how emission estimates were obtained for the Maricopa County-permitted sources listed in Table 2.2-2.

2.3.1.3 Example 1: United Metro Materials Plant #11

United Metro Materials Inc. operates a concrete batch plant. The firm provided the following information used to calculate emissions from truck loading (truck mix):

Calculation of annual PM₁₀ emissions from truck loading:

$$\begin{aligned}\text{Annual PM}_{10} \text{ emissions (lbs)} &= \text{Annual tons of material processed} \times \text{AP-42 emission factor} \\ &= 365,448 \text{ tons/yr} \times 0.051 \text{ lb PM}_{10} / \text{tons material processed} \\ &= 18,638 \text{ lbs PM}_{10}/\text{yr}\end{aligned}$$

Calculation of annual PM_{2.5} emissions:

EPA's "PM_{2.5} Calculator" software showed an uncontrolled PM_{2.5}: PM₁₀ ratio of 0.2941 for SCC 30501110, truck mix loading. This ratio was used to derive annual PM_{2.5} emissions from concrete batch plants:

$$\begin{aligned}\text{Annual PM}_{2.5} \text{ emissions (lbs)} &= \text{Annual PM}_{10} \text{ emissions} \times \text{PM}_{2.5}: \text{PM}_{10} \text{ ratio} \\ &= 18,638 \text{ lbs PM}_{10}/\text{yr} \times 0.2941 \\ &= 5,481 \text{ lbs PM}_{2.5}/\text{yr}\end{aligned}$$

Calculation of typical daily emissions:

United Metro Materials Inc. provided seasonal operating data for each piece of equipment. Typical daily emissions are calculated based on the daily and annual operating schedule, as follows:

$$\begin{aligned}\text{Typical daily emissions} &= \text{Annual emissions} \div (\text{days/week} \times \text{weeks/year}) \\ (\text{lbs/day}) &= 5,481 \text{ lbs PM}_{10}/\text{yr} \div (6 \text{ days/wk} \times 52 \text{ wks/yr}) \\ &= 17.6 \text{ lbs PM}_{10}/\text{day}\end{aligned}$$

2.3.1.4 Example 2: 23rd Ave. Wastewater Treatment Plant

One of the processes at this municipal wastewater treatment plant is a natural-gas powered aeration blower engine, with a catalytic converter. The example below demonstrates the steps involved in calculating emissions and the application of rule effectiveness.

$$\begin{aligned}\text{Uncontrolled emissions (lbs/yr)} &= \text{Fuel usage} \times \text{emission factor} \\ &= 0.31 \text{ MMCF/yr} \times 3,360 \text{ lbs NO}_x/\text{MMCF} \\ &= 1,041.6 \text{ lb NO}_x/\text{yr}\end{aligned}$$

Uncontrolled emissions from many processes can be reduced in a number of ways, including installation of a control device to capture and control pollutants. This process uses a catalytic converter to control NO_x emissions. From the reported specifications of the control device (derived from source testing), total controlled emissions are calculated as follows:

$$\begin{aligned}\text{Controlled emissions (lbs/yr)} &= \text{Uncontrolled emissions} \times [1 - \% \text{ capture efficiency} \times \% \text{ control effectiveness}] \\ &= 1,041.6 \text{ lbs} \times [1 - (100\% \text{ capture} \times 99.4\% \text{ control})] \\ &= 1,041.6 \times 0.006 \\ &= 6.2 \text{ lbs NO}_x / \text{yr}\end{aligned}$$

This total was reported on the facility's annual emissions inventory as actual NO_x emissions from this process. In developing the SIP inventory, rule effectiveness (RE) is applied to the reported control device efficiency, following EPA guidelines. As described in Section 2.3.1.2, the EPA default value of 80% RE was applied to this process. Thus the total annual emissions including RE was calculated as:

$$\begin{aligned}
 \text{Annual emissions reflecting RE} &= \text{Uncontrolled emissions} \times [1 - (\text{RE \%} \times \text{capture/control efficiency})] \\
 &= 1,041.6 \text{ lbs NO}_x/\text{yr} \times [1 - (80\% \times 100\% \times 99.4\%)] \\
 &= 1,041.6 \times 0.2048 \\
 &= 213.3 \text{ lbs NO}_x/\text{yr}
 \end{aligned}$$

Calculation of typical daily emissions:

Typical daily emissions were derived from annual emissions, using operating schedule data as follows:

$$\begin{aligned}
 \text{Typical daily emissions (lbs/day)} &= \text{Annual emissions} \div (\text{days/week} \times \text{weeks/year}) \\
 &= 213.3 \text{ lbs/yr} \div (7 \text{ days/wk} \times 52 \text{ wks/yr}) \\
 &= 0.6 \text{ lbs NO}_x/\text{day}
 \end{aligned}$$

2.3.2 Sources with air quality permits issued by Pinal County Air Quality Control District

Air quality officials from the Arizona Dept. of Environmental Quality and the Pinal County Air Quality Control District were contacted to determine if there were any point sources operating within a 25-mile boundary of the PM₁₀ nonattainment area. ADEQ representatives confirmed that there were no major sources operating in the Yavapai and Gila county portions of this 25-mile boundary, while Pinal County provided annual emissions data for two facilities (included in Table 2.2–2) that met the point source definition.

2.4 Detailed overview of point source emissions

2.4.1 Point source emissions by geographic location

Table 2.4–1 provides a summary of annual and typical daily emissions from all point sources, within and outside the PM₁₀ nonattainment area. Sources for which rule effectiveness has been applied (for NO_x emissions) are noted. Values of “0.00” and “0.0” for annual and daily emissions denote a value below the level of significance (0.005 tons/yr and 0.05 lbs/day, respectively).

Table 2.4–1. Annual and typical daily point source emissions, by facility.

Facilities inside the PM₁₀ nonattainment area:

ID # Business name	Annual (tons/yr)					Typical day (lbs/day)				
	PM ₁₀	PM _{2.5}	SO _x	NO _x	NH ₃	PM ₁₀	PM _{2.5}	SO _x	NO _x	NH ₃
1074 23rd Ave. Wastewater Treatment Plt. *	2.10	1.82	4.77	9.89	0.03	11.5	10.0	26.2	54.4	0.1
1075 91st Ave. Wastewater Treatment Plant	7.31	5.13	23.43	12.02		41.9	29.7	128.7	126.7	
245 A. F. Lorts Company Inc.	5.42	5.28	0.00	0.01	0.00	52.1	50.8	0.0	0.1	0.0
1952 Adesa Phoenix LLC	0.00	0.00	0.00	0.01	0.00	0.0	0.0	0.0	0.1	0.0
1874 Alleco Stone LLC	12.81	4.91	1.19	18.07		81.1	31.1	7.6	115.8	
35541 Allied Tube & Conduit Corp.	0.03	0.03	0.00	0.39	0.01	0.2	0.2	0.0	2.7	0.1

* = Source for which rule effectiveness has been applied.

Table 2.4–1. Annual and typical daily point source emissions, by facility (continued).

ID #	Business name	Annual (tons/yr)					Typical day (lbs/day)				
		PM ₁₀	PM _{2.5}	SO _x	NO _x	NH ₃	PM ₁₀	PM _{2.5}	SO _x	NO _x	NH ₃
31643	Allied Waste Industries Inc.	11.67	10.03	0.27	4.11		74.8	64.3	1.7	26.3	
199	Ameron Intl. Water Transmission Grp.	2.66	1.12	0.06	1.24	0.01	22.1	10.1	2.0	33.1	0.1
292	Anabolic Laboratories	1.03	0.01	0.00	0.14	0.00	7.9	0.1	0.0	1.1	0.0
31637	Anderson Clayton Corp. Valencia Gin	13.32	0.90	0.00	0.41		73.2	4.9	0.0	2.3	
3313	APS West Phoenix Power Plant	42.24	41.36	3.91	1,041.12	26.91	232.1	227.2	21.5	5,720.5	147.8
3938	Arizona Galvanizing Inc.	9.03	3.76	0.22	5.84	0.10	69.0	28.5	1.7	38.9	0.5
4364	Arizona State University	1.37	1.37	0.11	13.55	0.09	7.5	7.5	0.6	74.4	0.5
43124	Bonded Logic Inc.	9.49	9.48	0.00	0.20	0.01	73.0	72.9	0.0	1.5	0.0
458	Bryant Industries Inc.	0.01	0.00				0.1	0.0			
217	Building Products Co.	12.98	4.46	10.77	5.03	0.01	73.5	25.4	59.2	28.1	0.0
3442	Caljet				0.86					4.7	
60598	Case Furniture & Design LLC	0.05	0.02				0.3	0.1			
1316	Cavco Industries LLC (Durango Plant)	0.01	0.00				0.1	0.0			
1318	Cavco Industries LLC (Goodyear)	0.15	0.05				1.2	0.4			
1317	Cavco Industries LLC (Phoenix)	0.01	0.00				0.1	0.0			
4145	Cave Creek School District	0.10	0.09	0.02	22.73		0.7	0.7	0.2	174.9	
1267	Cemex Mesa Plants #61 & #71	8.32	2.89	0.33	31.25		46.0	15.9	1.8	171.7	
1266	Cemex USA (Phoenix)	11.86	3.61				65.5	19.9			
1268	Cemex USA (Sun City)	7.31	2.29				40.3	12.6			
1310	Century Graphics LLC *	0.00	0.00	0.00	0.04	0.00	0.0	0.0	0.0	0.3	0.0
1426	Cesar Color Inc.	0.04	0.04	0.00	0.48	0.05	0.3	0.3	0.0	3.7	0.4
4401	Chandler Ready Mix Inc.	6.46	1.94				35.5	10.7			
51073	Charles Schwab & Co Inc.	0.12	0.11	1.13	12.67		0.7	0.6	6.2	69.6	
3976	Cholla Custom Cabinets Inc.	0.08	0.03	0.00	0.09		0.6	0.2	0.0	0.7	
4083	Chris Fischer Productions Inc.	0.13	0.04				1.0	0.3			
399	Coreslab Structures (Ariz) Inc.	5.57	1.70				42.8	13.1			
1198	Courier Graphics Corp.	0.02	0.02	0.00	0.24	0.01	0.1	0.1	0.0	1.5	0.0
4368	Craftsmen in Wood Mfg.	0.12	0.13	0.00	0.08	0.00	0.9	1.0	0.0	0.6	0.0
4023	Creative Shutters Inc.	0.00	0.00				0.0	0.0			
1389	DaimlerChrysler AZ Proving Grounds	230.09	35.28	0.00	0.10		1,264.2	193.9	0.0	0.9	
130	Dolphin Inc.	8.13	7.64	0.04	2.05	0.07	63.9	59.9	0.3	15.8	0.5
508	Eagle Industries LLC	0.54	0.23	0.00	0.03	0.00	4.1	1.8	0.0	0.2	0.0
3305	Earthgrains Baking Companies Inc.	0.14	0.14	0.01	1.82	0.06	0.9	0.9	0.1	11.6	0.4
26	Empire Machinery Co.	0.87	0.84	0.48	39.28	0.03	5.6	5.3	3.4	227.1	0.2
1505	Executive Door	0.08	0.02				0.6	0.2			
27728	Flip Chip Division	0.03	0.03	0.00	0.33	0.16	0.1	0.1	0.0	1.8	0.9
41751	GCR Truck Tire Center	3.21	2.28				24.7	17.5			
4050	General Mills	0.11	0.06	0.00	0.80	0.03	0.7	0.4	0.0	5.1	0.2
4173	Glendale Municipal Sanitary Landfill	26.30	8.08	0.16	4.77		168.6	51.8	1.1	30.6	
781	Good Samaritan Regional Medical Ctr.	1.90	1.79	1.51	26.97	0.05	16.2	15.2	13.7	229.7	0.3
1418	Goodrich Aircraft Interior Products *	0.06	0.05	0.01	0.59	0.01	0.5	0.4	0.1	4.6	0.1
36772	GTI Capital Holdings LLC	5.39	1.29				34.6	8.3			
699	Hanson Aggregates of Arizona Inc.	34.00	13.83				251.1	96.0			
31565	Henry Products Inc.	0.04	0.04	0.00	0.58	0.02	0.3	0.3	0.0	4.4	0.1
529	Highland Products Inc.	0.10	0.10	0.01	1.37	0.04	0.8	0.8	0.1	10.5	0.3
3536	Holsum Bakery Inc.	0.25	0.25	0.02	3.30	0.11	1.9	1.9	0.2	25.3	0.8
3802	Holsum Bakery Tempe	0.08	0.08	0.01	1.06	0.03	0.6	0.6	0.1	8.1	0.3
1059	Honeywell Engines Systems & Service	0.48	0.48	0.48	1.48	0.03	3.0	3.0	3.1	8.6	0.2
355	Honeywell International Inc.	3.12	3.11	10.98	56.23	0.76	17.1	17.1	60.3	309.0	4.8
354	Imsamet of Arizona	13.92	12.40	0.04	15.76		76.5	68.1	0.2	86.6	
777	Insulfoam	0.08	0.08	0.01	1.11	0.04	0.5	0.5	0.0	7.1	0.2
3966	Intel Corp. Ocotillo (Fab 12 & 22) *	2.64	1.94	0.46	21.49	2.91	27.1	13.8	14.2	295.3	29.0
983	Isola Laminate Systems Corp.	0.49	0.46	0.02	22.03	0.12	3.1	2.9	0.1	141.2	0.8
3317	Kyrene Generating Station	11.70	11.59	1.86	119.15	0.82	64.3	63.7	10.2	654.6	4.5
341	L & M Laminates & Marble	0.03	0.01				0.2	0.1			
4182	Legends Furniture Inc.	0.18	0.09				1.7	0.8			
3300	Luke Air Force Base	2.35	2.32	2.35	11.10	0.02	17.2	16.9	18.0	72.9	0.1
744	M. E. Global Inc.	17.49	15.27	15.91	40.96	0.15	131.7	115.3	122.4	309.5	1.0
1248	Maax Spas	1.13	0.78				8.7	6.0			

* = Source for which rule effectiveness has been applied.

Table 2.4–1. Annual and typical daily point source emissions, by facility (continued).

ID #	Business name	Annual (tons/yr)					Typical day (lbs/day)				
		PM ₁₀	PM _{2.5}	SO _x	NO _x	NH ₃	PM ₁₀	PM _{2.5}	SO _x	NO _x	NH ₃
31261	Madison Granite Supplies	6.65	2.74	12.47	23.65		51.1	21.1	96.0	181.9	
205	Mail-Well Envelope	0.06	0.06	0.01	0.85	0.00	0.4	0.4	0.0	5.4	0.0
353	Marlam Industries Inc.	1.12	0.82	0.00	0.03	0.00	8.6	6.3	0.0	0.2	0.0
61268	Master Block Inc.	5.22	1.61	0.00	0.26		39.3	12.1	0.0	1.7	
62	Mastercraft Cabinets Inc.	0.05	0.02	0.00	0.15	0.00	0.5	0.2	0.0	1.5	0.0
3326	Mesa Fully Formed Inc.	0.08	0.05				0.6	0.4			
1414	Mesa Materials Inc. (Mesa)	8.57	5.50	5.60	5.96	0.01	65.9	42.3	43.1	45.9	0.1
1415	Mesa Materials Inc. (Phoenix)	8.28	4.50	3.86	4.11	0.00	63.7	34.6	29.7	31.6	0.0
29474	Metal Management Arizona Inc	25.53	12.38	0.05	0.74		163.6	79.3	0.3	4.7	
1203	Microchip Technology Inc. (Chandler)*	0.26	0.22	0.02	2.37	0.10	1.5	1.3	0.2	14.1	0.6
1875	Microchip Technology Inc. (Tempe) *	1.14	0.81	0.03	4.30	0.29	6.5	4.7	0.4	27.2	1.6
226	Monier Lifetile LLC	0.68	0.25	0.01	0.94	0.11	4.4	1.6	0.0	6.0	0.7
882	Morton Salt Glendale Facility	3.42	2.35	0.56	10.21	0.02	27.7	18.5	4.3	78.6	0.2
881	Motorola Inc.	0.90	0.86	0.68	5.68	0.54	7.0	6.6	24.4	95.4	3.0
223	MTD Southwest Inc.	0.44	0.27	0.06	1.53	0.00	3.4	2.1	0.5	11.8	0.0
693	Munters Corp.	0.18	0.14	0.00	0.17	0.01	1.4	1.1	0.0	1.3	0.0
34197	National Gypsum Co.	8.13	3.77	12.27	19.53	0.61	56.5	25.2	79.0	127.6	3.9
1309	New Directions Inc.	0.04	0.01				0.3	0.1			
1879	Northwest Regional Landfill	16.71	14.55	0.44	6.59		107.1	93.3	2.8	42.2	
1331	Oak Canyon Manufacturing Inc.	0.18	0.13				1.4	1.0			
3953	Oakcraft Inc.	0.09	0.14	0.00	0.08	0.00	0.7	1.0	0.0	0.6	0.0
27925	Oasis Bedroom Co.	0.06	0.03				0.4	0.3			
52382	Ocotillo Power Plant	17.37	17.01	1.22	260.57	5.45	95.5	93.4	6.7	1,431.7	29.9
3970	Pacific Designs	0.10	0.03				0.8	0.3			
733	Pan-Glo West	0.06	0.06	0.00	0.75	0.02	0.4	0.4	0.0	5.7	0.2
1341	Penn Racquet Sports Inc.	1.33	1.33	0.03	4.62	0.14	10.2	10.2	0.2	35.6	1.1
1014	Phoenix Brick Yard	24.60	11.42	25.97	10.17		136.5	63.8	142.7	55.9	
562	Phoenix Newspapers Inc.	0.02	0.02	0.00	0.61	0.00	0.1	0.1	0.0	14.8	0.0
148	Presto Casting Co.	0.16	0.15	0.76	1.18	0.04	1.2	1.1	5.8	9.1	0.3
60889	Purcells Western States Tire	7.60	7.60	0.00	0.18	0.01	58.4	58.4	0.0	1.4	0.0
1030	Quebecor World Phoenix Division	0.12	0.12	0.01	1.76	0.05	0.8	0.8	0.1	11.3	0.3
44182	Quincy Joist Company	0.43	0.43				3.3	3.3			
537	Red Mountain Mining Inc.	12.94	4.26	0.44	6.64		92.5	30.6	3.4	51.1	
1503	Redman Homes Inc.	0.01	0.00				0.1	0.0			
303	Rexam Beverage Can Company	0.39	0.39	0.03	5.11	0.16	2.1	2.1	0.2	28.1	0.9
4318	River Ranch Plant	22.85	7.14				175.7	54.9			
	Rogers Corp/Advanced Circuit										
759	Materials	0.13	0.13	0.01	9.07	0.05	0.7	0.7	0.1	49.8	0.3
1437	Sanmina Phoenix Division *	0.14	0.14	0.01	1.83	2.45	0.9	0.9	0.1	11.7	15.7
3315	Santan Generating Station	27.33	27.33	2.44	333.00		150.2	150.2	13.4	1,829.7	
266	Schuff Steel Co.	7.92	2.50	0.23	3.42		50.8	16.0	1.5	21.9	
246	Schult Homes	8.89	8.55				68.4	65.8			
42636	Scottsdale Health Care Hospital	0.24	0.22	0.24	3.11	0.02	1.3	1.2	1.3	17.1	0.1
4175	SFPP LP	0.24	0.24	0.01	5.41		1.3	1.3	0.1	29.7	
70634	Shell Oil / Phoenix Terminal	0.03	0.03	0.00	0.34	0.01	0.1	0.1	0.0	1.8	0.1
27933	Skunk Creek Landfill	38.06	35.52	1.03	1.78		209.1	195.2	5.7	9.8	
31627	South Mountain Gin	8.47	0.84	0.00	0.15	0.00	46.6	4.6	0.0	0.9	0.0
3316	SRP Agua Fria	29.56	29.55	2.51	806.46	11.25	162.4	162.4	13.8	4,431.1	61.8
4131	ST Microelectronics *	0.40	0.40	0.03	5.31	0.17	2.2	2.2	0.2	29.2	0.9
1444	Staco Architectural Roof Tile	0.26	0.08	0.00	0.06	0.00	2.5	0.8	0.0	0.6	0.0
582	Stone Creek Inc.	0.00	0.00				0.0	0.0			
281	Sun State Rock & Materials	4.42	2.03	4.93	24.58		28.3	13.0	31.6	157.6	
101	Sunland Beef Co.	1.88	1.50	0.07	12.15	6.42	11.3	8.9	0.4	68.2	35.3
52471	Superior Lime & Chemical	5.70	0.56				36.5	3.6			
3978	Team Two Design Assoc. Inc.	0.01	0.00				0.0	0.0			
249	The Boeing Company	0.33	0.17	0.01	1.34	0.04	2.5	1.3	0.1	10.3	0.3
232	The Phoenixian Resort	0.45	0.45	0.04	12.44	0.03	2.5	2.5	0.2	68.4	0.1
1102	The Procter & Gamble Mfg. Co.	14.28	12.80	0.01	0.84	0.03	109.9	98.4	0.0	6.4	0.2

* = Source for which rule effectiveness has been applied.

Table 2.4–1. Annual and typical daily point source emissions, by facility (continued).

ID # Business name	Annual (tons/yr)					Typical day (lbs/day)				
	PM ₁₀	PM _{2.5}	SO _x	NO _x	NH ₃	PM ₁₀	PM _{2.5}	SO _x	NO _x	NH ₃
552 Thornwood Furniture Mfg.	9.68	9.65				74.5	74.2			
363 Thunderbird Furniture	0.12	0.04				0.9	0.3			
56 TPAC Division of Kiewit Western Co.	6.04	1.92	0.01	0.96	0.03	46.5	14.8	0.0	7.4	0.2
1210 Trendwood Inc. (15th Ave.)	12.76	4.18				98.1	32.2			
1211 Trendwood Inc. (University Dr.)	0.65	0.51				5.0	3.9			
819 TRW Vehicle Safety Systems Inc	7.53	4.36	0.02	2.24	0.11	46.2	27.5	0.1	12.3	0.6
234 United Dairymen of Arizona	8.04	4.07	0.20	17.78	1.05	44.2	22.4	1.1	97.7	5.8
260 United Metro Plant #11	38.16	11.98	19.48	5.37	0.05	244.6	76.8	124.9	34.4	0.3
27933 Skunk Creek Landfill	38.06	35.52	1.03	1.78		209.1	195.2	5.7	9.8	
31627 South Mountain Gin	8.47	0.84	0.00	0.15	0.00	46.6	4.6	0.0	0.9	0.0
3316 SRP Agua Fria	29.56	29.55	2.51	806.46	11.25	162.4	162.4	13.8	4,431.1	61.8
4131 ST Microelectronics	0.40	0.40	0.03	5.31	0.17	2.2	2.2	0.2	29.2	0.9
1444 Staco Architectural Roof Tile	0.26	0.08	0.00	0.06	0.00	2.5	0.8	0.0	0.6	0.0
582 Stone Creek Inc.	0.00	0.00				0.0	0.0			
281 Sun State Rock & Materials	4.42	2.03	4.93	24.58		28.3	13.0	31.6	157.6	
101 Sunland Beef Co.	1.88	1.50	0.07	12.15	6.42	11.3	8.9	0.4	68.2	35.3
52471 Superior Lime & Chemical	5.70	0.56				36.5	3.6			
3978 Team Two Design Assoc. Inc.	0.01	0.00				0.0	0.0			
249 The Boeing Company	0.33	0.17	0.01	1.34	0.04	2.5	1.3	0.1	10.3	0.3
232 The Phoenician Resort	0.45	0.45	0.04	12.44	0.03	2.5	2.5	0.2	68.4	0.1
1102 The Procter & Gamble Mfg. Co.	14.28	12.80	0.01	0.84	0.03	109.9	98.4	0.0	6.4	0.2
552 Thornwood Furniture Mfg.	9.68	9.65				74.5	74.2			
363 Thunderbird Furniture	0.12	0.04				0.9	0.3			
56 TPAC Division of Kiewit Western Co.	6.04	1.92	0.01	0.96	0.03	46.5	14.8	0.0	7.4	0.2
213 United Metro Plant #12	29.86	12.20	18.96	7.70	0.03	191.4	78.2	121.5	49.4	0.2
403 VAW of America Inc.	11.82	9.92	0.41	11.21	0.43	75.8	63.6	2.7	71.9	2.8
2 Vulcan Materials Co. (El Mirage)	14.34	7.31	8.29	8.13	0.00	103.9	50.3	53.1	52.1	0.0
90 Vulcan Materials Co. (Phoenix)	10.91	3.33				83.6	25.5			
174 W. R. Meadows of AZ Inc.	0.01	0.01	0.00	0.19	0.01	0.2	0.2	0.0	2.4	0.1
141 Western Organics Inc.	22.98	18.58				145.7	117.0			
4384 Western Shutter LLC	0.01	0.00				0.1	0.0			
20706 Wincup Holdings Inc.	1.01	1.01	0.08	13.32	0.43	5.6	5.6	0.4	73.2	2.3
1382 Woodcase Fine Cabinetry Inc.	0.42	0.27				3.3	2.1			
72 Woodstuff Manufacturing Inc.	1.01	0.48	0.00	0.08	0.00	7.8	3.7	0.0	0.6	0.0
Total within the PM₁₀ NAA:	1,036.60	537.26	204.10	3,219.83	62.86	6,501.8	3,403.2	1,316.9	18,582.5	364.5

* = Source for which rule effectiveness has been applied.

Facilities outside the PM₁₀ nonattainment area:

ID # Business name	Annual (tons/yr)					Typical day (lbs/day)				
	PM ₁₀	PM _{2.5}	SO _x	NO _x	NH ₃	PM ₁₀	PM _{2.5}	SO _x	NO _x	NH ₃
31606 Acme Gin Co. Inc.	8.23	0.99	0.00	0.10		52.8	6.4	0.0	0.7	
1218 Butterfield Station	29.01	22.40	0.58	2.49		185.5	143.3	3.3	14.8	
43063 Duke Energy Arlington Valley LLC	8.57	8.18	0.17	17.69	0.20	66.2	63.3	2.3	141.5	1.5
1488 Farmers Gin Inc.	13.70	1.24	0.00	0.75		75.3	6.8	0.0	4.1	
10211 Hexcel Corp.	2.58	2.58	1.19	12.89		19.8	19.8	9.2	99.2	
725 Kilauea Crushers	6.32	2.48				40.5	15.9			
98 Palo Verde Nuclear Generating Station	35.95	30.02	0.72	55.26	10.87	197.5	164.9	3.9	303.6	124.3
428 Paloma Gin Properties LLC	6.85	0.61	0.00	0.09	0.00	43.9	3.9	0.0	0.5	0.0
289 Phoenix Agro Invest Inc.	6.23	1.82	0.00	0.02	0.00	40.0	11.7	0.0	0.1	0.0
42956 Pinnacle West Energy Corp.	23.36	22.16	4.15	69.80	49.16	128.3	121.7	22.8	383.5	270.1
10469 SRP Desert Basin Generating Station	100.50	100.50	7.70	135.40		552.2	552.2	42.3	744.0	
398 Wickenburg Facility	5.29	2.07	0.48	7.25		40.1	15.6	3.7	55.8	
Total outside PM₁₀ NAA:	246.59	195.06	14.99	301.72	60.23	1,442.1	1,125.5	87.4	1,747.6	396.0
Grand Total:	1,283.19	732.31	219.10	3,521.55	123.10	7,943.9	4,528.7	1,404.3	20,330.2	760.5

2.4.2 Point source emissions by process type

Table 2.4–2 lists annual and typical daily emissions from all point sources addressed in this chapter, listed by process type.

Table 2.4–2. Annual and typical daily point source emissions, by process type.

CATEGORY		Annual (tons/yr)					Typical day (lbs/day)				
ID #	Business name	PM ₁₀	PM _{2.5}	SO _x	NO _x	NH ₃	PM ₁₀	PM _{2.5}	SO _x	NO _x	NH ₃
ELECTRICITY GENERATION:											
Fuel Combustion: Fuel Oil:											
3313	APS West Phoenix Power Plant	0.01	0.01	0.04	0.64		0.0	0.0	0.2	3.5	
43063	Duke Energy Arlington Valley LLC †	0.01	0.01	0.03	0.18		0.4	0.4	1.2	6.8	
3317	Kyrene Generating Station	0.01	0.01	0.02	0.52		0.0	0.0	0.1	2.8	
98	Palo Verde Nuclear Generating Stn. †	0.00	0.00	0.00	0.00		0.0	0.0	0.0	0.0	
3316	SRP Agua Fria	0.04	0.03	0.15	2.49		0.2	0.2	0.8	13.7	
Total Fuel Combustion: Fuel Oil:		0.06	0.06	0.23	3.83		0.7	0.7	2.3	26.8	
Fuel Combustion: Natural Gas:											
3313	APS West Phoenix Power Plant	37.06	37.06	3.87	1,040.48	26.91	203.6	203.6	21.3	5,716.9	147.8
43063	Duke Energy Arlington Valley LLC †	6.32	6.32	0.14	17.51	0.20	48.6	48.6	1.1	134.7	1.5
3317	Kyrene Generating Station	11.07	11.07	1.84	118.63	0.82	60.8	60.8	10.1	651.8	4.5
52382	Ocotillo Power Plant	15.21	15.21	1.22	260.57	5.45	83.6	83.6	6.7	1,431.7	29.9
42956	Pinnacle West Energy Corp. †	16.31	16.31	4.15	69.80	49.16	89.6	89.6	22.8	383.5	270.1
3315	Santan Generating Station	27.33	27.33	2.44	333.00		150.2	150.2	13.4	1,829.7	
3316	SRP Agua Fria	29.52	29.52	2.36	803.97	11.25	162.2	162.2	13.0	4,417.4	61.8
10469	SRP Desert Basin Generating Station †	100.50	100.50	7.70	135.40		552.2	552.2	42.3	744.0	
Total Fuel Combustion: Nat. Gas:		243.32	243.32	23.73	2,779.36	93.78	1,350.8	1,350.8	130.7	15,309.7	515.7
TOTAL: ELECTRICITY GENERATION:		243.38	243.38	23.97	2,783.19	93.78	1,351.5	1,351.5	133.0	15,336.5	515.7
COMMERCIAL/INSTITUTIONAL FUEL COMBUSTION:											
Fuel Oil:											
1074	23rd Ave. Wastewater Treatment Plant	0.00	0.00	0.00	0.12		0.0	0.0	0.0	0.7	
1075	91st Ave. Wastewater Treatment Plant	0.06	0.05	0.01	1.97		2.1	1.8	0.1	71.6	
4364	Arizona State University	0.00	0.00	0.00	0.09		0.0	0.0	0.0	0.5	
4145	Cave Creek School District	0.02	0.01	0.01	0.23		0.1	0.1	0.1	1.7	
51073	Charles Schwab & Co. Inc.	0.12	0.11	1.13	12.67		0.7	0.6	6.2	69.6	
781	Good Samaritan Regional Medical Ctr.	1.60	1.50	1.49	23.07	0.03	14.5	13.6	13.5	208.3	0.1
3300	Luke Air Force Base	0.17	0.16	0.28	3.11		1.3	1.2	2.2	23.9	
42636	Scottsdale Health Care Hospital	0.15	0.14	0.24	1.99	0.01	0.8	0.7	1.3	10.9	0.1
Total Comm./Inst. Fuel Oil:		2.13	1.98	3.16	43.26	0.04	19.6	18.1	23.4	387.3	0.2
Natural Gas:											
1074	23rd Ave. Wastewater Treatment Plant	0.06	0.06	0.01	1.69	0.03	0.3	0.3	0.0	9.3	0.1
4364	Arizona State University	1.37	1.37	0.11	13.46	0.09	7.5	7.5	0.6	73.9	0.5
4145	Cave Creek School District	0.08	0.08	0.00	22.51		0.6	0.6	0.0	173.1	
781	Good Samaritan Regional Medical Ctr.	0.30	0.30	0.02	3.90	0.02	1.6	1.6	0.1	21.4	0.1
3300	Luke Air Force Base	0.38	0.38	0.03	5.00	0.02	2.1	2.1	0.2	27.5	0.1
42636	Scottsdale Health Care Hospital	0.09	0.09	0.01	1.12	0.01	0.5	0.5	0.0	6.1	0.0
232	The Phoenician Resort	0.45	0.45	0.04	12.44	0.03	2.5	2.5	0.2	68.4	0.1
Total Comm./Inst. Natural Gas:		2.73	2.73	0.22	60.12	0.19	15.2	15.1	1.2	379.8	1.0
Other Fuels:											
3300	Luke Air Force Base	0.02	0.02	0.00	0.51		0.1	0.1	0.0	2.8	
TOTAL: COMMERCIAL/INSTITUTIONAL FUEL COMBUSTION:		4.88	4.72	3.38	103.90	0.23	34.9	33.4	24.6	769.9	1.3

† Source is outside the PM₁₀ nonattainment area.

Table 2.4–2. Annual and typical daily point source emissions, by process type (continued).

CATEGORY		Annual (tons/yr)					Typical day (lbs/day)				
ID #	Business name	PM ₁₀	PM _{2.5}	SO _x	NO _x	NH ₃	PM ₁₀	PM _{2.5}	SO _x	NO _x	NH ₃
INDUSTRIAL FUEL COMBUSTION:											
Industrial Fuel Oil:											
1874	Alleco Stone LLC †	1.27	1.27	1.19	18.07		8.2	8.2	7.6	115.8	
199	Ameron Intl.	0.06	0.05	0.05	0.82		2.1	2.0	2.0	29.9	
3938	Arizona Galvanizing Inc.	0.24	0.22	0.20	3.08		1.8	1.7	1.6	23.7	
1218	Butterfield Station †	0.09	0.08	0.08	1.21		0.5	0.5	0.5	7.7	
1267	Cemex Mesa Plants #61 & #71	0.38	0.35	0.33	31.25		2.1	1.9	1.8	171.7	
26	Empire Machinery Co.	0.41	0.38	0.45	14.08		3.0	2.8	3.2	88.1	
1418	Goodrich Aircraft Interior Products	0.01	0.01	0.01	0.10		0.1	0.0	0.0	0.7	
3966	Intel Corp. Ocotillo (Fab 12 & 22)	0.38	0.10	0.36	5.39	0.39	14.7	3.7	13.7	206.9	15.2
31261	Madison Granite Supplies	1.15	1.08	12.47	23.65		8.8	8.3	96.0	181.9	
1414	Mesa Materials Inc. (Mesa)	4.19	4.18	5.60	5.96	0.01	32.3	32.2	43.1	45.9	0.1
1415	Mesa Materials Inc. (Phoenix)	2.89	2.88	3.86	4.11	0.00	22.2	22.1	29.7	31.6	0.0
29474	Metal Management Arizona Inc.	0.05	0.05	0.05	0.74		0.3	0.3	0.3	4.7	
1203	Microchip Technology Inc. (Chandler)	0.00	0.00	0.00	0.03		0.1	0.1	0.1	1.3	
1875	Microchip Technology Inc. (Tempe)	0.01	0.01	0.01	0.11		0.3	0.3	0.3	4.2	
882	Morton Salt Glendale Facility	1.18	1.10	0.56	9.51		9.1	8.5	4.3	73.1	
881	Motorola Inc.	0.06	0.06	0.63	1.95		2.4	2.2	24.1	74.9	
34197	National Gypsum Co.	0.01	0.01	0.05	0.38		0.1	0.1	0.7	4.9	
1879	Northwest Regional Landfill †	0.47	0.44	0.44	6.59		3.0	2.8	2.8	42.2	
98	Palo Verde Nuclear Generating Stn. †	1.36	1.20	0.71	55.21		7.5	6.6	3.9	303.3	
537	Red Mountain Mining Inc.	0.47	0.44	0.44	6.64		3.6	3.4	3.4	51.1	
266	Schuff Steel Co.	0.24	0.23	0.23	3.42		1.6	1.5	1.5	21.9	
281	Sun State Rock & Materials	1.16	1.09	4.93	24.58		7.5	7.0	31.6	157.6	
260	United Metro Plant #11	0.07	0.02	1.87	0.65	0.03	0.4	0.1	12.0	4.2	0.2
213	United Metro Plant #12	0.08	0.02	2.21	0.77	0.03	0.5	0.1	14.2	4.9	0.2
2	Vulcan Materials Co. (El Mirage)	4.00	4.00	8.29	8.08		25.6	25.6	53.1	51.8	
398	Wickenburg Facility †	0.51	0.48	0.48	7.25		3.9	3.7	3.7	55.8	
Total Industrial Fuel Oil:		20.72	19.73	45.49	233.62	0.46	161.5	145.6	354.9	1,759.8	15.6
Industrial Natural Gas:											
245	A. F. Lorts Company Inc.	0.00	0.00	0.00	0.01	0.00	0.0	0.0	0.0	0.1	0.0
1952	Adesa Phoenix LLC	0.00	0.00	0.00	0.01	0.00	0.0	0.0	0.0	0.1	0.0
35541	Allied Tube & Conduit Corp.	0.03	0.03	0.00	0.39	0.01	0.2	0.2	0.0	2.7	0.1
199	Ameron Intl. Water Transmission Grp.	0.03	0.03	0.00	0.41	0.01	0.2	0.2	0.0	3.2	0.1
292	Anabolic Laboratories	0.01	0.01	0.00	0.14	0.00	0.1	0.1	0.0	1.1	0.0
3938	Arizona Galvanizing Inc.	0.21	0.21	0.02	2.76	0.09	1.2	1.2	0.1	15.2	0.5
43124	Bonded Logic Inc.	0.02	0.01	0.00	0.20	0.01	0.1	0.1	0.0	1.5	0.0
217	Building Products Co.	12.02	4.09	10.77	5.03	0.01	66.1	22.5	59.2	28.1	0.0
1310	Century Graphics LLC	0.00	0.00	0.00	0.04	0.00	0.0	0.0	0.0	0.3	0.0
1426	Cesar Color Inc.	0.04	0.04	0.00	0.48	0.02	0.3	0.3	0.0	3.7	0.1
1198	Courier Graphics Corp.	0.02	0.02	0.00	0.24	0.01	0.1	0.1	0.0	1.5	0.0
4368	Craftsmen in Wood Mfg.	0.01	0.01	0.00	0.08	0.00	0.0	0.0	0.0	0.6	0.0
130	Dolphin Inc.	0.16	0.16	0.01	2.04	0.07	1.2	1.2	0.1	15.7	0.5
508	Eagle Industries LLC	0.00	0.00	0.00	0.03	0.00	0.0	0.0	0.0	0.2	0.0
3305	Earthgrains Baking Companies Inc.	0.14	0.14	0.01	1.82	0.06	0.9	0.9	0.1	11.6	0.4
26	Empire Machinery Co.	0.45	0.45	0.03	25.20	0.03	2.5	2.5	0.2	139.0	0.2
27728	FlipChip International LLC	0.03	0.03	0.00	0.33	0.01	0.1	0.1	0.0	1.8	0.1
4050	General Mills	0.06	0.06	0.00	0.80	0.03	0.4	0.4	0.0	5.1	0.2
1418	Goodrich Aircraft Interior Products	0.03	0.03	0.00	0.46	0.01	0.3	0.3	0.0	3.5	0.1
31565	Henry Products Inc.	0.04	0.04	0.00	0.58	0.02	0.3	0.3	0.0	4.4	0.1
529	Highland Products Inc.	0.10	0.10	0.01	1.37	0.04	0.8	0.8	0.1	10.5	0.3
3536	Holsum Bakery Inc.	0.25	0.25	0.02	3.30	0.11	1.9	1.9	0.2	25.3	0.8
3802	Holsum Bakery Tempe	0.08	0.08	0.01	1.06	0.03	0.6	0.6	0.1	8.1	0.3
1059	Honeywell Engines Systems & Service	0.07	0.07	0.01	0.95	0.03	0.4	0.4	0.0	5.2	0.2
355	Honeywell International Inc.	0.34	0.34	0.03	4.47	0.14	1.9	1.9	0.1	24.6	0.8
777	Insulfoam	0.08	0.08	0.01	1.11	0.04	0.5	0.5	0.0	7.1	0.2
3966	Intel Corp. Ocotillo (Fab 12 & 22)	1.22	1.22	0.10	16.11	0.52	6.7	6.7	0.5	88.5	2.8

† Source is outside the PM₁₀ nonattainment area.

Table 2.4-2. Annual and typical daily point source emissions, by process type (continued).

CATEGORY		Annual (tons/yr)					Typical day (lbs/day)				
ID #	Business name	PM ₁₀	PM _{2.5}	SO _x	NO _x	NH ₃	PM ₁₀	PM _{2.5}	SO _x	NO _x	NH ₃
INDUSTRIAL FUEL COMBUSTION: Natural Gas (cont'd):											
983	Isola Laminate Systems Corp.	0.42	0.41	0.02	22.03	0.12	2.7	2.6	0.1	141.2	0.8
744	M. E. Global Inc.	0.36	0.36	0.03	4.75	0.15	2.4	2.4	0.2	31.0	1.0
205	Mail-Well Envelope	0.06	0.06	0.01	0.85	0.00	0.4	0.4	0.0	5.4	0.0
353	Marlam Industries Inc.	0.00	0.00	0.00	0.03	0.00	0.0	0.0	0.0	0.2	0.0
61268	Master Block Inc.	0.02	0.02	0.00	0.26		0.1	0.1	0.0	1.7	
62	Mastercraft Cabinets Inc.	0.01	0.01	0.00	0.15	0.00	0.1	0.1	0.0	1.5	0.0
1203	Microchip Technology Inc. (Chandler)	0.17	0.17	0.01	2.30	0.07	1.0	1.0	0.1	12.6	0.4
1875	Microchip Technology Inc. (Tempe)	0.32	0.32	0.03	4.19	0.13	1.7	1.7	0.1	23.0	0.7
226	Monier Lifetile LLC	0.07	0.07	0.01	0.94	0.03	0.5	0.5	0.0	6.0	0.2
882	Morton Salt Glendale Facility			0.00	0.68	0.02			0.0	5.2	0.2
881	Motorola Inc.	0.70	0.70	0.06	3.73	0.30	3.9	3.9	0.3	20.5	1.6
223	MTD Southwest Inc.	0.01	0.01	0.00	0.34	0.00	0.1	0.1	0.0	2.6	0.0
693	Munters Corp.	0.01	0.01	0.00	0.17	0.01	0.1	0.1	0.0	1.3	0.0
34197	National Gypsum Co.	1.46	1.46	0.12	19.15	0.61	9.3	9.3	0.7	122.7	3.9
3953	Oakcraft Inc.	0.01	0.01	0.00	0.08	0.00	0.1	0.1	0.0	0.6	0.0
428	Paloma Gin Properties LLC †	0.01	0.01	0.00	0.09	0.00	0.0	0.0	0.0	0.5	0.0
733	Pan-Glo West	0.06	0.06	0.00	0.75	0.02	0.4	0.4	0.0	5.7	0.2
1341	Penn Racquet Sports Inc.	0.35	0.35	0.03	4.62	0.14	2.7	2.7	0.2	35.6	1.1
289	Phoenix Agro Invest Inc. †	0.00	0.00	0.00	0.02	0.00	0.0	0.0	0.0	0.1	0.0
1014	Phoenix Brick Yard	23.99	10.95	25.97	10.17		131.8	60.2	142.7	55.9	
562	Phoenix Newspapers Inc.	0.02	0.02	0.00	0.61	0.00	0.1	0.1	0.0	14.8	0.0
148	Presto Casting Co.	0.09	0.09	0.01	1.14	0.04	0.7	0.7	0.1	8.7	0.3
60889	Purcells Western States Tire	0.01	0.01	0.00	0.18	0.01	0.1	0.1	0.0	1.4	0.0
1030	Quebecor World Phoenix Division	0.12	0.12	0.01	1.76	0.05	0.8	0.8	0.1	11.3	0.3
303	Rexam Beverage Can Company	0.39	0.39	0.03	5.11	0.16	2.1	2.1	0.2	28.1	0.9
759	Rogers Corp. Advanced Circuit Matls.	0.13	0.13	0.01	9.07	0.05	0.7	0.7	0.1	49.8	0.3
1437	Sanmina Phoenix Division	0.14	0.14	0.01	1.83	0.06	0.9	0.9	0.1	11.7	0.4
70634	Shell Oil Phoenix Terminal	0.03	0.03	0.00	0.34	0.01	0.1	0.1	0.0	1.8	0.1
31627	South Mountain Gin	0.01	0.01	0.00	0.15	0.00	0.1	0.1	0.0	0.9	0.0
4131	ST Microelectronics	0.40	0.40	0.03	5.31	0.17	2.2	2.2	0.2	29.2	0.9
1444	Staco Architectural Roof Tile	0.00	0.00	0.00	0.06	0.00	0.0	0.0	0.0	0.6	0.0
101	Sunland Beef Co.	0.92	0.92	0.07	12.15	0.07	5.2	5.2	0.4	68.2	0.4
249	The Boeing Company	0.10	0.10	0.01	1.26	0.04	0.7	0.7	0.1	9.7	0.3
1102	The Procter & Gamble Mfg. Co.	0.06	0.06	0.01	0.84	0.03	0.5	0.5	0.0	6.4	0.2
56	TPAC Division of Kiewit Western Co.	0.07	0.07	0.01	0.96	0.03	0.6	0.6	0.0	7.4	0.2
819	TRW Vehicle Safety Systems Inc.	0.25	0.25	0.02	2.24	0.11	1.4	1.4	0.1	12.3	0.6
234	United Dairymen of Arizona	2.49	2.49	0.20	17.78	1.05	13.7	13.7	1.1	97.7	5.8
260	United Metro Plant #11	0.71	0.71	0.15	4.72	0.02	4.5	4.5	1.0	30.2	0.2
213	United Metro Plant #12	5.30	5.30	0.78	6.93		34.0	34.0	5.0	44.4	
403	VAW of America Inc.	0.73	0.73	0.08	11.04	0.40	4.7	4.7	0.5	70.8	2.6
2	Vulcan Materials Co. (El Mirage)	0.00	0.00	0.00	0.06	0.00	0.0	0.0	0.0	0.3	0.0
174	W. R. Meadows of AZ Inc.	0.01	0.01	0.00	0.19	0.01	0.2	0.2	0.0	2.4	0.1
20706	Wincup Holdings Inc.	1.01	1.01	0.08	13.32	0.43	5.6	5.6	0.4	73.2	2.3
72	Woodstuff Manufacturing Inc.	0.01	0.01	0.00	0.08	0.00	0.1	0.1	0.0	0.6	0.0
Total Industrial Natural Gas:		56.50	35.52	38.82	241.80	5.67	323.2	207.9	214.7	1,464.5	34.2
Industrial Fuel Combustion: Gasoline:											
31643	Allied Waste Industries Inc. †	0.29	0.27	0.27	4.11		1.9	1.8	1.7	26.3	
1418	Goodrich Aircraft Interior Products	0.00	0.00	0.00	0.01		0.0	0.0	0.0	0.1	
882	Morton Salt Glendale Facility	0.00	0.00	0.00	0.02		0.0	0.0	0.0	0.2	
98	Palo Verde Nuclear Generating Stn. †	0.00	0.00	0.00	0.05		0.0	0.0	0.0	0.3	
Total Industrial Gasoline:		0.30	0.28	0.28	4.19		1.9	1.8	1.8	26.9	

† Source is outside the PM₁₀ nonattainment area.

Table 2.4–2. Annual and typical daily point source emissions, by process type (continued).

CATEGORY		Annual (tons/yr)					Typical day (lbs/day)				
ID #	Business name	PM ₁₀	PM _{2.5}	SO _x	NO _x	NH ₃	PM ₁₀	PM _{2.5}	SO _x	NO _x	NH ₃
INDUSTRIAL FUEL COMBUSTION: (cont'd):											
Industrial Fuel Combustion: LPG:											
31606	Acme Gin Co Inc. †	0.00	0.00	0.00	0.10		0.0	0.0	0.0	0.7	
31637	Anderson Clayton Corp. Valencia Gin	0.01	0.01	0.00	0.41		0.1	0.1	0.0	2.3	
3976	Cholla Custom Cabinets Inc.	0.00	0.00	0.00	0.09		0.0	0.0	0.0	0.7	
1389	DaimlerChrysler AZ Proving Ground †	0.00	0.00	0.00	0.10		0.0	0.0	0.0	0.9	
1488	Farmers Gin Inc. †	0.02	0.02	0.00	0.75		0.1	0.1	0.0	4.1	
1418	Goodrich Aircraft Interior Products	0.00	0.00	0.00	0.03		0.0	0.0	0.0	0.2	
Total Industrial LPG:		0.05	0.05	0.00	1.42		0.3	0.3	0.0	8.4	
TOTAL INDUSTRIAL FUEL COMBUSTION:		77.57	55.58	84.59	481.08	6.13	487.0	355.6	571.5	3,260.1	49.8
FOOD/AGRICULTURE:											
Dairies:											
234	United Dairymen of Arizona	5.55	1.59				30.5	8.7			
Ginning:											
31606	Acme Gin Co Inc.	7.76	0.52				49.7	3.3			
31637	Anderson Clayton Corp. Valencia Gin	13.31	0.89				73.1	4.9			
1488	Farmers Gin Inc.	13.00	0.87				71.4	4.8			
428	Paloma Gin Properties LLC	6.24	0.42				40.0	2.7			
289	Phoenix Agro Invest Inc.	0.49	0.03				3.1	0.2			
31627	South Mountain Gin	8.18	0.55				44.9	3.0			
Total Ginning:		48.96	3.26				282.3	18.8			
Grain:											
289	Phoenix Agro Invest Inc.	5.41	1.73				34.7	11.1			
Rendering:											
101	Sunland Beef Co.	0.96	0.58				6.2	3.7			
TOTAL FOOD/AGRICULTURE:		60.89	7.16				353.6	42.4			
INDUSTRIAL PROCESSES:											
Abrasive Blasting:											
199	Ameron Intl. Water Transmission Grp.	0.38	0.36				2.9	2.8			
Asphalt, Concrete And Tile:											
199	Ameron Intl. Water Transmission Grp.	0.25	0.07				1.9	0.6			
217	Building Products Co.	0.19	0.13				1.5	1.0			
1267	Cemex Mesa Plants #61 & #71	1.14	0.44				6.2	2.4			
1266	Cemex USA (Phoenix)	1.22	0.36				6.7	2.0			
1268	Cemex USA (Sun City)	2.64	0.83				14.5	4.6			
4401	Chandler Ready Mix Inc.	3.45	1.01				19.0	5.6			
399	Coreslab Structures (Ariz) Inc.	0.46	0.14				3.6	1.0			
36772	GTI Capital Holdings LLC	1.89	0.55				12.1	3.6			
699	Hanson Aggregates of Arizona Inc.	1.49	0.65				11.5	5.0			
61268	Master Block Inc.	0.45	0.13				2.9	0.9			
226	Monier Lifetile LLC	0.53	0.16				3.4	1.0			
34197	National Gypsum Co.	4.13	1.81	12.10			26.1	11.2	77.5		
1014	Phoenix Brick Yard	0.35	0.21				2.7	1.6			
4318	River Ranch Plant	2.78	0.98				21.4	7.5			
1444	Staco Architectural Roof Tile	0.26	0.08				2.5	0.7			
56	TPAC Division of Kiewit Western Co.	0.41	0.15				3.2	1.1			
260	United Metro Plant #11	10.67	3.13	17.45			68.4	20.1	111.9		
213	United Metro Plant #12	3.48	1.02	15.97			22.3	6.5	102.4		
2	Vulcan Materials Co. (El Mirage)	0.21	0.06				1.6	0.5			
90	Vulcan Materials Co. (Phoenix)	0.41	0.12				3.2	0.9			
398	Wickenburg Facility †	0.36	0.12				2.7	1.0			
Total Asphalt, Concrete And Tile:		36.78	12.15	45.51			237.3	78.6	291.8		

† Source is outside the PM₁₀ nonattainment area.

Table 2.4-2. Annual and typical daily point source emissions, by process type (continued).

CATEGORY		Annual (tons/yr)					Typical day (lbs/day)				
		PM ₁₀	PM _{2.5}	SO _x	NO _x	NH ₃	PM ₁₀	PM _{2.5}	SO _x	NO _x	NH ₃
INDUSTRIAL PROCESSES: Asphalt, Concrete & Tile (cont'd):											
Cooling Towers:											
3313	APS West Phoenix Power Plant	5.17	4.29				28.4	23.6			
43063	Duke Energy Arlington Valley LLC	2.24	1.86				17.2	14.3			
3317	Kyrene Generating Station	0.62	0.51				3.4	2.8			
52382	Ocotillo Power Plant	2.16	1.79				11.9	9.9			
98	Palo Verde Nuclear Generating Stn. †	33.50	27.80				184.1	152.8			
42956	Pinnacle West Energy Corp.	7.05	5.85				38.7	32.1			
819	TRW Vehicle Safety Systems Inc.	4.84	2.90				26.6	16.0			
Total Cooling Towers:		55.58	45.01				310.3	251.4			
Engine Testing:											
1059	Honeywell Engines Systems & Service	0.41	0.41	0.47	0.53		2.6	2.6	3.0	3.4	
355	Honeywell International Inc.	2.77	2.76	10.96	51.76		15.2	15.2	60.2	284.4	
3300	Luke Air Force Base	1.77	1.75	2.04	2.29		13.6	13.5	15.7	17.6	
223	MTD Southwest Inc.	0.07	0.07	0.06	1.19		0.6	0.5	0.5	9.2	
249	The Boeing Company	0.01	0.01		0.08		0.0	0.0		0.6	
Total Engine Testing:		5.03	5.00	13.53	55.85		32.1	31.8	79.4	315.2	
Sand & Gravel:											
1874	Alleco Stone LLC	1.68	0.62				9.8	3.6			
199	Ameron Intl. Water Transmission Grp.	0.00	0.00				0.0	0.0			
217	Building Products Co.	0.64	0.20				5.0	1.6			
1218	Butterfield Station	5.67	3.56				36.3	22.8			
1267	Cemex Mesa Plants #61 & #71	1.79	0.55				10.1	3.1			
1266	Cemex Usa (Phoenix)	2.75	0.83				15.5	4.7			
1268	Cemex Usa (Sun City)	1.20	0.40				6.7	2.2			
4401	Chandler Ready Mix Inc.	0.32	0.10				1.7	0.5			
399	Coreslab Structures (Ariz) Inc.	0.06	0.02				0.5	0.2			
130	Dolphin Inc.	0.00	0.00				0.0	0.0			
4173	Glendale Municipal Sanitary Landfill	0.63	0.20				4.0	1.3			
36772	GTI Capital Holdings LLC	1.49	0.43				9.6	2.8			
699	Hanson Aggregates of Arizona Inc.	5.98	5.05				35.7	28.5			
354	Imsamet of Arizona	0.04	0.03				0.2	0.1			
725	Kilauea Crushers Inc.	1.88	1.12				12.0	7.2			
31261	Madison Granite Supplies	2.22	0.66				17.0	5.1			
61268	Master Block Inc.	0.16	0.05				1.0	0.3			
1414	Mesa Materials Inc. (Mesa)	1.45	0.42				11.2	3.2			
1415	Mesa Materials Inc. (Phoenix)	1.71	0.49				13.2	3.8			
226	Monier Lifetile LLC	0.08	0.02				0.5	0.1			
882	Morton Salt Glendale Facility	2.05	1.22				17.2	9.8			
34197	National Gypsum Co.	0.75	0.23				9.6	2.9			
1879	Northwest Regional Landfill	2.84	1.78				18.2	11.4			
1014	Phoenix Brick Yard	0.01	0.01				0.1	0.1			
537	Red Mountain Mining Inc.	4.26	1.30				25.8	7.8			
4318	River Ranch Plant	10.66	3.39				82.0	26.1			
266	Schuff Steel Co.	6.52	1.92				41.8	12.3			
281	Sun State Rock & Materials	2.35	0.66				15.1	4.2			
249	The Boeing Company	0.00	0.00				0.0	0.0			
56	TPAC Division of Kiewit Western Co.	0.01	0.01				0.1	0.0			
260	United Metro Plant #11	5.06	1.48				32.5	9.5			
213	United Metro Plant #12	4.22	1.23				27.0	7.9			
2	Vulcan Materials Co. (El Mirage)	2.17	0.81				15.5	5.4			
90	Vulcan Materials Co. (Phoenix)	1.85	0.56				14.0	5.4			
398	Wickenburg Facility †	0.51	0.27				3.3	1.7			
Total Sand & Gravel:		73.03	29.62				492.1	194.5			

† Source is outside the PM₁₀ nonattainment area.

Table 2.4-2. Annual and typical daily point source emissions, by process type (continued).

CATEGORY		Annual (tons/yr)					Typical day (lbs/day)				
ID #	Business name	PM ₁₀	PM _{2.5}	SO _x	NO _x	NH ₃	PM ₁₀	PM _{2.5}	SO _x	NO _x	NH ₃
INDUSTRIAL PROCESSES (cont'd):											
Unpaved Road Travel:											
31606	Acme Gin Co Inc.	0.47	0.47				3.0	3.0			
1874	Alleco Stone LLC	9.85	3.02				63.2	19.4			
31643	Allied Waste Industries Inc.	11.26	9.63				72.2	61.7			
199	Ameron Intl. Water Transmission Grp.	1.93	0.59				14.9	4.6			
217	Building Products Co.	0.13	0.04				1.0	0.3			
1218	Butterfield Station	22.71	18.38				145.6	117.9			
1267	Cemex Mesa Plants #61 & #71	5.01	1.54				27.5	8.4			
1266	Cemex Usa (Phoenix)	7.89	2.42				43.3	13.3			
1268	Cemex Usa (Sun City)	3.47	1.07				19.1	5.9			
4401	Chandler Ready Mix Inc.	2.70	0.83				14.8	4.5			
399	Coreslab Structures (Ariz) Inc.	5.04	1.55				38.8	11.9			
1389	DaimlerChrysler AZ Proving Grounds	230.09	35.28				1,264.2	193.8			
1488	Farmers Gin Inc.	0.68	0.35				3.7	1.9			
4173	Glendale Municipal Sanitary Landfill	25.64	7.86				164.3	50.4			
36772	GTI Capital Holdings LLC	2.01	0.31				12.9	2.0			
699	Hanson Aggregates of Arizona Inc.	26.52	8.13				204.0	62.6			
725	Kilauea Crushers Inc.	4.44	1.36				28.4	8.7			
31261	Madison Granite Supplies	3.28	1.01				25.3	7.7			
61268	Master Block Inc.	4.59	1.41				35.3	10.8			
1414	Mesa Materials Inc. (Mesa)	2.93	0.90				22.5	6.9			
1415	Mesa Materials Inc. (Phoenix)	3.68	1.13				28.3	8.7			
29474	Metal Management Arizona Inc.	18.87	5.74				121.0	36.8			
882	Morton Salt Glendale Facility	0.19	0.03				1.5	0.2			
34197	National Gypsum Co.	1.78	0.27				11.4	1.8			
1879	Northwest Regional Landfill	13.40	12.33				85.9	79.1			
428	Paloma Gin Properties LLC	0.61	0.19				3.9	1.2			
289	Phoenix Agro Invest Inc.	0.34	0.05				2.2	0.3			
1014	Phoenix Brick Yard	0.24	0.24				1.9	1.9			
537	Red Mountain Mining Inc.	8.22	2.52				63.2	19.4			
4318	River Ranch Plant	9.40	2.77				72.3	21.3			
266	Schuff Steel Co.	1.16	0.36				7.4	2.3			
27933	Skunk Creek Landfill	5.60	3.42				30.8	18.8			
31627	South Mountain Gin	0.28	0.28				1.6	1.6			
281	Sun State Rock & Materials	0.90	0.28				5.8	1.8			
56	TPAC Division of Kiewit Western Co.	5.54	1.70				42.6	13.1			
819	TRW Vehicle Safety Systems Inc.	1.06	0.16				6.1	0.9			
260	United Metro Plant #11	21.66	6.64				138.8	42.6			
213	United Metro Plant #12	16.78	4.63				107.6	29.7			
2	Vulcan Materials Co. (El Mirage)	7.96	2.44				61.2	18.8			
90	Vulcan Materials Co. (Phoenix)	8.64	2.65				66.5	20.4			
141	Western Organics Inc.	0.60	0.18				4.6	1.4			
398	Wickenburg Facility †	3.91	1.20				30.1	9.2			
Total Unpaved Road Travel:		501.47	145.36				3,098.7	926.8			
Other Industrial Processes:											
3442	Caljet				0.86					4.7	
4050	General Mills	0.05	0.00				0.3	0.0			
29474	Metal Management Arizona Inc.	0.15	0.13				0.9	0.8			
881	Motorola Inc.	0.14	0.10				0.7	0.5			
98	Palo Verde Nuclear Generating Station	1.08	1.01			10.87	5.9	5.6			124.3
44182	Quincy Joist Company	0.43	0.43				3.3	3.3			
4175	SFPP LP	0.18	0.18	0.01	4.03		1.0	1.0	0.0	22.1	
101	Sunland Beef Co.					6.35					34.9
249	The Boeing Company	0.23	0.07				1.8	0.5			
141	Western Organics Inc.	22.38	18.39				141.1	115.6			
Total, Other Industrial Processes:		24.64	20.31	0.01	4.89	17.22	155.1	127.3	0.0	26.8	159.2
TOTAL INDUSTRIAL PROCESSES:		696.92	257.81	59.05	60.74	17.22	4,328.5	1,613.2	371.2	340.2	159.2

† Source is outside the PM₁₀ nonattainment area.

Table 2.4-2. Annual and typical daily point source emissions, by process type (continued).

CATEGORY		Annual (tons/yr)					Typical day (lbs/day)				
ID #	Business name	PM ₁₀	PM _{2.5}	SO _x	NO _x	NH ₃	PM ₁₀	PM _{2.5}	SO _x	NO _x	NH ₃
MANUFACTURING PROCESSES:											
Chemicals:											
52471	Superior Lime & Chemical	5.70	0.56				36.5	3.6			
Electrical Equipment:											
27728	FlipChip International LLC					0.15					0.8
355	Honeywell International Inc.					0.62					4.0
1059	Intel Corp. Ocotillo (Fab 12 & 22)	1.03	0.62			2.00	5.7	3.4			11.0
1203	Microchip Technology Inc. (Chandler)	0.08	0.05		0.04	0.03	0.4	0.3		0.2	0.2
1875	Microchip Technology Inc. (Tempe)	0.81	0.49			0.15	4.5	2.7			0.8
881	Motorola Inc.					0.24					1.3
759	Sanmina Phoenix Division					2.39					15.3
Total Electrical Equipment:		1.93	1.16		0.04	5.58	10.6	6.4		0.2	33.4
Fabricated Metal Products:											
3938	Arizona Galvanizing Inc.	8.58	3.33				66.0	25.6			
10211	Hexcel Corp. †	2.58	2.58	1.19	12.89		19.8	19.8	9.2	99.2	
Total Fabricated Metal Products:		11.16	5.91	1.19	12.89		85.9	45.5	9.2	99.2	
Paper Products:											
693	Munters Corp.	0.16	0.13				1.3	1.0			
Pharmaceuticals:											
292	Anabolic Laboratories	1.02	0.00				7.9	0.0			
1102	The Procter & Gamble Mfg. Co.	14.22	12.73				109.4	97.9			
Total Pharmaceuticals:		15.24	12.73				117.2	98.0			
Rubber/Plastic Products:											
41751	GCR Truck Tire Center	3.21	2.28				24.7	17.5			
1418	Goodrich Aircraft Interior Products	0.01	0.01				0.1	0.1			
1248	Maax Spas	0.99	0.74				7.6	5.7			
353	Marlam Industries Inc.	1.12	0.82				8.6	6.3			
3326	Mesa Fully Formed Inc.	0.01	0.01				0.1	0.1			
1341	Penn Racquet Sports Inc.	0.98	0.98				7.5	7.5			
60889	Purcells Western States Tire	7.58	7.58				58.3	58.3			
Total Rubber/Plastic Products:		13.90	12.42				107.0	95.5			
Secondary Metal Products:											
3938	Arizona Galvanizing Inc.					0.01					0.1
130	Dolphin Inc.	7.98	7.48	0.03	0.01		62.7	58.7	0.2	0.1	
354	Imsamet of Arizona	13.88	12.37	0.04	15.76		76.3	68.0	0.2	86.6	
744	M. E. Global Inc.	17.13	14.91	15.89	36.22		129.4	112.9	122.2	278.6	
29474	Metal Management Arizona Inc.	6.46	6.46				41.4	41.4			
148	Presto Casting Co.	0.07	0.06	0.75	0.05		0.5	0.5	5.8	0.3	
403	VAW of America Inc.	11.10	9.19	0.34	0.17	0.03	71.1	58.9	2.2	1.1	0.2
Total Secondary Metal Products:		56.62	50.47	17.05	52.20	0.04	381.4	340.3	130.6	366.7	0.3
Woodworking:											
245	A. F. Lorts Company Inc.	5.42	5.28				52.1	50.8			
458	Bryant Industries Inc.	0.01	0.00				0.1	0.0			
60598	Case Furniture & Design LLC	0.05	0.02				0.3	0.1			
1316	Cavco Industries LLC (Durango Plant)	0.01	0.00				0.1	0.0			
1318	Cavco Industries LLC (Goodyear)	0.15	0.05				1.2	0.4			
1317	Cavco Industries LLC (Phoenix)	0.01	0.00				0.1	0.0			
3976	Cholla Custom Cabinets Inc.	0.07	0.02				0.6	0.2			
4083	Chris Fischer Productions Inc.	0.13	0.04				1.0	0.3			
4368	Craftsmen in Wood Mfg.	0.11	0.11				0.8	0.8			
508	Eagle Industries LLC	0.53	0.23				4.1	1.8			
4023	Creative Shutters Inc.	0.00	0.00				0.0	0.0			
1505	Executive Door	0.08	0.02				0.6	0.2			
341	L & M Laminates & Marble	0.03	0.01				0.2	0.1			
4182	Legends Furniture Inc.	0.18	0.09				1.7	0.8			
1248	Maax Spas	0.14	0.05				1.1	0.4			

† Source is outside the PM₁₀ nonattainment area.

Table 2.4-2. Annual and typical daily point source emissions, by process type (continued).

CATEGORY		Annual (tons/yr)					Typical day (lbs/day)				
ID #	Business name	PM ₁₀	PM _{2.5}	SO _x	NO _x	NH ₃	PM ₁₀	PM _{2.5}	SO _x	NO _x	NH ₃
MANUFACTURING: Woodworking (cont'd.):											
62	Mastercraft Cabinets Inc.	0.04	0.01				0.3	0.1			
3326	Mesa Fully Formed Inc.	0.07	0.04				0.6	0.3			
1309	New Directions Inc.	0.04	0.01				0.3	0.1			
1331	Oak Canyon Manufacturing Inc.	0.18	0.13				1.4	1.0			
3953	Oakcraft Inc.	0.08	0.13				0.6	1.0			
27925	Oasis Bedroom Co.	0.06	0.03				0.4	0.3			
3970	Pacific Designs	0.10	0.03				0.8	0.3			
1503	Redman Homes Inc.	0.01	0.00				0.1	0.0			
246	Schult Homes	0.01	0.00				0.1	0.0			
582	Stone Creek Inc.	0.00	0.00				0.0	0.0			
3978	Team Two Design Assoc. Inc.	0.01	0.00				0.0	0.0			
232	The Phoenician Resort	0.00	0.00				0.0	0.0			
552	Thornwood Furniture Mfg.	9.68	9.65				74.5	74.2			
363	Thunderbird Furniture	0.12	0.04				0.9	0.3			
1210	Trendwood Inc. (15th Ave.)	12.76	4.18				98.1	32.2			
1211	Trendwood Inc. (University Dr.)	0.65	0.51				5.0	3.9			
4384	Western Shutter LLC	0.01	0.00				0.1	0.0			
1382	Woodcase Fine Cabinetry Inc.	0.42	0.27				3.3	2.1			
72	Woodstuff Manufacturing Inc.	1.00	0.48				7.7	3.7			
Total Woodworking:		32.20	21.47				258.4	175.5			
Other Manufacturing:											
43124	Bonded Logic Inc.	9.47	9.47				72.8	72.8			
1426	Cesar Color					0.04					0.3
983	Isola Laminate Systems Corp.	0.07	0.05				0.4	0.3			
226	Monier Lifetile					0.08					0.5
223	Mtd Southwest Inc.	0.36	0.19				2.7	1.5			
246	Schult Homes	8.87	8.55				68.3	65.8			
819	TRW Vehicle Safety Systems Inc.	1.38	1.04				12.1	9.2			
Total Other Manufacturing:		20.14	19.30			0.12	156.4	149.6			0.8
TOTAL MANUFACTURING:		157.06	124.15	18.24	65.13	5.74	1,154.7	915.4	139.7	466.1	34.5
WASTE DISPOSAL:											
Landfills:											
31643	Allied Waste Industries Inc. †	0.12	0.12				0.8	0.8			
1218	Butterfield Station †	0.54	0.37	0.50	1.28		3.0	2.0	2.7	7.0	
4173	Glendale Municipal Sanitary Landfill	0.04	0.02	0.16	4.77		0.2	0.2	1.1	30.6	
27933	Skunk Creek Landfill	32.47	32.10	1.03	1.78		178.4	176.4	5.7	9.8	
Total Landfills:		33.17	32.62	1.70	7.83		182.4	179.4	9.5	47.4	
Publicly Owned Treatment Works (POTWs):											
1074	23rd Ave. Wastewater Treatment Plant	2.03	1.76	4.77	8.08		11.2	9.6	26.2	44.4	
1075	91st Ave. Wastewater Treatment Plant	7.24	5.07	23.42	10.04		39.8	27.9	128.7	55.2	
Total POTWs:		9.28	6.83	28.18	18.12		51.0	37.5	154.9	99.6	
Site Remediation:											
3300	Luke Air Force Base				0.18						1.0
4175	SFPP LP	0.06	0.06		1.38		0.3	0.3			7.6
Total Site Remediation:		0.06	0.06		1.56		0.3	0.3			8.6
TOTAL WASTE DISPOSAL:		42.51	39.51	29.88	27.51		233.7	217.2	164.3	155.5	
TOTAL, ALL POINT SOURCES:		1,283.19	732.31	219.10	3,521.55	123.10	7,943.9	4,528.7	1,404.3	20,330.2	760.5

† Source is outside the PM₁₀ nonattainment area.

2.5 Emission reduction credits

A major source or major modification planned in a nonattainment area must obtain emissions reductions as a condition for approval. These emissions reductions, generally obtained from existing sources located in the vicinity of a proposed source, must offset the emissions increase from the new source or modification. The obvious purpose of acquiring offsetting emissions decreases is to allow an area to move towards attainment of the national ambient air quality standards while still allowing some industrial growth.

Table 2.5–1 provides a list of emission reduction credits for PM₁₀, NO_x, and SO_x. Two facilities shut down their equipment prior to 2002 and requested that their emissions continue to be listed in the emission inventory for possible future use as emission reduction credits. A third facility shut down operations in 2002 and received a credit generation certificate for their emissions from the Arizona Emissions Bank.

In order for these emission reductions to be available in the future for offsetting, they must be: 1) explicitly included and quantified as growth in projection year inventories required in rate of progress plans or attainment demonstrations that were based on 1990 actual inventories, and 2) meet the requirements outlined in MCESD Rule 240 (Permit Requirements for New Major Sources and Major Modification to Existing Major Sources).

Table 2.5–1. Emission reduction credits.

Facility	Emission reduction credits (tons)		
	PM ₁₀	NO _x	SO _x
Anderson Clayton Oilseed Plant		6.4	0.03
Motorola (Mesa)	2	12	
The Scottsdale Princess Cogeneration Partnership		98.19	
Totals:	2	116.59	0.03

2.6 Summary of point source emissions

Table 2.6–1 provides an overview of source category contributions to total point source emissions.

Table 2.6–1. Summary of annual and typical daily point source emissions, by source category.

Source Category	Annual (tons/yr)					Typical day (lbs/day)				
	PM ₁₀	PM _{2.5}	SO _x	NO _x	NH ₃	PM ₁₀	PM _{2.5}	SO _x	NO _x	NH ₃
Electricity generation	243.38	243.38	23.97	2,783.19	93.78	1,351.5	1,351.5	133.0	15,336.5	515.7
Comm./inst. fuel combustion	4.88	4.72	3.38	103.90	0.23	34.9	33.4	24.6	769.9	1.3
Industrial fuel combustion	77.57	55.58	84.59	481.08	6.13	487.0	355.6	571.5	3,260.1	49.8
Food/agriculture	60.89	7.16				353.6	42.4			
Industrial processes	696.92	257.81	59.05	60.74	17.22	4,328.5	1,613.2	371.2	342.0	159.2
Manufacturing processes	157.06	124.15	18.24	65.13	5.74	1,154.7	915.4	139.7	466.1	34.5
Waste disposal	42.51	39.51	29.88	27.51		233.7	217.2	164.3	155.5	
ALL POINT SOURCES:	1,283.19	732.31	219.10	3,521.55	123.10	7,943.9	4,528.7	1,404.3	20,330.2	760.5

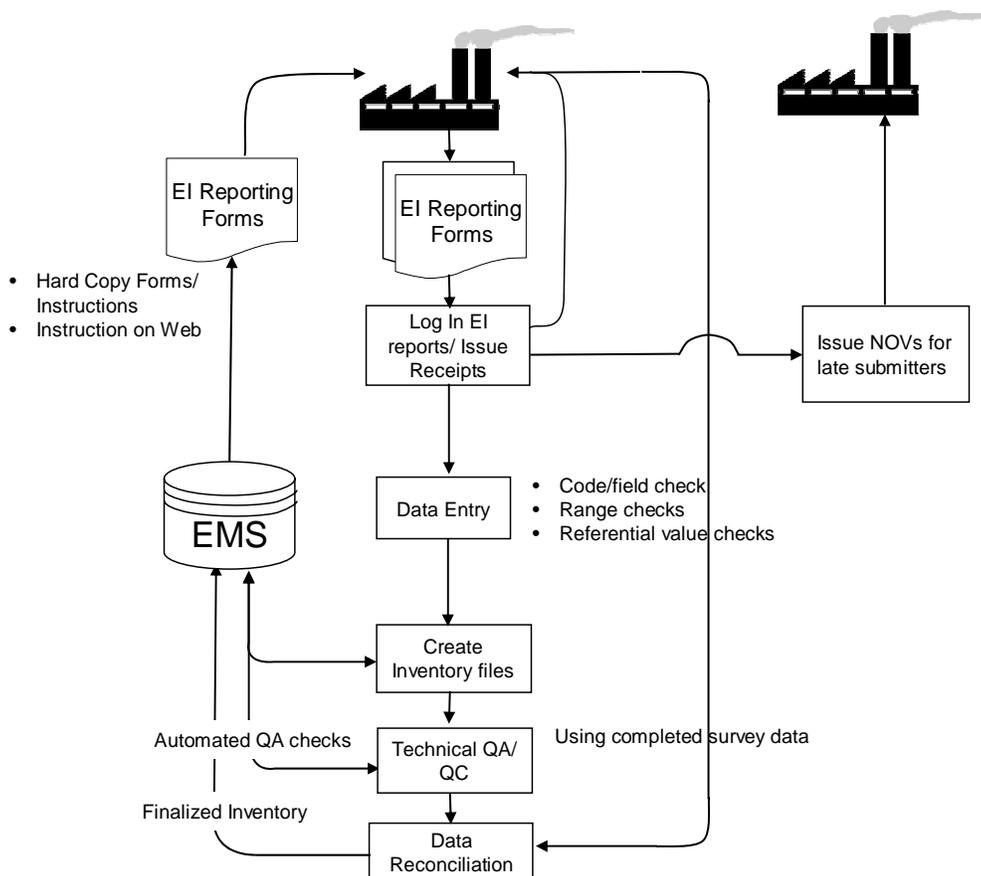
2.7 Quality assurance / quality control procedures

2.7.1 Emission survey preparation and data collection

The MCESD's Emissions Inventory (EI) Unit annually collects point source criteria pollutant emission data from sources in the county. MCESD annually reviews EPA guidance, documents from the Emission Inventory Improvement Program (EIIP), and other source materials to ensure that the most current emission factors and emission calculation methods are used for each year's survey. Each January, the EI Unit prepares a pre-populated hard copy of the preceding year's submissions and mails reporting forms to permitted sources, along with detailed instructions for completing the forms. (A copy of these instructions is included as Appendix 2.1). The EI Unit asks sources to verify and update the data. The EI Unit also holds weekly workshops from January through April to assist businesses in completing EI forms.

The general data flow for data collection and inventory preparation is shown in Figure 2.7-1.

Figure 2.7-1. Data flow for annual point source emission inventory reporting.



2.7.2 Submission processing

Submitted EI reports are logged in as they are received, and receipts are issued for emissions fees paid. The data are input “as received” into the department's data base. During data entry, numerous automated quality control (QC) checks are performed, including:

- pull-down menus to minimize data entry errors (e.g., city, pollutant, emission factor unit, etc.)
- mandatory data field requirement checks (e.g., a warning screen appears if a user tries to save an emission record with a missing emission factor).
- range checks (e.g., were valid SCC, Tier, SIC, and NAICS codes entered?)
- referential value checks (e.g., emission factor units, annual throughput units)
- automatic formatting of date, time, telephone number fields, etc.

Automated quality assurance (QA) checks on the report that has been entered include the following:

- Comparing reported emission factors to SCC reference lists
- Comparing reported emission factors to material name reference list
- Checking the report for calculation errors. This includes annual throughput, emission factors, unit conversion factors (e.g., BTU to therms), capture efficiency, primary / secondary control device efficiency, and any offsite recycling credits claimed.
- Checking the report for completeness of required data.

When data entry is complete, an electronic version of the original data is preserved separately to document changes made during the technical review and QA/QC process.

When errors are flagged, the businesses are contacted and correct information is obtained and input to the EMS. Outstanding reporting issues are documented. Confidential business information (CBI) is identified by a checkbox on the form, and these data elements are flagged during data entry and are not transmitted to the EPA. To prepare the inventory for submittal to the National Emissions Inventory (NEI), the EI Unit runs Microsoft Access queries on the data in the EMS to pull fields for the NEI Input format (NIF) tables.

2.7.3 Analysis of annual point source emissions data for this inventory

Two environmental planners checked inventory accuracy and reasonableness, and assured that all point sources had been identified and that the methodology applied to calculate emissions was appropriate and that the calculations were correct. Other reasonableness checks were conducted by recalculating emissions using methods other than those used to make the initial emissions calculations and then comparing results. QA was conducted by checking all emissions reports submitted to MCESD for the year 2002 for missing and questionable data and by checking the accuracy and reasonableness of all emissions calculations made for such reports. Notes concerning follow-up calls and corrections to calculations were documented on each 2002 annual emissions report.

The QA point source coordinator reviewed and checked calculations, identified errors, and performed completeness, reasonableness and accuracy checks.

2.8 References

- CARB, 2004. Speciation Profiles and Size Fractions. Available at: <http://www.arb.ca.gov/emisinv/speciate/speciate.htm>
- US EPA, 1992. Guidelines for Estimating and Applying Rule Effectiveness for Ozone/CO State Implementation Plan Base Year Inventories. USEPA Office of Air Quality Planning and Standards, Research Triangle Park, NC. Rep. EPA-452/R-92-010, November 1992. Available at: http://www.epa.gov/ttn/chief/old/eidocs/454r92010_nov1992.pdf.
- US EPA, 2003a. 2002 National Emission Inventory (NEI) Preparation Plan (draft). USEPA Office of Air Quality Planning and Standards, Dec. 19, 2003. Available at: <http://www.epa.gov/ttn/chief/net/2002inventory.html>.
- US EPA, 2003b. Emissions Inventory Guidance for Implementation of Ozone and Particulate Matter National Ambient Air Quality Standards (NAAQS) and Regional Haze Regulations. USEPA Office of Air Quality Planning and Standards, Research Triangle Park, NC. Draft Rep. June 2003. Available at: <http://www.epa.gov/ttn/chief/eidocs/eiguid/>.

3. Area Sources

3.1 Scope and methodology

This chapter considers all stationary sources which are too small or too numerous to be treated as point sources. EPA guidance documents, including “Introduction to Area Source Inventory Development” (US EPA, 2001a) as well as permit and emissions data in the MCESD’s Environmental Management System (EMS) database, and previous SIP inventories, were evaluated to develop the list of area-source categories for inclusion. Some source categories were deemed “insignificant” because there are no large production facilities and/or very few small sources, and therefore emissions were not quantified. MCESD prepared the area-source emission estimates for all area sources and provided quality assurance checks on all data. Table 3.1–1 contains a list of all area-source categories, with Source Classification Codes (SCCs), addressed in this chapter.

Table 3.1–1. List of area-source categories.

SCC Code	Category Description	Section
<i>Fuel combustion:</i>		
2102006000	Industrial natural gas	3.2.1
2102004000	Industrial fuel oil	3.2.2
2103006000	Commercial/institutional natural gas	3.2.3
2103004000	Commercial/institutional fuel oil	3.2.4
2104006000	Residential natural gas	3.2.5
2104008000	Residential wood	3.2.6
2104004000	Residential fuel oil	3.2.7
<i>Industrial processes:</i>		
2301010000	Chemical manufacturing	3.3.1
2302002000	Commercial cooking	3.3.2.1
2302040000	Grain handling/processing	3.3.2.2
2302080000	Ammonia cold storage	3.3.2.3
2304000000	Secondary metal production	3.3.3
2305000000	Non-metallic mineral processes	3.3.4
2325000000	Mining and quarrying	3.3.5
2307000000	Wood product manufacturing	3.3.6
2308000000	Rubber/plastics manufacturing	3.3.7
2309000000	Fabricated metal products manufacturing	3.3.8
2311000000	Construction	3.3.9
2312000000	Electrical equipment manufacturing	3.3.10
n/a	State-permitted portable sources	3.3.11
n/a	Paved/unpaved road travel on industrial sites	3.3.12
2399000000	Industrial processes not elsewhere classified	3.3.13
<i>Waste treatment and disposal:</i>		
2601000000	On-site incineration	3.4.1
2610000000	Open burning	3.4.2
2620000000	Landfills	3.4.3
2630000000	Publicly owned treatment works (POTWs)	3.4.4
2650000000	Other industrial waste and disposal	3.4.5
<i>Miscellaneous area sources:</i>		
2810001000	Wildfires and brush fires	3.5.1.1
2810030000	Structure fires	3.5.1.2
2810050000	Vehicle fires	3.5.1.3
2810040000	Engine testing	3.5.1.4
2801000003	Tilling	3.5.2.1

Table 3.1–1. List of area-source categories (continued).

SCC Code	Category Description	Section
<i>Miscellaneous area sources:</i>		
2801000005	Harvesting	3.5.2.2
2801000000	Cotton ginning	3.5.2.3
2801700000	Fertilizer application	3.5.2.4
2805000000	Livestock	3.5.3
2850000000	Health services	3.5.4
2830000000	Accidental releases	3.5.5
2810010000	Humans	3.5.6
2730100000	Windblown dust	3.5.7

For nearly all categories, emissions were calculated in one of the following ways:

- emissions estimates for some categories were developed by conducting surveys on local usage (e.g., natural gas consumption, pesticide usage) or derived from state-wide data (e.g., fuel oil use).
- for some widespread or diverse categories (e.g., consumer solvent use), emissions were calculated using published per-capita or per-employee emission factors.
- for source categories with some information available from annual emissions reports (e.g., bakeries), these data were combined with employment data to “scale up” reported emissions to reflect the entire source category.
- for those source categories with detailed emissions data available from most or all significant sources in the category, emissions were calculated based on detailed process and operational data provided by these sources.
- The specific emissions estimation methodologies used for each source category (including any application of rule effectiveness) are described in greater detail in the respective sections.

3.2 Fuel combustion

Area-source emissions for the following seven categories of fuel consumption were calculated: Industrial natural gas, industrial fuel oil, commercial/institutional natural gas, commercial/institutional fuel oil, residential natural gas, residential wood, and residential fuel oil. Data for emissions calculations from natural gas combustion came from a survey of the four natural gas suppliers in Maricopa County. Table 3.2–1 summarizes the natural gas sales data received from Maricopa County natural gas suppliers.

Table 3.2–1. Maricopa County natural gas sales data by supply company and end-user category.

Natural gas supplier	Sales by end user category (in MMCF/yr)					
	Electric Utilities	Industrial	Commercial/Institutional	Residential	Transport*	Other*
Southwest Gas	n/a	3,092.760	13,774.986	14,842.508	3,802.155	1,977.644
City of Mesa	80.169	386.692	1,486.877	1,112.936	59.924	n/a
El Paso	58,334.169	161.429	n/a	n/a	n/a	n/a
Black Mountain	n/a	n/a	142.561	464.084	n/a	n/a

* For emissions calculations, sales from these two categories were grouped with industrial sales.

Area-source emissions for wood and fuel oil combustion were calculated from Arizona state-level sales and consumption data as described in the following subsections. Area-source emissions from coal and liquid petroleum gas were not calculated, as emissions from these categories were determined to be insignificant.

3.2.1 Industrial natural gas

All natural gas suppliers in Maricopa County were surveyed to gather information on the volume of natural gas distributed, by user category, within the county in 2002. Area-source industrial natural gas usage for the county is based on the reported total volume of natural gas sold to industrial sources, minus natural gas used by industrial point sources:

$$\begin{aligned}
 \text{County area-source industrial natural gas usage} &= \text{Total reported industrial natural gas sales} - \text{Industrial point source natural gas usage} \\
 &= 9,480.60 \text{ MMCF} - 7,929.38 \text{ MMCF} \\
 &= 1,551.23 \text{ MMCF}
 \end{aligned}$$

Natural gas is used for both external combustions (boilers, heaters) and internal combustion (generators), each of which have different emission factors. Thus the area-source natural gas usage derived above must be apportioned between these two categories. This apportionment was based on the percentages of external and internal natural gas combustion reported by all industrial area sources in 2002.

Annual emissions for the county and the PM₁₀ nonattainment area are calculated by multiplying natural gas usage by the respective AP-42 emission factors for external and internal combustion, as in this example for PM₁₀ emissions from external natural gas combustion:

$$\begin{aligned}
 \text{Annual PM}_{10} \text{ emissions from external natural gas combustion} &= \text{External industrial natural gas usage (MMCF)} \times \text{PM}_{10} \text{ emission factor for external natural gas combustion (lb/MMCF)} \div 2,000 \text{ lb/ton} \\
 &= 1,527.09 \times 7.6 \div 2,000 \\
 &= 5.80 \text{ tons PM}_{10}/\text{yr}
 \end{aligned}$$

Table 3.2–2. Emission factors and annual emissions from area-source industrial natural gas combustion, by combustion type.

Combustion type	% of total	Natural gas usage (MMCF)	Emission factors (lb/MMCF)					Annual emissions (tons/yr)				
			PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
External	98.44	1,527.09	7.6	7.6	100	0.6	3.2	5.80	5.80	76.35	0.46	2.44
Internal	1.56	24.14	10.0	10.0	2840	0.6	n/a	0.12	0.12	34.27	0.01	
Total:	100.00	1,551.23						5.92	5.92	110.63	0.47	2.44

Typical daily emissions for the county are calculated by dividing annual emissions by the number of days that activity occurs throughout the year:

$$\begin{aligned}
 \text{PM}_{10} \text{ typical daily emissions from industrial natural gas} &= \text{Annual PM}_{10} \text{ emissions (tons/yr)} \div (\text{days/week} \times \text{wks/yr}) \times 2,000 \text{ lbs/ton} \\
 &= 5.92 \div (6 \times 52) \times 2,000 \\
 &= 38.0 \text{ lbs PM}_{10}/\text{day}
 \end{aligned}$$

Annual and typical daily emissions within the PM₁₀ nonattainment area are calculated by applying the ratio of industrial employment in the nonattainment area to county-level emission calculations. (See Section 1.5.1 for a discussion of the employment data used).

$$\begin{aligned}
 \text{Emissions from area-source industrial natural gas combustion in the PM}_{10} \text{ NAA} &= \text{Annual county PM}_{10} \text{ emissions (tons/yr)} \times \text{NAA:County Industrial employment ratio} \\
 &= 5.92 \times 0.9891 \\
 &= 5.86 \text{ tons PM}_{10}/\text{yr}
 \end{aligned}$$

Table 3.2–3. Annual and typical daily emissions from area-source industrial natural gas combustion.

Geographic area	Annual emissions (tons/yr)					Typical daily emissions (lbs/day)				
	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
Maricopa County	5.92	5.92	110.63	0.47	2.44	38.0	38.0	709.2	3.0	15.7
PM ₁₀ NAA	5.86	5.86	109.42	0.46	2.42	37.6	37.6	701.4	3.0	15.5

3.2.2 Industrial fuel oil

Area-source emissions from industrial fuel oil combustion are calculated by a multi-step process which allocates Arizona state-level industrial fuel oil sales as reported by the U.S. Department of Energy, Energy Information Administration (US DOE, 2002b) to Maricopa County.

To derive industrial fuel oil usage in Maricopa County, reported Arizona state-level sales of high-sulfur diesel for 2002 are first subtracted from Arizona state-level total industrial fuel oil sales, as it is presumed that no high-sulfur diesel fuel is used in Maricopa County due to local air quality regulations and market conditions.

$$\begin{aligned}
 \text{State industrial fuel oil sales other than high-sulfur diesel (in thousand gallons, or Mgal)} &= \text{Reported state total industrial fuel oil sales} - \text{Reported state high-sulfur diesel sales} \\
 &= 61,748 \text{ Mgal} - 34,076 \text{ Mgal} \\
 &= 27,672 \text{ Mgal/yr}
 \end{aligned}$$

Arizona state industrial fuel oil sales (less high-sulfur diesel fuel) are then multiplied by the ratio of industrial employment in Maricopa County to Arizona state (0.71), as determined by data from the US Census Bureau (2003b) to estimate annual Maricopa County-level industrial fuel oil sales, as follows:

$$\begin{aligned}
 \text{Maricopa County industrial fuel oil sales} &= \text{Arizona state industrial fuel oil sales less high-sulfur diesel} \times \text{Maricopa County:state industrial employment ratio} \\
 &= 27,672 \text{ Mgal} \times 0.71 \\
 &= 19,647.12 \text{ Mgal/yr}
 \end{aligned}$$

To avoid double-counting, industrial fuel oil use attributable to stationary point sources (addressed in Chapter 2) and nonroad mobile sources (addressed in Chapter 4) are subtracted from County industrial fuel oil sales to estimate county fuel oil usage by area sources:

$$\begin{aligned}
 \text{Maricopa County area source fuel oil sales} &= \text{Maricopa County industrial fuel oil sales} - \text{Fuel oil used by industrial nonroad mobile equipment} - \text{Fuel oil used by industrial stationary point sources} \\
 &= 19,647.12 \text{ Mgal} - 7,365.927 \text{ Mgal} - 2,021.10 \text{ Mgal} \\
 &= 10,260.097 \text{ Mgal/yr}
 \end{aligned}$$

Industrial fuel oil is used for both external combustions (boilers, heaters) and internal combustion (generators), each of which have different emission factors. Thus the area-source industrial fuel oil sales derived above must be apportioned between these two categories. This apportionment was based on the percentages of external and internal fuel oil combustion reported by all industrial area sources surveyed by MCESD in 2002 (shown in Table 3.2–4 below).

Annual emissions for the county and the PM₁₀ nonattainment area are calculated by multiplying industrial fuel oil sales by the respective AP-42 emission factors for external and internal combustion, as in this example for PM₁₀ emissions from external fuel oil combustion:

$$\begin{aligned}
 \text{Annual PM}_{10} \text{ emissions from external industrial fuel oil combustion} &= \text{External industrial fuel oil sales (Mgal)} \times \text{PM}_{10} \text{ emission factor for external fuel oil combustion (lb/Mgal)} \div 2,000 \text{ lb/ton} \\
 &= 8,003.949 \times 2 \div 2,000 \\
 &= 8.00 \text{ tons PM}_{10}/\text{yr}
 \end{aligned}$$

Table 3.2–4. Emission factors and annual emissions from area-source industrial fuel oil combustion, by combustion type.

Combustion type	% of total	Annual sales (Mgal)	Emission factors (lb/Mgal)					Annual emissions (tons/yr)				
			PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
External	78.01	8,003.949	2	2	24	7.39	0.8	8.00	8.00	96.05	29.55	3.20
Internal	21.99	2,256.147	42.5	42.5	604	39.7	–	47.94	47.94	681.36	44.78	0.00
Totals:	100.00	10,260.097						55.95	55.95	777.40	74.34	3.20

Typical daily emissions for the county are calculated by dividing annual emissions by the number of days activity that occurs throughout the year, as recommended by EIIP guidance (US EPA, 2001a):

$$\begin{aligned}
 \text{PM}_{10} \text{ typical daily emissions from industrial fuel oil} &= \text{Annual PM}_{10} \text{ emissions (tons/yr)} \div (\text{days/week} \times \text{wks/yr}) \times 2,000 \text{ lbs/ton} \\
 &= 55.95 \div (6 \times 52) \times 2,000 \\
 &= 358.6 \text{ lbs PM}_{10}/\text{day}
 \end{aligned}$$

Annual and typical daily emissions in the PM₁₀ nonattainment area are calculated by applying the ratio of industrial employment in the nonattainment area to county-level emission calculations. (See Section 1.5.1 for a discussion of the employment data used).

$$\begin{aligned}
 \text{PM}_{10} \text{ NAA emissions from area source industrial fuel oil combustion} &= \text{Annual county PM}_{10} \text{ emissions} \times \text{NAA:County industrial employment ratio} \\
 &= 55.95 \text{ tons/yr} \times 0.9891 \\
 &= 55.34 \text{ tons PM}_{10}/\text{yr}
 \end{aligned}$$

Table 3.2–5. Annual and typical daily emissions from area-source industrial fuel oil combustion.

Geographic area	Annual emissions (tons/yr)					Typical daily emissions (lbs/day)				
	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
Maricopa County	55.95	55.95	777.40	74.34	3.20	358.6	358.6	4,983.4	476.5	20.5
PM ₁₀ NAA	55.34	55.34	768.93	73.53	3.17	354.7	354.7	4,929.0	471.3	20.3

3.2.3 Commercial/institutional natural gas

All natural gas suppliers in Maricopa County were surveyed to gather information on the volume of natural gas distributed, by user category, within the county in 2002. Area-source commercial and institutional (C&I) natural gas usage for the county is based on the reported total volume of natural gas sold to C&I sources, minus natural gas used by C&I point sources:

$$\begin{aligned}
 \text{County area-source C\&I natural gas usage} &= \text{Reported C\&I natural gas sales} - \text{C\&I point source natural gas usage} \\
 &= 15,404.42 \text{ MMCF} - 725.35 \text{ MMCF} \\
 &= 14,679.07 \text{ MMCF}
 \end{aligned}$$

Natural gas is used for both external combustion (boilers, heaters) and internal combustion (generators), each of which have different emission factors. Thus the area-source natural gas usage derived above must be apportioned between these two categories. This apportionment was based on the percentages of external and internal natural gas combustion reported by all C&I area sources in 2002.

Annual emissions for the county are calculated by multiplying natural gas usage by the respective AP-42 emission factors for external and internal combustion, as in this example for PM₁₀ emissions from external natural gas combustion:

$$\begin{aligned}
 \text{Annual PM}_{10} \text{ emissions from external natural gas combustion} &= \text{External C\&I natural gas usage (MMCF)} \times \text{PM}_{10} \text{ emission factor for external natural gas combustion (lb/MMCF)} \div 2,000 \text{ lb/ton} \\
 &= 14,434.79 \times 7.6 \div 2,000 \\
 &= 54.85 \text{ tons PM}_{10}/\text{yr}
 \end{aligned}$$

Table 3.2–6. Emission factors and annual emissions from area-source commercial/institutional natural gas combustion, by combustion type.

Combustion type	% of total	C&I natural gas usage (MMCF)	Emission factors (lb/MMCF)					Annual emissions (tons/yr)				
			PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
External	98.34	14,434.79	7.6	7.6	100	0.6	0.49	54.85	54.85	721.74	4.33	3.54
Internal	1.66	244.29	10	10	2840	0.6	n/a	1.22	1.22	346.89	0.07	
Total:	100.00	14,679.07						56.07	56.07	1,068.63	4.40	3.54

Typical daily emissions for the county are calculated by dividing annual emissions by the number of days that activity occurs throughout the year:

$$\begin{aligned}
 \text{PM}_{10} \text{ typical daily emissions from C\&I natural gas} &= \text{Annual PM}_{10} \text{ emissions (tons/yr)} \div (\text{days/week} \times \text{wks/yr}) \times 2,000 \text{ lbs/ton} \\
 &= 56.07 \div (6 \times 52) \times 2,000 \\
 &= 359.4 \text{ lbs/day}
 \end{aligned}$$

Annual and typical daily emissions within the PM₁₀ nonattainment area are calculated by applying the combined ratio of retail, office, public and other employment in the nonattainment area to county-level emission calculations. (See Section 1.5.1 for a discussion of the employment data used).

$$\begin{aligned}
\text{Emissions from area-source C\&I natural gas combustion in the PM}_{10}\text{ NAA} &= \text{Annual county PM}_{10}\text{ emissions (tons/yr)} \times \text{NAA:County C\&I employment ratio} \\
&= 56.07 \times 0.9893 \\
&= 55.47 \text{ tons PM}_{10}\text{/yr}
\end{aligned}$$

Table 3.2-7. Annual and typical daily emissions from area-source commercial/institutional natural gas combustion.

Geographic area	Annual emissions (tons/yr)					Typical daily emissions (lbs/day)				
	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
Maricopa County	56.07	56.07	1,068.63	4.40	3.54	359.4	359.4	6,850.2	28.2	22.7
PM ₁₀ NAA	55.47	55.47	1,057.19	4.36	3.50	355.6	355.6	6,776.9	27.9	22.4

3.2.4 Commercial/institutional fuel oil

Area-source emissions from commercial and institutional (C&I) fuel oil combustion are calculated by a multi-step process of allocating Arizona state-level C&I fuel oil sales as reported by the U.S. Department of Energy, Energy Information Administration (US DOE, 2002a) to Maricopa County.

To derive commercial/institutional fuel oil usage in Maricopa County, reported Arizona state-level sales of high-sulfur diesel for 2002 are first subtracted from Arizona state-level total C&I fuel oil sales, as it is presumed that no high-sulfur diesel fuel is used in Maricopa County due to local clean air act requirements and market conditions.

$$\begin{aligned}
\text{State C\&I fuel oil sales other than high-sulfur diesel (in thousand gallons, or Mgal)} &= \text{Reported state total C\&I fuel oil sales} - \text{Reported state high-sulfur diesel sales} \\
&= 30,077 \text{ Mgal} - 71 \text{ Mgal} \\
&= 30,006 \text{ Mgal/yr}
\end{aligned}$$

Arizona state commercial/institutional fuel oil sales (less high-sulfur diesel fuel) are then multiplied by the ratio of C&I employment in Maricopa County to Arizona state (0.71), as determined by data from the US Census Bureau (2003b) to estimate annual Maricopa County-level commercial/institutional fuel oil sales, as follows:

$$\begin{aligned}
\text{Maricopa County C\&I fuel oil sales} &= \text{Arizona state C\&I fuel oil sales less high-sulfur diesel} \times \text{Maricopa County:state commercial/institutional employment ratio} \\
&= 30,006 \text{ Mgal} \times 0.71 \\
&= 21,304.26 \text{ Mgal/yr}
\end{aligned}$$

To avoid double-counting, C&I fuel oil use attributable to stationary point sources (addressed in Chapter 2) and nonroad mobile sources (addressed in Chapter 4) are subtracted from County C&I fuel oil sales to estimate county fuel oil usage used by area sources:

$$\begin{aligned}
\text{Annual Maricopa County commercial/institutional area-source fuel oil sales} &= \text{Maricopa County C\&I fuel oil sales} - \text{Fuel oil used by C\&I nonroad mobile equipment} - \text{Fuel oil used by C\&I stationary point sources} \\
&= 21,304.26 \text{ Mgal} - 4,435.974 \text{ Mgal} - 190.672 \text{ Mgal} \\
&= 16,677.614 \text{ Mgal/yr}
\end{aligned}$$

Fuel oil is used for both external combustions (boilers, heaters) and internal combustion (generators), each of which have different emission factors. Thus the area-source C&I fuel oil sales derived above must be apportioned between these two categories. This apportionment was based on the percentages of external and internal fuel oil combustion reported by all commercial and institutional area sources surveyed by MCESD in 2002 (shown in Table 3.2–8 below).

Annual emissions for the county are calculated by multiplying C&I fuel oil sales by the respective AP-42 emission factors for external and internal combustion, as in this example for PM₁₀ emissions from external fuel oil combustion:

$$\begin{aligned}
 \text{Annual PM}_{10} \text{ emissions from external fuel oil combustion} &= \text{External C\&I fuel oil sales (Mgal)} \times \text{PM}_{10} \text{ emission factor for external fuel oil combustion (lb/Mgal)} \div 2,000 \text{ lb/ton} \\
 &= 11,165.542 \times 1.08 \div 2,000 \\
 &= 6.03 \text{ tons PM}_{10}/\text{yr}
 \end{aligned}$$

Table 3.2–8. Emission factors and annual emissions from area-source commercial/institutional fuel oil combustion, by combustion type.

Combustion type	% of total	C&I fuel oil sales (Mgal)	Emission factors (lb/Mgal)					Annual emissions (tons/yr)				
			PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
External	66.95	11,165.542	1.08	1.08	24	7.1	0.8	6.03	6.03	133.99	39.64	4.47
Internal	33.05	5,512.072	42.5	42.5	604	39.7	–	117.13	117.13	1,664.65	109.41	0.00
Total:	100.00	16,677.614						123.16	123.16	1,798.63	149.05	4.47

Typical daily emissions for the county are calculated by dividing annual emissions by the number of days activity occurs throughout the year, as recommended by EIIP guidance (US EPA, 2001a):

$$\begin{aligned}
 \text{Typical daily PM}_{10} \text{ emissions from C\&I fuel oil combustion} &= \text{Annual PM}_{10} \text{ emissions (tons/yr)} \div (\text{days/week} \times \text{wks/yr}) \times 2,000 \text{ lbs/ton} \\
 &= 123.16 \div (6 \times 52) \times 2,000 \\
 &= 789.5 \text{ lbs/day}
 \end{aligned}$$

Annual and typical daily emissions within the PM₁₀ nonattainment area are calculated by applying the combined ratio of retail, public, office and other employment in the nonattainment area to county-level emission calculations. (See Section 1.5.1 for a discussion of the employment data used).

$$\begin{aligned}
 \text{PM}_{10} \text{ NAA emissions from area source C\&I fuel oil combustion} &= \text{Annual county PM}_{10} \text{ emissions (tons/yr)} \times \text{NAA:County C\&I employment ratio} \\
 &= 123.16 \times 0.9892 \\
 &= 121.60 \text{ tons PM}_{10}/\text{yr}
 \end{aligned}$$

Table 3.2–9. Annual and typical daily emissions from area-source commercial/institutional fuel oil combustion.

Geographic area	Annual emissions (tons/yr)					Typical daily emissions (lbs/day)				
	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
Maricopa County	123.16	123.16	1,798.63	149.05	4.47	789.5	789.5	11,529.7	955.5	28.6
PM ₁₀ NAA	121.84	121.84	1,779.39	147.46	4.42	781.0	781.0	11,406.3	945.2	28.3

3.2.5 Residential natural gas

All natural gas suppliers in Maricopa County were surveyed to gather information on the volume of natural gas sold, by user category, within the county. Annual emissions from residential natural gas combustion emissions were calculated by multiplying residential natural gas sales by emission factors for residential natural gas combustion summarized in the table below (US EPA, 1998a), as follows:

Table 3.2–10. Residential natural gas combustion emission factors (in lb/MMCF).

PM ₁₀	PM _{2.5}	NO _x	SO _x
7.6	7.6	94	0.6

$$\begin{aligned}
 \text{Annual PM}_{10} \text{ emissions from residential natural gas combustion} &= \text{Residential natural gas annual sales (MMCF)} \times \text{Residential natural gas emission factor for PM}_{10} \text{ (lbs/MMCF)} \div 2,000 \text{ lbs/ton} \\
 &= 16,419.53 \times 7.6 \div 2,000 \\
 &= 62.39 \text{ tons PM}_{10}/\text{yr}
 \end{aligned}$$

Typical daily emissions are calculated by dividing annual emissions by the number of days (365) that activity occurs for residential natural gas combustion, as follows:

$$\begin{aligned}
 \text{Typical daily PM}_{10} \text{ emissions from residential natural gas combustion} &= \text{Annual PM}_{10} \text{ emissions} \times 2,000 \text{ lbs/ton} \div \text{days/yr} \\
 &= 62.39 \text{ tons/yr} \times 2,000 \div 365 \\
 &= 341.9 \text{ lbs PM}_{10}/\text{day}
 \end{aligned}$$

Annual and typical daily residential natural gas emissions in the PM₁₀ nonattainment area are calculated by multiplying county-level emissions by the percentage of total occupied households (99.18%) in the PM₁₀ nonattainment area as follows:

$$\begin{aligned}
 \text{Annual PM}_{10} \text{ emissions from residential natural gas combustion in the NAA} &= \text{County annual emissions} \times \text{Percentage of occupied households in the NAA} \\
 &= 62.39 \times 99.18\% \\
 &= 61.88 \text{ tons PM}_{10}/\text{yr}
 \end{aligned}$$

Table 3.2–11. Annual and typical daily emissions from residential natural gas combustion.

Geographic area	Annual emissions (tons/yr)				Typical daily emissions (lbs/day)			
	PM ₁₀	PM _{2.5}	NO _x	SO _x	PM ₁₀	PM _{2.5}	NO _x	SO _x
Maricopa County	62.39	62.39	771.72	4.93	341.9	341.9	4,228.6	27.0
PM ₁₀ NAA	61.88	61.88	765.39	4.89	339.1	339.1	4,193.9	26.8

3.2.6 Residential wood combustion

Area-source emissions from residential wood combustion are calculated based on the amount of wood burned in fireplaces and woodstoves in Maricopa County, as recommended by EIIP guidance (US EPA, 2001d). Residential wood combustion in the county is estimated by multiplying data on statewide residential wood combustion usage from the US Department of Energy (2003) by the ratio of county to state households that report use of wood for heating from the US

Census Bureau (2003a). The latest available data on residential wood use for household heating from the US Census Bureau is for the calendar year 2000. Since all fireplaces in homes constructed since 1999 are required by Arizona statute to be clean-burning, it is assumed that these new homes have negligible emissions. Thus, year 2000 data is assumed to be representative of 2002 emissions.

$$\begin{aligned}
 \text{Maricopa County residential wood usage (cords/yr)} &= \text{Arizona residential wood usage (cords/yr)} \times \text{Ratio of county:state households using wood for heat} \\
 &= 491,000 \times 1,655 / 39,842 \\
 &= 20,396 \text{ cords/yr}
 \end{aligned}$$

To calculate emissions, the amount of wood used is converted to tons by multiplying cords by the number of cubic feet of wood in a cord and by the density of the wood used (US EPA, 2001d). Wood density is determined by weighted average of types of wood used for residential combustion in Maricopa County, provided by the US Forest Service (USFS, 1993).

$$\begin{aligned}
 \text{County residential wood usage (tons/yr)} &= \text{County wood usage (cords)} \times \text{avg. ft}^3 \text{ wood/cord} \times \text{Wood density (lbs/ft}^3) \div 2,000 \text{ lbs/ton} \\
 &= 20,396 \times 79 \times 31.57 \div 2,000 \\
 &= 25,433.73 \text{ tons}
 \end{aligned}$$

Annual emissions from residential wood combustion are calculated by multiplying the tons of wood used by the PM₁₀ emission factor for residential woodstoves and fireplaces from US EPA (2001d), Table 2.4-1:

$$\begin{aligned}
 \text{Annual PM}_{10} \text{ emissions from residential wood combustion (tons/yr)} &= \text{Residential wood usage (tons)} \times \text{PM}_{10} \text{ emission factor (lbs/ton)} \div 2,000 \text{ lbs/ton} \\
 &= 25,433.73 \times 34.6 \div 2,000 \\
 &= 440.00 \text{ tons PM}_{10}/\text{yr}
 \end{aligned}$$

Table 3.2–12. Annual wood usage, emission factors, and annual emissions from residential wood combustion.

Residential wood usage (tons/yr)	Emission factors (lbs/ton)				Annual emissions (tons/yr)			
	PM ₁₀	PM _{2.5} *	NO _x	SO _x	PM ₁₀	PM _{2.5} *	NO _x	SO _x
25,433.73	34.6	32.2	2.6	0.4	440.00	409.20	33.06	5.09

*PM_{2.5} is assumed to be 93% of PM₁₀ (Houck and Tiegs, 1998).

Typical daily emissions are calculated by apportioning wood burning activity based on heating degree days (i.e., the number of degrees per day that the daily average temperature is below 65°F). Data provided by Arizona State University (2003) indicated that there were six months (April–September, totaling 184 days) in 2002 where no heating degree days were recorded. Assuming that no wood burning activity took place during those months, that leaves 181 days were residential wood burning can be assumed to occur. Thus, typical daily emissions are calculated by dividing annual emissions by the number of days residential wood burning occurred, as follows:

$$\begin{aligned}
 \text{Typical daily PM}_{10} \text{ emissions from residential wood combustion (lbs/day)} &= \text{Annual PM}_{10} \text{ emissions} \times 2,000 \text{ lbs/ton} \div \text{number of days wood burning occurred} \\
 &= 440.00 \times 2,000 \div 181 \\
 &= 4,861.9 \text{ lbs PM}_{10}/\text{day}
 \end{aligned}$$

Annual and typical daily emissions within the PM₁₀ nonattainment area (NAA) are calculated by multiplying county totals by the ratio of total occupied housing units in the nonattainment area (1,350,717) to the total residential housing units in the county (1,361,837). See Section 1.5.1 for a further discussion of the housing data used.

$$\begin{aligned}
 \text{NAA annual emissions from residential wood combustion (tons/yr)} &= \text{County annual emissions (tons/yr)} \times \text{NAA:county residential housing ratio} \\
 &= 440.00 \times 0.9918 \\
 &= 436.40 \text{ tons PM}_{10}/\text{yr}
 \end{aligned}$$

Table 3.2–13. Annual and typical daily emissions from residential wood combustion.

Geographic area	Annual emissions (tons/yr)				Typical daily emissions (lbs/day)			
	PM ₁₀	PM _{2.5}	NO _x	SO _x	PM ₁₀	PM _{2.5}	NO _x	SO _x
Maricopa County	440.00	409.20	33.06	5.09	4,861.9	4,521.6	365.3	56.2
PM ₁₀ NAA	436.40	405.85	32.79	5.05	4,822.0	4,484.5	362.4	55.7

3.2.7 Residential fuel oil

Emissions from residential fuel oil use were calculated using an approach similar to that used for residential wood combustion described in Section 3.2.6. County-level residential fuel oil use was derived from statewide totals using the ratio of county to state households that report fuel oil use from the US Census Bureau (2003a):

$$\begin{aligned}
 \text{Maricopa County residential fuel oil usage (Mgal/yr)} &= \text{Arizona residential fuel oil use (Mgal/yr)} \times \text{Ratio of county:state households reporting fuel oil use} \\
 &= 340 \times 490 / 1,813 \\
 &= 91.89 \text{ Mgal/yr}
 \end{aligned}$$

Using an AP-42 emission factors, and data on heating degree days and residential housing units described in Section 3.2.6, annual and daily emissions were calculated as shown in Table 3-2.14.

Table 3.2–14. Annual and typical daily emissions from residential fuel oil combustion.

Geographic area	Emission factors (lb/Mgal)				Annual emissions (tons/yr)				Typical daily emissions (lbs/day)			
	PM ₁₀	PM _{2.5}	NO _x	SO _x	PM ₁₀	PM _{2.5}	NO _x	SO _x	PM ₁₀	PM _{2.5}	NO _x	SO _x
Maricopa County	0.4	0.4	18	7.1	0.02	0.02	0.83	0.33	0.2	0.2	9.1	3.6
PM ₁₀ NAA	0.4	0.4	18	7.1	0.02	0.02	0.82	0.32	0.2	0.2	9.1	3.6

3.2.8 Summary of all area-source fuel combustion

Tables 3.2–15 and 3.2–16 provide a summary of annual and typical daily emissions from all fuel combustion, for Maricopa County and the PM₁₀ nonattainment area, respectively.

Table 3.2–15. Annual and typical daily emissions from all area-source fuel combustion for Maricopa County.

Fuel combustion type	Annual emissions (tons/yr)					Typical daily emissions (lbs/day)				
	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
Ind. natural gas	5.92	5.92	110.63	0.47	2.44	38.0	38.0	709.2	3.0	15.7
Ind. fuel oil	55.95	55.95	777.40	74.34	3.20	358.6	358.6	4,983.4	476.5	20.5
C&I natural gas	56.07	56.07	1,068.63	4.40	3.54	359.4	359.4	6,850.2	28.2	22.7
C&I fuel oil	123.16	123.16	1,798.63	149.05	4.47	789.5	789.5	11,529.7	955.5	28.6
Res. natural gas	62.39	62.39	771.72	4.93		341.9	341.9	4,228.6	27.0	
Res. wood	440.00	409.20	33.06	5.09		4,861.9	4,521.6	365.3	56.2	
Res. fuel oil	0.02	0.02	0.83	0.33		0.2	0.2	9.1	3.6	
Total:	743.52	712.72	4,560.90	238.60	13.65	6,749.6	6,409.2	28,675.4	1,550.0	87.5

Table 3.2–16. Annual and typical daily emissions from all area-source fuel combustion for the PM₁₀ NAA.

Fuel combustion type	Annual emissions (tons/yr)					Typical daily emissions (lbs/day)				
	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
Ind. natural gas	5.86	5.86	109.42	0.46	2.42	37.6	37.6	701.4	3.0	15.5
Ind. fuel oil	55.34	55.34	768.93	73.53	3.17	354.7	354.7	4,929.0	471.3	20.3
C&I natural gas	55.47	55.47	1,057.19	4.36	3.50	355.6	355.6	6,776.9	27.9	22.4
C&I fuel oil	121.84	121.84	1,779.39	147.46	4.42	781.0	781.0	11,406.3	945.2	28.3
Res. natural gas	61.88	61.88	765.39	4.89		339.1	339.1	4,193.9	26.8	
Res. wood	436.40	405.85	32.79	5.05		4,822.0	4,484.5	362.4	55.7	
Res. fuel oil	0.02	0.02	0.82	0.32		0.2	0.2	9.1	3.6	
Total:	736.81	706.26	4,513.93	236.06	13.50	6,690.3	6,352.7	28,379.0	1,533.5	86.5

3.3 Industrial processes

3.3.1 Chemical manufacturing

Emissions from area-source chemical manufacturing were calculated by the “scaling up” method as described in EPA emission inventory guidance (US EPA, 2001a). This method combines detailed emissions data from a subset of sources, and county-level employment data from the US Census Bureau (2003b) to develop a per-employee emission factor that is then used to estimate emissions from all sources in an industry category.

The most recent data from the US Census Bureau’s County Business Patterns (CBP) for 2001 employment, were used. Where CBP employment estimates were presented as a range, the midpoint values was chosen for these calculations. Table 3-3.1 shows the NAICS codes and employment data used to calculate emissions from chemical manufacturing.

Table 3.3–1. NAICS codes and descriptions for chemical manufacturing.

NAICS Code	Description	US Census employment data	Value used
32551	Paint & coating manufacturing	100–249	175
32591	Printing ink manufacturing	20–99	60
422910	Farm supplies, wholesale	298	298
325991	Custom compounding of purchased resin	100–249	175
325998	All other misc. chemical product & prep. manufacturing	316	316
325188	All other basic inorganic chemical manufacturing	100–249	175
325412	Pharmaceutical manufacturing.	500–999	750
Total:			1,949

Some facilities in this category are considered point sources, and have been addressed in Chapter 2. To avoid double-counting, employment at point sources is subtracted from total employment as follows:

$$\begin{aligned}
 \text{Total area-source employment in chemical mfg.} &= \text{Total employment (from US Census' County Business Patterns)} && - \text{Employment at point sources (from annual emission reports)} \\
 &= 1,949 && - 191 \\
 &= 1,758 \text{ employees}
 \end{aligned}$$

This area-source employment estimate is used to “scale up” emissions reported from those facilities surveyed in 2002 as follows:

$$\begin{aligned}
 \text{Area-source PM}_{10} \text{ emissions from chemical mfg.} &= \frac{\text{Emissions from surveyed area sources}}{\text{Employment at surveyed area sources}} \times \text{Total area-source employment} \\
 &= \frac{12.07 \text{ tons of PM}_{10}/\text{yr}}{744 \text{ employees}} \times 1,758 \text{ employees} \\
 &= 28.52 \text{ tons PM}_{10}/\text{yr}
 \end{aligned}$$

PM₁₀ typical daily emissions are calculated based on the operating schedule data reported by chemical manufacturing facilities. From annual emission surveys, the modal values were identified for two items: days/week and annual activity. This data was used to calculate typical daily emissions as follows:

$$\begin{aligned}
 \text{Typical daily PM}_{10} \text{ emissions from chemical mfg.} &= \frac{\text{Annual emissions (tons/yr)}}{\text{Days/week} \times \text{Weeks/year}} \times \frac{2,000 \text{ lbs}}{\text{ton}} \\
 &= \frac{28.52}{5 \times 52} \times 2,000 \\
 &= 219.4 \text{ lbs PM}_{10}/\text{day}
 \end{aligned}$$

Annual and typical daily emissions for the PM₁₀ nonattainment area were calculated by multiplying the Maricopa County emission totals by the percentage industrial employment within the nonattainment area. (See Section 1.5.1 for a discussion of the employment data used.)

$$\begin{aligned}
 \text{PM}_{10} \text{ emissions from area-source chemical mfg. in the PM}_{10} \text{ NAA (tons/yr)} &= \text{Annual Maricopa County emissions} \times \text{NAA:county ratio of industrial employment} \\
 &= 28.52 \text{ tons/yr} \times .9891 \\
 &= 28.21 \text{ tons VOC/yr}
 \end{aligned}$$

Table 3.3–2 summarizes annual and typical daily emissions from chemical manufacturing in both Maricopa County and the PM₁₀ nonattainment area.

Table 3.3–2. Annual and typical daily emissions from area-source chemical manufacturing.

Geographic area	Annual emissions (tons/yr)					Typical daily emissions (lbs/day)				
	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
Maricopa County	28.53	17.72	1.08	0.25	0.61	219.4	136.3	8.3	1.9	4.7
PM ₁₀ NAA	28.22	17.53	1.07	0.25	0.61	217.1	134.8	8.2	1.9	4.7

3.3.2 Food and kindred products

3.3.2.1 Commercial cooking

Emissions from commercial cooking were estimated for five source categories based on equipment type. These equipment types include: chain-driven (conveyorized) charbroilers (SCC 2302002100), under-fired charbroilers (2302002200), flat griddles (2302003100), clamshell griddles (2302003200), and deep-fat fryers (2302003000). Emission inventory methods outlined in EPA guidance (US EPA, 2004) for these source categories include emissions from all meat types (hamburger, steak, fish, pork, and chicken) and five restaurant types (ethnic, fast food, family, seafood, and steak & barbeque).

Data obtained from MCESD’s eating and drinking establishments permit database indicated that 9,038 restaurants operated in Maricopa County in 2002. The percent of restaurants in Maricopa County for the five restaurant types was obtained from a commercial business database (Harris InfoSource, 2003). The percent of restaurants for each restaurant type was multiplied by the total number of restaurants operated in Maricopa County in 2002 to derive the number of restaurants for each restaurant type as shown in Table 3.3–3.

Table 3.3–3. Maricopa County restaurants by type.

Restaurant category	Percentage	# of restaurants
Ethnic food	14.47	1,308
Fast food	15.35	329
Family	3.64	1,387
Seafood	0.61	55
Steak & barbeque	1.15	104
Unrelated restaurant types e.g., lunchroom, bars,...	64.79	5,856
All restaurants	100.00	9,038

Using the number of restaurants for each restaurant type, along with the default emission factors and equations from EPA (2004), emissions for each combination of equipment type, restaurant type, and meat type were calculated, and the results were summed to estimate annual emissions for each type of cooking equipment, as shown in Table 3.3–4.

Table 3.3–4. Annual emissions from commercial cooking equipment, by equipment type.

Equipment type	Annual emissions (tons/yr)	
	PM ₁₀	PM _{2.5}
Chain-driven charbroilers	72.71	70.49
Underfired charbroilers	500.61	483.94
Deep fat fryers	0.00	0.00
Flat griddles	131.81	100.18
Clamshell griddles	8.71	7.38
Totals:	713.85	661.98

Commercial cooking is assumed to occur uniformly throughout the year, therefore, it was assumed that the annual activity was 7 days/week.

Table 3.3-5. Typical daily emissions from commercial cooking equipment, by equipment type.

Equipment type	Typical daily emissions (lbs/day)	
	PM ₁₀	PM _{2.5}
Chain-driven charbroilers	399.5	387.3
Underfired charbroilers	2,750.6	2,659.0
Deep fat fryers	0.0	0.0
Flat griddles	724.2	550.4
Clamshell griddles	47.9	40.5
Totals:	3,922.2	3,637.2

Annual and typical daily emissions for the PM₁₀ nonattainment area were calculated by multiplying the Maricopa County emission totals by the percentage population within the nonattainment area of 99.14%. (See Section 1.5.1 for a discussion of the population data used.) Table 3.3-6 summarizes the annual and typical daily emissions from commercial cooking for Maricopa County and the PM₁₀ NAA.

Table 3.3-6. Annual and typical daily emissions from commercial cooking equipment.

Equipment type	Maricopa County				PM ₁₀ nonattainment area			
	Annual emissions (tons/yr)		Typical daily emissions (lbs/day)		Annual emissions (tons/yr)		Typical daily emissions (lbs/day)	
	PM ₁₀	PM _{2.5}	PM ₁₀	PM _{2.5}	PM ₁₀	PM _{2.5}	PM ₁₀	PM _{2.5}
Chain-driven charbroilers	72.71	70.49	399.5	387.3	72.09	69.88	396.1	384.0
Underfired charbroilers	500.61	483.94	2,750.6	2,659.0	496.31	479.77	2,727.0	2,636.1
Deep fat fryers	0.00	0.00	0.0	0.0	0.00	0.0	0.0	0.0
Flat griddles	131.81	100.18	724.2	550.4	130.68	99.31	718.0	545.7
Clamshell griddles	8.71	7.38	47.9	40.5	8.63	7.31	47.4	40.2
Totals:	713.85	661.98	3,922.2	3,637.2	707.71	656.28	3,888.5	3,605.9

3.3.2.2 Grain handling/processing

Annual emissions from area-source grain handling and processing operations were derived from annual emission reports submitted by permitted sources. It was assumed that there were no significant unpermitted sources within Maricopa County. Note that larger operations are treated as point sources, and addressed in Chapter 2.

Typical daily emissions were calculated based on reported activity data (days per week) for each individual process, and then summed. Nearly all processes reported operating on either a 5- or 6-day week. As all facilities addressed in this source category are located within the PM₁₀ nonattainment area, emission totals for both areas are equal. Annual and typical daily emissions are shown in Table 3.3-7.

Table 3.3-7. Annual and typical daily emissions from area-source grain handling and processing.

Category	Annual emissions (tons/yr)		Typical daily emissions (lbs/day)	
	PM ₁₀	PM _{2.5}	PM ₁₀	PM _{2.5}
Maricopa County	7.01	1.80	53.1	13.5
PM ₁₀ NAA	7.01	1.80	53.1	13.5

3.3.2.3 Ammonia cold storage

Area-source emissions from ammonia cold storage are estimates of ammonia emissions from food and kindred products industrial sources that use ammonia for refrigeration of food products. Emission calculations are based on the number of employees in the food and kindred products industry classification (NAICS codes 311, 3121) as reported by the 2001 County Business Patterns (US Census Bureau, 2003b). Annual emissions are calculated by multiplying employment numbers by the emission factor for ammonia cold storage as listed in Table 6-5 of “Development and Selection of Ammonia Emission Factors” (Battye et al., 1994) as follows:

$$\begin{aligned}
 \text{Annual NH}_3 \text{ emissions from ammonia cold storage (tons/yr)} &= \text{Number of employees in relevant industries (from CBP)} \times \text{NH}_3 \text{ emission factor (lb/employee-yr)} \div 2,000 \text{ lbs/ton} \\
 &= 8,033 \times 413 \div 2,000 \\
 &= 1,658.81 \text{ tons NH}_3/\text{yr}
 \end{aligned}$$

Typical daily emissions are calculated by dividing annual emissions by the number of days per year that activity occurred, as follows:

$$\begin{aligned}
 \text{Typical daily NH}_3 \text{ emissions (lbs/day)} &= \text{Annual emissions (tons/yr)} \times 2,000 \text{ lbs/ton} \div (\text{weeks/year} \times \text{days/week}) \\
 &= 1,685.81 \times 2,000 \div (52 \times 6) \\
 &= 10,633.4 \text{ lbs NH}_3/\text{day}
 \end{aligned}$$

Annual and typical daily emissions for the PM₁₀ nonattainment area are calculated by multiplying Maricopa County emissions by the ratio of County industrial employment that occurs in the PM₁₀ nonattainment area. (See Section 1.5.1 for a discussion of employment data).

$$\begin{aligned}
 \text{Annual NH}_3 \text{ emissions from ammonia cold storage in the PM}_{10} \text{ NAA (tons/yr)} &= \text{Annual county emissions (tons/yr)} \times \text{NAA:County Industrial employment ratio} \\
 &= 1,658.81 \times 0.9891 \\
 &= 1,640.73 \text{ tons NH}_3/\text{yr}
 \end{aligned}$$

Table 3.3–8. Annual and typical daily NH₃ emissions from ammonia cold storage.

Geographic area	Annual emissions (tons/yr)	Typical daily emissions (lbs/day)
Maricopa County	1,658.81	10,633.4
PM ₁₀ NAA	1,640.73	10,517.5

3.3.3 Secondary metal production

Annual emissions from secondary metal production facilities were derived from annual emission reports from permitted sources. As this category consists primarily of foundries, it was assumed that there were no significant unpermitted sources within Maricopa County. Since all facilities considered in this section are located within the PM₁₀ nonattainment area, total emission values for the county and the PM₁₀ NAA from area-source secondary metal production are equal.

Table 3.3–9. Annual and typical daily emissions from secondary metal production.

Geographic area	Annual emissions (tons/yr)					Typical daily emissions (lbs/day)				
	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
Maricopa County	6.72	3.68	0.03	0.03	2.68	52.1	28.7	0.2	0.3	15.6
PM ₁₀ NAA	6.72	3.68	0.03	0.03	2.68	52.1	28.7	0.2	0.3	15.6

3.3.4 Non-metallic mineral processes

The primary contributors to this source category include concrete batch plants, ceramic clay and tile manufacturing, brick manufacturing, and gypsum mining. Emissions from this source category were calculated by the “scaling up” method as described in EPA emission inventory guidance (US EPA, 2001a). This method combines detailed emissions data from a subset of sources, and county-level employment data from the US Census Bureau (2003b) to develop a per-employee emission factor that is then used to estimate emissions from all sources in an industry category.

The most recent data from the US Census Bureau’s County Business Patterns (CBP) for 2001 employment were used. Total employment in Maricopa County for NAICS code group 327, non-metallic mineral product manufacturing, for 2001 (the most recent data available) was used. In addition, some portable concrete batch operations which operate within Maricopa County for only part of the year, are issued air quality permits by the Arizona Department of Environmental Quality (ADEQ). All state-permitted portable sources are addressed in Section 3.3.11.

Some facilities in this category are considered point sources, and have been addressed in Chapter 2. To avoid double-counting, employment at point sources is subtracted from total employment as follows:

$$\begin{aligned}
 \text{Total area-source employment in non-metallic mineral products} &= \text{Total employment (from US Census' County Business Patterns)} - \text{Employment at point sources (from annual emission reports)} \\
 &= 4,054 - 1,412 \\
 &= 2,642 \text{ employees}
 \end{aligned}$$

This area-source employment estimate is used to “scale up” emissions reported from those facilities surveyed in 2002 as follows:

$$\text{Total area-source emissions} = \frac{\text{Emissions from surveyed area sources}}{\text{Employment at surveyed area sources}} \times \text{Total area-source employment}$$

$$\begin{aligned}
 \text{Area-source PM}_{10} \text{ emissions} &= \frac{35.21 \text{ tons of PM}_{10}/\text{yr}}{1,068 \text{ employees}} \times 2,642 \text{ employees} \\
 &= 87.11 \text{ tons PM}_{10}/\text{yr}
 \end{aligned}$$

Typical daily emissions are calculated based on the operating schedule data reported by surveyed facilities. From annual emission surveys, the modal values were identified for two items: days/week and annual activity. This data was used to calculate typical daily emissions as follows:

$$\begin{aligned}
 \text{Typical daily PM}_{10} \text{ emissions} &= \frac{\text{annual emissions (tons/yr)}}{\text{days/week} \times \text{weeks/year}} \times \frac{2,000 \text{ lbs}}{\text{ton}} \\
 &= \frac{87.11}{5 \times 52} \times 2,000 \\
 &= 670.1 \text{ lbs PM}_{10}/\text{day}
 \end{aligned}$$

Annual and typical daily emissions for the PM₁₀ nonattainment area were calculated by multiplying the Maricopa County emission totals by the percentage industrial employment within the nonattainment area. (See Section 1.5.1 for a discussion of the employment data used.)

$$\begin{aligned}
 \text{PM}_{10} \text{ emissions from area sources within the PM}_{10} \text{ NAA (tons/yr)} &= \text{Annual Maricopa County emissions} \times \text{NAA:county ratio of industrial employment} \\
 &= 87.11 \text{ tons/yr} \times .9891 \\
 &= 86.16 \text{ tons PM}_{10}/\text{yr}
 \end{aligned}$$

Table 3.3–10 summarizes annual and typical daily emissions from non-metallic mineral processing in both Maricopa County and the PM₁₀ nonattainment area.

Table 3.3–10. Annual and typical daily emissions from area-source non-metallic mineral products.

Category	Annual emissions (tons/yr)		Typical daily emissions (lbs/day)	
	PM ₁₀	PM _{2.5}	PM ₁₀	PM _{2.5}
Maricopa County	87.11	31.61	670.1	243.2
PM ₁₀ NAA	86.16	31.27	662.8	240.5

3.3.5 Mining and quarrying

Annual emissions from area-source mining and quarrying (sand and gravel) operations were derived from annual emission reports submitted by permitted sources. It was assumed that there were no significant unpermitted sources within Maricopa County. Note that larger mining and quarrying operations are treated as point sources, and addressed in Chapter 2. Some portable mining and quarrying operations which operate within Maricopa County for only part of the year, are issued air quality permits by the Arizona Department of Environmental Quality (ADEQ). All state-permitted portable sources are addressed in Section 3.3.11.

Typical daily emissions were calculated based on reported activity data (days per week) for each individual process, and then summed. Nearly all processes reported operating on either a 5- or 6-day week. Emissions within the PM₁₀ nonattainment area were identified using information on the location of each permitted facility. Annual and daily emissions are shown in Table 3.3–11.

Table 3.3–11. Annual and typical daily emissions from area-source mining and quarrying operations.

Category	Annual emissions (tons/yr)		Typical daily emissions (lbs/day)	
	PM ₁₀	PM _{2.5}	PM ₁₀	PM _{2.5}
Maricopa County	28.43	11.09	177.1	68.3
PM ₁₀ NAA	22.92	9.20	138.9	55.1

3.3.6 Wood product manufacturing

Emissions from wood product manufacturing were calculated by the “scaling up” method as described in EPA emission inventory guidance (US EPA, 2001a). This method combines detailed emissions data from a subset of sources, and county-level employment data from the US Census Bureau (2003b) to develop a per-employee emission factor that is then used to estimate emissions from all sources in an industry category.

The most recent data from the US Census Bureau’s County Business Patterns (CBP) for 2001 employment were used. Where CBP employment estimates were presented as a range, the midpoint values was chosen for these calculations. Table 3.3–12 shows the NAICS codes and employment data used to calculate emissions from wood product manufacturing.

Table 3.3–12. NAICS codes and descriptions for wood product manufacturing.

NAICS Code	Description	US Census employment data	Value used
321---	Wood products manufacturing	6,720	6,720
337110	Wood kitchen cabinet & countertop manufacturing	1,703	1,703
337121	Upholstered household furniture manufacturing	281	281
337122	Non-upholstered wood household furniture manufacturing	3,160	3,160
337127	Institutional furniture manufacturing	100–249	175
337129	Wood television, radio and sewing machine cabinet mfg.	20–99	60
337211	Wood office furniture manufacturing	20–99	60
337212	Custom architectural woodwork & millwork mfg.	436	436
337215	Showcase, partition, shelving & locker manufacturing	610	610
337920	Blind & shade manufacturing	202	202
Total:			13,407

Some facilities in this category are considered point sources, and have been addressed in Chapter 2. To avoid double-counting, employment at point sources is subtracted from total employment as follows:

$$\begin{aligned}
 \text{Total area-source employment in wood products} &= \text{Total employment (from US Census' County Business Patterns)} - \text{Employment at point sources (from annual emission reports)} \\
 &= 13,407 - 1,097 \\
 &= 12,310 \text{ employees}
 \end{aligned}$$

This area-source employment estimate is used to “scale up” emissions reported from those facilities surveyed in 2002 as follows:

$$\begin{aligned}
 \text{Total area-source emissions} &= \frac{\text{Emissions from surveyed area sources}}{\text{Employment at surveyed area sources}} \times \text{Total area-source employment} \\
 \text{Area-source PM}_{10} \text{ emissions from wood products} &= \frac{13.56 \text{ tons of PM}_{10}/\text{yr}}{1,150 \text{ employees}} \times 12,310 \text{ employees} \\
 &= 145.14 \text{ tons PM}_{10}/\text{yr}
 \end{aligned}$$

Typical daily emissions are calculated based on the operating schedule data reported by wood products facilities. From annual emission surveys, the modal values were identified for two items: days/week and annual activity. This data was used to calculate typical daily emissions as follows:

$$\begin{aligned}
 \text{Typical daily PM}_{10} \text{ emissions from wood products} &= \frac{\text{Annual emissions (tons/yr)}}{\text{Days/week} \times \text{Weeks/year}} \times \frac{2,000 \text{ lbs}}{\text{ton}} \\
 &= \frac{145.14}{5 \times 52} \times 2,000 \\
 &= 1,116.5 \text{ lbs PM}_{10}/\text{day}
 \end{aligned}$$

Annual and typical daily emissions for the PM₁₀ nonattainment area were calculated by multiplying the Maricopa County emission totals by the percentage of industrial employment within the nonattainment area. (See Section 1.5.1 for a discussion of the employment data used.)

$$\begin{aligned}
 \text{PM}_{10} \text{ emissions from area-source wood products in the PM}_{10} \text{ NAA (tons/yr)} &= \text{Annual Maricopa County emissions} \times \text{NAA:county ratio of industrial employment} \\
 &= 145.14 \text{ tons/yr} \times .9891 \\
 &= 143.56 \text{ tons PM}_{10}/\text{yr}
 \end{aligned}$$

Table 3.3–13 summarizes annual and typical daily emissions from wood products manufacturing in both Maricopa County and the PM₁₀ nonattainment area.

Table 3.3–13. Annual and typical daily emissions from area-source wood products manufacturing.

Category	Annual emissions (tons/yr)		Typical daily emissions (lbs/day)	
	PM ₁₀	PM _{2.5}	PM ₁₀	PM _{2.5}
Maricopa County	145.14	89.36	1,116.5	687.4
PM ₁₀ NAA	143.56	88.38	1,104.3	679.9

3.3.7 Rubber/plastics manufacturing

Emissions from area-source rubber and plastic manufacturing facilities were calculated by the “scaling up” method as described in EPA emission inventory guidance (US EPA, 2001a). This method combines detailed emissions data from a subset of sources, and county-level employment data from the US Census Bureau (2003b) to develop a per-employee emission factor that is then used to estimate emissions from all sources in an industry category. The most recent data from the US Census Bureau’s County Business Patterns (CBP) for 2001 employment, were used. Where CBP employment estimates were presented as a range, the midpoint values was chosen for these calculations. Table 3.3–14 shows the NAICS codes and employment data used to calculate emissions from rubber and plastic manufacturing facilities.

Table 3.3–14. NAICS codes and descriptions for rubber and plastic manufacturing facilities.

NAICS Code	Description	US Census employment data	Value used
32613	Laminated plastics plate, sheet & shape mfg	20–99	60
32614	Polystyrene foam product mfg	250–499	375
32622	Rubber & plastics hoses & belting mfg	100–249	175
33992	Sporting & athletic goods mfg	1,293	1,293
325991	Custom compounding of purchased resin	100–249	175
326122	Plastics pipe & pipe fitting mfg	100–249	175
326160	Plastics bottle mfg	250–499	375
326191	Plastics plumbing fixture mfg	250–499	375
326199	All other plastics product mfg	4,282	4,282
326212	Tire retreading	20–99	60
326299	All other rubber product mfg	250–499	375
327991	Cut stone & stone product mfg	111	111
336612	Boat building	250–499	375
Total:			8,206

Some facilities in this category are considered point sources, and have been addressed in Chapter 2. To avoid double-counting, employment at point sources is subtracted from total employment as follows:

$$\begin{aligned}
 \text{Total area-source employment in rubber \& plastic product manufacturing} &= \text{Total employment (from US Census' County Business Patterns)} && - \text{Employment at point sources (from annual emission reports)} \\
 &= 8,206 && - 1,862 \\
 &= 6,344 \text{ employees}
 \end{aligned}$$

This area-source employment estimate is used to “scale up” emissions reported from those facilities surveyed in 2002 as follows:

$$\begin{aligned}
 \text{Total area-source PM}_{10} \text{ emissions from rubber/plastic product mfg.} &= \frac{\text{Emissions from surveyed area sources}}{\text{Employment at surveyed area sources}} \times \text{Total area-source employment} \\
 &= \frac{3.706 \text{ tons of PM}_{10}/\text{yr}}{923 \text{ employees}} \times 6,344 \text{ employees} \\
 &= 25.47 \text{ tons PM}_{10}/\text{yr}
 \end{aligned}$$

Typical daily emissions are calculated based on the operating schedule data reported by rubber/plastics products manufacturing facilities. From annual emission surveys, the modal values were identified for two items: days/week and annual activity. This data was used to calculate typical daily emissions as follows:

$$\begin{aligned}
 \text{Typical daily PM}_{10} \text{ emissions from rubber \& plastic manufacturing} &= \frac{\text{Annual emissions (tons/yr)}}{\text{Days/week} \times \text{Weeks/year}} \times \frac{2,000 \text{ lbs}}{\text{ton}} \\
 &= \frac{25.47}{5 \times 52} \times 2,000 \\
 &= 195.9 \text{ lbs PM}_{10}/\text{day}
 \end{aligned}$$

Annual and typical daily emissions for the PM₁₀ nonattainment area were calculated by multiplying the Maricopa County emission totals by the percentage industrial employment within the nonattainment area. (See Section 1.5.1 for a discussion of the employment data used.)

$$\begin{aligned}
 \text{PM}_{10} \text{ emissions from area-source in the PM}_{10} \text{ NAA (tons/yr)} &= \text{Annual Maricopa County emissions} \times \text{NAA:county ratio of industrial employment} \\
 &= 25.47 \text{ tons/yr} \times .9891 \\
 &= 25.19 \text{ tons PM}_{10}/\text{yr}
 \end{aligned}$$

Table 3.3–15 summarizes annual and typical daily emissions from rubber/plastic products manufacturing in both Maricopa County and the PM₁₀ nonattainment area.

Table 3.3–15. Annual and typical daily emissions from area-source rubber/plastic products manufacturing.

Category	Annual emissions (tons/yr)		Typical daily emissions (lbs/day)	
	PM ₁₀	PM _{2.5}	PM ₁₀	PM _{2.5}
Maricopa County	25.47	23.41	195.9	180.1
PM ₁₀ NAA	25.19	23.16	193.7	178.1

3.3.8 Fabricated metal products manufacturing

Emissions from fabricated metal products manufacturing were calculated by the “scaling up” method as described in EPA emission inventory guidance (US EPA, 2001a). This method combines detailed emissions data from a subset of sources, and county-level employment data from the US Census Bureau (2003b) to develop a per-employee emission factor that is then used to estimate emissions from all sources in an industry category.

The most recent data from the US Census Bureau’s County Business Patterns (CBP) for 2001 employment were used. CBP employment data for NAICS code 332* (fabricated metal products manufacturing) indicated that there were 16,232 employees in this industry in Maricopa County. Some facilities in this category are considered point sources, and have been addressed in Chapter 2. To avoid double-counting, employment at point sources is subtracted from total employment as follows:

$$\begin{aligned}
 \text{Total area-source employment in fab. metal products} &= \text{Total employment (from US Census' County Business Patterns)} - \text{Employment at point sources (from annual emission reports)} \\
 &= 16,232 - 75 \\
 &= 16,157 \text{ employees}
 \end{aligned}$$

This area-source employment estimate is used to “scale up” emissions reported from those facilities surveyed in 2002 as follows:

$$\begin{aligned}
 \text{Total area-source emissions} &= \frac{\text{Emissions from surveyed area sources}}{\text{Employment at surveyed area sources}} \times \text{Total area-source employment} \\
 \text{Area-source PM}_{10} \text{ emissions from fab. metal products} &= \frac{0.025 \text{ tons of PM}_{10}/\text{yr}}{638 \text{ employees}} \times 16,157 \text{ employees} \\
 &= 0.63 \text{ tons PM}_{10}/\text{yr}
 \end{aligned}$$

Typical daily emissions are calculated based on the operating schedule data reported by fabricated metal products facilities. From annual emission surveys, the modal values were identified for two items: days/week and annual activity. This data was used to calculate typical daily emissions as follows:

$$\begin{aligned}
 \text{Typical daily PM}_{10} \text{ emissions from fab. metal products} &= \frac{\text{Annual emissions (tons/yr)}}{\text{Days/week} \times \text{Weeks/year}} \times \frac{2,000 \text{ lbs}}{\text{ton}} \\
 &= \frac{0.63}{5 \times 52} \times 2,000 \\
 &= 4.8 \text{ lbs PM}_{10}/\text{day}
 \end{aligned}$$

Annual and typical daily emissions for the PM₁₀ nonattainment area were calculated by multiplying the Maricopa County emission totals by the percentage industrial employment within the nonattainment area. (See Section 1.5.1 for a discussion of the employment data used.)

$$\begin{aligned}
 \text{PM}_{10} \text{ emissions from area-source fab. metal prod. in the PM}_{10} \text{ NAA (tons/yr)} &= \text{Annual Maricopa County emissions} \times \text{NAA:County ratio of industrial employment} \\
 &= 0.63 \text{ tons/yr} \times 0.9891 \\
 &= 0.62 \text{ tons PM}_{10}/\text{yr}
 \end{aligned}$$

Table 3.3–16 summarizes annual and typical daily emissions from fabricated metal products manufacturing in both Maricopa County and the PM₁₀ nonattainment area.

Table 3.3–16. Annual and typical daily emissions from area-source fabricated metal product manufacturing.

Category	Annual emissions (tons/yr)		Typical daily emissions (lbs/day)	
	PM ₁₀	PM _{2.5}	PM ₁₀	PM _{2.5}
Maricopa County	0.63	0.44	4.8	3.4
PM ₁₀ NAA	0.62	0.44	4.8	3.4

3.3.9 Construction

Maricopa County’s air quality permits database was used to identify all earthmoving permits issued during 2002. A total of 3,506 permits were issued, comprising a total of 51,803 acres (Table 3.3–17). Data requested on each earthmoving permit application includes the activity type and acreage. Where the activity type was unknown, this acreage was apportioned to residential and commercial construction, the two largest categories, as shown below.

Table 3.3–17. 2002 Maricopa County earthmoving permits issued, by type.

Earthmoving Permit Category	Reported Acres	“All other” category apportionment	Revised Acres
Residential	29,431.9	+ 13,073.9	42,505.8
Commercial	4,457.8	+1,980.2	6,438.0
Road construction	2,129.1		2,129.1
Trenching	649.5		649.5
Weed control	80.4		80.4
All other categories / unknown	15,054.1		
Totals:	51,802.8		51,802.8

The latest EPA guidance (US EPA, 2002) provides different emission factors of single-family vs. multi-unit residential construction activity. As no information was available about the breakout of residential construction activity between these two categories, the following assumptions were made:

- all permits less than 1 acre were assumed to be single-family construction.
- the remainder of residential permits were assumed to be split equally between single- and multi-unit housing.

The average duration of construction activity and emission factors were applied to each of these categories as shown below in Table 3.3–18. Estimates of project duration for residential construction are from EIIP guidance (US EPA, 2002); estimates for commercial, road construction, and trenching/weed control are from MRI (1996):

Table 3.3–18. Average project duration and emission factor, by permit type.

Permit Category	Total Acres	Average Duration (months)	Total acre-months	Emission factor (tons PM₁₀/acre-month)
Residential: single-family	22,117.1	6	132,702.9	0.032
Residential: multi-family	20,388.7	12	244,663.9	0.11
Commercial	6,438.0	12	77,256.0	0.11
Road construction	2,129.1	12	25,549.1	0.11
Trenching	649.5	1	649.5	0.11
Weed control	80.4	1	80.4	0.11
Totals:	51,802.8			

county-wide annual uncontrolled PM₁₀ emissions for each construction category were then calculated as follows:

$$\text{Annual uncontrolled PM}_{10} \text{ emissions} = \text{total acres/yr} \times \text{no. months} \times \text{emission factor (tons of PM}_{10}\text{/acre-month)}$$

Example:

$$\begin{aligned} \text{Annual uncontrolled PM}_{10} \text{ emissions from single-family residential construction} &= 22,117.1 \text{ acres/yr} \times 6 \text{ months} \times 0.032 \text{ tons PM}_{10}\text{/acre-month} \\ &= 4,246.50 \text{ tons PM}_{10}\text{/yr} \end{aligned}$$

A control efficiency of 70% was applied to the uncontrolled emissions calculations. A recent rule effectiveness study by Maricopa County (MCESD, 2003) indicates a 80% compliance rate with County Rule 310 on dust control. Thus, an overall control effectiveness of 56% (= 70% × 80%) was applied, consistent with the approach used by ADEQ to estimate construction activity emissions for the Salt River PM₁₀ State Implementation Plan Revision (ADEQ, 2004).

Controlled PM₁₀ emissions were calculated as follows:

$$\text{Annual controlled PM}_{10} \text{ emissions} = \text{Uncontrolled PM}_{10} \text{ emissions (tons/yr)} \times [1 - (\text{control efficiency} \times \text{rule effectiveness})]$$

Example:

$$\begin{aligned} \text{Annual controlled PM}_{10} \text{ emissions from single-family residential construction} &= 4,246.5 \text{ tons} \times [1 - (70\% \text{ control} \times 80\% \text{ rule effectiveness})] \\ &= 1,868.5 \text{ tons PM}_{10}\text{/yr} \end{aligned}$$

PM_{2.5} emissions were calculated as 20% of PM₁₀ emissions (US EPA, 2002). Table 3.3–19 summarizes the calculations for each construction category.

Table 3.3–19. Annual emissions from construction (tons/yr).

Category	Total acre-months	Emission factor (tons/acre-month)	Uncontrolled PM ₁₀	Controlled PM ₁₀	Controlled PM _{2.5}
Residential: single-family	132,702.9	0.032	4,246.5	1,868.5	373.7
Residential: multi-unit	244,663.9	0.11	26,913.0	11,841.7	2,368.3
Commercial	77,256.0	0.11	8,498.2	3,739.2	747.8
Road construction	25,549.1	0.11	2,810.4	1,236.6	247.3
Trenching	649.5	0.11	71.4	31.4	6.3
Weed control	80.4	0.11	8.8	3.9	0.8
Totals:			42,548.4	18,721.3	3,744.3

It was assumed that construction activity occurs 5 days per week and evenly throughout the year. Thus, County typical daily emissions were calculated by dividing Maricopa County annual emissions by 260 (5 days/wk × 52 wks/yr).

A review of earthmoving permit site location data indicated that 95.7 percent of the earthmoving activity occurred in the PM₁₀ nonattainment area, thus, annual and typical daily emissions for the PM₁₀ nonattainment area were calculated by multiplying the Maricopa County emission totals by 95.7 percent.

Table 3.3–20. Annual and typical daily emissions from construction.

Geographic area	Annual emissions (tons/yr)		Typical daily emissions (lbs/day)	
	PM ₁₀	PM _{2.5}	PM ₁₀	PM _{2.5}
Maricopa County	18,721.29	3,744.26	144,009.9	28,802.0
PM ₁₀ NAA	17,916.27	3,583.25	137,817.5	27,563.5

3.3.10 Electrical equipment manufacturing

Emissions from electric equipment manufacturing were calculated by the “scaling up” method as described in EPA emission inventory guidance (US EPA, 2001a). This method combines detailed emissions data from a subset of sources, and county-level employment data from the US Census Bureau (2003b) to develop a per-employee emission factor that is then used to estimate emissions from all sources in an industry category.

The most recent data from the US Census Bureau’s County Business Patterns (CBP) for 2001 employment were used. Where CBP employment estimates were presented as a range, the midpoint values was chosen for these calculations. Table 3.3–21 shows the NAICS codes and employment data used to calculate emissions from electrical equipment manufacturing.

Some facilities in this category are considered point sources, and have been addressed in Chapter 2. To avoid double-counting, employment at point sources is subtracted from total employment as follows:

Total area-source employment in electric equipment manufacturing = Total employment (from US Census' County Business Patterns) - Employment at point sources (from annual emission reports)

= 44,756 - 10,316

= 34,440 employees

Table 3.3–21. NAICS codes and descriptions for electric equipment manufacturing.

NAICS Code	Description	CBP employment data provided	Value used
32613	Laminated plastics plate, sheet & shape mfg.	20–99	60
333315	Photographic & photocopying equipment mfg.	68	68
33421	Telephone apparatus mfg.	782	782
33422	Radio, TV broadcast & wireless communication equipment mfg.	3,471	3,471
334412	Bare printed circuit board mfg.	2,134	2,134
334413	Semiconductor & related device mfg.	18,479	18,479
334416	Electronic coil, transformer, other inductor mfg.	346	346
334418	Printed circuit assembly (electronic assembly) mfg.	2,500–4,999	3,750
334419	Other electronic component mfg.	656	656
334511	Search, detection & navigation instrument mfg.	5,000–9,999	7,500
336412	Aircraft engine & engine parts mfg.	5,000–9,999	7,500
336419	Other missile, space vehicle parts & auxiliary equipment mfg.	0–19	10
Total:			44,756

This area-source employment estimate is used to “scale up” emissions reported from those facilities surveyed in 2002 as follows:

$$\text{Total area-source emissions} = \frac{\text{Emissions from surveyed area sources}}{\text{Employment at surveyed area sources}} \times \text{Total area-source employment}$$

$$\begin{aligned} \text{Area-source PM}_{10} \text{ emissions from electric equipment manufacturing} &= \frac{0.70 \text{ tons of PM}_{10}/\text{yr}}{23,516 \text{ employees}} \times 34,440 \text{ employees} \\ &= 1.03 \text{ tons PM}_{10}/\text{yr} \end{aligned}$$

Typical daily emissions are calculated based on the operating schedule data reported by electric equipment manufacturing facilities. From annual emission surveys, the modal values were identified for two items: days/week and annual activity. This data was used to calculate typical daily emissions as follows:

$$\begin{aligned} \text{Typical daily PM}_{10} \text{ emissions from electric equipment mfg.} &= \frac{\text{Annual emissions (tons/yr)}}{\text{Days/week} \times \text{Weeks/year}} \times \frac{2,000 \text{ lbs}}{\text{ton}} \\ &= \frac{1.03}{7 \times 52} \times 2,000 \\ &= 5.7 \text{ lbs PM}_{10}/\text{day} \end{aligned}$$

Annual and typical daily emissions for the PM₁₀ nonattainment area were calculated by multiplying the Maricopa County emission totals by the percentage industrial employment within the nonattainment area. (See Section 1.5.1 for a discussion of the employment data used.)

$$\begin{aligned}
 \text{PM}_{10} \text{ emissions from area-source in the PM}_{10} \text{ NAA (tons/yr)} &= \text{Annual Maricopa County emissions} \times \text{NAA:county ratio of industrial employment} \\
 &= 1.03 \text{ tons/yr} \times .9891 \\
 &= 1.02 \text{ tons PM}_{10}/\text{yr}
 \end{aligned}$$

Table 3.3–22 summarizes annual and typical daily emissions from electrical equipment manufacturing in both Maricopa County and the PM₁₀ nonattainment area.

Table 3.3–22. Annual and typical daily emissions from area-source electric equipment manufacturing.

Geographic area	Annual emissions (tons/yr)					Typical daily emissions (lbs/day)				
	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
Maricopa County	1.03	0.63	16.28	0.00	6.27	5.7	3.4	89.4	0.0	34.4
PM ₁₀ NAA	1.02	0.62	16.10	0.00	6.20	5.6	3.4	88.5	0.0	34.0

3.3.11 State-permitted portable sources

The Arizona Department of Environmental Quality (ADEQ) retains the authority to permit certain categories of sources within Maricopa County, including portable sources. MCESD requested information from ADEQ for all ADEQ-permitted sources that reported any activity in Maricopa County during 2002. Annual total emissions for each pollutant were provided, along with information on the facility type, and information on the location of the site during the year. Permits were classified into four major types: asphalt batch, concrete batch, crushing/screening, and other (including soil remediation, generators, etc.). From this information, emissions that occurred within Maricopa County were estimated as in the following example.

Data provided:

Source information: Onyx Construction – Kevin’s Spread, ID S7710
 Permit type: Portable crushing/screening plant
 Operating schedule: Operated in Mohave County 6/10/02 to 7/28/02, Maricopa County from 7/30/02 to 10/22/02, and La Paz County from 10/24/02 to 12/31/02.

Total annual emissions: (tons/yr)	PM ₁₀	PM _{2.5} ¹	NO _x	SO _x
	4.8448	2.4224	54.2499	10.0424

1. PM_{2.5} was assumed to be 50% of reported PM₁₀ for crushing/screening operations.

Using this information, calculations were made to determine:

$$\begin{aligned}
 \text{Total operating days in 2002:} & 203 = 21 \text{ (June)} + 30 \text{ (July)} + \dots + 31 \text{ (Dec.)} \\
 \text{Total operating days in Maricopa County:} & 85 = 2 \text{ (July)} + 31 \text{ (Aug.)} + \dots + 22 \text{ (Oct.)}
 \end{aligned}$$

All emissions were assumed to be equally distributed among all reported days of operation. First, the total emissions attributable to activity in Maricopa County was calculated as follows:

$$\begin{aligned}
 \text{Annual PM}_{10} \text{ emissions in Maricopa County (tons/yr)} &= \text{Total annual emissions} \times \frac{\text{operating days in Maricopa County}}{\text{total operating days in 2002}} \\
 &= 4.84 \times \frac{85}{203} \\
 &= 2.03 \text{ tons PM}_{10}/\text{yr}
 \end{aligned}$$

Typical daily emissions were then calculated as follows:

$$\begin{aligned} \text{Typical daily emissions (lbs/day)} &= \frac{\text{total emissions attributable to activity in Maricopa County}}{\text{number of operating days in Maricopa County}} \times \frac{2,000 \text{ lbs}}{\text{ton}} \\ &= \frac{2.03 \text{ tons}}{85 \text{ days}} \times \frac{2,000 \text{ lbs}}{\text{ton}} \\ &= 47.7 \text{ lbs PM}_{10}/\text{day} \end{aligned}$$

Table 3.3–23 summarizes the annual and typical daily emissions for all ADEQ-permitted portable sources that operated within Maricopa County at some point during 2002. Since no precise location data was available, all emissions are conservatively assumed to have originated within the PM₁₀ nonattainment area, therefore emissions in Maricopa County and the PM₁₀ nonattainment area are equal.

Table 3.3–23. Emissions from ADEQ-permitted portable sources, by permit type.

Permit type	Annual emissions (tons/yr)				Typical daily emissions (lbs/day)			
	PM ₁₀	PM _{2.5}	NO _x	SO _x	PM ₁₀	PM _{2.5}	NO _x	SO _x
Asphalt batch	27.46	13.73	68.87	42.92	239.6	119.8	639.2	343.5
Concrete batch	10.07	5.03	31.81	7.97	56.5	28.3	199.0	50.4
Crushing/screening	72.39	36.20	466.40	105.42	564.4	282.2	4,352.1	864.4
Other	0.91	0.91	5.35	0.83	5.0	5.0	29.3	4.5
Total:	110.83	55.87	572.42	157.14	865.5	435.3	5,219.6	1,262.8

3.3.12 Paved/unpaved road travel on industrial sites

This section addresses emissions from travel on paved and unpaved roads within the boundaries of a permitted facility. Emissions from motor vehicle travel on public and private roads is addressed in Chapter 5, Mobile Sources, and road travel emissions from facilities considered point sources are addressed in Chapter 2, Point Sources. PM₁₀ emissions from this source category were derived from annual emission reports from permitted sources, using AP-42 equations based on vehicle size and average speed (US EPA, 1997; 1998b). It is assumed that there are no unpermitted sources with significant emissions from on-site road travel.

PM_{2.5} emissions were calculated from PM₁₀ using the ratio of the constant *k* for paved and unpaved industrial roads, respectively, from AP-42, as in this example for medium-duty vehicles traveling at 15 mph:

$$\begin{aligned} \text{Uncontrolled PM}_{10} \text{ emissions from unpaved road travel} &= \text{Vehicle miles traveled (mi/yr)} \times \text{AP-42 emission factor (lb PM}_{10}/\text{mi)} \\ &= 5,968 \text{ mi/yr} \times 0.86 \\ &= 5,132 \text{ lbs PM}_{10}/\text{yr} \end{aligned}$$

Dust control measures are required under County Rule 310 for all industrial haul roads in the county. The most common practice, watering, is assumed to have a 70% control efficiency for PM₁₀, calculated as:

$$\begin{aligned}
 \text{Controlled PM}_{10} \text{ emissions} &= \text{uncontrolled PM}_{10} \text{ emissions} \times 1 - (\text{control efficiency \%}) \\
 &= 5,132 \text{ lb/yr} \times 1 - 0.70 \\
 &= 1,540 \text{ lbs PM}_{10}/\text{yr}
 \end{aligned}$$

PM_{2.5} emissions were calculated using the ratio of the constant *k* in the respective AP-42 equations for paved and unpaved roads, as well as a 40% control efficiency, from EPA's PM Calculator software (US EPA, 2001c).

$$\begin{aligned}
 \text{Uncontrolled PM}_{2.5} \text{ emissions} &= \text{Uncontrolled PM}_{10} \text{ emissions} \times \text{ratio of } k \text{ for unpaved roads} \\
 &= 5,132 \text{ lbs/yr} \times 0.15333 \\
 &= 787 \text{ lbs PM}_{2.5}/\text{yr}
 \end{aligned}$$

Controlled PM_{2.5} emissions, reflecting the lesser control efficiency of watering, are then calculated as:

$$\begin{aligned}
 \text{Controlled PM}_{2.5} \text{ emissions} &= \text{uncontrolled PM}_{2.5} \text{ emissions} \times 1 - (\text{control efficiency \%}) \\
 &= 787 \text{ lb/yr} \times 1 - 0.40 \\
 &= 472 \text{ lbs PM}_{10}/\text{yr}
 \end{aligned}$$

Typical daily emissions were calculated using operating schedule information for each reported process (normally a 5- or 6-day week), which were then summed to provide total daily emissions for the county. Emissions totals for the PM₁₀ nonattainment area were determined from the site locations of each facility.

Table 3.3–24. Annual and typical daily emissions from paved and unpaved road travel at industrial facilities.

Geographic area	Annual emissions (tons/yr)		Typical daily emissions (lbs/day)	
	PM ₁₀	PM _{2.5}	PM ₁₀	PM _{2.5}
Maricopa County	74.58	23.36	543.0	166.1
PM ₁₀ NAA	69.11	22.11	504.1	157.3

3.3.13 Industrial processes not elsewhere classified (NEC)

Annual area-source emissions from other industrial processes NEC were derived from annual emissions reports from permitted facilities. Other industrial processes include a wide array of industrial activities that are often specific to the permitted facility that reported the process. For this reason, it is assumed there are no significant emissions from other industrial processes, other than those reported by permitted facilities on their annual emissions reports. Typical daily emissions are calculated based on operating schedule information provided by the facilities in their annual emissions report.

All facilities that reported area-source emissions from other industrial processes NEC are located inside the PM₁₀ nonattainment area, therefore emissions for Maricopa County and the PM₁₀ NAA are equal.

Table 3.3–25. Annual and typical daily emissions from other industrial processes not elsewhere classified.

Geographic area	Annual emissions (tons/yr)					Typical daily emissions (lbs/day)				
	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
Maricopa County	23.83	18.39	0.05	0.03	4.42	183.3	141.5	0.4	0.4	34.0
PM ₁₀ NAA	23.83	18.39	0.05	0.03	4.42	183.3	141.5	0.4	0.4	34.0

3.3.14 Summary of all area-source industrial processes

Tables 3.3–26 and 3.3–27 provide a summary of annual and typical daily emissions from all industrial sources, for Maricopa County and the PM₁₀ nonattainment area, respectively.

Table 3.3–26. Annual and typical daily emissions from all area-source industrial processes in Maricopa County.

Source category	Annual emissions (tons/yr)				
	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
Chemical manufacturing	28.53	17.72	1.08	0.25	0.61
Commercial cooking	713.85	661.98			
Grain handling/processing	7.01	1.80			
Ammonia cold storage					1,658.81
Secondary metal production	6.72	3.68	0.03	0.03	2.68
Non-metallic mineral processes	87.11	31.61			
Mining and quarrying	28.43	11.09			
Wood product manufacturing.	145.14	89.36			
Rubber/plastic product manufacturing	25.47	23.41			
Fabricated metal product manufacturing	0.63	0.44			
Construction	18,721.29	3,744.26			
Electrical equipment manufacturing	1.03	0.63	16.28		6.27
ADEQ-permitted portable sources	110.83	55.87	572.42	157.14	
Road travel at industrial sites	74.58	23.36			
Industrial processes NEC	23.83	18.39	0.05	0.03	4.42
All industrial processes:	19,974.43	4,683.60	589.86	157.46	1,672.79

Source category	Typical daily emissions (lbs/day)				
	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
Chemical manufacturing	219.4	136.3	8.3	1.9	4.7
Commercial cooking	3,922.2	3,637.2			
Grain handling/processing	53.1	13.5			
Ammonia cold storage					10,633.4
Secondary metal production	52.1	28.7	0.2	0.3	15.6
Non-metallic mineral processes	670.1	243.2			
Mining and quarrying	177.1	68.3			
Wood product manufacturing.	1,116.5	687.4			
Rubber/plastic product manufacturing	195.9	180.1			
Fabricated metal product manufacturing	4.8	3.4			
Construction	144,009.9	28,802.0			
Electrical equipment manufacturing	5.7	3.4	89.4		34.4
ADEQ-permitted portable sources	865.5	435.3	5,219.6	1,262.8	
Road travel at industrial sites	543.0	166.1			
Industrial processes NEC	183.3	141.5	0.4	0.4	34.0
All industrial processes:	152,018.5	34,546.4	5,318.0	1,265.4	10,722.2

Table 3.3–27. Annual and typical daily emissions from all area-source industrial processes in the PM₁₀ NAA.

Source category	Annual emissions (tons/yr)				
	PM₁₀	PM_{2.5}	NO_x	SO_x	NH₃
Chemical manufacturing	28.22	17.53	1.07	0.25	0.61
Commercial cooking	707.71	656.28			
Grain handling/processing	7.01	1.80			
Ammonia cold storage					1,640.73
Secondary metal production	6.72	3.68	0.03	0.03	2.68
Non-metallic mineral processes	86.16	31.27			
Mining and quarrying	22.92	9.20			
Wood product manufacturing.	143.56	88.38			
Rubber/plastic product manufacturing	25.19	23.16			
Fabricated metal product manufacturing	0.62	0.44			
Construction	17,916.27	3,583.25			
Electrical equipment manufacturing	1.02	0.62	16.10		6.20
ADEQ-permitted portable sources	110.83	55.87	572.42	157.14	
Road travel at industrial sites	69.11	22.11			
Industrial processes NEC	23.83	18.39	0.05	0.03	4.42
All industrial processes:	19,149.15	4,511.99	589.67	157.45	1,654.64

Source category	Typical daily emissions (lbs/day)				
	PM₁₀	PM_{2.5}	NO_x	SO_x	NH₃
Chemical manufacturing	217.1	134.8	8.2	1.9	4.7
Commercial cooking	3,888.5	3,605.9			
Grain handling/processing	53.1	13.5			
Ammonia cold storage					10,517.5
Secondary metal production	52.1	28.7	0.2	0.3	15.6
Non-metallic mineral processes	662.8	240.5			
Mining and quarrying	138.9	55.1			
Wood product manufacturing.	1,104.3	679.9			
Rubber/plastic product manufacturing	193.7	178.1			
Fabricated metal product manufacturing	4.8	3.4			
Construction	137,817.5	27,563.5			
Electrical equipment manufacturing	5.6	3.4	88.5		34.0
ADEQ-permitted portable sources	865.5	435.3	5,219.6	1,262.8	
Road travel at industrial sites	504.1	157.3			
Industrial processes NEC	183.3	141.5	0.4	0.4	34.0
All industrial processes:	145,691.2	33,240.8	5,316.9	1,265.4	10,605.8

3.4 Waste treatment and disposal

3.4.1 On-site incineration

This section includes emissions from on-site industrial incinerators, primarily burn-off ovens used to reclaim electric wire or other materials. Emissions from human and animal crematories are addressed in Section 3.5.4. There were no incinerators at residential (e.g., apartment complexes) or commercial/institutional facilities (e.g., hospitals, service establishments) in operation during 2002.

Emissions from on-site incineration were determined from annual emission inventory reports. Of the four incinerators under permit in 2002, two were surveyed and reported annual emissions. As all four facilities are roughly similar in terms of capacity, these survey results were doubled to estimate total annual and typical daily emissions from all four incinerators in Maricopa

County. All four facilities are located within the PM₁₀ nonattainment area, thus total emissions for the county and NAA are equal.

Table 3.4-1. Annual and typical daily emissions from on-site incineration.

Geographic area	Annual emissions (tons/yr)				Typical daily emissions (lbs/day)			
	PM ₁₀	PM _{2.5}	NO _x	SO _x	PM ₁₀	PM _{2.5}	NO _x	SO _x
Maricopa County	0.67	0.59	28.90	0.03	5.2	4.6	222.3	0.2
PM ₁₀ NAA	0.67	0.59	28.90	0.03	5.2	4.6	222.3	0.2

3.4.2 Open burning

Emissions from controlled open burning are regulated by MCESD Rule 314, which requires a burn permit for open burning in Maricopa County. Burn permits are issued primarily for purposes of agricultural ditch bank and fence row burning, tumbleweed burning, land clearance, air curtain destructor burning of trees, and fire fighting training. Maricopa County's burn permit data base was used to identify all burn permits issued during 2002. A total of 140 permits were issued during the year; however, not all permit applications contained the information needed to calculate emissions. Where data were missing, activity data for each permit category was grown from those permits that contained information, as follows:

$$\text{Total activity} = \sum \text{activity reported} \times \frac{\text{total number of permits issued}}{\text{number of permits with activity data}}$$

Example:

$$\text{Total ditch - bank/fencerows} = 973,885 \text{ linear ft} \times \frac{85 \text{ ditchbank/fencerow permits issued}}{29 \text{ permits with quantitative data}} = 2,854,491 \text{ linear ft}$$

Reported and estimated activity data for each open burning category are summarized in Table 3.4-2. Permits issued for fire fighting training will be addressed Section 3.5.1.2.

Table 3.4-2. 2002 Maricopa County burn permit activity data.

Category	Unit of measure	Total reported activity	Number of permits with activity data	Total permits issued	Activity grown to total number of permits issued
Ditchbank/fencerow	Linear ft	973,885	29	85	2,854,491
Land clearance	Acres	1,345	17	34	2,690
Land clearance	Piles	69	8	34	293
Air curtain	Trees	200	1	2	400
Tumbleweeds	Piles	9	3	8	24

The above activity data were converted to tons material burned using fuel loading factors from AP-42, Table 2.5-5 (US EPA, 1992). The emission and loading factors used are shown in Table 3.4-3. As a conservative estimate, all particulate matter is presumed to be PM₁₀ (and PM_{2.5}).

Table 3.4-3. Emission and fuel loading factors for open burning.

Category	Emission factors (lb/ton burned)					Fuel loading factor
	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃	
Weeds, unspecified	15	15	4	n/a	n/a	3.2 tons/acre
Russian Thistle (tumbleweeds)	22	22	4	n/a	n/a	0.1 tons/acre
Orchard Crops: Citrus	6	6	4	n/a	n/a	1.0 tons/acre

The following assumptions were made based on previous MCESD emission inventory work:

- Ditch banks and fence rows in Maricopa County average 7 feet in width and are burned twice per year (MCESD, 1999).
- A pile of tumbleweeds 15 feet in diameter and 5 feet high weighs 200 lbs (MCESD, 1993). This is equivalent to the AP-42 fuel loading factor for tumbleweeds – 0.1 tons/acre.
- The estimated weight of a mature, partially dried citrus tree, including trunk, limbs and bulk of root is 500 lbs per tree (MCESD, 1993).

To calculate the annual amount of material burned on ditch banks and fence rows in Maricopa County, MCESD estimated the area burned and then applied AP-42 fuel loading factor. The tons of material burned in ditch banks and fence rows in Maricopa County were estimated as follows:

$$\begin{aligned} \text{Material burned from ditchbanks and fence rows} &= \frac{2,854,491 \text{ ft length}}{43,560 \text{ ft}^2 / \text{acre}} \times 7 \text{ ft width} \times 3.2 \text{ tons/acre} \times 2 \text{ times/yr} \\ &= 2,936 \text{ tons material burned/yr} \end{aligned}$$

Activity data for the other categories were similarly converted to material burned using AP-42 fuel loading factors.

Annual emissions were then calculated by multiplying the amount of material burned by AP-42 emission factors (listed in Table 3.4–3) for each open burning category. To account for unpermitted illegal outdoor burning, the county’s Air Quality Complaint data base was examined, which indicated 65 illegal outdoor open burning complaints (mostly residential) and 6 issued Notices of Violation. All calculated emissions estimates were thus increased by 10 percent, as a conservative estimate.

$$\begin{aligned} \text{Annual PM}_{10} \text{ emissions from ditchbank and fence row burning} &= \text{Total material burned} \times \text{emission factor} \times \text{unit conversion factor} \\ &= 2,936 \text{ tons} \times 15 \text{ lbs/ton} \times 1 \text{ ton} / 2,000 \text{ lbs} \\ &= 22.02 \text{ tons/yr} \end{aligned}$$

$$\begin{aligned} \text{Total annual PM}_{10} \text{ emissions including unpermitted burning} &= \text{Calculated emissions from permit data} + \text{unpermitted burning adjustment factor} \\ &= 22.02 \text{ tons/yr} + (10\% \times 22.02) \\ &= 24.22 \text{ tons PM}_{10}\text{/yr} \end{aligned}$$

Table 3.4–4 summarizes the annual emissions for Maricopa County from each open burning category.

Table 3.4–4. Annual emissions from open burning in Maricopa County.

Category	Ton-equivalents	Annual emissions (tons/yr)		
		PM ₁₀	PM _{2.5}	NO _x
Ditchbank/fencerow	2,935.7	24.22	24.22	6.46
Land clearance	9,545.5	78.75	78.75	21.00
Air curtain	100.0	0.33	0.33	0.22
Tumbleweeds	2.4	0.03	0.03	0.01
Totals:		103.33	103.33	27.68

Annual emissions for the nonattainment area are calculated by multiplying the percentage of agricultural and/or vacant land use located in the PM₁₀ nonattainment area by the Maricopa County emission totals. (See Section 1.5.1 for a discussion of the land-use data used.) Table 3.4–5 summarizes the annual emissions for the PM₁₀ nonattainment area.

Table 3.4–5. Surrogate land-use classes, ratios, and annual emissions from open burning in the PM₁₀ NAA.

Category	Surrogate land use categories	2000 NAA:county land-use ratio	Emissions (tons/yr)		
			PM ₁₀	PM _{2.5}	NO _x
Ditchbank/fencerow	Agriculture	53.43 %	12.95	12.95	3.45
Land clearance	Vacant	28.25 %	22.25	22.25	5.93
Air curtain	Agriculture and vacant	31.66 %	0.10	0.10	0.07
Tumbleweeds	Agriculture and vacant	31.66 %	0.01	0.01	0.00
Totals:			35.31	35.31	9.46

It was assumed that open burning occurs 5 days per week (most burn permits are issued for weekdays but permits may be issued on weekends depending on circumstances). Open burning occurs year-round with the exception of ditch bank and fence row burning, which is not allowed during the CO season (November through February).

PM₁₀ typical daily emissions for Maricopa County are derived as follows:

$$\text{Typical daily PM}_{10} \text{ emissions} = \frac{\text{annual PM}_{10} \text{ emissions (lbs)}}{(\text{burn days/week}) \times (\text{burn weeks/year})}$$

$$\begin{aligned} \text{Typical daily PM}_{10} \text{ emissions from ditchbank/ fence row burning} &= \frac{48,440 \text{ lbs}}{5 \text{ days/wk} \times 35 \text{ wks/yr}} \\ &= 276.8 \text{ lbs PM}_{10}/\text{day} \end{aligned}$$

Typical daily emissions for the PM₁₀ nonattainment area are calculated by multiplying the percentage of agricultural and/or vacant land use located in the nonattainment area by the Maricopa County typical daily emissions. (See Section 1.5.2 for a discussion of the land-use data used.) Table 3.4–6 summarizes the typical daily emissions from open burning for both Maricopa County and the PM₁₀ nonattainment area.

Table 3.4–6. Typical daily emissions from open burning.

Category	Maricopa County			PM ₁₀ nonattainment area		
	PM ₁₀	PM _{2.5}	NO _x	PM ₁₀	PM _{2.5}	NO _x
Ditchbank/fencerow	276.8	276.8	73.8	148.0	148.0	39.5
Land clearance	605.8	605.8	161.5	171.1	171.1	45.6
Air curtain	2.5	2.5	1.7	0.8	0.8	0.5
Tumbleweeds	0.2	0.2	0.0	0.1	0.1	0.0
Totals:	885.3	885.3	237.1	320.0	320.0	85.6

3.4.3 Landfills

Emissions from municipal solid waste (MSW) landfills come from uncontrolled landfill gas emissions as well as from combustion from control measures, such as a flare. Total emissions were calculated from annual emissions inventory reports from all landfills located within the county. Two MSW landfills (Butterfield Station and Allied Waste Industries Southwest

Regional Facility) are considered point sources and are reported in Chapter 2 . All other MSW landfills are reported here as area-source landfills.

Since all of the landfills considered in this section are located within the PM₁₀ nonattainment area, total emission values for the county and the NAA are equal. Typical daily emissions were calculated based on reported activity data (days per week) for each individual process, and then summed. Nearly all processes reported operating on a 7 day week. Annual and daily emissions are shown in Table 3.4–7.

Table 3.4-7. Annual and typical daily emissions from landfills.

Geographic area	Annual emissions (tons/yr)				Typical daily emissions (lbs/day)			
	PM ₁₀	PM _{2.5}	NO _x	SO _x	PM ₁₀	PM _{2.5}	NO _x	SO _x
Maricopa County	4.53	3.30	10.44	2.33	24.9	18.1	57.4	12.8
PM ₁₀ NAA	4.53	3.30	10.44	2.33	24.9	18.1	57.4	12.8

3.4.4 Publicly owned treatment works (POTWs)

Emissions from publicly owned treatment works (POTWs) were calculated by multiplying per-capita emission factors (Battye et al., 1994) by population estimates and per-capita wastewater usage estimates of 100 gallons per day per person (Tchobanoglous, 1979), as shown in Table 3.4–8. Typical daily emissions were calculated dividing annual emission by 365 day as activity is assumed to occur uniformly throughout the year.

Table 3.4-8. NH₃ emissions from publicly-owned treatment works (POTWs).

Geographic area	2002 Population	NH ₃ emission factor (lbs/10 ⁶ gals treated)	Annual NH ₃ emissions	Typical daily NH ₃ emissions
			(tons/yr)	(lbs/day)
Maricopa County	3,549,693	19.0	1,230.86	6,744.4
PM ₁₀ NAA	3,519,288	19.0	1,220.31	6,686.6

3.4.5 Other industrial waste disposal

Annual area-source emissions from other industrial waste disposal were derived from annual emissions reports from permitted facilities. Other industrial waste disposal processes include a wide array of industrial activities that are often specific to the permitted facility that reported the process. For this reason, it is assumed there are no significant emissions from this category, other than those reported by permitted facilities on their annual emissions reports. Typical daily emissions are calculated based on operating schedule information provided by the facilities in their annual emissions report.

All facilities that reported area-source emissions from other industrial waste disposal are located inside the PM₁₀ nonattainment area, therefore emissions for Maricopa County and the PM₁₀ NAA are equal.

Table 3.4-9. Annual and typical daily emissions from other industrial waste disposal.

Geographic area	Annual emissions (tons/yr)				Typical daily emissions (lbs/day)			
	PM ₁₀	PM _{2.5}	NO _x	SO _x	PM ₁₀	PM _{2.5}	NO _x	SO _x
Maricopa County	3.05	2.53	0.33	0.31	23.5	19.5	2.6	2.4
PM ₁₀ NAA	3.05	2.53	0.33	0.31	23.5	19.5	2.6	2.4

3.4.6 Summary of all area-source waste disposal

Tables 3.4–10 and 3.4–11 provide a summary of annual and typical daily emissions from all waste disposal, for Maricopa County and the PM₁₀ nonattainment area, respectively.

Table 3.4–10. Annual and typical daily emissions from all area-source waste disposal for Maricopa County.

Category	Annual emissions (tons/yr)					Typical daily emissions (lbs/day)				
	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
On-site incineration	0.67	0.59	28.90	0.03		5.2	4.6	222.3	0.2	
Open burning	103.33	103.33	27.68			885.3	885.3	237.1		
Landfills	4.53	3.30	10.44	2.33		24.9	18.1	57.4	12.8	
POTWs					1,230.86					6,744.4
Other	3.05	2.53	0.33	0.31		23.5	19.5	2.6	2.4	
Total:	111.58	109.76	67.36	2.67	1,230.86	938.8	927.5	519.3	15.4	6,744.4

Table 3.4–11. Annual and typical daily emissions from all area-source waste disposal for the PM₁₀ NAA.

Category	Annual emissions (tons/yr)					Typical daily emissions (lbs/day)				
	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
On-site incineration	0.67	0.59	28.90	0.03		5.2	4.6	222.3	0.2	
Open burning	35.31	35.31	9.46			320.0	320.0	85.6		
Landfills	4.53	3.30	10.44	2.33		24.9	18.1	57.4	12.8	
POTWs					1,220.31					6,686.6
Other	3.05	2.53	0.33	0.31		23.5	19.5	2.6	2.4	
Total:	43.56	41.74	49.13	2.67	1,220.31	373.6	362.2	367.9	15.4	6,686.6

3.5 Miscellaneous area sources

3.5.1 Other combustion

3.5.1.1 Wildfires and brush fires

The Arizona Department of Environmental Quality, in cooperation with the United States Forest Service, reported that one wildfire burned 1000 acres in the Tonto National Forest on July 16–18, 2002. The wildfire occurred within Maricopa County but outside of the nonattainment area. ADEQ also reported that negligible prescribed fires occurred in Maricopa County in 2002.

In addition, 2002 survey results from Maricopa County fire departments, the Bureau of Land Management, and the Arizona State Land Department were used to calculate emissions from brush fires. In some cases, the survey results included limited information on the average size of fires. Thus, when acreage data was incomplete or unclear, each reported brush fire was assumed to be equal to 0.1 acres. Survey results are included in Appendix 3.1. It was estimated that 7,054 brush fires occurred in Maricopa County in 2002 and burned approximately 1,656.5 acres.

Wildfire emission factors and fuel loading factors were obtained from the Western Regional Air Partnership's (WRAP) 1996 Fire Emission Inventory (WGA/WRAP, 2002), while brush fire emission factor and fuel loading factors were obtained from AP-42 (US EPA, 1992). Both are listed in Table 3.5–1. Estimates of the material burned in are derived by multiplying the number of acres burned by the appropriate fuel loading factor. For wildfires, a “combustive efficiency” factor of 90% is included in the calculation to reflect the fact that not all available material (fuel) is consumed in a wildfire (WGA/WRAP, 2002).

Table 3.5–1. Emission and fuel loading factors for wildfires and brush fires.

Type of fire	Fires reported	Number of acres burned	Fuel loading factor (tons/acre)	Emission factors (lbs/ton burned)				
				PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
Wildfire (Calif. chaparral)	1	1,000	19.5	28.1	24.1	6.2	1.7	1.3
Brush fire (weeds)	7,054	1,656.5	3.2	15	15	4	n/a	n/a

Annual emissions from wildfires in Maricopa County were calculated as follows.

$$\begin{aligned}
 \text{Annual CO emissions from wildfires in Maricopa County} &= \frac{\text{acres burned} \times \text{fuel loading factor} \times \text{combustive efficiency} \times \text{emission factor (lbs/ton)}}{2,000 \text{ lbs/ton}} \\
 &= \frac{1,000 \text{ acres burned} \times 19.5 \text{ tons/acre} \times 90\% \times 289 \text{ lbs/ton}}{2,000 \text{ lbs/ton}} \\
 &= 2,535.98 \text{ tons CO/yr}
 \end{aligned}$$

Because the 1,000-acre wildfire occurred in the Tonto National Forest, which is located outside of the nonattainment area, emissions from wildfires within the nonattainment area were determined to be zero. However, annual emissions from brush fires for the nonattainment area were calculated by multiplying the Maricopa County annual emissions by the percentage of vacant land located in the PM₁₀ nonattainment area (28.25%). See Section 1.5.2 for a discussion of the land-use data used.

$$\begin{aligned}
 \text{Annual PM}_{10} \text{ emissions from brush fires within the PM}_{10} \text{ NAA} &= \text{Annual PM}_{10} \text{ emissions from brush fires, County total} \times \text{Percentage of vacant land within the NAA} \\
 &= 39.75 \text{ tons/yr} \times 28.25\% \\
 &= 11.23 \text{ tons PM}_{10}/\text{yr}
 \end{aligned}$$

Table 3.5–2. Annual emissions from wildfires and brush fires (tons/yr).

Type of fire	Maricopa County					PM ₁₀ nonattainment area				
	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
Wildfires	246.58	211.48	54.41	14.92	11.41	0.00	0.00	0.00	0.00	0.00
Brush fires	39.75	39.75	10.60	–	–	11.23	11.23	2.99	–	–
Totals:	286.33	251.23	65.01	14.92	11.41	11.23	11.23	2.99	0.00	0.00

Since the 1,000-acre wildfire lasted three days, annual emissions from this category were divided by 3 to derive a “worst-case” daily emissions value. It was assumed that brush fires occur evenly throughout the year. Thus, daily emissions from brush fires were derived by dividing the annual emissions for Maricopa County and the nonattainment area by a 365 days/yr, as follows:

$$\begin{aligned}
 \text{Season-day CO emissions from wildfires in Maricopa County} &= \frac{2,535.98 \text{ tons/yr} \times 2,000 \text{ lbs/ton}}{3 \text{ days/yr}} \\
 &= 1,690,650 \text{ lbs CO/day}
 \end{aligned}$$

Table 3.5–3. Typical daily emissions from wildfires and brush fires (lbs/day).

Type of fire	Maricopa County					PM ₁₀ nonattainment area				
	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
Wildfires	164,385.0	140,985.0	36,270.0	9,945.0	7,605.0	0.0	0.0	0.0	0.0	0.0
Brush fires	217.8	217.8	58.1	–	–	61.5	61.5	16.4	–	–
Totals:	164,602.8	141,202.8	36,328.1	9,945.0	7,605.0	61.5	61.5	16.4	0.0	0.0

3.5.1.2 Structure fires

2002 structure fire data were obtained by surveying fire departments in Maricopa County and by querying Maricopa County's burn permit data base. The fire departments surveyed reported 3,597 structure fires in Maricopa County in 2002. The list of fire departments surveyed and survey results are contained in Appendix 3.1. Eleven open burn permits were issued in 2002 for fire training; these were included in the total number of estimated structure fires for 2002. It was estimated that 3,608 structure fires occurred in Maricopa County in 2002.

Estimates of the material burned in a structure fire were determined by multiplying the number of structure fires by a fuel loading factor of 1.15 tons of material per fire, which factors in percent structural loss and content loss (US EPA, 2001e). Tons of material burned were estimated as follows:

$$\begin{aligned} \text{Material burned in} &= 3,608 \text{ fires} \quad \times 1.15 \text{ tons/fire} \\ \text{structure fires (tons/yr)} &= 4,149.2 \text{ tons material burned/yr} \end{aligned}$$

Table 3.5–4. Estimated material burned, emission and fuel loading factors for structure fires.

Structure fires reported	Fuel loading factor (tons/fire)	Material burned (tons)	Emission factors (lbs/ton)				
			PM ₁₀	PM _{2.5} *	NO _x	SO _x	NH ₃
3,608	1.15	4,149.20	10.8	10.8	1.4	n/a	n/a

* All PM₁₀ is assumed to be PM_{2.5}.

Annual emissions were then calculated by multiplying the amount of material burned by the emission factors listed in Table 3.5–4 (from US EPA, 2001e), as follows:

$$\begin{aligned} \text{Annual PM}_{10} \text{ emissions} &= \text{Quantity of material burned} \times \text{emission factor} \times \text{unit conversion factor} \\ \text{from structure fires} & \\ \text{Maricopa County} & \\ &= 4,149.20 \text{ tons} \times 10.8 \text{ lbs/ton} \times (1 \text{ ton}/2,000 \text{ lbs.}) \\ &= 22.41 \text{ tons PM}_{10}/\text{yr} \end{aligned}$$

Annual emissions for the PM₁₀ nonattainment area were derived by multiplying Maricopa County annual emissions by the percentage of total residential population within the PM₁₀ nonattainment area (99.14%), as shown in the example below. See Section 1.5.2 for a discussion of the population data used.

$$\begin{aligned} \text{Annual PM}_{10} \text{ emissions} &= \text{annual PM}_{10} \text{ emissions} \times \text{percentage residential} \\ \text{within the PM}_{10} \text{ NAA} & \quad \text{for Maricopa County} \quad \text{population within the NAA} \\ &= 22.41 \text{ tons/yr} \quad \times 99.14\% \\ &= 22.22 \text{ tons PM}_{10}/\text{yr} \end{aligned}$$

Typical daily emissions for both Maricopa County and the PM₁₀ nonattainment area are calculated by dividing annual emissions by 364, as activity is assumed to take place 7 days a week. Typical daily emissions for Maricopa County were derived using the following formula:

$$\begin{aligned}
 \text{Typical daily PM}_{10} \text{ emissions from structure fires} &= \frac{\text{annual PM}_{10} \text{ emissions (lbs)}}{7 \text{ days/wk} \times 52 \text{ weeks/yr}} \\
 &= \frac{44,820 \text{ lbs}}{364} \\
 &= 123.1 \text{ lbs/day}
 \end{aligned}$$

Table 3.5-5. Annual and typical daily emissions from structure fires.

Geographic area	Annual emissions (tons/yr)			Typical daily emissions (lbs/day)		
	PM ₁₀	PM _{2.5}	NO _x	PM ₁₀	PM _{2.5}	NO _x
Maricopa County	22.41	22.41	2.90	123.1	123.1	16.0
PM ₁₀ NAA	22.21	22.21	2.88	122.0	122.0	15.8

3.5.1.3 Vehicle fires

2002 vehicle fire data were obtained by surveying fire departments in Maricopa County. The fire departments surveyed reported 5,316 vehicle fires (4 boat fires were included in vehicle fires) in Maricopa County in 2002. The list of fire departments surveyed and survey results are presented in Appendix 3.1.

Annual emissions from vehicle fires are calculated by first multiplying the number of vehicle fires by a fuel loading factor of per vehicle fire to estimate the annual amount of material burned in vehicle fires. The amount of annual material burned in vehicle fires is then multiplied by emission factors for open burning of automobile components from AP-42 as listed in table 3.5-6 (US EPA, 1992).

$$\begin{aligned}
 \text{Annual PM}_{10} \text{ emissions from vehicle fires} &= \text{annual number of vehicle fires} \times \text{fuel loading factor} \times \text{emission factor} \times \text{unit conversion factor} \\
 &= 5,316 \times 0.25 \text{ tons/vehicle} \times 100 \text{ lbs/ton} \times (1 \text{ ton} / 2,000 \text{ lbs}) \\
 &= 66.45 \text{ tons PM}_{10}/\text{yr}
 \end{aligned}$$

Table 3.5-6. Estimated material burned, fuel loading factors, and emission factors for vehicle fires.

Vehicle fires reported	Fuel loading factor (tons/fire)	Material burned (tons)	Emission factors (lbs/ton)				
			PM ₁₀	PM _{2.5} *	NO _x	SO _x	NH ₃
5,316	0.25	1,329	100	100	4	n/a	n/a

* All PM₁₀ is assumed to be PM_{2.5}.

Annual emissions for the PM₁₀ nonattainment area were derived by multiplying Maricopa County annual emissions by the percentage of total residential population within the PM₁₀ nonattainment area (99.14%). See Section 1.5.1 for a discussion of the population data used.

$$\begin{aligned}
 \text{Annual PM}_{10} \text{ emissions from vehicle fires in the PM}_{10} \text{ NAA} &= \text{annual PM}_{10} \text{ emissions for Maricopa County} \times \text{percentage of total residential population within the PM}_{10} \text{ NAA} \\
 &= 66.45 \text{ tons/yr} \times 99.14\% \\
 &= 65.88 \text{ tons/yr}
 \end{aligned}$$

It is assumed that vehicle fires occur evenly throughout the year. Thus, typical daily emissions were derived by dividing the Maricopa County and nonattainment area annual emissions by 365 days/year. The results are shown in Table 3.5–7 below.

Table 3.5–7. Annual and typical daily emissions from vehicle fires.

Geographic area	Annual emissions (tons/yr)			Typical daily emissions (lbs/day)		
	PM ₁₀	PM _{2.5}	NO _x	PM ₁₀	PM _{2.5}	NO _x
Maricopa County	66.45	66.45	2.66	364.1	364.1	14.6
PM ₁₀ NAA	65.88	65.88	2.64	361.0	361.0	14.4

3.5.1.4 Engine testing

Annual emissions from engine testing facilities were derived from annual emission reports from permitted sources that were not considered point sources in this inventory. It was assumed that there were no significant unpermitted sources within Maricopa County. Typical daily emissions were calculated based on operating schedule information provided in the facilities' annual emission reports.

Since all facilities considered in this section are located within the PM₁₀ nonattainment area, total emission values for the county and the PM₁₀ NAA are equal. Results are shown in Table 3.5–8.

Table 3.5–8. Annual and typical daily emissions from engine testing.

Geographic area	Annual emissions (tons/yr)				Typical daily emissions (lbs/day)			
	PM ₁₀	PM _{2.5}	NO _x	SO _x	PM ₁₀	PM _{2.5}	NO _x	SO _x
Maricopa County	0.41	0.30	4.26	0.82	6.5	5.4	89.1	7.4
PM ₁₀ NAA	0.41	0.30	4.26	0.82	6.5	5.4	89.1	7.4

3.5.2 Agricultural crops

3.5.2.1 Tilling

Tillage emissions were estimated using the tillage emission factor equation and Maricopa County specific soil silt content for agricultural land (URS and ERG, 2001). The number of planted or harvested acres by crop were obtained from the Arizona Agricultural Statistics Service (AASS, 2003). Crop specific annual land preparation operations data were obtained from the Technical Support Document for Quantification of Agricultural Best Management Practices (URS and ERG, 2001). The agricultural tillage emission factor was calculated as follows:

$$EF = k (4.8) s^{0.6}$$

where:

EF = Agricultural emission tillage factor (lbs PM₁₀ / acre-pass)

k = Particle size multiplier (value of 0.15 for PM₁₀)

s = Silt content of soil (percent) = 35.2% (URS and ERG, 2001)

$$\text{Thus: } EF = 0.15 \times 4.8 \times (35.2)^{0.6} = 6.10 \text{ lbs PM}_{10} / \text{acre-pass}$$

Annual PM₁₀ emissions from agricultural tillage were calculated for each crop category using the following equation (URS and ERG, 2001; Pollack *et al.*, 2003):

$$\text{Tillage}_{\text{Crop}} = \text{EF} \times \text{AP}_{\text{Crop}} \times \text{A}_{\text{Crop}} \times \text{ton} / 2,000 \text{ lb}$$

where:

$\text{Tillage}_{\text{Crop}}$ = Tillage emissions for each crop type (lbs PM₁₀),
 EF = Tillage emission factor (lbs PM₁₀/acre-pass),
 AP_{Crop} = Number of tillage passes per crop (passes), and
 A_{Crop} = Total number of tilled acres for each crop type (acres)

Example:

EF = 6.10 lbs PM₁₀/acre-pass
 AP_{Crop} = 15 tillage passes for a cotton crop
 A_{Crop} = 46,300 acres of cotton

$$\begin{aligned} \text{Tillage}_{\text{Cotton}} &= 6.10 \text{ lbs PM}_{10} / \text{acre-pass} \times 15 \text{ passes} \times 46,300 \text{ acres} \times \text{ton} / 2,000 \text{ lb} \\ &= 2,118 \text{ tons PM}_{10} / \text{year} \end{aligned}$$

Table 3.5–9 lists crop types and acreage; typical number of land preparation operations and acre-passes; and annual uncontrolled PM₁₀ emissions from agricultural tillage for Maricopa County.

Table 3.5–9. 2002 Maricopa County agricultural crop acreage, activity, and uncontrolled annual PM₁₀ emissions.

Crop	Reported Acres	Annual land preparation operations	Acre-passes	Annual uncontrolled PM ₁₀ emissions (tons/yr)
Cotton	46,300	12	555,600	1,694.58
Corn	19,500	12	234,000	713.70
Durham wheat	12,100	5	60,500	184.53
Winter wheat	1,500	5	7,500	22.88
Barley	18,900	4	75,600	230.58
Alfalfa (stand establishment)	17,250 ⁽¹⁾	6	103,500	315.68
Cantaloupe (fall)	3,600	9	32,000	98.82
Cantaloupe (spring)	7,400	9	66,600	203.13
Watermelon	3,800	9	34,200	104.31
Honeydew (fall)	800	9	7,200	21.96
Honeydew (summer)	1,200	7	8,400	25.62
Dry onion	500	11	5,500	16.78
Broccoli	3,300	10	33,000	100.65
Grapefruit	120 ⁽²⁾	6	720	2.20
Navel Oranges and miscellaneous	640 ⁽²⁾	6	3,840	11.71
Valencia Oranges	320 ⁽²⁾	6	1,920	5.86
Lemon	300 ⁽²⁾	6	1,800	5.49
Tangerine	480 ⁽²⁾	6	2,880	8.78
Total acreage:	138,010			3,767.24

1. Alfalfa is a multi-year crop and alfalfa stand establishment is assumed to occur once every 4 years to approximately 25% of the total alfalfa acreage (URS and ERG, 2001).
2. 15 to 20% of citrus orchard acreage is non-bearing in a given year (URS and ERG, 2001); therefore, tillage is assumed to occur in 20% of the reported harvested acreage.

In the Maricopa County PM₁₀ nonattainment area, the agricultural PM₁₀ general permit (Arizona Administrative Code [AAC], R18-2-610 and 611) requires that commercial farmers implement at least three agricultural best management practice (BMP) to control PM₁₀ emissions generated from tillage and harvest, non-cropland, and cropland.

Net control efficiencies from implementation of agricultural BMPs were developed by URS and ERG (2001) in the Technical Support Document for Quantification of Agricultural BMPs. Three BMPs were quantified for tillage: 1) combining tractor operations, 2) limited activity during high-wind events, and 3) multi-year crops. To estimate controlled tillage emissions from agricultural operations taking place within the PM₁₀ NAA, the mid-point net control efficiency for each BMP were applied to 53.46% (the percent of agricultural land in the PM₁₀ NAA) of the uncontrolled annual PM₁₀ emissions as follows:

$$\text{Controlled annual tillage}_{\text{Crop}} \text{ emissions} = \text{Annual uncontrolled PM}_{10} \text{ emissions} \times (100\% - \text{mid-point net control efficiency}_{\text{crop}}) \times \% \text{ agricultural land in the PM}_{10} \text{ NAA}$$

$$\begin{aligned} \text{Controlled annual tillage}_{\text{Cotton}} \text{ emissions} &= 1,694.58 \text{ tons PM}_{10}/\text{yr} \times (100\% - 33.0\%) \times 53.46\% \\ &= 606.97 \text{ tons PM}_{10}/\text{yr} \end{aligned}$$

The uncontrolled portion of tillage emissions from agricultural operations taking place outside the PM₁₀ NAA but within Maricopa County were estimated by multiplying the uncontrolled annual PM₁₀ emissions by the percent of agricultural land located within Maricopa County by outside of the PM₁₀ NAA (100% – 53.46%) as follows:

$$\begin{aligned} \text{Uncontrolled annual tillage}_{\text{Crop}} \text{ emissions} &= \text{Uncontrolled annual PM}_{10} \text{ emissions} \times 46.54\% \\ &= 1,694.58 \text{ tons PM}_{10}/\text{yr} \times 46.54\% \\ &= 788.66 \text{ tons PM}_{10}/\text{yr} \end{aligned}$$

Controlled and uncontrolled emissions were then summed to estimate total annual PM₁₀ emissions from agricultural tillage in Maricopa County. Results are shown in Table 3.5–10.

Table 3.5–10. Annual controlled PM₁₀ emissions from agricultural tillage in Maricopa County.

Crop	Net control efficiency ⁽¹⁾	Maricopa County Annual PM ₁₀ emissions (tons/yr)		
		Controlled PM ₁₀ Emissions (within the PM ₁₀ NAA)	Uncontrolled PM ₁₀ emissions (outside the PM ₁₀ NAA)	Total PM ₁₀ (controlled + uncontrolled)
Cotton	0.33	606.97	788.66	1,395.63
Corn	0.33	255.63	332.16	587.79
Durham wheat	0.33	66.09	85.88	151.97
Winter wheat	0.33	8.19	10.65	18.84
Barley	0.33	82.59	107.31	189.90
Alfalfa (stand establishment)	0.20	135.01	146.92	281.92
Cantaloupe (fall)	0.244	39.94	45.99	85.93
Cantaloupe (spring)	0.244	82.10	94.54	176.63
Watermelon	0.244	42.16	48.55	90.70
Honeydew (fall)	0.244	8.88	10.22	19.10
Honeydew (summer)	0.244	10.35	11.92	22.28
Dry onion	0.244	6.78	7.81	14.59
Broccoli	0.244	40.68	46.84	87.52
Grapefruit	0.244	0.89	1.02	1.91
Navel oranges and miscellaneous	0.244	4.73	5.45	10.18
Valencia oranges	0.244	2.37	2.73	5.09
Lemon	0.244	2.22	2.56	4.77
Tangerine	0.244	3.55	4.09	7.64
Total		1,399.12	1,753.27	3,152.40

1. Source: URS and ERG, 2001, p. B-7.

Annual PM_{2.5} emissions from agricultural tillage were calculated by multiplying the total annual PM₁₀ emissions by a conversion factor of 0.20 (US EPA, 2003b). Table 3.5–11 summarizes the 2002 PM₁₀ and PM_{2.5} emissions for Maricopa County and the PM₁₀ NAA from agricultural tillage after the implementation of agricultural BMPs.

Table 3.5–11. Annual controlled PM₁₀ and PM_{2.5} emissions from agricultural tillage.

Crop	Maricopa County (tons/yr)		PM ₁₀ NAA (tons/yr)	
	PM ₁₀	PM _{2.5}	PM ₁₀	PM _{2.5}
Cotton	1395.63	279.12	606.97	121.39
Corn	587.79	117.56	255.63	51.13
Durham wheat	151.97	30.39	66.09	13.22
Winter wheat	18.84	3.77	8.19	1.64
Barley	189.90	37.98	82.59	16.52
Alfalfa (stand establishment)	281.92	56.38	135.01	27.00
Cantaloupe (fall)	85.93	17.19	39.94	7.99
Cantaloupe (spring)	176.63	35.33	82.10	16.42
Watermelon	90.70	18.14	42.16	8.43
Honeydew (fall)	19.10	3.82	8.88	1.78
Honeydew (summer)	22.28	4.46	10.35	2.07
Dry onion	14.59	2.92	6.78	1.36
Broccoli	87.52	17.50	40.68	8.14
Grapefruit	1.91	0.38	0.89	0.18
Navel Oranges and miscellaneous	10.18	2.04	4.73	0.95
Valencia Oranges	5.09	1.02	2.37	0.47
Lemon	4.77	0.96	2.22	0.44
Tangerine	7.64	1.53	3.55	0.71
Total	3,152.40	630.48	1,399.12	279.82

Typical daily emissions for Maricopa County and the PM₁₀ NAA were calculated by dividing the annual PM₁₀ emissions by an estimated days per year of tillage operation by crop. The number of days of tillage operations was estimated using the calendar of tillage operations by crop in the Technical Support Document for Quantification of Agricultural BMPs (URS and ERG, 2001) and assuming tillage activities occur 7 days per week during the months of tillage operations. Results are shown in Table 3.5–12. The calendar of tillage operations did not include months of tillage operations for citrus, thus, a conservative estimate of three (3) months per year was assumed.

Table 3.5–12. Controlled typical daily emissions from tillage in Maricopa County.

Crop	Tillage operations ⁽¹⁾ (months/yr)	Tillage operations (days/yr)	Typical daily emissions (lbs/day)	
			PM ₁₀	PM _{2.5}
Cotton	12	364	7,668.3	1533.7
Corn	5	152	7,751.1	1550.2
Durham wheat	8	243	1,252.5	250.5
Winter wheat	8	243	155.3	31.1
Barley	8	243	1,565.1	313.0
Alfalfa (stand establishment)	3	91	6,196.1	1239.2
Cantaloupe (fall)	6	182	944.3	188.9
Cantaloupe (spring)	6	182	1,941.0	388.2
Watermelon	6	182	996.7	199.3
Honeydew (fall)	6	182	209.8	42.0
Honeydew (summer)	6	182	244.8	49.0
Dry onion	6	182	160.3	32.1
Broccoli	6	182	961.8	192.4
Grapefruit	3	91	42.0	8.4
Navel Oranges and miscellaneous	3	91	223.8	44.8
Valencia Oranges	3	91	111.9	22.4
Lemon	3	91	104.9	21.0
Tangerine	3	91	167.9	33.6
Total			30,697.6	6,140.0

(1) Source: URS and ERG, 2001, Table 3-2, p. 3-5.

Typical daily emissions for the PM₁₀ nonattainment area were calculated by dividing the annual PM₁₀ emissions for the PM₁₀ NAA by an estimated day per year of tillage operation by crop. Results are shown in Table 3.5–13.

Table 3.5–13. Controlled annual and typical daily emissions from tillage within the PM₁₀ NAA.

Crop	Typical daily emissions (lbs/day)	
	PM ₁₀	PM _{2.5}
Cotton	3,335.0	667.0
Corn	3,371.0	674.2
Durham wheat	544.7	108.9
Winter wheat	67.5	13.5
Barley	680.7	136.1
Alfalfa (stand establishment)	2,967.2	593.4
Cantaloupe (fall)	438.9	87.8
Cantaloupe (spring)	902.2	180.4
Watermelon	463.3	92.7
Honeydew (fall)	97.5	19.5
Honeydew (summer)	113.8	22.8
Dry onion	74.5	14.9
Broccoli	447.0	89.4
Grapefruit	19.5	3.9
Navel Oranges and miscellaneous	104.0	20.8
Valencia Oranges	52.0	10.4
Lemon	48.8	9.8
tangerine	78.0	15.6
Total	13,805.6	2,761.1

3.5.2.2 Harvesting

Harvest emissions were estimated using crop-specific emission factors for cotton (URS and ERG, 2001) and for wheat and barley (US EPA, 1980). Emission factors are only available for these three crops grown in Maricopa County (URS and ERG, 2001). The number of harvested acres by crop was obtained from the Arizona Agricultural Statistics Report (AASS, 2003). Table 3.5–14 lists the crop types and associated PM₁₀ emission factors used to calculate emissions from agricultural harvesting.

Annual PM₁₀ emissions from agricultural harvesting were calculated for the above crop categories using the following equation:

$$\text{Uncontrolled annual harvest}_{\text{Crop}} \text{ emissions} = \text{EF} \times \text{A}_{\text{Crop}} \times \text{ton} / 2,000 \text{ lb}$$

where:

$$\begin{aligned} \text{harvest}_{\text{Crop}} &= \text{harvest emissions for each crop type (tons PM}_{10}\text{/yr)} \\ \text{EF} &= \text{harvest emission factor (lbs PM}_{10}\text{/acre)} \\ \text{A}_{\text{Crop}} &= \text{total number of reported acres for each crop type per year} \end{aligned}$$

Example:

$$\begin{aligned} \text{EF} &= 1.12 \text{ lbs PM}_{10}\text{/acre for cotton} \\ \text{A}_{\text{Crop}} &= 45,900 \text{ acres of cotton} \end{aligned}$$

$$\begin{aligned} \text{Uncontrolled annual Harvest}_{\text{Cotton}} \text{ Emissions} &= 1.12 \text{ lbs PM}_{10}\text{/acre} \times 45,900 \text{ acres} \times 1 \text{ ton}/2,000 \text{ lbs} \\ &= 25.70 \text{ tons PM}_{10}\text{/yr} \end{aligned}$$

Table 3.5–14. Maricopa County harvested acres and emission factors.

Crop	2002 Acreage	PM ₁₀ emission factor (lb/acre-yr)	Source	Uncontrolled Annual PM ₁₀ Emissions (tons/yr)
Cotton	45,900	1.12	URS and ERG, 2001	25.70
Wheat	13,600	0.002625	US EPA, 1980 (AP-42, Table 9.3.2. wheat emission factor)	0.02
Barley	17,000	0.002625	US EPA, 1980 (AP-42, Table 9.3.2. wheat emission factor)	0.02
Total	76,500			25.74

In the Maricopa County PM₁₀ nonattainment area, the agricultural PM₁₀ general permit (Arizona Administrative Code [AAC], R18-2-610 and 611) requires that commercial farmers implement at least three agricultural best management practice (BMP) to control PM₁₀ emissions generated from tillage and harvest, non-cropland, and cropland. Net control efficiencies from implementation of agricultural BMPs were developed by URS and ERG (2003) in the *Technical Support Document for Quantification of Agricultural BMPs*. Two BMPs were quantified for harvesting: 1) combining tractor operations, and 2) reduced harvest activity. To estimate controlled harvest emissions from agricultural operations taking place within the PM₁₀ NAA, the mid-point net control efficiency for each BMP were applied to 53.46% of the uncontrolled annual emissions (the percent of agricultural land in the PM₁₀ NAA) as follows:

$$\text{Controlled annual harvest}_{\text{Crop}} \text{ emissions} = \text{annual uncontrolled PM}_{10} \text{ emissions} \times (100\% - \text{mid-point net control efficiency}_{\text{crop}}) \times \% \text{ agricultural land in PM}_{10} \text{ NAA}$$

$$\begin{aligned} \text{Controlled annual harvest}_{\text{Cotton}} \text{ emissions from within the PM}_{10} \text{ NAA} &= 25.70 \text{ tons PM}_{10}/\text{yr} \times (100\% - 37\%) \times 53.46\% \\ &= 8.66 \text{ tons PM}_{10}/\text{yr} \end{aligned}$$

The uncontrolled portion of harvest emissions from agricultural operations outside the PM₁₀ NAA but within Maricopa County were estimated by multiplying the uncontrolled annual PM₁₀ emissions by the percent of agricultural land located within Maricopa County but outside of the PM₁₀ NAA (100% - 53.46%) as follows:

$$\begin{aligned} \text{Uncontrolled annual Harvest}_{\text{Cotton}} \text{ emission from outside the PM}_{10} \text{ NAA} &= \text{Uncontrolled PM}_{10} \text{ emissions} \times 46.54\% \\ &= 25.70 \text{ tons PM}_{10}/\text{yr} \times 46.54\% \\ &= 11.96 \text{ tons PM}_{10}/\text{yr} \end{aligned}$$

The total controlled and uncontrolled annual emissions were then summed to estimate total annual PM₁₀ emissions from agricultural harvesting in Maricopa County as follows:

$$\begin{aligned} \text{Total annual harvest}_{\text{Cotton}} \text{ emissions for Maricopa County} &= \text{Uncontrolled annual harvest}_{\text{Cotton}} \text{ emissions from outside the PM}_{10} \text{ NAA} + \text{Controlled annual harvest}_{\text{Cotton}} \text{ emissions from within the PM}_{10} \text{ NAA} \\ &= 8.66 + 11.96 \\ &= 20.62 \text{ tons PM}_{10}/\text{yr} \end{aligned}$$

Table 3.5–15. Annual emissions from harvesting (tons/yr).

Crop	Uncontrolled PM ₁₀ (tons/yr)	Net control efficiency (%)	PM ₁₀ NAA		Maricopa County (controlled + uncontrolled)		PM ₁₀ NAA (controlled)
			(controlled) PM ₁₀	(uncontrolled) PM ₁₀	PM ₁₀	PM _{2.5}	PM _{2.5}
Cotton	25.70	37.0	8.66	11.96	20.62	4.12	1.73
Wheat	0.02	33.9	0.01	0.01	0.01	0.00	0.00
Barley	0.02	33.9	0.01	0.01	0.02	0.00	0.00
Totals:	25.74		8.67	11.98	20.65	4.12	1.73

Annual PM_{2.5} emissions from agricultural harvesting were calculated by multiplying the annual PM₁₀ emissions by a conversion factor of 0.20 (US EPA, 2003b).

Typical daily emissions for Maricopa County and the PM₁₀ NAA were calculated by dividing the controlled annual emissions by the number of harvest days per year (URS and ERG, 2001), as shown in Table 3.5–16.

Table 3.5–16. Typical daily emissions from harvesting (lbs/day).

Crop	Harvest days/yr	Maricopa County		PM ₁₀ nonattainment area	
		PM ₁₀	PM _{2.5}	PM ₁₀	PM _{2.5}
Cotton	99	416.56	83.31	174.9	35.0
Wheat	49	0.6	0.12	0.3	0.05
Barley	49	0.8	0.15	0.3	0.05
Totals:		417.90	83.58	175.4	35.1

3.5.2.3 Cotton ginning

Annual emissions from cotton ginning were derived from annual emission reports from permitted sources. Both the Maricopa County permit database and County Business Patterns from the US Census Bureau's (2003b) indicate that there are 10 cotton gins within the county; thus it was assumed that there were no unpermitted sources in this category. Total PM₁₀ emissions from gins that operated in 2002, and are not treated as point sources in this report, totaled 2.06 tons per year. Based on operating schedule information provided in the reports, typical daily PM₁₀ emissions were calculated at 13.3 lbs/day.

Data from EPA's PM calculator software (US EPA, 2001c) were used to calculate PM_{2.5} emissions, assumed to be 6.7% of PM₁₀ emissions. Since all cotton gins considered in this section are located within the PM₁₀ nonattainment area, total emission values for the county and the PM₁₀ NAA from cotton ginning are equal. Results are shown in Table 3.5-17.

Table 3.5-17. Annual and typical daily emissions from area-source cotton ginning.

Geographic area	Annual emissions (tons/yr)		Typical daily emissions (lbs/day)	
	PM ₁₀	PM _{2.5}	PM ₁₀	PM _{2.5}
Maricopa County	2.06	0.14	13.3	0.9
PM ₁₀ NAA	2.06	0.14	13.3	0.9

3.5.2.4 Fertilizer application

A significant source of ammonia (NH₃) emissions is fertilizer application. The Arizona Department of Agriculture provided the grade¹ and annual tonnage of fertilizer distributed in Arizona in 2002 (ADOA, 2004); data contained in Appendix 3.2). Ammonia emissions were calculated using fertilizer-specific nitrogen content and emission factors from Battye et al. (1994).

State-wide fertilizer tonnage was apportioned to Maricopa County using 2002 field crop and vegetable harvested acreage obtained from the Arizona Agricultural Statistics Service (AASS, 2003). In 2002, 696,800 acres of cotton hay, wheat, barley, corn, broccoli, honeydew, cantaloupe, and watermelon were harvested in Arizona, with 172,500 acres (24.76%) harvested within Maricopa County. ADOA (2004) reported 458,080 tons of fertilizer sold in Arizona in 2002. Maricopa County fertilizer tonnage was estimated for each "grade" of fertilizer reported as in this example for liquid fertilizer "grade" 82-0-0:

$$\begin{aligned}
 \text{Grade 82-0-0 fertilizer} &= \text{Statewide distribution of grade} \times \text{Ratio of Maricopa County:Arizona harvested acreage} \\
 \text{distributed in Maricopa} & \quad \text{82-0-0 fertilizer in 2002 (tons)} \\
 \text{County (tons)} &= 6,703.06 \text{ tons} \quad \times 24.76\% \\
 &= 1,659.41 \text{ tons}
 \end{aligned}$$

US EPA guidance (Battye et al., 1994) contains nitrogen content and ammonia emission factors for ten major categories of nitrogen fertilizers (e.g., anhydrous ammonia, ammonium nitrates, ammonium sulfates, urea, etc.). Because the fertilizer tonnage data provided by ADOA was reported by fertilizer "grade" the individual grades were assigned into one of the ten major

¹ "Grade" means the percentage of total nitrogen, available phosphate or soluble potash stated in whole numbers.

categories of nitrogen fertilizers based on their N-P-K ratios. For example, anhydrous ammonia is reported with a grade of “82-0-0” under liquid fertilizer. Fertilizer grades that did not contain nitrogen (N) were excluded. Once each grade was assigned to a fertilizer category, the total nitrogen content was estimated using the nitrogen content for each fertilizer category as in this example for anhydrous ammonia:

$$\begin{aligned} \text{Total N content of anhydrous ammonia (tons)} &= \text{tons of anhydrous ammonia distributed} \times \text{N content of anhydrous ammonia} \\ &= 1,659.41 \text{ tons} \times 82\% \\ &= 1,360.72 \text{ tons} \end{aligned}$$

Annual NH₃ emissions from fertilizer applications were then calculated as follows:

$$\begin{aligned} \text{Annual NH}_3 \text{ emissions from anhydrous ammonia} &= \text{Nitrogen content of anhydrous ammonia (tons)} \times \text{emission factor} \times \text{unit conversion factor from} \\ &= 1,360.72 \text{ tons} \times 24 \text{ lb of NH}_3 / \text{ton of N} \times 1 \text{ ton} / 2,000 \text{ lbs} \\ &= 16.33 \text{ tons} \end{aligned}$$

This procedure was followed for each fertilizer category. Emissions from all ten fertilizer categories were then summed to derive annual emissions from all fertilizer application. Typical daily emissions were calculated by dividing annual emissions by 365.

Annual and typical daily emissions for the PM₁₀ nonattainment area were derived by multiplying the county annual and typical daily emissions by the percentage of agricultural land located in the PM₁₀ NAA (53.46%). See Section 1.5.2 for a discussion of the land-use data used.

Table 3.5–18. Annual and typical daily ammonia emissions from fertilizer application.

Fertilizer Category	AMS code	Maricopa County		PM ₁₀ NAA	
		Annual emissions (tons/yr)	Typical daily emissions (lbs/day)	Annual emissions (tons/yr)	Typical daily emissions (lbs/day)
Anhydrous ammonia	28-01-700-001	16.33	89.5	8.73	47.8
Aqua ammonia	28-01-700-002	1.13	6.2	0.60	3.3
Nitrogen solutions	28-01-700-003	–	–	–	–
Urea	28-01-700-004	265.42	1,454.3	141.89	777.5
Ammonium nitrate	28-01-700-005	280.34	1,536.1	149.87	821.2
Ammonium sulfate	28-01-700-006	49.07	268.9	26.23	143.7
Ammonium thiosulfate	28-01-700-007	2.21	12.1	1.18	6.5
Other straight nitrogen	28-01-700-008	49.91	273.5	26.68	146.2
Ammonium phosphates	28-01-700-009	101.78	557.7	54.41	298.2
N-P-K mixture	28-01-700-010	202.76	1,111.0	108.40	594.0
Total:	28-01-700-000	968.94	5,309.3	518.00	2,838.3

3.5.3 Livestock

Estimates of Maricopa County’s inventory of cattle and calves in 2002 were obtained from published statistics (AASS, 2003). Beef cows were excluded from the inventory as information provided by Arizona Agricultural Statistics staff indicated that the majority of beef cows that are not on feed are grazed on range and pastures. Cattle on feed, milk cows, and other cattle (heifers, steers, bulls, and calves) were included in the PM₁₀ emission estimates. The emission factor for PM₁₀ from cattle feedlots was obtained from the California Air Resources Board

(CARB, 1999). PM_{2.5} was presumed to be 15% of PM₁₀ per EPA guidance (US EPA, 2003c). A composite emission factor for cattle and calves for NH₃ was obtained from Battye et al. (1994). The 2002 Maricopa County cattle inventory and applicable emission factors are contained in Table 3.5–19.

Table 3.5–19. Maricopa County cattle inventory and emission factors.

Animal type	Head	Emission factors		
		PM ₁₀ (ton/1000 head)	PM _{2.5} (ton/1000 head)	NH ₃ (lb/head)
Cattle on feed	6,000	17.2	2.58	50.50
Milk cows	119,000	17.2	2.58	50.50
Other cattle	54,000	17.2	2.58	50.50
Total	179,000			

Annual PM₁₀ emissions from feedlots and dairies in Maricopa County were calculated using the following formula:

$$\begin{aligned}
 \text{Annual emissions (tons/yr)} &= \text{county cattle inventory (1,000 head)} \times \text{emission factor (tons PM}_{10}/1,000 \text{ head)} \\
 &= 179 \times 17.2 \\
 &= 3,078.8 \text{ tons PM}_{10}/\text{yr}
 \end{aligned}$$

Annual NH₃ emissions from feedlots and dairies in Maricopa County were calculated using the following formula:

$$\begin{aligned}
 \text{Annual emissions (tons/yr)} &= \text{county cattle inventory} \times \text{emission factor} \times \text{unit conversion factor} \\
 &= 179,000 \times 50.50 \times 1 \text{ ton}/2,000 \text{ lbs} \\
 &= 4,519.75 \text{ tons NH}_3/\text{yr}
 \end{aligned}$$

Annual emissions for the nonattainment area were calculated by multiplying the Maricopa County emission totals by the percentage of agricultural land-use located in the PM₁₀ nonattainment area. (See Section 1.5.2 for a discussion of the land-use data used.) It was assumed that cattle feedlot and dairy emissions occur evenly throughout the year. Typical daily emissions were derived by dividing annual emissions for Maricopa County and the nonattainment area by 365 days/year. Table 3.5–20 summarizes the annual and typical daily emissions from cattle feedlots and dairies for Maricopa County and the PM₁₀ nonattainment area.

Table 3.5–20. Annual and typical daily emissions from cattle feedlots and dairies.

Geographic area	Annual emissions (tons/yr)			Typical daily emissions (lbs/day)		
	PM ₁₀	PM _{2.5}	NH ₃	PM ₁₀	PM _{2.5}	NH ₃
Maricopa County	3,078.80	461.82	4,519.75	16,870.1	2,530.5	24,765.8
PM ₁₀ NAA	1,645.93	246.89	2,416.26	9,018.8	1,352.8	13,239.8

3.5.4 Health services: crematories

Emissions from human and animal crematories were calculated by the “scaling up” method as described in EPA emission inventory guidance (US EPA, 2001a). This method combines detailed emissions data from a subset of sources, and county-level employment data from the US Census Bureau (2003) to develop a per-employee emission factor that is then used to estimate emissions from all sources in an industry category.

The most recent data from the Census Bureau’s County Business Patterns (CBP), for 2001 employment, were used. CBP employment data for NAICS code 81222 (cemeteries and crematories) indicated 683 employees in this industry in Maricopa County. This employment estimate is used to “scale up” emissions reported from those facilities surveyed in 2002 as follows:

$$\text{Total area-source emissions} = \frac{\text{Emissions from surveyed area sources}}{\text{Employment at surveyed area sources}} \times \text{Total area-source employment}$$

$$\begin{aligned} \text{Area-source PM}_{10} \text{ emissions from crematories} &= \frac{0.23 \text{ tons/yr}}{110} \times 683 \text{ employees} \\ &= 1.41 \text{ tons PM}_{10}/\text{yr} \end{aligned}$$

Typical daily emissions are calculated based on the operating schedule data reported by surveyed facilities. From annual emission surveys, it was determined that crematories operate on a 5-day week throughout the year. This data was used to calculate typical daily emissions as follows:

$$\begin{aligned} \text{Typical daily PM}_{10} \text{ emissions from crematories} &= \frac{\text{Annual emissions (tons/yr)}}{\text{Days/week} \times \text{Weeks/yr}} \times \frac{2,000 \text{ lbs}}{\text{ton}} \\ &= \frac{1.41}{5 \times 52} \times 2,000 \\ &= 10.9 \text{ lbs PM}_{10}/\text{day} \end{aligned}$$

As all facilities addressed in this source category are located within the PM₁₀ nonattainment area, emission totals for both areas are equal. Annual and daily emissions are shown in Table 3.5–21.

Table 3.5–21. Annual and typical daily emissions from crematories.

Geographic area	Annual emissions (tons/yr)				Typical daily emissions (lbs/day)			
	PM ₁₀	PM _{2.5}	NO _x	SO _x	PM ₁₀	PM _{2.5}	NO _x	SO _x
Maricopa County	1.41	0.94	19.46	2.48	10.9	7.3	149.7	19.1
PM ₁₀ NAA	1.41	0.94	19.46	2.48	10.9	7.3	149.7	19.1

3.5.5 Accidental releases

As part of its air quality permit compliance program, MCESD keeps an “upset log”, for each calendar year that records excess emissions and accidental releases at permitted facilities. Annual emissions inventory reports also provide for recording of accidental releases. Data from these two sources documented the release of 0.29 tons of PM₁₀, 0.29 tons of PM_{2.5}, and 1.08 tons of NO_x for the year 2002. (No accidental releases of SO_x or NH₃ were reported).

Typical daily emissions are calculated by summing reported releases and dividing the total by 365 days. Emissions in the PM₁₀ nonattainment area are calculated based on locations of facilities that reported releases.

Table 3.5–22. Annual and typical daily emissions from accidental releases.

Geographic area	Annual emissions (tons/yr)			Typical daily emissions (lbs/day)		
	PM ₁₀	PM _{2.5}	NO _x	PM ₁₀	PM _{2.5}	NO _x
Maricopa County	0.29	0.29	1.08	1.6	1.6	5.9
PM ₁₀ NAA	0.29	0.29	0.00	1.6	1.6	0.0

* As a conservative estimate, all PM₁₀ emissions are assumed to be PM_{2.5}.

3.5.6 Humans

A literature review by Battye et al. (1994) recommends using a per-capita emission factor developed for the National Acid Precipitation Assessment Program (NAPAP) inventory in 1985. This factor was applied to MAG population estimates for the county and PM₁₀ nonattainment areas. Daily emissions were calculated by dividing annual values by 365.

Table 3.5–23. Annual and typical daily NH₃ emissions from human activity.

Area	Population	Emission factor (lbs/ person-yr)	Annual NH ₃ emissions (tons/yr)	Typical daily NH ₃ emissions (lbs/day)
Maricopa County	3,549,693	0.55	976.17	5,348.9
PM ₁₀ NAA	3,519,288	0.55	967.80	5,303.0

3.5.7 Windblown dust

Windblown dust emissions estimates for Maricopa County are based on the windblown dust PM₁₀ emissions estimated by MAG for the nonattainment area, as described in the Technical Support Document (TSD) for the Serious Area PM₁₀ Plan (MAG, 2000). Emissions were estimated by MAG separately for windblown dust from vacant land, fluvial channels, agricultural land, and construction. MAG estimated annual average windblown PM₁₀, calculated for hours with average wind speed greater than 15mph, for the years 1995 and 2001. MAG estimated total windblown dust PM₁₀ emissions for the PM₁₀ nonattainment area for 1995 and 2001 as follows:

Table 3.5–24. 1995 and 2001 emissions from windblown dust for the PM₁₀ nonattainment area.

Land-use categories	PM ₁₀ emissions ¹			
	1995		2001	
	tons/yr	tons/day	tons/yr	tons/day
Disturbed vacant land	1,973	5.41	1,533	4.20
Agricultural fields	8,071	22.11	5,925	16.24
Fluvial channels	1,387	3.80	1,387	3.80
Construction	1,809	4.96	2,013	5.51
Totals:	13,240	36.27	10,858	29.75

1. MAG 2000, Tables II-1 and II-2, converted to English units.

For year 2002, PM₁₀ windblown dust emissions were estimated by determining the 1995 to 2001 emissions growth rate (in fact a decrease of –3.25% per year) and then extrapolating it to 2002. Thus, total 2002 PM₁₀ windblown emissions for the nonattainment were estimated as 10,504.58 tons/yr and 28.78 tons/day. Total 2002 PM₁₀ windblown emissions were then apportioned to the different windblown categories based on 2001 percentages as follows:

$$\begin{aligned}
\text{2002 windblown emissions from} &= \text{total estimated PM}_{10} && \times && \text{2001 percentage of emissions} \\
\text{disturbed vacant land (tons/yr)} & \text{windblown emissions} && && \text{from disturbed vacant land} \\
&= 10,504.58 && \times && 14.12\% \\
&= 1,483.44 \text{ tons PM}_{10}/\text{yr}
\end{aligned}$$

Table 3.5–25. Annual and daily emissions from windblown dust within the PM₁₀ nonattainment area.

Land-use categories	2001 contribution (%)	2002 PM ₁₀ emissions		2002 PM _{2.5} emissions	
		tons/yr	lbs/day	tons/yr	lbs/day
Disturbed vacant land	14.12	1,483.44	8,128.4	328.88	1,802.1
Agricultural fields	54.57	5,732.20	31,409.3	1,270.83	6,963.4
Fluvial channels	12.77	1,341.60	7,351.2	297.43	1,629.8
Construction	18.54	1,947.35	10,670.4	431.73	2,365.6
Totals:	100.00	10,504.58	57,559.4	2,328.87	12,760.9

PM_{2.5} was estimated by applying a PM_{2.5} to PM₁₀ fraction of 0.2217 (CARB, 2003) as follows:

$$\begin{aligned}
\text{PM}_{2.5} \text{ emissions from} &= \text{2002 PM}_{10} \text{ from} && \times && \text{PM}_{2.5}:\text{PM}_{10} \text{ ratio} \\
\text{disturbed vacant land} & \text{disturbed vacant land} && && \\
\text{(tons/yr)} & && && \\
&= 1,483.44 && \times && 0.2217 \\
&= 328.88 \text{ tons PM}_{10}/\text{yr}
\end{aligned}$$

The estimates for the nonattainment area were adjusted to the county level using a combination of adjustment factors based on land-use acreage (for fluvial channels, disturbed vacant land, and agricultural fields) and population (for construction). Refer to Sections 1.5.1 and 1.5.2 for descriptions of the population and land-use data used.

$$\begin{aligned}
\text{Annual PM}_{10} \text{ emissions} &= \text{total PM}_{10} \text{ emissions from} && \div && \text{NAA:county ratio of land use} \\
\text{from disturbed vacant land} & \text{disturbed vacant land within} && && \\
\text{in Maricopa County} & \text{the PM}_{10} \text{ NAA (tons/yr)} && && \\
&= 1,483.44 && \div && 28.25\% \\
&= 5,251.11
\end{aligned}$$

Table 3.5–26. Annual and daily emissions from windblown dust in Maricopa County.

Land-use categories	Surrogate	NAA: County ratio (%)	PM ₁₀ emissions		PM _{2.5} emissions	
			tons/yr	lbs/day	tons/yr	lbs/day
Disturbed vacant land	Vacant land	28.25	5,251.50	28,775.4	1,164.26	6,379.5
Agricultural fields	Agricultural land	53.46	10,721.83	58,749.8	2,377.03	13,024.8
Fluvial channels	Total area	31.29	4,287.07	23,490.8	950.44	5,207.9
Construction	population	99.14	1,964.24	10,763.0	435.47	2,386.2
Totals:			22,224.64	121,778.9	4,927.20	26,998.4

3.5.8 Summary of all miscellaneous area sources

Tables 3.5–27 and 3.5–28 provide a summary of annual and typical daily emissions from all miscellaneous area sources, for Maricopa County and the PM₁₀ nonattainment area, respectively.

Table 3.5–27. Annual and typical daily emissions from all miscellaneous area sources for Maricopa County.

Category	Annual emissions (tons/yr)					Typical daily emissions (lbs/day)				
	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
Wildfires/brush	286.33	251.23	65.01	14.92	11.41	164,602.8	141,202.8	36,328.1	9,945.0	7,605.0
Structure fires	22.41	22.41	2.90			123.1	123.1	16.0		
Vehicle fires	66.45	66.45	2.66			364.1	364.1	14.6		
Engine testing	0.41	0.30	4.26	0.82		6.5	5.4	89.1	7.4	
Tilling	3152.40	630.48				30,697.60	6,139.50			
Harvesting	20.65	4.13				417.9	83.6			
Cotton ginning	2.06	0.14				13.3	0.9			
Fertilizer					968.94					5,309.3
Livestock	3,078.80	461.82			4,519.75	16,870.1	2,530.5			24,765.8
Crematories	1.41	0.94	19.46	2.48		10.9	7.3	149.7	19.1	
Accidental releases	0.29	0.29	1.08			1.6	1.6	5.9		
Humans					976.17					5,348.9
Windblown dust	22,224.64	4,927.20				121,778.9	26,998.4			
Total:	28,855.85	6,365.39	95.36	18.22	6,476.27	334,886.8	177,457.1	36,603.3	9,971.5	43,028.9

Table 3.5–28. Annual and typical daily emissions from all miscellaneous area sources for the PM₁₀ NAA.

Category	Annual emissions (tons/yr)					Typical daily emissions (lbs/day)				
	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
Wildfires/brush	11.23	11.23	2.99	0.00	0.00	61.5	61.5	16.4	0.0	0.0
Structure fires	22.21	22.21	2.88			122.0	122.0	15.8		
Vehicle fires	65.88	65.88	2.64			361.0	361.0	14.4		
Engine testing	0.41	0.30	4.26	0.82		6.5	5.4	89.1	7.4	
Tilling	1,399.12	279.82				13,805.60	2,761.1			
Harvesting	8.67	1.73				175.5	35.1			
Cotton ginning	2.06	0.14				13.3	0.9			
Fertilizer					518.00					2,838.3
Livestock	1,645.93	246.89			2,416.26	9,018.8	1,352.8			13,239.8
Crematories	1.41	0.94	19.46	2.48		10.9	7.3	149.7	19.1	
Accidental releases	0.29	0.29	0.00			1.6	1.6	0.0		
Humans					967.80					5,303.0
Windblown dust	10,504.58	2,328.87				57,559.4	12,760.9			
Total:	13,661.81	2,958.31	32.22	3.30	3,902.06	81,136.1	17,469.6	285.4	26.5	21,381.1

3.6 Summary of all area sources

Tables 3.6–1 and 3.6–2 summarize the total annual and typical daily emissions from all area sources addressed in this chapter, for both Maricopa County and the PM₁₀ nonattainment area, respectively.

Table 3.6–1. Summary of annual and typical daily emissions from all area sources in Maricopa County.

Category	Annual emissions (tons/yr)					Typical daily emissions (lbs/day)				
	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
Fuel Combustion										
Industrial natural gas	5.92	5.92	110.63	0.47	2.44	38.0	38.0	709.2	3.0	15.7
Industrial fuel oil	55.95	55.95	777.40	74.34	3.20	358.6	358.6	4,983.4	476.5	20.5
Comm./inst. nat. gas	56.07	56.07	1,068.63	4.40	3.54	359.4	359.4	6,850.2	28.2	22.7
Comm./inst. fuel oil	123.16	123.16	1,798.63	149.05	4.47	789.5	789.5	11,529.7	955.5	28.6
Residential nat. gas	62.39	62.39	771.72	4.93		341.9	341.9	4,228.6	27.0	
Residential wood	440.00	409.20	33.06	5.09		4,861.9	4,521.6	365.3	56.2	
Residential fuel oil	0.02	0.02	0.83	0.33		0.2	0.2	9.1	3.6	
All fuel combustion	743.52	712.72	4,560.90	238.60	13.65	6,749.6	6,409.2	28,675.4	1,550.0	87.5
Industrial Processes										
Chemical mfg.	28.53	17.72	1.08	0.25	0.61	219.4	136.3	8.3	1.9	4.7
Comm. cooking	713.85	661.98				3,922.2	3,637.2			
Grain processing	7.01	1.80				53.1	13.5			
Cold storage					1,658.81					10,633.4
Secondary metal production	6.72	3.68	0.03	0.03	2.68	52.1	28.7	0.2	0.3	15.6
Mineral processes	87.11	31.61				670.1	243.2			
Mining & quarrying	28.43	11.09				177.1	68.3			
Wood product mfg.	145.14	89.36				1,116.5	687.4			
Rubber/plastic product mfg.	25.47	23.41				195.9	180.1			
Fabricated metal product mfg.	0.63	0.44				4.8	3.4			
Construction	18,721.29	3,744.26				144,009.9	28,802.0			
Electrical equipment mfg.	1.03	0.63	16.28		6.27	5.7	3.4	89.4		34.4
ADEQ-permitted portable sources	110.83	55.87	572.42	157.14		865.5	435.3	5,219.6	1,262.8	
Road travel at industrial sites	74.58	23.36				543.0	166.1			
Industrial processes NEC	23.83	18.39	0.05	0.03	4.42	183.3	141.5	0.4	0.4	34.0
All Industrial Processes	19,974.43	4,683.60	589.86	157.46	1,672.79	152,018.5	34,546.4	5,318.0	1,265.4	10,722.2
Waste Treatment/Disposal										
On-site incineration	0.67	0.59	28.90	0.03		5.2	4.6	222.3	0.2	
Open burning	103.33	103.33	27.68			885.3	885.3	237.1		
Landfills	4.53	3.30	10.44	2.33		24.9	18.1	57.4	12.8	
POTWs					1,230.86					6,744.4
Other waste	3.05	2.53	0.33	0.31		23.5	19.5	2.6	2.4	
All Waste Treatment/Disposal	111.58	109.76	67.36	2.67	1,230.86	938.8	927.5	519.3	15.4	6,744.4
Misc. Area Sources										
Wildfires & brush fires	286.33	251.23	65.01	14.92	11.41	164,602.8	141,202.8	36,328.1	9,945.0	7,605.0
Structure fires	22.41	22.41	2.90			123.1	123.1	16.0		
Vehicle fires	66.45	66.45	2.66			364.1	364.1	14.6		
Engine testing	0.41	0.30	4.26	0.82		6.5	5.4	89.1	7.4	
Tilling	3,158.40	630.48				30,697.6	6,139.50			
Harvesting	20.65	4.13				417.9	83.6			
Cotton ginning	2.06	0.14				13.3	0.9			
Fertilizer application					968.94					5,309.3
Livestock	3,078.80	461.82			4,519.75	16,870.1	2,530.5			24,765.8
Crematories	1.41	0.94	19.46	2.48		10.9	7.3	149.7	19.1	
Accidental releases	0.29	0.29	1.08			1.6	1.6	5.9		
Humans					976.17					5,348.9
Windblown dust	22,224.64	4,927.20				121,778.9	26,998.4			
All Misc. Sources	28,855.85	6,365.39	95.36	18.22	6,476.27	334,886.8	177,457.1	36,603.3	9,971.5	43,028.9
TOTAL, ALL AREA SOURCES	49,685.38	11,871.47	5,313.47	416.94	9,393.56	494,593.6	219,340.2	71,116.0	12,802.3	60,582.9

Table 3.6–2. Summary of annual and typical daily emissions from all area sources in the PM₁₀ NAA.

Category	Annual emissions (tons/yr)					Typical daily emissions (lbs/day)				
	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
Fuel Combustion										
Industrial natural gas	5.86	5.86	109.42	0.46	2.42	37.6	37.6	701.4	3.0	15.5
Industrial fuel oil	55.34	55.34	768.93	73.53	3.17	354.7	354.7	4,929.0	471.3	20.3
Comm./inst. nat. gas	55.47	55.47	1,057.19	4.36	3.50	355.6	355.6	6,776.9	27.9	22.4
Comm./inst. fuel oil	121.84	121.84	1,779.39	147.46	4.42	781.0	781.0	11,406.3	945.2	28.3
Residential nat. gas	61.88	61.88	765.39	4.89		339.1	339.1	4,193.9	26.8	
Residential wood	436.40	405.85	32.79	5.05		4,822.0	4,484.5	362.4	55.7	
Residential fuel oil	0.02	0.02	0.82	0.32		0.2	0.2	9.1	3.6	
All fuel combustion	736.81	706.26	4,513.93	236.06	13.50	6,690.3	6,352.7	28,379.0	1,533.0	86.5
Industrial Processes										
Chemical mfg.	28.22	17.53	1.07	0.25	0.61	217.1	134.8	8.2	1.9	4.7
Comm. Cooking	707.71	656.28				3,888.5	3,605.9			
Grain processing	7.01	1.80				53.1	13.5			
Cold storage					1,640.73					10,517.5
Secondary metal production	6.72	3.68	0.03	0.03	2.68	52.1	28.7	0.2	0.3	15.6
Mineral processes	86.16	31.27				662.8	240.5			
Mining & quarrying	22.92	9.20				138.9	55.1			
Wood product mfg.	143.56	88.38				1,104.3	679.9			
Rubber/plastic product mfg.	25.19	23.16				193.7	178.1			
Fabricated metal product mfg.	0.62	0.44				4.8	3.4			
Construction	17,916.27	3,583.25				137,817.5	27,563.5			
Electrical equipment mfg.	1.02	0.62	16.10		6.20	5.6	3.4	88.5		34.0
ADEQ-permitted portable sources	110.83	55.87	572.42	157.14		865.5	435.3	5,219.6	1,262.8	
Road travel at industrial sites	69.11	22.11				504.1	157.3			
Industrial processes NEC	23.83	18.39	0.05	0.03	4.42	183.3	141.5	0.4	0.4	34.0
All Industrial Processes	19,149.15	4,511.99	589.67	157.45	1,654.64	145,691.2	33,240.8	5,316.9	1,265.4	10,605.8
Waste Treatment/Disposal										
On-site incineration	0.67	0.59	28.90	0.03		5.2	4.6	222.3	0.2	
Open burning	35.31	35.31	9.46			320.0	320.0	85.6		
Landfills	4.53	3.30	10.44	2.33		24.9	18.1	57.4	12.8	
POTWs					1,220.31					6,686.6
Other waste	3.05	2.53	0.33	0.31		23.5	19.5	2.6	2.4	
All Waste Treatment/Disposal	43.56	41.74	49.13	2.67	1,220.31	373.5	362.2	367.9	15.4	6,686.6
Misc. Area Sources										
Wildfires & brush fires	11.23	11.23	2.99	0.00	0.00	61.5	61.5	16.4	0.0	0.0
Structure fires	22.21	22.21	2.88			122.0	122.0	15.8		
Vehicle fires	65.88	65.88	2.64			361.0	361.0	14.4		
Engine testing	0.41	0.30	4.26	0.82		6.5	5.4	89.1	7.4	
Tilling	1,399.12	279.82				13,805.6	2,761.1			
Harvesting	8.67	1.73				175.5	35.1			
Cotton ginning	2.06	0.14				13.3	0.9			
Fertilizer application					518.00					2,838.3
Livestock	1,645.93	246.89			2,416.26	9,018.8	1,352.8			13,239.8
Crematories	1.41	0.94	19.46	2.48		10.9	7.3	149.7	19.1	
Accidental releases	0.29	0.29	0.00			1.6	1.6	0.0		
Humans					967.80					5,303.0
Windblown dust	10,504.58	2,328.87				57,559.4	12,760.9			
All Misc. Sources	13,661.81	2,958.31	32.22	3.30	3,902.06	81,136.1	17,469.6	285.4	26.5	21,381.1
TOTAL, ALL AREA SOURCES:	33,591.32	8,218.30	5,184.95	399.48	6,790.51	233,890.9	57,425.4	34,349.2	2,840.8	38,760.2

3.7 Quality assurance / quality control procedures

Quality assurance and quality control (QA/QC) activities for the area source emissions inventory were driven by the goal of creating a comprehensive, accurate, representative and comparable inventory of area source emissions for Maricopa County and the nonattainment area. During each step of creating, building and reviewing the area source emissions inventory, quality checks and assurances were performed to establish confidence in the inventory structure and data.

Area source categories were selected for inclusion in the inventory based on the latest Emission Inventory Improvement Program (EIIP) guidance available. EPA's guidance for area source categories included in the draft 2002 National Emission Inventory (NEI) was also evaluated, as area source emissions from this inventory will be submitted to EPA for the 2002 NEI. The list of area source categories developed based on these guidance documents was modified to fit the characteristics of Maricopa County, with some area source categories determined to be insignificant (such as industrial coal combustion and oil and gas production). The 1999 Maricopa County Periodic Ozone and Carbon Monoxide Emission Inventories and other regional emission inventories were also consulted to confirm the completeness of the area source categories chosen for inclusion.

Data for area source emission calculations were gathered from a wide universe of resources. Whenever applicable, local surveyed data (such as annual emissions report) was used as this data best reflects activity in the county and the nonattainment area. When local data was not available, state data from Arizona State agencies (such as the Arizona Department of Transportation) and regional bodies (such as the Western Regional Air Partnership, WRAP) were used. National level data (such as the US Census Bureau) was used when no local, state or regional data was available. In addition, the most recent EIIP guidance for area sources was consulted for direction in determining the most relevant data source for use in emissions calculations.

Emissions calculations for area sources were performed by three air quality planners and one unit manager. All area source emission estimates were calculated in spreadsheets to ensure the calculations could be verified and reproduced. Whenever possible or available, the "preferred method" described in the most recent EIIP guidance documents for area sources was used to calculate emissions. Emissions were estimated using emission factors from EIIP guidance, AP-42, and local source testing. Local seasonal and activity data were used when available, with EPA and EIIP guidance used when no local seasonal or activity data existed. All calculations were evaluated to ensure that emissions from point sources were not being double-counted and to determine if rule effectiveness applied.

Once area source emission estimates had been produced, several quality control checks were performed to substantiate the calculations. Most area source calculations were peer-reviewed by two other planners, with all area sources being reviewed by at least one other planner. Peer review ensured that all emission calculations were reasonable and could be reproduced. Sensitivity analyses and computational method checks were performed on area sources when emissions seemed to be outside the expected ranges. When errors were found, the appropriate changes were made by the author of the calculations to ensure consistency of the emissions calculations. The peer-reviewed emissions estimates were combined into a draft area source

chapter. This draft chapter was read through in its entirety by the unit manager and the three air quality planners for final review, with any identified errors corrected by the author of the section.

The draft version of the area source chapter was sent to the Arizona Department of Environmental Quality, the Arizona Department of Transportation, and the Maricopa Association of Governments for a quality assurance review. These agencies provided comments which were addressed and incorporated into the final area source chapter. Further quality analysis was performed by inputting the emission estimates into EPA's "QA/QC basic format and content checker", prior to submitting the data to the 2002 NEI.

The QA/QC activities described here have produced high levels of confidence in the area source emissions estimates detailed in this chapter, and represent the best efforts of the inventory preparers.

3.8 References

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4. Nonroad Mobile Sources

4.1 Introduction

Nonroad mobile sources are defined as those that move or are moved within a 12-month period and are not licensed or certified as highway vehicles. Nonroad mobile sources are vehicles and engines that fall under the following categories:

- Agricultural equipment, such as tractors, combines and balers;
- Airport ground support equipment, such as baggage tugs, and terminal tractors;
- Commercial equipment, such as generators and pumps;
- Industrial equipment, such as forklifts and sweepers;
- Construction and mining equipment, such as graders, back hoes and trenchers;
- Lawn and garden equipment, such as leaf blowers and lawn mowers;
- Logging equipment, such as shredders and large chain saws;
- Pleasure craft, such as power boats and personal watercraft;
- Railway maintenance equipment, such as rail straighteners;
- Recreational equipment, such as all-terrain vehicles and off-road motorcycles;
- Underground mining and oil field equipment, such as mechanical drilling engines (not present in Maricopa County);
- Aircraft, such as jet and piston engines; and
- Locomotives, such as switching and line haul trains.

Emission calculations for most nonroad mobile sources are derived from a Maricopa County nonroad emission inventory of certain visibility-impairing pollutants (PM₁₀, PM_{2.5}, NO_x and SO_x) developed by ENVIRON International Corp. for calendar year 2002 (ENVIRON *et al.*, 2003). ENVIRON prepared the inventory for use and review by the Cap and Trade Oversight Committee (CTOC) formed by the Arizona Department of Environmental Quality (ADEQ). In the inventory prepared for the Cap and Trade Committee, ENVIRON used the EPA NONROAD2002 model (Core Version 2.1d March, 2002) to estimate emissions for all categories except aircraft and locomotives. Nonroad modeling for the ENVIRON inventory was based on recent NONROAD modeling performed for the Western Regional Air Partnership (WRAP) for use in the development of a regional haze rule.

Since the modeling done for the CTOC was only annual totals for Maricopa County, additional work was needed to develop estimates for the PM₁₀ nonattainment area and for an average day. Emission calculations for this report differ from the CTOC work in one major area: emission estimates prepared for the CTOC were derived from season average weekday calculations, which were then multiplied by the number of days in each season to produce season totals, and then summed to produce annual emission totals. This approach assumes that activity levels of nonroad equipment are the same on weekdays and weekends.

For this report, ENVIRON re-ran the NONROAD2002 model to produce season totals, which are then summed to produce annual emission totals. The revised method used for this report results in annual emissions levels that are about 15% less than the method used for the CTOC inventory. The method used by ENVIRON for this report takes into account the different

activity levels experienced on weekdays versus weekends, which explains the lower annual emissions.

The NONROAD model defines four seasons as follows: spring – March through May, summer – June through August, fall – September through November, and winter – December through February. Since the gasoline oxygen content in Maricopa County changes on September 30, emissions from the fall quarter were calculated for each month separately, and then summed. Seasonal emissions totals are then summed to produce annual emission totals. The methods used to estimate PM₁₀ average daily emissions are described in each section of this chapter.

Temperature and fuel-related inputs are required for the operation of the NONROAD2002 model. The inputs listed below were used by ENVIRON after ADEQ review:

- Fuel volatility (Reid Vapor Pressure [RVP]), psi: 9.0 in winter, 8.1 in spring, 7.8 in summer and fall.
- Gasoline oxygen content (weight %): 3.36 from October through February, 0.0 otherwise.
- Gasoline sulfur content (ppm): 179 in fall and winter, 115 in spring and summer.
- Diesel sulfur content (ppm): 310 all seasons.
- Temperatures (minimum/average/maximum °F): 39/55/65 winter, 53/72/83 spring, 78/94/104 summer, 57/78/87 fall.

EPA recommends adjusting default NONROAD2002 model values (such as equipment population, activity levels of equipment, growth factors, etc.) where local data is available, as the default values in the model are derived from national averages. ENVIRON adjusted the NONROAD2002 model defaults in the following manner:

- The NONROAD model uses 1996 as a base year, and then projects emissions for any given year based on growth factors inherent in the model. The default growth factors in the model were zeroed out to reflect base year 1996 equipment population numbers. Arizona-specific growth factors developed for WRAP were then applied to the NONROAD2002 model outputs to produce 2002 year population numbers and associated emissions.
- Equipment population numbers and activity levels for commercial lawn and garden equipment were adjusted based on survey results of the commercial lawn and garden industry performed by ENVIRON as part of the CTOC work. Survey results show that for most categories of lawn and garden equipment, the equipment populations for Maricopa County are significantly lower than EPA default values, while the average annual hours of operation for most equipment types are slightly higher than EPA's values. Using these new local data results is a considerable decrease in emissions from this category, compared with earlier results using EPA default data.
- Equipment population numbers and activity levels for airport ground support equipment were adjusted based on Maricopa County-specific data provided by the Maricopa Association of Governments (MAG) for the CTOC inventory.

Spatial allocation factors were developed, based on EPA guidance documents, to apportion nonroad emissions to the PM₁₀ nonattainment area. The approaches used are described in each section of this chapter.

Temporal allocations (used to calculate PM₁₀ average-day emissions) for nonroad equipment categories modeled in the NONROAD2002 model come from EPA recommendations on weekday and weekend day activity levels for each nonroad equipment category (US EPA, 1999). Table 4.1–1 below lists the weighted activity level allocation fractions for each equipment class for weekdays and weekend days. For this report, the most conservative (highest) allocation fraction in each nonroad equipment class was used to calculate average-day emissions.

Table 4.1–1. Default weekday and weekend day activity allocation fractions.

Equipment category	Weekday	Weekend day
Agricultural	0.1666667	0.0833334
Airport ground support	0.1428571	0.1428571
Commercial	0.1666667	0.0833334
Construction and mining	0.1666667	0.0833334
Industrial	0.1666667	0.0833334
Lawn and garden (residential)	0.1111111	0.2222222
Lawn and garden (commercial)	0.1600000	0.1000000
Logging	0.1666667	0.0833334
Pleasure craft	0.0600000	0.3500000
Railway maintenance	0.1800000	0.0500000
Recreational	0.1111111	0.2222222

4.2 Agricultural equipment

Annual emissions from agricultural equipment in Maricopa County were calculated using EPA’s NONROAD2002 model, as discussed above. Emissions are reported by engine type: gasoline 2-stroke, gasoline 4-stroke, diesel, compressed natural gas (CNG), and liquid petroleum gas (LPG). Emissions from CNG and LPG equipment are reported in the gasoline 4-stroke category, as total emissions from these engine types were either trivial or none. County-wide results are shown in Table 4.2–1.

Table 4.2–1. Annual emissions (in tons/yr) from agricultural equipment in Maricopa County.

Source Classification Code (SCC)	Engine type	PM₁₀	PM_{2.5}	NO_x	SO_x	NH₃
2260005000	Gasoline 2-stroke	0.04	0.04	< 0.005	< 0.005	< 0.005
2265005000	Gasoline 4-stroke	0.08	0.08	6.16	0.06	0.22
2270005000	Diesel	56.78	52.24	471.30	6.53	0.73
Totals:		56.90	52.35	477.46	6.59	0.96

PM₁₀ nonattainment area annual emissions were calculated based on EIIP guidance (US EPA, 2002) which recommends using the ratio of agricultural land inside the nonattainment area (222,124 acres) to agricultural land inside the county (415,473 acres). See Section 1.5.2 for a discussion of land-use data used.

$$\begin{aligned}
 \text{PM}_{10} \text{ nonattainment area emissions from agricultural equipment} &= \text{County PM}_{10} \text{ emissions} \times \text{Agricultural land-use allocation factor} \\
 &= 56.90 \text{ tons} \times 53.46\% \\
 &= 30.42 \text{ tons PM}_{10} / \text{yr}
 \end{aligned}$$

Table 4.2–2. Annual emissions (in tons/yr) from agricultural equipment in the PM₁₀ NAA.

SCC	Engine type	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
2260005000	Gasoline 2-stroke	0.02	0.02	< 0.005	< 0.005	< 0.005
2265005000	Gasoline 4-stroke	0.04	0.04	3.29	0.03	0.12
2270005000	Diesel	30.36	27.93	251.96	3.49	0.39
Totals:		30.42	27.99	255.25	3.52	0.51

County average-day emissions were calculated by multiplying annual emissions (generated by the NONROAD2002 model) by the most conservative weekday/weekend day activity allocation factor for agricultural equipment listed in Table 4.1–1, and dividing the product by the number of weeks (52) in the year (US EPA, 1999), as follows:

$$\begin{aligned}
 \text{Maricopa County PM}_{10} \text{ average-day emissions (lbs/day)} &= \text{Annual PM}_{10} \text{ emissions (tons/year)} \times 2000 \text{ (lb/ton)} \times \text{daily activity allocation factor for agricultural equipment expressed as (week/day)} \div 52 \text{ (weeks per year)} \\
 &= 56.90 \times 2000 \times 0.166667 \div 52 \\
 &= 364.8 \text{ lbs/day}
 \end{aligned}$$

Table 4.2–3. Typical daily emissions (in lbs/day) from agricultural equipment in Maricopa County.

SCC	Engine type	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
2260005000	Gasoline 2-stroke	0.3	0.3	< 0.05	< 0.05	< 0.05
2265005000	Gasoline 4-stroke	0.5	0.5	39.5	0.4	1.4
2270005000	Diesel	364.0	334.9	3,021.2	41.9	4.7
Totals:		364.8	335.7	3,060.7	42.3	6.1

PM₁₀ nonattainment area average-day emissions were calculated by multiplying County average-day emissions by the agricultural land-use allocation factor:

$$\begin{aligned}
 \text{PM}_{10} \text{ nonattainment area average-day emissions} &= \text{Maricopa County PM}_{10} \text{ average-day emissions} \times \text{Agricultural land-use allocation factor} \\
 &= 364.8 \text{ lbs/day} \times 53.46\% \\
 &= 195.0 \text{ lbs/day}
 \end{aligned}$$

Table 4.2–4. Typical daily emissions (in lbs/day) from agricultural equipment in the PM₁₀ nonattainment area.

SCC	Engine type	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
2260005000	Gasoline 2-stroke	0.1	0.1	< 0.05	< 0.05	< 0.05
2265005000	Gasoline 4-stroke	0.3	0.3	21.1	0.2	0.7
2270005000	Diesel	194.6	179.0	1,615.1	22.4	2.5
Totals:		195.0	179.4	1,636.2	22.6	3.2

4.3 Airport ground support equipment

Annual emissions from airport ground support equipment (GSE) in Maricopa County were calculated using EPA’s NONROAD2002 model, as described in Section 4.1. Annual emissions for the PM₁₀ nonattainment area for this category were derived by applying the ratio of the number of FAA landings and takeoffs (LTO) in the nonattainment area to Maricopa County-level totals, as recommended by EIIP guidance (US EPA, 2002). See Section 4.12 for a discussion of aircraft LTO data.

Table 4.3–1. Annual emissions (in tons/yr) from airport ground support equipment.

Engine type	Maricopa County					PM ₁₀ nonattainment area				
	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
Gasoline 2-stroke	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gasoline 4-stroke	0.74	0.69	92.10	0.81	3.32	0.72	0.67	89.80	0.79	3.24
Diesel	3.93	3.62	54.99	0.86	0.09	3.83	3.53	53.62	0.84	0.09
Totals:	4.67	4.31	147.09	1.67	3.41	4.55	4.20	143.42	1.63	3.33

County average-day emissions were calculated by first multiplying Maricopa County annual emissions by the most conservative weekday/weekend day activity allocation factor for airport ground support equipment (0.1428571) listed in Table 4.1–1, and dividing the product by the number of weeks (52) in the year (US EPA, 1999). PM₁₀ nonattainment area average-day emissions were calculated based on LTOs as described above. results are shown in Table 4.3–2.

Table 4.3–2. Typical daily emissions (in lbs/day) from airport ground support equipment.

Engine type	Maricopa County					PM ₁₀ nonattainment area				
	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
Gasoline 2-stroke	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gasoline 4-stroke	4.1	3.8	506.0	4.5	18.2	4.0	3.7	493.4	4.4	17.7
Diesel	21.6	19.9	302.1	4.7	0.5	21.1	19.4	294.5	4.6	0.5
Totals:	25.7	23.7	808.1	9.2	18.7	25.1	23.1	787.9	9.0	18.2

4.4 Commercial equipment

Annual emissions from commercial equipment in Maricopa County were calculated using EPA’s NONROAD2002 model, as described in Section 4.1. Annual emissions for the PM₁₀ nonattainment area for this category were derived by applying the ratio of industrial employment in the nonattainment area to Maricopa County-level totals, as data on the number of wholesale establishments recommended by EIIP guidance (US EPA, 2002) was not available. See Section 1.5.1 for a discussion of the industrial employment data used.

Table 4.4–1. Annual emissions (in tons/yr) from commercial equipment.

Engine type	Maricopa County					PM ₁₀ nonattainment area				
	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
Gasoline 2-stroke	12.43	11.44	1.28	0.11	0.05	12.29	11.32	1.27	0.11	0.05
Gasoline 4-stroke	12.61	11.69	567.59	7.79	20.47	12.47	11.56	561.40	7.70	20.25
Diesel	95.45	87.82	750.57	11.38	1.17	94.41	86.86	742.39	11.26	1.16
Totals:	120.50	110.95	1,319.44	19.28	21.68	119.17	109.74	1,305.06	19.07	21.46

County average-day emissions were calculated by multiplying Maricopa County annual emissions (generated by the NONROAD2002 model) by the most conservative weekday/weekend day activity allocation factor for commercial equipment (0.1666667) listed in Table 4.1–1, and dividing the product by the number of weeks (52) in the year (US EPA, 1999). PM₁₀ nonattainment area average-day emissions were calculated based on industrial employment ratios as described above.

Table 4.4–2. Typical daily emissions (in lbs/day) from commercial equipment.

Engine type	Maricopa County					PM ₁₀ nonattainment area				
	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
Gasoline 2-stroke	79.7	73.3	8.2	0.7	0.3	78.8	72.5	8.1	0.7	0.3
Gasoline 4-stroke	80.8	74.9	3,638.4	49.9	131.2	79.9	74.1	3,598.7	49.4	129.8
Diesel	611.9	562.9	4,811.3	72.9	7.5	605.2	556.8	4,758.9	72.1	7.4
Totals:	772.4	711.1	8,457.9	123.5	139.0	763.9	703.4	8,365.7	122.2	137.5

4.5 Construction and mining equipment

Annual emissions from construction and mining equipment in Maricopa County were calculated using EPA’s NONROAD2002 model as described in Section 4.1. Annual emissions for the PM₁₀ nonattainment area for this category were derived by applying the ratio of population in the nonattainment area to Maricopa County-level totals as a conservative estimate, as the EIIP-recommended allocation factor of total dollar value of construction was unavailable (US EPA, 2002). See Section 1.5.1 for a discussion of the population data used.

Table 4.5–1. Annual emissions (in tons/yr) from construction and mining equipment.

Engine type	Maricopa County					PM ₁₀ nonattainment area				
	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
Gasoline 2-stroke	28.34	26.07	6.28	0.20	0.23	28.10	25.85	6.23	0.20	0.23
Gasoline 4-stroke	2.33	2.16	114.49	1.46	4.13	2.31	2.14	113.51	1.45	4.09
Diesel	828.67	762.37	9,713.92	152.39	15.12	821.54	755.81	9,630.38	151.08	14.99
Totals:	859.34	790.60	9,834.69	154.05	19.47	851.95	783.80	9,750.12	152.73	19.31

County average-day emissions were calculated by multiplying Maricopa County annual emissions (generated by the NONROAD2002 model) by the most conservative weekday/weekend day activity allocation factor for construction/mining equipment (0.1666667) listed in Table 4.1–1, and dividing the product by the number of weeks (52) in the year (US EPA, 1999). PM₁₀ nonattainment area average-day emissions were calculated based on population ratios as described above.

Table 4.5–2. Typical daily emissions (in lbs/day) from construction and mining equipment.

Engine type	Maricopa County					PM ₁₀ nonattainment area				
	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
Gasoline 2-stroke	181.7	167.1	40.3	1.3	1.5	180.1	165.7	40.0	1.3	1.5
Gasoline 4-stroke	14.9	13.8	733.9	9.4	26.5	14.8	13.7	727.6	9.3	26.3
Diesel	5,312.0	4,887.0	62,268.7	976.9	96.9	5,266.3	4,845.0	61,733.2	968.5	96.1
Totals:	5,508.6	5,067.9	63,042.9	987.6	124.9	5,461.2	5,024.4	62,500.8	979.1	123.9

4.6 Industrial equipment

Annual emissions from industrial equipment in Maricopa County were calculated using EPA’s NONROAD2002 model, as described in Section 4.1. Annual emissions for the PM₁₀ nonattainment area for this category were derived by applying the ratio of industrial employment in the nonattainment area to Maricopa County-level totals as a conservative estimate, as the number of employees in manufacturing recommended by EIIP guidance (US EPA, 2002) was not available. See Section 1.5.1 for a discussion of the industrial employment data used.

Table 4.6–1. Annual emissions (in tons/yr) from industrial equipment.

Engine type	Maricopa County					PM ₁₀ nonattainment area				
	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
Gasoline 2-stroke	0.17	0.15	0.02	< 0.005	< 0.005	0.17	0.15	0.02	< 0.005	< 0.005
Gasoline 4-stroke	10.90	10.77	2,108.32	3.49	76.03	10.78	10.65	2,085.34	3.45	75.20
Diesel	96.15	88.46	1,066.46	18.95	1.66	95.10	87.50	1,054.84	18.74	1.64
Totals:	107.22	99.38	3,174.80	22.45	77.69	106.05	98.30	3,140.20	22.19	76.84

County average-day emissions were calculated by multiplying Maricopa County annual emissions (generated by the NONROAD2002 model) by the most conservative weekday/weekend day activity allocation factor for industrial equipment (0.1666667) listed in Table 4.1–1, and dividing the product by the number of weeks (52) in the year (US EPA, 1999). PM₁₀ nonattainment area average-day emissions were calculated based on industrial employment ratios as described above.

Table 4.6–2. Typical daily emissions (in lbs/day) from industrial equipment.

Engine type	Maricopa County					PM ₁₀ nonattainment area				
	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
Gasoline 2-stroke	1.1	1.0	0.1	< 0.05	< 0.05	1.1	1.0	0.1	< 0.05	< 0.05
Gasoline 4-stroke	69.9	69.0	13,514.9	22.4	487.4	69.1	68.2	13,367.6	22.2	482.1
Diesel	616.6	567.1	6,836.3	121.5	10.6	609.9	560.9	6,761.8	120.2	10.5
Totals:	687.6	637.1	20,351.3	143.9	498.0	680.1	630.1	20,129.5	142.4	492.6

4.7 Lawn and garden equipment

Annual emissions from lawn and garden equipment in Maricopa County were calculated using EPA’s NONROAD2002 model, as described in Section 4.1. These results reflect new equipment population and usage estimates from survey work done in early 2003 for the Arizona Department of Environmental Quality (discussed further in Section 4.1). Annual emissions for the PM₁₀ nonattainment area for this category were derived by applying the ratio of housing units in the nonattainment area to Maricopa County-level totals, as recommended by EIIP guidance (US EPA, 2002). See Section 1.5.1 for a discussion of the housing data used.

Table 4.7–1. Annual emissions (in tons/yr) from lawn and garden equipment.

Engine type	Maricopa County					PM ₁₀ nonattainment area				
	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
Gasoline 2-stroke	100.27	92.24	13.04	0.85	0.47	99.45	91.48	12.93	0.84	0.47
Gasoline 4-stroke	18.57	17.10	463.63	10.76	16.73	18.42	16.96	459.83	10.67	16.59
Diesel	22.75	20.93	218.81	3.59	0.34	22.56	20.76	217.02	3.56	0.34
Totals:	141.59	130.27	695.48	15.20	17.54	140.43	129.20	689.78	15.07	17.40

County average-day emissions were calculated by multiplying Maricopa County annual emissions (generated by the NONROAD2002 model) by the most conservative weekday/weekend day activity allocation factor for lawn and garden equipment (0.1600000 for the commercial segment, 0.2222222 for residential) listed in Table 4.1–1, and dividing the product by the number of weeks (52) in the year (US EPA, 1999). PM₁₀ nonattainment area average-day emissions were calculated based on housing units as described above.

Table 4.7–2. Typical daily emissions (in lbs/day) from lawn and garden equipment.

Engine type	Maricopa County					PM ₁₀ nonattainment area				
	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
Gasoline 2-stroke	696.3	640.6	86.7	6.0	2.9	690.6	635.3	86.0	6.0	2.9
Gasoline 4-stroke	138.3	127.3	2,853.1	80.3	123.8	137.2	126.3	2,829.7	79.6	122.8
Diesel	140.0	128.8	1,346.5	22.1	2.1	138.9	127.7	1,335.5	21.9	2.1
Totals:	974.6	896.7	4,286.3	108.4	128.8	966.7	889.3	4,251.2	107.5	127.8

4.8 Logging equipment

Annual emissions from logging equipment in Maricopa County were calculated using EPA’s NONROAD2002 model, as described in Section 4.1. Logging equipment includes equipment such as large chain saws and shredders used by such entities such as city parks departments and large landscaping companies. Annual emissions for the PM₁₀ nonattainment area for this category were derived by applying the ratio of population in the nonattainment area to Maricopa County-level totals as a conservative estimate, as the number of employees in logging recommended by EIIP guidance was not available (US EPA, 2002). See Section 1.5.1 for a discussion of the population figures used.

Table 4.8–1. Annual emissions (in tons/yr) from logging equipment.

Engine type	Maricopa County					PM ₁₀ nonattainment area				
	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
Gasoline 2-stroke	0.85	0.78	0.20	0.01	0.01	0.84	0.77	0.20	0.01	0.01
Gasoline 4-stroke	0.02	0.02	0.60	0.02	0.02	0.02	0.02	0.59	0.02	0.02
Diesel	2.38	2.19	37.94	0.69	0.06	2.36	2.17	37.61	0.68	0.06
Totals:	3.25	2.99	38.74	0.71	0.09	3.22	2.96	38.40	0.70	0.09

County average-day emissions were calculated by multiplying Maricopa County annual emissions (generated by the NONROAD2002 model) by the most conservative weekday/weekend day activity allocation factor for logging equipment (0.1666667) listed in Table 4.1–1, and dividing the product by the number of weeks (52) in the year (US EPA, 1999). PM₁₀ nonattainment area season-day emissions were calculated based on population as described above.

Table 4.8–2. Typical daily emissions (in lbs/day) from logging equipment.

Engine type	Maricopa County					PM ₁₀ nonattainment area				
	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
Gasoline 2-stroke	5.4	5.0	1.3	0.1	0.1	5.4	5.0	1.3	0.1	0.1
Gasoline 4-stroke	0.1	0.1	3.8	0.1	0.1	0.1	0.1	3.8	0.1	0.1
Diesel	15.3	14.0	243.2	4.4	0.4	15.2	13.9	241.1	4.4	0.4
Totals:	20.8	19.1	248.3	4.6	0.6	20.7	19.0	246.2	4.6	0.6

4.9 Pleasure craft

Annual emissions from pleasure craft equipment in Maricopa County were calculated using EPA’s NONROAD2002 model, as described in Section 4.1. Annual emissions for the PM₁₀ nonattainment area for this category were derived by applying the ratio of water surface area in the nonattainment area to Maricopa County-level totals, as recommended by EIIP guidance (US EPA, 2002). See Section 1.5.2 for a discussion of the land-use data used.

Table 4.9–1. Annual emissions (in tons/yr) from pleasure craft equipment.

Engine type	Maricopa County					PM ₁₀ nonattainment area				
	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
Gasoline 2-stroke	26.76	24.62	11.60	0.43	0.42	12.92	11.89	5.60	0.21	0.20
Gasoline 4-stroke	0.18	0.16	15.90	0.21	0.57	0.09	0.08	7.68	0.10	0.28
Diesel	0.29	0.27	15.52	0.23	0.02	0.14	0.13	7.49	0.11	0.01
Totals:	27.23	25.05	43.01	0.88	1.02	13.15	12.10	20.77	0.42	0.49

County average-day emissions were calculated by multiplying Maricopa County annual emissions (generated by the NONROAD2002 model) by the most conservative weekday/weekend day activity allocation factor for pleasure craft (0.3500000) listed in Table 4.1–1, and dividing the product by the number of weeks (52) in the year (US EPA, 1999). PM₁₀ nonattainment area average-day emissions were calculated based on water surface area as described above.

Table 4.9–2. Typical daily emissions (in lbs/day) from pleasure craft equipment.

Engine type	Maricopa County					PM ₁₀ nonattainment area				
	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
Gasoline 2-stroke	360.2	331.4	156.2	5.8	5.7	173.9	160.0	75.4	2.8	2.8
Gasoline 4-stroke	2.4	2.2	214.0	2.8	7.7	1.2	1.1	103.3	1.4	3.7
Diesel	3.9	3.6	208.9	3.1	0.3	1.9	1.7	100.9	1.5	0.1
Totals:	366.5	337.2	579.1	11.7	13.7	177.0	162.8	279.6	5.7	6.6

4.10 Railway maintenance equipment

Annual emissions from railway maintenance equipment in Maricopa County were calculated using EPA’s NONROAD2002 model, as described in Section 4.1. Annual emissions for the PM₁₀ nonattainment area for this category were derived by applying the ratio of population in the nonattainment area to Maricopa County-level totals, as recommended by EIIP guidance (US EPA, 2002). See Section 1.5.1 for a discussion of the population data used.

Table 4.10–1. Annual emissions (in tons/yr) from railway maintenance equipment.

Engine type	Maricopa County					PM ₁₀ nonattainment area				
	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
Gasoline 2-stroke	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gasoline 4-stroke	0.01	0.01	0.39	0.01	0.01	0.01	0.01	0.39	0.01	0.01
Diesel	3.04	2.80	19.96	0.26	0.03	3.01	2.78	19.79	0.26	0.03
Totals:	3.05	2.81	20.35	0.27	0.05	3.02	2.79	20.18	0.27	0.05

County average-day emissions were calculated by multiplying Maricopa County annual emissions (generated by the NONROAD2002 model) by the most conservative weekday/weekend day activity allocation factor for railway maintenance equipment (0.1800000) listed in Table 4.1–1, and dividing the product by the number of weeks (52) in the year (US EPA, 1999). PM₁₀ nonattainment area average-day emissions were calculated based on the population ratio as described above.

Table 4.10–2. Typical daily emissions (in lbs/day) from railway maintenance equipment.

Engine type	Maricopa County					PM ₁₀ nonattainment area				
	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
Gasoline 2-stroke	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Gasoline 4-stroke	0.1	0.1	2.7	0.1	0.1	0.1	0.1	2.7	0.1	0.1
Diesel	21.0	19.4	138.2	1.8	0.2	20.8	19.2	137.0	1.8	0.2
Totals:	21.1	19.5	140.9	1.9	0.3	20.9	19.3	139.7	1.9	0.3

4.11 Recreational equipment

Annual emissions from recreational equipment in Maricopa County were calculated using EPA's NONROAD2002 model, as described in Section 4.1. Annual emissions for the PM₁₀ nonattainment area for this category were derived by applying the ratio of passive open space, golf courses and vacant land use in the nonattainment area to Maricopa County-level totals as recommended by EIPP guidance (US EPA, 2002). See Section 1.5.2 for a discussion of the land-use data used.

Table 4.11–1. Annual emissions (in tons/yr) from recreational equipment.

Engine type	Maricopa County					PM ₁₀ nonattainment area				
	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
Gasoline 2-stroke	0.29	0.27	4.95	0.24	0.18	0.06	0.05	0.99	0.05	0.04
Gasoline 4-stroke	2.03	1.87	47.92	1.90	1.73	0.41	0.37	9.59	0.38	0.35
Diesel	2.21	2.03	10.47	0.15	0.02	0.44	0.41	2.10	0.03	<0.005
Totals:	4.53	4.17	63.34	2.29	1.92	0.91	0.83	12.68	0.46	0.39

County average-day emissions were calculated by multiplying Maricopa County annual emissions (generated by the NONROAD2002 model) by the most conservative weekday/weekend day activity allocation factor for recreational equipment (0.2222222) listed in Table 4.1–1, and dividing the product by the number of weeks (52) in the year (US EPA, 1999). PM₁₀ nonattainment area average-day emissions were calculated based on land use as described above.

Table 4.11–2. Typical daily emissions (in lbs/day) from recreational equipment.

Engine type	Maricopa County					PM ₁₀ nonattainment area				
	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
Gasoline 2-stroke	2.5	2.3	42.3	2.1	1.5	0.5	0.5	8.5	0.4	0.3
Gasoline 4-stroke	17.4	16.0	409.6	16.2	14.8	3.5	3.2	82.0	3.2	3.0
Diesel	18.9	17.4	89.5	1.3	0.1	3.8	3.5	17.9	0.3	<0.05
Totals:	38.8	35.7	541.4	19.6	16.5	7.8	7.2	108.4	3.9	3.3

4.12 Aircraft

A survey of all 16 airports in Maricopa County was conducted to collect data on the total number of landing and take-off operations (LTO's) as well as fleet mix to determine the types of aircraft used and idle times to calculate annual emissions. Of these airports, three locations (Buckeye Municipal Airport, Gila Bend Municipal Airport and Wickenburg Municipal Airport) are outside of the nonattainment area. Data provided by many airports were in the form of the US Federal Aviation Administration's (FAA) monthly reporting Form 7230-1, which documents the traffic flow in four major activity categories: air carrier, air taxi, general aviation and military.

Emissions were derived from both computer modeling and National Emissions Inventory (NEI) default emission factors. For airports that provided complete survey data, the FAA’s latest airport Emissions and Dispersion Modeling Software (EDMS 4.11) was used to calculate emissions. Parameters required to apply this model include annual LTO figures, fleet mix of types of aircraft in each activity category, and average idle-in and idle-out times.

For those airports that provided only partial data, the EDMS model could not be used to calculate emissions. Instead, NEI default emission factors were used to calculate emissions. Examples of missing data were detailed fleet mix data or unknown idle times. For airports that did not respond to the survey, LTO figures and fleet mix were derived from an online database that provides free detailed aeronautical information on airports at <http://www.airnav.com>. The “Airport Operational Statistics” section of this database contains data on average daily aircraft operations at the airport by aircraft type (air carrier, air taxi, general aviation and military). These data were multiplied by 365 to derive annual LTO totals and was used to grow LTO’s and fleet mix. Since the EDMS model requires specific aircraft types to run and the Airport Operational Statistics only provide general aircraft type information, the NEI default emission factors shown in Table 4.12–1 were applied to these activity data to calculate emissions. Since the EDMS model results do not calculate PM₁₀ or PM_{2.5} values, a ratio was calculated based on the NEI default emission factors between NO_x and PM₁₀ as well as NO_x and PM_{2.5}. This ratio was then applied to the EDMS output results for NO_x to derive PM₁₀ and PM_{2.5} emission factors. [*NOTE: Refer to the Errata sheet that accompanies this document for details on how PM₁₀ and PM_{2.5} emissions for air carriers have been calculated.*]

Table 4.12–1. NEI default emission factors (lbs/LTO), and conversion factors, by aircraft type.

Aircraft type	Abbreviation	SCC	NO _x	SO _x	NO _x :PM		PM ₁₀	PM _{2.5}
					ratio	ratio		
Air Taxi	AT	2275060000	0.158	0.015	3.8185	2.6329	0.603	0.416
General Aviation	GA	2275050000	0.065	0.010	3.6415	2.4923	0.237	0.162
Military	ML	2275001000	0.158	0.015	3.8185	2.6329	0.603	0.416

Table 4.12–2 summarizes the data received from each airport, and the approach used (using the EDMS model or default emission factors from the 1999 NEI) to calculate emissions from each airport.

The following provides an example of how aircraft emissions were calculated using EDMS for Sky ranch at Carefree, a small, general-aviation only airport with a mix of aircraft 12,500 lbs or less. Since the EDMS model requires an exact LTO value for each airframe considered in the model, and since the survey did not require respondents to supply exact LTO counts for each individual airframe, an averaging method was used. EDMS was run to produce an composite emission factor for an airport based on the most common type of aircraft using that facility. For Sky ranch, a composite profile was created by selecting within EDMS 12 aircraft types likely to utilize the airport, based on data provided by the airport survey and follow-up correspondence. These 12 aircraft types are: Cessna 150, Commanche, Robin R 2160, Socata Tampico, Cessna 172 Skyhawk, Piper PA-28, Robin R 3000, Socata Tobago, Cherokee six, Robin DR 400, Rockwell Commander, and Spencer S-12 Air Car.

The EDMS model was run with the above 12 aircraft types and for ease of calculation, each air craft was allocated 2000 LTO/year. It was then necessary to divide the lbs/LTO result by the 12 representative aircraft used to derive an emission factor for an “average” aircraft LTO.

Table 4.12–2. 2002 airport activity data, emission calculation methods, and emission factors.

Airport name	Activity category	2002 LTOs	LTO data source ¹	Emission calculation method ²	Lbs/LTO			
					PM ₁₀	PM _{2.5}	NO _x	SO _x
Arizona Army National Guard	ML	780	reported	NEI default	0.603	0.416	0.158	0.015
Buckeye Municipal Airport ³	GA	16,796	reported	EDMS	0.160	0.110	0.044	0.002
Chandler Municipal Airport	AT	914	reported	NEI default	0.603	0.416	0.158	0.015
	GA	80,689	reported	NEI default	0.237	0.162	0.065	0.010
	ML	10	reported	NEI default	0.603	0.416	0.158	0.015
Falcon Field	AT	1,319	AirNav	NEI default	0.603	0.416	0.158	0.015
	GA	125,350	AirNav	NEI default	0.237	0.162	0.065	0.010
	ML	5,278	AirNav	NEI default	0.603	0.416	0.158	0.015
Gila Bend Municipal Airport ³	GA	522	AirNav	NEI default	0.236	0.162	0.065	0.010
Glendale Municipal Airport	GA	59,352	reported	NEI default	0.237	0.162	0.065	0.010
Luke Air Force Base	ML	61,225	reported	EDMS	41.650	28.739	10.906	0.387
Phoenix Deer Valley Airport	AT	2,495	reported	NEI default	0.603	0.416	0.158	0.015
	GA	192,254	reported	NEI default	0.237	0.162	0.065	0.010
	ML	37	reported	NEI default	0.603	0.416	0.158	0.015
Phoenix Goodyear Airport	AC	131	reported	EDMS	1.48	1.45	37.718	1.887
	AT	270	reported	NEI default	0.603	0.416	0.158	0.015
	GA	68,317	reported	NEI default	0.237	0.162	0.065	0.010
	ML	569	reported	NEI default	0.603	0.416	0.158	0.015
Phoenix Sky Harbor Int'l.	AC	187,125	reported	EDMS	1.28	1.25	40.201	2.933
	AT	57,570	reported	EDMS	5.266	3.634	1.379	0.145
	GA	26,204	reported	EDMS	0.062	0.042	0.017	0.001
	ML	1,987	reported	EDMS	1.264	0.872	0.331	0.012
Pleasant Valley Airport	GA	19,302	reported	EDMS	1.205	0.824	0.331	0.059
Scottsdale Airport	AT	5,026	reported	NEI default	0.603	0.416	0.158	0.015
	GA	92,365	reported	NEI default	0.237	0.162	0.065	0.010
	ML	291	reported	NEI default	0.603	0.416	0.158	0.015
Skyranch at Carefree	GA	2,453	reported	EDMS	0.160	0.110	0.044	0.002
Stellar Airpark	GA	22,000	reported	NEI default	0.236	0.162	0.065	0.010
Wickenburg Mun. Airport ³	AT	179	AirNav	NEI default	0.603	0.416	0.158	0.015
	GA	8,495	AirNav	NEI default	0.236	0.162	0.065	0.010
	ML	268	AirNav	NEI default	0.603	0.416	0.158	0.015
Williams Gateway Airport	AC	421	reported	EDMS	1.08	1.05	18.067	1.346
	AT	3,104	reported	EDMS	5.266	3.634	1.379	0.145
	GA	79,731	reported	EDMS	0.163	0.112	0.045	0.002
	ML	5,990	reported	EDMS	20.240	13.966	5.300	0.195

1. “reported” = using 2002 survey results supplied by the airport,
“AirNav” = using available data on average daily LTOs from www.airnav.com.
2. “EDMS” = emission factors were based on EDMS model calculations,
“NEI default” = NEI default emission factors Table 4.12–1 were used.
3. Airport is outside the nonattainment area.

For example, the model run with the 12 aircraft types resulted in total NO_x emissions of 0.532 tons (assuming each of the 12 aircraft types had 2000 LTOs each during the period).

$$\begin{aligned} \text{Composite NO}_x \text{ emission factor (lb/LTO)} &= \sum \text{modeled NO}_x \text{ emissions (tons/yr)} \times 1 \text{ yr} / 24,000 \text{ LTOs} \times 2000 \text{ lb/ton} \\ &= 0.044 \text{ lb NO}_x \text{ /LTO} \end{aligned}$$

This composite emission factor was then multiplied by the actual number of LTOs at the airport to derive an annual NO_x emissions total:

$$\begin{aligned} \text{NO}_x \text{ emissions (lb/ yr)} &= 2,453 \text{ LTO/yr} \times 0.044 \text{ lb NO}_x \text{ /LTO} \\ &= 107.9 \text{ lb NO}_x \text{ /yr} \end{aligned}$$

The above approach was used to calculate NO_x and SO_x directly from the EDMS model. Emissions of PM₁₀ and PM_{2.5} were derived by applying the appropriate NO_x:PM₁₀ and NO_x:PM_{2.5} ratios listed in Table 4.12–1.

For all airports, activity is presumed to occur evenly over a 7-day week and average daily emissions were calculated by dividing annual totals by 365 days per year. Table 4.12–3 lists the total annual emissions and average daily emissions, for each airport and aircraft type.

Table 4.12–3. Annual and typical daily emissions, by airport and aircraft type.

Facility	Cate- gory ¹	Tons/yr				Lbs/day			
		PM ₁₀	PM _{2.5}	NO _x	SO _x	PM ₁₀	PM _{2.5}	NO _x	SO _x
Arizona Army Natl. Guard	ML	0.24	0.16	0.06	0.01	1.3	0.9	0.3	0.0
Chandler Municipal Airport	AT	0.28	0.19	0.07	0.01	1.5	1.0	0.4	0.0
	GA	9.55	6.53	2.62	0.40	52.3	35.8	14.4	2.2
	ML	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0
Falcon Field	AT	0.40	0.27	0.10	0.01	2.2	1.5	0.6	0.1
	GA	14.84	10.15	4.07	0.63	81.3	55.6	22.3	3.4
	ML	1.59	1.10	0.42	0.04	8.7	6.0	2.3	0.2
Glendale Municipal Airport	GA	7.02	4.81	1.93	0.30	38.5	26.3	10.6	1.6
Luke Air Force Base	ML	1,275.01	879.76	333.86	11.85	6,986.4	4,820.6	1,829.4	64.9
Phoenix Deer Valley Airpt.	AT	0.75	0.52	0.20	0.02	4.1	2.8	1.1	0.1
	GA	22.75	15.57	6.25	0.96	124.7	85.3	34.2	5.3
	ML	0.01	0.01	0.00	0.00	0.0	0.0	0.0	0.0
Phoenix Goodyear Airport	AC	0.10	0.09	2.47	0.12	0.5	0.5	13.5	0.7
	AT	0.08	0.06	0.02	0.00	0.4	0.3	0.1	0.0
	GA	8.09	5.53	2.22	0.34	44.3	30.3	12.2	1.9
	ML	0.17	0.12	0.04	0.00	0.9	0.6	0.2	0.0
Phoenix Sky Harbor Int'l.	AC	119.76	116.95	3,761.31	274.42	656.2	640.8	20,609.9	1,503.7
	AT	151.59	104.60	39.69	4.17	830.6	573.1	217.5	22.9
	GA	0.81	0.55	0.22	0.01	4.4	3.0	1.2	0.1
	ML	1.26	0.87	0.33	0.01	6.9	4.7	1.8	0.1
Pleasant Valley Airport	GA	11.63	7.96	3.19	0.57	63.7	43.6	17.5	3.1
Scottsdale Airport	AT	1.52	1.05	0.40	0.04	8.3	5.7	2.2	0.2
	GA	10.93	7.48	3.00	0.46	59.9	41.0	16.4	2.5
	ML	0.09	0.06	0.02	0.00	0.5	0.3	0.1	0.0
Skyranch at Carefree	GA	0.20	0.13	0.05	0.00	1.1	0.7	0.3	0.0
Stellar Airpark	GA	2.60	1.78	0.72	0.11	14.3	9.8	3.9	0.6
Williams Gateway Airport	AC	0.23	0.22	3.80	0.28	1.2	1.2	20.8	1.6
	AT	8.17	5.64	2.14	0.23	44.8	30.9	11.7	1.2
	GA	6.53	4.47	1.79	0.08	35.8	24.5	9.8	0.4
	ML	60.62	41.83	15.87	0.58	332.2	229.2	87.0	3.2
PM₁₀ nonattainment area totals:		1,716.82	1,218.47	4,186.89	295.66	9,407.2	6,676.6	22,941.9	1,620.1

Airports outside the nonattainment area:

Buckeye Mun. Airport	GA	1.35	0.92	0.37	0.02	7.4	5.0	2.0	0.1
Gila Bend Mun. Airport	GA	0.06	0.04	0.02	0.00	0.3	0.2	0.1	0.0
Wickenburg Mun. Airport	AT	0.05	0.04	0.01	0.00	0.3	0.2	0.1	0.0
	GA	1.01	0.69	0.28	0.04	5.5	3.8	1.5	0.2
	ML	0.08	0.06	0.02	0.00	0.4	0.3	0.1	0.0
Maricopa County totals:		1,719.37	1,220.22	4,187.66	295.81	9,421.2	6,686.1	22,946.1	1,620.9

1. AC = air carrier, GA = general aviation, AT = air taxi, ML = military.

4.13 Locomotives

Annual emissions from locomotives were calculated based on diesel fuel usage provided by Burlington Northern/Santa Fe Railway (BNSF) and Union Pacific Railway (UP). Railway operations from these companies fall into two categories: Class I haul lines and yard/switching operations (no Class II or Class III haul lines operated in Maricopa County in 2002). Annual emissions from Class I haul operations and yard/switching operations were calculated by multiplying diesel fuel usage by the emission factors listed in Table 4.13–1.

Table 4.13–1. Emission factors for locomotives.

Activity type	Emission factors (lbs/gal diesel)				
	PM ₁₀ ⁽¹⁾	PM _{2.5} ⁽¹⁾	NO _x ⁽¹⁾	SO _x ⁽²⁾	NH ₃ ⁽³⁾
Class I haul line	0.015	0.013	0.595	0.036	0.00095
Yard/switch operations	0.020	0.019	0.798	0.036	0.00095

Sources: (1) EPA, 1997. (2) EPA, 1992. (3) EPA, 1998.

The example below illustrates how emissions were calculated for each locomotive activity type. Fuel use reported by railroads, and emission totals are summarized in Table 4.13–2.

$$\begin{aligned}
 \text{PM}_{10} \text{ emissions from UP Class I haul lines} &= \text{Diesel fuel used (gals)} \times \text{EPA emission factor (lbs/gal) for PM}_{10} \div 2000 \text{ lbs/ton} \\
 &= 9,204,320 \text{ gallons} \times 0.015 \text{ lbs/gal} \div 2000 \text{ lbs/ton} \\
 &= 69.03 \text{ tons PM}_{10}/\text{yr}
 \end{aligned}$$

Table 4.13–2. Fuel use and annual emissions from locomotives in Maricopa County.

Locomotive type	Diesel fuel used (gals)	Annual emissions (tons/yr)				
		PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
BNSF Class I haul line	824,339	6.18	5.36	245.24	14.84	0.39
UP Class I haul line	9,204,320	69.03	59.83	2,738.29	165.68	4.37
BNSF yard/switch operations	824,900	8.25	7.84	329.14	14.85	0.39
UP yard/switch operations	329,960	3.30	3.13	131.65	5.94	0.16
Totals:	11,183,519	86.76	76.16	3,444.32	201.30	5.31

PM₁₀ nonattainment area emissions were calculated by multiplying Maricopa County emissions by the percentage of track miles inside the PM₁₀ nonattainment area, determined by GIS mapping:

$$\begin{aligned}
 \text{PM}_{10} \text{ nonattainment area emissions from UP Class I haul lines} &= \text{County PM}_{10} \text{ emissions} \times \text{Percentage of track in the nonattainment area} \\
 &= 69.03 \text{ tons PM}_{10}/\text{yr} \times 44.27\% \\
 &= 30.56 \text{ tons PM}_{10}/\text{yr}
 \end{aligned}$$

Table 4.13–3. Annual emissions (in tons/yr) from locomotives in the PM₁₀ NAA.

Locomotive type	Track in nonattainment area (%)	Annual emissions (tons/yr)				
		PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
BNSF Class I haul line	44.27	2.74	2.37	108.57	6.57	0.17
UP Class I haul line	44.27	30.56	26.49	1,212.24	73.35	1.94
BNSF yard/switch operations	100.00	8.25	7.84	329.14	14.85	0.39
UP yard/switch operations	100.00	3.30	3.13	131.65	5.94	0.16
Totals:		44.85	39.83	1,781.60	100.70	2.66

PM₁₀ typical daily emissions for both the county (shown in Table 4.13–4) and the PM₁₀ nonattainment area (Table 4.13–5) were calculated by dividing annual totals by 365 days per year, as locomotive activity is assumed to be uniform throughout the year.

$$\begin{aligned}
 \text{PM}_{10} \text{ typical daily} &= \text{Annual PM}_{10} \text{ emissions (tons)} \times 2000 \text{ lbs/ton} \div 365 \text{ days} \\
 \text{emissions from haul lines} &= 69.03 \text{ tons} \times 2000 \text{ lbs/ton} \div 365 \text{ days} \\
 &= 378.3 \text{ lbs PM}_{10} / \text{day}
 \end{aligned}$$

Table 4.13–4. Typical daily emissions (in lbs/day) from locomotives in Maricopa County.

Locomotive type	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
BNSF Class I haul line	33.9	29.4	1,343.8	81.3	2.1
UP Class I haul line	378.3	327.8	15,004.3	907.8	24.0
BNSF yard/switch operations	45.2	42.9	1,803.5	81.4	2.1
UP yard/switch operations	18.1	17.2	721.4	32.5	0.9
Totals:	475.4	417.3	18,873.0	1,103.0	29.1

Table 4.13–5. Typical daily emissions (in lbs/day) from locomotives in the PM₁₀ nonattainment area.

Locomotive type	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
BNSF Class I haul line	15.0	13.0	594.9	36.0	0.9
UP Class I haul line	167.5	145.1	6,642.4	401.9	10.6
BNSF yard/switch operations	45.2	42.9	1,803.5	81.4	2.1
UP yard/switch operations	18.1	17.2	721.4	32.5	0.9
Totals:	245.7	218.2	9,762.2	551.8	14.6

4.14 Summary of all nonroad mobile source emissions

Table 4.14–1 summarizes annual and daily emissions of PM₁₀, PM_{2.5}, NO_x, SO_x and NH₃ from nonroad mobile sources in Maricopa County respectively. Table 4.14–2 shows annual and typical daily emissions for these pollutants for the PM₁₀ nonattainment area.

Table 4.14–1. Annual and typical daily emissions from nonroad mobile sources in Maricopa County.

Category	Annual emissions (tons/yr)					Typical daily emissions (lbs/day)				
	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
Agricultural	56.90	52.35	477.46	6.59	0.96	364.8	335.7	3,060.7	42.3	6.1
Airport ground support	4.67	4.31	147.09	1.67	3.41	25.7	23.7	808.1	9.2	18.7
Commercial	120.50	110.95	1,319.44	19.28	21.68	772.4	711.1	8,457.9	123.5	139.0
Construction & mining	859.34	790.60	9,834.69	154.05	19.47	5,508.6	5,067.9	63,042.9	987.6	124.9
Industrial	107.22	99.38	3,174.80	22.45	77.69	687.6	637.1	20,351.3	143.9	498.0
Lawn & garden	141.59	130.27	695.48	15.20	17.54	974.6	896.7	4,286.3	108.4	128.8
Logging	3.25	2.99	38.74	0.71	0.09	20.8	19.1	248.3	4.6	0.6
Pleasure craft	27.23	25.06	43.01	0.88	1.02	366.5	337.2	579.1	11.7	13.7
Railway maintenance	3.05	2.81	20.35	0.27	0.05	21.1	19.5	140.9	1.9	0.3
Recreational	4.53	4.17	63.35	2.29	1.92	38.8	35.7	541.4	19.6	16.5
Aircraft	1,719.37	1,220.22	4,187.66	295.81	0.00	9,421.2	6,686.1	22,946.1	1,620.5	0.0
Locomotives	86.76	76.16	3,444.32	201.30	5.31	475.4	417.3	18,873.0	1,103.0	29.1
Totals:	3,134.41	2,519.27	23,446.39	720.50	149.14	18,677.5	15,187.1	143,336.0	4,176.6	975.7

Table 4.14–2. Annual and typical daily emissions from nonroad mobile sources in the PM₁₀ NAA.

Category	Annual emissions (tons/yr)					Typical daily emissions (lbs/day)				
	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
Agricultural	30.42	27.99	255.25	3.52	0.51	195.0	179.4	1,636.2	22.6	3.2
Airport ground support	4.55	4.20	143.42	1.63	3.33	25.1	23.1	787.9	9.0	18.2
Commercial	119.17	109.74	1,305.06	19.07	21.46	763.9	703.4	8,365.7	122.2	267.6
Construction & mining	851.95	783.80	9,750.12	152.73	19.31	5,461.2	5,024.4	62,500.8	979.1	123.9
Industrial	106.05	98.30	3,140.20	22.19	76.84	680.1	630.1	20,129.5	142.4	492.6
Lawn & garden	140.43	129.20	689.78	15.07	17.40	966.7	889.3	4,251.2	107.5	127.8
Logging	3.22	2.96	38.40	0.70	0.09	20.7	19.0	246.2	4.6	0.6
Pleasure craft	13.15	12.10	20.77	0.42	0.49	177.0	162.8	279.6	5.7	6.6
Railway maintenance	3.02	2.79	20.18	0.27	0.05	20.9	19.3	139.7	1.9	0.3
Recreational	0.91	0.83	12.68	0.46	0.39	7.8	7.2	108.4	3.9	3.3
Aircraft	1,716.82	1,218.47	4,186.89	295.66	0.00	9,407.2	6,676.6	22,941.9	1,620.1	0.0
Locomotives	44.85	39.83	1,781.60	100.70	2.66	245.7	218.2	9,762.2	551.8	14.6
Totals:	3,034.54	2,430.21	21,344.35	612.42	142.53	17,971.3	14,552.8	131,149.3	3,570.8	1,058.7

4.15 Quality assurance procedures

Established procedures were used to check, and correct when necessary, the nonroad mobile sources emissions estimates. All NONROAD model input and output files, and Excel spreadsheets used to calculate the emissions, were checked by personnel who were not involved in the development of the modeling inputs/outputs and spreadsheets. In addition, the emissions estimates were reviewed for reasonableness by external agency staff.

4.16 References

- ENVIRON *et al.*, 2003. Maricopa County 2002 Comprehensive Emission Inventory for the Cap and Trade Oversight Committee, Final Rep. prepared for Arizona Dept. of Environmental Quality, Oct. 9, 2003.
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- EPA, 1998. National Air Pollutant Emission Trends Procedures Document, 1900-1996. Office of Air Quality Planning and Standards, Rep. EPA-454/R-98-008, Research Triangle Park, NC. May.
- EPA, 1997. Emission Factors for Locomotives. Office of Mobile Sources. Techn. Highlights, (Table 9) Rep. EPA420-F-97-051, Dec. 1997. Internet address: <http://www.epa.gov/otaq/regs/nonroad/locomotv/frm/42097051.pdf>
- EPA, 1992. Procedures for Emission Inventory Preparation – Vol. IV: Mobile Sources. Office of Air and Radiation, EPA Rep. EPA420-R-92-009, December.

5. Onroad Mobile Sources

5.1 Introduction

Onroad mobile source emission estimates have been calculated for particulate matter for the 2002 Periodic Particulate Matter Emissions Inventory. For the purposes of this particulate matter study, the following pollutants were included; PM₁₀, PM_{2.5}, nitrogen oxides (NO_x), sulfur oxides (SO_x), and ammonia (NH₃). PM₁₀ refers to all particles less than or equal to 10 micrometers in diameter, about one seventh the diameter of a human hair. PM_{2.5} refers to particles less than or equal to 2.5 micrometers in diameter. Given the nature of the primary particulates, PM₁₀ and PM_{2.5}, the total fugitive dust emissions from paved and unpaved roads are calculated separately from onroad emissions from other sources (exhaust, tire wear, and brake wear).

The fugitive dust emissions are calculated separately from the remaining onroad factors because fugitive dust is primarily a function of the silt loading on different roadway types and whether a road is paved or unpaved. While calculated using a separate model than exhaust or evaporative emissions, the fugitive dust emissions are included in this report. The remaining onroad emissions are not dependent upon silt loading but may depend upon items such as fuel quality or temperature.

Onroad mobile source emissions are estimated for the portion of PM₁₀ nonattainment area located primarily within Maricopa County (approximately 2,900 square miles) as well as for Maricopa County as a whole. Emission estimates were calculated for the following eight vehicle types: light duty gas vehicles (LDGV), light duty gas trucks of gross vehicle weight under 6000 pounds (LDGT1/LDGT2), light duty gas trucks of gross weight over 6000 pounds (LDGT3/LDGT4), heavy duty gas vehicles (HDGV), light duty diesel vehicles (LDDV), light duty diesel trucks (LDDT), heavy duty diesel vehicles (HDDV), and motorcycles (MC). Emission factors for these vehicle types were calculated using two tools, MOBILE6.2 and AP-42. MOBILE6.2 is the latest version in a series of models developed by the US Environmental Protection Agency (EPA) for the purpose of estimating motor vehicle emission factors. AP-42 is the EPA Compilation of Air Pollutant Emission Factors. AP-42 emission factors were used to calculate fugitive dust emission factors while the MOBILE6.2 model was used to estimate all other emission factors. The resulting emission factors were multiplied by the estimates of vehicle miles of travel (VMT) to generate emission estimates.

Unlike the periodic inventory analyses for carbon monoxide and ozone precursors, there is no "PM season". This report will include annual average day emissions or annual total emissions estimates only and not include any emission estimates for a particulate season.

The main reference sources for preparing the onroad mobile source portion of the inventory were as follows:

- Emission Inventory Requirements for Ozone State Implementation Plans, EPA-450/4-91-010, March 1991,
- Technical Guidance on the Use of MOBILE6 for Emission Inventory Preparation, US EPA, January 2002,
- User's Guide to MOBILE6.1 and MOBILE6.2 (Mobile Source Emission Factor Model), EPA420-R-03-010, August 2003, and

- Procedures for Emission Inventory Preparation Volume IV: Mobile Sources, EPA-450/4-81/026d (Revised), 1992.

5.2 VMT estimation procedure

MAG prepared the 2002 vehicle miles of travel (VMT) estimates for the PM₁₀ nonattainment area and Maricopa County. The source of data for these estimates is the 2002 Highway Performance Monitoring System (HPMS) data (see Appendix 5.1) submitted to the US Department of Transportation, Federal Highway Administration (FHWA) by the Arizona Department of Transportation (ADOT). The ADOT contact person for the HPMS VMT estimates is Mark Catchpole (602-712-8596).

Each year, ADOT coordinates the collection of HPMS data, including the annual average daily traffic (AADT) estimates which are utilized to develop HPMS VMT estimates. ADOT provides the AADT for the state highway system routes including interstates, urban freeways, and principal arterials in Maricopa County. AADTs for other non-local facilities are provided by local jurisdictions. ADOT merges the Maricopa County data with information from other Arizona counties to create the statewide HPMS dataset submitted to FHWA each year.

HPMS contains a number of data elements which describe roadway characteristics and performance for every non-local roadway in Arizona. All non-local roadways have been divided into sections which are 0.3 to 10 miles in length, in accordance with HPMS criteria. These sections are called HPMS universe sections. HPMS contains additional data elements which provide more detailed information on a randomly-selected set of sample sections. The VMT estimates which ADOT submits to FHWA each year are generated from HPMS universe data for all interstates, urban freeways, and principal arterials. Sample section data are expanded to estimate VMT on all other non-local systems.

VMT on local streets in the urbanized portion of Maricopa County is estimated using traffic counts collected on 50 randomly-selected local streets in June-July of 1994. These counts resulted in an AADT of 587 for local roads in the urbanized area. To calculate VMT, this AADT was applied to local road mileage in 1994 obtained from the Maricopa County street centerline coverage. In 1994, an AADT of 150 was assumed for local roads which are in the “donut” area. The “donut” area is an HPMS term referring to the specific area inside the PM₁₀ nonattainment area, but outside the Phoenix urbanized area boundary. Since 1994, the AADTs on local streets have been increased annually on the basis of the rate of population growth in the Maricopa County population; the mileage on local streets is updated annually by the local jurisdictions in Maricopa County.

The 2002 HPMS System Length and Daily Vehicle Travel for individual urbanized areas (in Appendix 5.1) was submitted to FHWA by ADOT in October 2003. This table reported a 2002 average daily VMT (AADT) for the Phoenix urbanized area (#33) of 63.338 million. The HPMS System Length and Daily Travel, Donut Area Data for Individual NAAQS Nonattainment Areas, (in Appendix 5.1), reported a 2002 VMT for the “donut” area (#33) of 6.694 million.

The distribution of VMT by facility type for the PM₁₀ nonattainment area in Table 5.2–1 was derived from the 2002 HPMS data, while the distribution by area type was derived from a MAG

EMME/2 travel demand model run for 2002. The output of this traffic assignment was evaluated using GIS to obtain VMT by area type and facility type for the Phoenix urbanized and “donut” areas. The area type distributions from the EMME/2 assignment were applied to the 2002 HPMS VMT estimates by facility type for the urbanized and “donut” areas to create Table 5.2–1. VMT estimates for all of Maricopa County may be found in Table 5.2–2.

Table 5.2–1. 2002 HPMS VMT by area type and facility type for the PM₁₀ nonattainment area (annual average daily traffic).

Facility type	Area Type					Total
	1	2	3	4	5	
Interstate / Freeway	1,129,051	9,046,583	6,240,489	4,525,653	3,416,224	24,358,000
Principal Arterial / Minor Arterial	1,087,462	8,834,531	9,795,953	6,923,412	3,494,642	30,136,000
Collector	1,046,993	2,727,290	1,694,159	872,616	1,678,942	8,020,000
Local	195,247	1,991,136	2,564,545	1,689,510	1,077,562	7,518,000
Totals:	3,458,753	22,599,540	20,295,146	14,011,191	9,667,370	70,032,000

Notes:

1. Area Type = f(DENSITY of a planning district) where:
 $DENSITY = (Population + 2 \times Employment) / Area$
 For Area Type 1, DENSITY = 20,001+ (Central Business District)
 For Area Type 2, DENSITY = 10,001–20,000 (Outlying Central Business District)
 For Area Type 3, DENSITY = 5,001–10,000 (Mixed Urban)
 For Area Type 4, DENSITY = 1,001–5,000 (Suburban)
 For Area Type 5, DENSITY = 0–1,000 (Rural)
2. Total VMT by facility type is extracted from the appropriate HPMS templates.
3. VMT is split up into Area Types using data from MAG 2002 EMME/2 travel demand modeling results.
4. In some cases, the total VMT estimates may differ slightly from the sum of the component VMT estimates due to rounding. This difference will not exceed one vehicle mile of travel.

Table 5.2–2. 2002 HPMS VMT by area type and facility type for Maricopa County (annual average daily traffic).

Facility type	Area Type					Total
	1	2	3	4	5	
Interstate / Freeway	1,129,051	9,046,583	6,240,489	4,525,653	5,662,224	26,604,000
Principal Arterial / Minor Arterial	1,087,462	8,834,531	9,795,953	6,923,412	3,738,642	30,380,000
Collector	1,046,993	2,727,290	1,694,159	872,616	2,390,942	8,732,000
Local	195,247	1,991,136	2,564,545	1,689,510	1,422,562	7,863,000
Totals:	3,458,753	22,599,540	20,295,146	14,011,191	13,214,370	73,579,000

Notes:

1. For the definition of “Area Type”, see Table 5.2–1, Note 1.
2. VMT is split up into Area Types using data from MAG 2002 EMME/2 travel demand modeling results. All VMT outside of the HPMS urbanized and donut areas were applied to Area Type 5.
3. In some cases, the total VMT estimates may differ slightly from the sum of the component VMT estimates due to rounding. This difference will not exceed one vehicle mile of travel.

The VMT estimates by facility type for all of Maricopa County were developed by the Arizona Department of Transportation, as described in Appendix 5.1. Total VMT estimates by facility type were split into area type using the same methodology as was used for the PM₁₀ non-attainment area.

Roadway silt loading measurements used in the Serious Area PM₁₀ plan reflect three silt loading classifications; freeways, high ADT non-freeways (greater than 5,000 ADT), and low ADT non-freeways (less than 5,000 ADT). Unfortunately, these categories do not correspond directly to the roadway categories used in periodic inventory analyses. For this reason, a conversion table of facility types was needed, with the weighting of each of the three PM₁₀ plan categories to the categories used in the particulate matter periodic inventory. VMT estimates by silt loading category including this weighting may be found in Table 5.2–3.

Table 5.2–3. VMT by silt loading category (percent of VMT in each silt loading category).

HPMS facility type	Silt Loading Category			Total
	0.02 g/m ²	0.067 g/m ²	0.23 g/m ²	
Interstate / Freeway	93.7%	5.4%	0.9%	100%
Principal Arterial / Minor Arterial	1.7%	85.0%	13.3%	100%
Collector	0.0%	40.2%	59.8%	100%
Local	0.0%	0.0%	100.0%	100%

Although HPMS reports vehicle mix data for urban and rural areas of Arizona, there are insufficient classification stations in the Phoenix urbanized area to justify use of this information in calculating VMT by vehicle class. In addition, the HPMS vehicle class data do not discriminate between gas and diesel vehicles. Therefore, MOBILE6.2 model defaults, representing the fraction of total VMT for each vehicle class, were applied to VMT estimates for each facility type and area type.

The MAG Serious Area PM₁₀ Plan groups paved roads into three silt loading categories: freeways, high ADT non-freeways (greater than 5,000 ADT), and low ADT non-freeways (less than 5,000 ADT). These silt loading categories do not correspond on a one to one basis with the paved roadway types considered in the HPMS report. As a result, the table shown above was developed by MAG to indicate how the PM₁₀ plan silt loading categories correspond to the four roadway classifications included in the periodic inventory.

All local roadways are assumed to be in the Low ADT non-freeways (0.23 grams per square meter) category. All roadway links identified in the MAG transportation modeling network as 6 legged arterials are assumed to have “freeway” silt loading (0.02 grams per square meter).

The 0.02 grams per square meter silt loading category is the silt loading assumed in the MAG PM₁₀ plan for roadway links identified as freeways in the MAG transportation modeling networks. The PART5 model and AP-42 equations identify these roadways as having a PM₁₀ reentrained dust factor of 0.16 gram per vehicle mile of travel (VMT) and a PM_{2.5} factor of zero grams per mile.

The 0.067 grams per square meter silt loading category is the silt loading assumed in the MAG PM₁₀ plan for roadway links identified as non-freeways in the MAG transportation modeling networks with average daily traffic of greater than 5,000 vehicles. The PART5 model and AP-42 equations identify these roadways as having a PM₁₀ reentrained dust factor of 0.60 gram per vehicle mile of travel (VMT) and a PM_{2.5} factor of 0.04 grams per mile.

The 0.23 grams per square meter silt loading category is the silt loading assumed in the MAG PM₁₀ plan for roadway links identified as non-freeways in the MAG transportation modeling networks with average daily traffic of less than 5,000 vehicles. The PART5 model and AP-42

equations identify these roadways as having a PM₁₀ reentrained dust factor of 1.59 gram per vehicle mile of travel (VMT) and a PM_{2.5} factor of 0.28 grams per mile.

5.3 Speed estimation procedure

MAG prepared the average daily speeds for the onroad mobile sources portion of the 2002 periodic particulate matter emissions inventory. The average daily speeds were developed from several sources representing the latest planning assumptions for 2002. Vehicle speeds have no effect on the emission factors modeled in the MOBILE6.2 program for the pollutants carbonaceous particulate matter, reentrained dust from paved roads, brake wear, tire wear, ammonia (NH₃) and have only a very slight effect on the pollutants SO₄ and SO₂. Speeds do have significant effect on estimated NO_x emissions which are also included in this inventory. Speeds also have a significant effect on re-entrained dust from unpaved roads, but it is assumed that the vehicle speeds on unpaved roads are 20 miles per hour for all aspects of this inventory. Paved road speed estimates are indicated in Table 5.3–1. Vehicle speeds are not assumed to vary by month.

For the Interstate/Freeway category and for the Principal/Minor Arterial category, the speeds were developed using data in the February 11, 2004 draft report 2002-2003 MAG Regional Travel Time & Travel Speed Study. This report contained data for the functional classifications “HOV”, “Freeway”, “Expressway”, “6 Leg Arterial”, and “Major Arterial”. Speeds for the first three categories were combined through a weighted average to develop the average speed for the Interstate/Freeway category used in the Periodic Inventory. Similarly, the two arterial categories contained in the speed study were combined through a weighted averaging to obtain a Principal Arterial/Minor Arterial category speed. In both of these categories, speeds were unique by area type.

The third facility type included in the periodic inventory is collectors. To develop speed estimates for this facility type, speeds were extracted from the latest 2002 travel demand model run created using the EMME/2 software. In the EMME/2 runs performed by MAG, some traffic links that are classified as “locals” would actually be classified as “collectors” by HPMS. The EMME/2 runs also contain artificial links that are categorized as locals. Since the HPMS collector category includes some EMME/2 collector links and some EMME/2 locals, the EMME/2 speeds for locals and collectors were averaged and the result was used for the HPMS category of collectors. Like the speeds for the Interstate/Freeway and Principal/Minor Arterials categories, the speeds for Collectors were calculated separately for each of the five area types.

The fourth of the HPMS facility types is local roadways. The MOBILE6.2 model assumes a set speed of 12.9 miles per hour for local roadways. This speed was incorporated into the current analysis for all local roadways, regardless of area type.

Table 5.3–1. Average daily speeds (mph) for the 2002 periodic emissions inventory.

Facility type:	Area Type *				
	1	2	3	4	5
Interstate / Freeway	59.7	60.3	63.2	64.8	64.2
Principal Arterial / Minor Arterial	30.3	34.4	36.1	39.0	42.6
Collector	18.2	19.1	24.4	24.7	28.2
Local	12.9	12.9	12.9	12.9	12.9

* For the definition of “Area Type”, see Table 5.2–1, Note 1.

5.4 Monthly VMT factors

In this inventory, the emission factor estimates for NO_x were estimated independently for each month, with month-specific meteorological and fuel data. Since average daily VMT varies by month, and the number of days in each month varies, these monthly average emission factors were weighted to more appropriately represent an annual average emission factor.

Average daily VMT estimate factors were developed from the 1998 MAG Regional Congestion Study and the monthly factors are as follows:

Table 5.4-1. Average daily VMT estimate factors by month.

Month	Avg daily VMT estimate factor	Month	Avg daily VMT estimate factor
January	0.98	July	0.94
February	1.03	August	0.96
March	1.03	September	0.99
April	1.03	October	1.02
May	0.99	November	1.02
June	0.98	December	1.04

These factors indicate, as an example, that an average day in February has three percent more traffic than an average month while an average day in June has two percent less traffic than average. Separately, the different number of days in a month will effect the weighting of monthly emission factors to an annual average. For instance, if each month had the same number of days, each monthly emission factor would be equally weighted by 1/12 (0.0833). Since each month does not have the same number of days, the monthly emission factors are weighted accordingly, with January being weighted 31/365 (0.0849), February being weighted 28/365 (0.0767), etc. Combining the two sets of adjustments, the February emission factors would be weighted by 1.03 * 0.0767 in the development of the annual emission factors.

These weightings are applied by the FORTRAN program “NEIProgram”, which was created by MAG. NEIProgram reads in the individual MOBILE6.2 output files for all twelve months and for the I/M versus non-I/M scenarios. NEIProgram weighs those 24 sets of MOBILE6.2 output files to a single set of annual average emission factors. The complete source code for NEIProgram may be found in Appendix 5.6.

This weighting is not needed for the calculation of PM₁₀, PM_{2.5}, SO_x, and NH₃ emissions because those pollutants are not affected by meteorological conditions and fuel settings the same way as NO_x. For those pollutants, a single MOBILE6.2 run was used to develop annual average emission factors.

5.5 Emission factor estimation procedure

5.5.1 Emission factor model

PM₁₀, PM_{2.5}, SO₂, NH₃, and oxides of nitrogen (NO_x) vehicle exhaust emission factors were calculated using MOBILE6.2. The PM₁₀ and PM_{2.5} non-exhaust components of tire wear and brake wear were also estimated using MOBILE6.2. The PM₁₀ and PM_{2.5} estimates include the components lead, elemental carbon from diesel exhaust, organic carbon from diesel exhaust, sulfate portion, and carbon portion of gasoline exhaust. Reentrained dust emission factors were developed using equations found in the EPA AP-42 emission factor database and the EPA PART5 model. AP-42 is the common name for the EPA Compilation of Air Pollutant Emission Factors. MOBILE6.2 is the latest version in a series of models developed by the US EPA for the purpose of estimating motor vehicle emission factors. The MOBILE6.2 runs were executed by the Maricopa Association of Governments. The contact person for the MOBILE6.2 emission estimates is Roger Roy (602-254-6300).

While most types of emission factors (exhaust, evaporative, tire wear, etc) were calculated using the EPA MOBILE6.2 model, fugitive dust from paved and unpaved roads were calculated using equations found in AP-42, Fifth Edition. Specifically, sections 13.2.1 and 13.2.2 describe calculations for fugitive dust from paved and unpaved roads, respectively.

The calculations for paved road fugitive dust emissions are related to silt loading values on road surfaces. Consistent with the Serious Area PM₁₀ Plan, paved roads were split into three silt loading levels; freeways at a silt loading of 0.02 grams per square meter, high ADT non-freeways at 0.067 grams per square meter, and low ADT non-freeways at 0.23 grams per square meter. All local roadways were assumed to fall into the low ADT non-freeway category. All roadway links categorized as 6 legged arterials (portions of Grand Avenue) were assumed to be in the high ADT non-freeway category. These silt loading estimates are consistent with the raw silt loading estimates from the serious area PM₁₀ plan, and resulted in raw emission factors as follows; freeways 0.16 grams per VMT, high ADT non-freeways at 0.60 grams per VMT, and low ADT non-freeways at 1.59 grams per VMT. These factors were further adjusted to take into account the reduced road silt loading resulting from continuing PM₁₀ efficient street sweeper purchases, consistent with the Serious Area PM₁₀ Plan. This resulted in emission factors on freeways of 0.157 grams per VMT, high ADT non-freeways at 0.596 grams per VMT, and low ADT non-freeways at 1.586 grams per VMT.

The percent of each HPMS roadway category (weighted on a VMT basis) in each silt loading category may be found in Table 5.2–3. The net paved road fugitive dust emission factors, after VMT weighting, for each of the HPMS categories are 0.19 grams per mile for Interstate/Freeway/Expressway, 0.72 grams per mile for Principal and Minor Arterials, 1.19 grams per mile for Collectors, and 1.59 grams per mile for Locals. For PM_{2.5}, those factors are 0.00, 0.07, 0.18, and 0.28 grams per mile, respectively. Combining these emission factors with the VMT estimates in Tables 5.2–1 and 5.2–2 results in the emission totals shown in Table 5.5–1.

For unpaved roads, emission factors were derived from the latest AP-42 equation. Consistent with the Serious Area PM₁₀ plan, the fugitive dust PM₁₀ emission factor from unpaved roads is 573.91 grams per vehicle mile. The PM_{2.5} emission factor is 85.95 grams per vehicle mile. The equation to calculate unpaved road fugitive dust emissions may be found at the web site <http://www.epa.gov/ttn/chief/ap42/ch13/final/c13s0202.pdf>. Combining these emission factors

with the VMT estimates from the Serious Area PM₁₀ Plan results in the emissions totals shown in Table 5.5–2. The Serious Area PM₁₀ Plan included estimates of unpaved road VMT estimates for the PM₁₀ nonattainment area. In order to grow these VMT estimates to reflect all of Maricopa County, the ratio of estimated Local VMT in the nonattainment area versus Maricopa County (a ratio of 1.046) was used, as derived from Tables 5.2–1 and 5.2–2. The equation and input values assumed in the modeling of the emission factors for unpaved roads may be found in Appendix 5.2.

The emission factors not related to fugitive dust were calculated using MOBILE6.2. Two MOBILE6.2 runs were executed for an annual average day (24-hour period) reflecting vehicles registered locally (subject to the I/M program) and those not registered locally (not participating in the I/M program). Twenty four MOBILE6.2 runs were executed reflecting each month of the year and the presence or absence of the I/M program. Of the pollutants modeled for this study, the presence or lack of an I/M program only effects the modeled emission factors for NO_x. Refer to Appendix 5.2 for portions of the actual input and output files.

The emission factors estimated with these runs were combined to reflect the actual proportions of vehicles subject to the specified levels of inspection. The term “I/M vehicles” denotes vehicles which are required to undergo an emission test and/or inspection under the Arizona Vehicle Inspection/Maintenance Program. It is important to note that participation in the I/M program is required for all vehicles registered in the nonattainment area, with the exception of certain model year and vehicle types. However, it is assumed that of the vehicles which are of an age and type subject to an I/M program, only 91.7 percent of the vehicles operating within the nonattainment area participate in the I/M program. The remaining 8.3 percent do not participate in the program. These percentages reflect the implementation of the control measures “Tougher Registration Enforcement” and “Expansion of Area A Boundaries”, described in the Revised MAG 1999 Serious Area Carbon Monoxide Plan for the Maricopa County Nonattainment Area, MAG, March 2001. In the absence of any additional data, this percentage split is assumed to apply directly to VMT as well.

In order to accurately reflect the state of the I/M program in the modeling area, several MOBILE6.2 runs were performed and the emission factors from those runs were weighted together. Refer to Appendix 5.2 for portions of the actual input and output files. The specific model run inputs to the MOBILE6.2 model were are listed and described in the following section.

Table 5.5–1. Paved road fugitive dust emissions.

Facility type	Total VMT by facility type	
	Nonattainment area	Maricopa County
Interstate / Freeway	24,358,000	26,604,000
Principal Arterial / Minor Arterial	30,136,000	30,380,000
Collector	8,020,000	8,732,000
Local	7,518,000	7,863,000
Emission factors by facility type (g/mile)		
	PM₁₀	PM_{2.5}
Interstate / Freeway	0.19	0.00
Principal Arterial / Minor Arterial	0.72	0.07
Collector	1.19	0.18
Local	1.59	0.28
Total emissions (kg/yr)		
	PM₁₀	PM_{2.5}
Nonattainment area	47,823	5,658
Maricopa County	49,822	5,900

Table 5.5–2. Unpaved road fugitive dust emissions.

Facility type	Total VMT by facility type	
	Nonattainment area	Maricopa County
Very low ADT unpaved roads	4,520	4,728
Low ADT unpaved roads	33,914	35,471
High ADT unpaved roads	1,157	1,211
Emission factors by facility type (g/mile)		
	PM₁₀	PM_{2.5}
All unpaved road types	573.91	85.95
Total Emissions (kg/yr)		
	PM₁₀	PM_{2.5}
Nonattainment area	22,722	3,403
Maricopa County	23,765	3,559

5.5.2 Development of MOBILE6.2 model inputs

The inputs to MOBILE6.2 are grouped into three categories: Header inputs, run inputs, and scenario inputs. The input values used in the MOBILE6.2 runs are specified and explained below. Humidity was not used as an input to these runs. After reviewing the MOBILE6.2 guidance on the use of humidity (see page 7 of <http://www.epa.gov/otaq/models/mobile6/m6techgd.pdf>), inputting specific humidity values would be appropriate for the development of an annual average emissions inventory of this type.

For several inputs (mostly fuel and meteorology related), there are separate inputs for an annual analysis versus a monthly analysis. For these inputs, the annual analysis value is listed first, followed by a description of the monthly values.

Header Section

1. **MOBILE6 INPUT FILE:** indicates that the MOBILE6.2 input file is a regular command file rather than a batch file.

2. **PARTICULATES:** indicates that emissions estimates for particulate matter are desired as output from the model.

Run Data Section

1. **NO REFUELING:** indicates that refueling emissions are excluded from the MOBILE6.2 outputs. Refueling emissions are included in the Area Sources chapter of the 2002 ozone precursors inventory.

2. **I/M PROGRAM: 1 1977 2050 1 T/O LOADED IDLE** indicates the program start and end dates, frequency of testing, and test type. There are five components of the I/M program modeled; a loaded idle test for heavy duty gasoline vehicles (shown in the example in Appendix 5.2), a transient idle test (I/M240 modeled as a surrogate for the I/M147 test) for light duty cars and trucks through model year 1995, a loaded idle test for light duty cars and trucks of model years 1967 to 1980, an on-board diagnostic (OBD) exhaust test for model year 1996 and newer vehicles, and an OBD evaporative test for the same vehicles. The remaining four occurrences of this command are as follows:

I/M PROGRAM: 2 1977 2050 2 T/O IM240 - relating to the transient idle I/M240 program modeled as a surrogate for the I/M147 program.

I/M PROGRAM: 3 1977 2050 1 T/O LOADED IDLE - relating to the loaded idle program for model year 1967-1980 light duty cars and trucks.

I/M PROGRAM: 4 2001 2050 2 T/O OBD I/M - relating to the exhaust portion of the OBD test.

I/M PROGRAM: 5 2001 2050 2 T/O EVAP OBD & GC - relating to the evaporative and gas cap portion of the OBD test.

3. **I/M MODEL YEARS: 1 1967 2050** indicates the first and last model years affected by the given component of the I/M program. The inputs shown above indicate that model years 1967 and newer are tested by component 1 of the I/M program. The remaining four occurrences of this command are as follows:

I/M MODEL YEARS: 2 1981 1995 -relating to the transient idle I/M240 program modeled as a surrogate for the I/M147 program.

I/M MODEL YEARS: 3 1967 1980 -relating to the loaded idle program for model year 1967-1980 light duty cars and trucks.

I/M MODEL YEARS: 4 1996 2050 -relating to the exhaust portion of the OBD test.

I/M MODEL YEARS: 5 1996 2050 -relating to the evaporative and gas cap portion of the OBD test.

4. **I/M VEHICLES: 1 11111 22222222 2** indicates that for the first component of the I/M program (1), the five vehicle categories LDGV, LDGT1, LDGT2, LDGT3, and LDGT4

are not subject to this portion of the I/M program (indicated by “1”) while HDGV2B, HDGV3, HDGV4, HDGV5, HDGV6, HDGV7, HDGV8A, HDGV8B, and gasoline buses are covered (indicated by “2”). The remaining four occurrences of this command are all identical and are as follows:

I/M VEHICLES: 2 22222 11111111 1 indicates that the remaining eligible vehicle classes are subject to the transient idle I/M240 program modeled as a surrogate for the I/M147 program. This selection of vehicle classes is also applied to the remaining three portions of the I/M program.

5. **I/M STRINGENCY: 1 28.0** indicates that the initial test failure rate for pre-1981 LDGVs and pre-1984 LDGTs is 28.0 percent. This stringency rate is also applied to the remaining portions of the I/M program.
6. **I/M COMPLIANCE: 1 97.0** indicates that the fraction of the total vehicle fleet subject to the I/M program that passes the I/M test or receives a waiver is 97.0 percent. This compliance rate is also applied to the remaining portion of the I/M program.
7. **I/M WAIVER RATES: 1 1.3 1.0** indicates that the fraction of vehicles that fail the I/M program is 1.3 for pre-1981 model years and 1.0 percent for 1981 and later model years. These waiver rates are also applied to the remaining portion of the I/M program.
8. **I/M GRACE PERIOD: 1 5** indicates that vehicles less than 5 years old are exempted from the I/M program. This exemption is identical for all portions of the I/M program.
9. **I/M CUTPOINTS: 2 CUTcmp02.d** indicates that MOBILE6.2 reads the external data file “CUTcmp02.d” for the I/M cutpoint values for HC, CO, and NOX. There are 25 values for each vehicle class and pollutant, for the most recent 25 model years, starting with the youngest vehicle. This data is only input for the I/M240 program. The file CUTcmp03.d was used for the October through December 2002 analyses as these are closer to a January 2003 scenario than a July 2002 scenario.
10. **ANTI-TAMP PROGRAM : 87 75 80 22222 22222222 2 11 097. 22111222** indicates the nature of the anti-tampering program. Specifically, this portion of the anti-tampering program began in 1987 and covers model year vehicles 1975 to 1980. Vehicle classes subject to the inspection (indicated by a “2”) include LDGV, LDGT1, LDGT2, LDGT3, LDGT4, HDGV2B, HDGV3, HDGV4, HDGV5, HDGV6, HDGV7, HDGV8A, HDGV8B, and gasoline powered buses. The test is performed annually. The test has a 97 percent compliance rate. The parameters tested include air pump disablement, catalyst removal, evaporative system disablement, PCV system disablement, and missing gas cap. The parameters not tested are fuel inlet restrictor disablement, tailpipe lead deposit test, and EGR disablement. A second data line indicates that the same test is also performed on model year 1981 to 1995 vehicles, but with the LDGV, LDGT1, LDGT2, LDGT3, and LDGT4 classes omitted because those vehicles are subject to the transient I/M or OBD test.
11. **REG DIST: 02reg02.d** indicates that vehicle registration distributions by age for the 16 composite vehicle types are read by MOBILE6.2 from an external data file, called

02reg02.d. The raw data upon which the registration distributions and diesel fractions are based may be found in Appendix 5.3. The file 02reg03.d was used for the months October through December as these months are closer to a January 2003 scenario than a July 2002 scenario.

- 12 DIESEL FRACTIONS:** indicates the user-supplied diesel sales fractions. This input is followed by 350 fractional values representing the fraction of the 14 vehicle classes internally examined by MOBILE6.2 and 25 most recent model years that are diesel vehicles. As an example, the first value, 0.0050, indicates that for the most recent model year of light duty vehicles, 0.5 percent of the vehicles sold are diesel.

Scenario Section

- 1. SCENARIO RECORD:** Allows the user to enter a name to identify the scenario being run.
- 2. PARTICULATE EF:** Indicates that the EPA default files provided for base particulate emission factors were used.
- 3. PARTICULATE SIZE: 10.0** indicates that the emission factors are desired for particulate matter of 10 micrometers and smaller. Particulate matter emitted with particle sizes larger than this were ignored. Particulate matter of sizes 2.5 micrometers and smaller were also examined.
- 4. DIESEL SULFUR: 310.0** indicates that average diesel fuel sulfur content for the modeled scenario is 310 parts per million. This estimate is the onroad fuel sulfur levels used by the Western Regional Air Partnership for a 2002 analysis.
- 5. CALENDAR YEAR: 2002** was input for the annual average day analysis. For the months of January through September 2002, the calendar year 2002 was also chosen. For the months of October through December, the calendar year 2003 was chosen because a January 2003 scenario more closely matches those months than a January 2002 scenario.
- 6. EVALUATION MONTH: 7** indicates that the month modeled was July. The months April through September were run with this setting while the remaining months, January through March and October through December, were processed with the evaluation month set to January. January and July are the only settings allowed for the evaluation month.
- 7. ALTITUDE:1** indicates the geographic area modeled was low altitude.
- 8. MIN/MAX TEMPERATURE: 64. 88.** provides the model with the daily minimum and maximum temperatures for the average annual day modeled. Of the pollutants modeled in this report, the temperatures input to the model only effect the modeled emission factors for NOX. For the monthly analyses used to estimate NOX emissions, temperatures were derived from the appropriate Sky Harbor Airport Local Climatological Data (LCD) reports. Meteorological data used in this analysis may be found in Appendix 5.4.

9. **AVERAGE SPEED: (area/facility type specific)** indicates to MOBILE6.2 the average speed to be modeled for each facility type and area type combination. All facility and area type combinations with unique speeds will be modeled in this manner. Please see Table 5.3–1 for the speeds modeled for each roadway type combination.
10. **VMT BY FACILITY: allfwy.def** indicates to MOBILE6.2 that the external file allfwy.def is to be referenced for the ratio of VMT by hour by facility type. The file allfwy indicates that all VMT is occurring on the MOBILE6.2 facility type freeways for use in developing the emission factors for the periodic inventory functional classifications Interstates/Freeways/Expressways. Similarly, the external file allart.def is called when estimating the emission factors for the arterials or collectors, and allloc.def is called when estimating the emission factors for the periodic inventory category locals.
11. **FUEL RVP: 7.8** indicates that the average Reid Vapor Pressure of the gasoline sold during this time period is 7.8 pounds per square inch. This estimate is based upon raw gasoline data provided by the Arizona Department of Weights and Measures. Specifically, this value represents the average RVP of 793 samples collected in 2002. Monthly RVP estimates were derived from the Arizona Department of Weights and Measures data table for use in the monthly MOBILE6.2 analyses incorporated into this analysis. Monthly fuel qualities, including RVP, sulfur content, and ethanol content, are summarized in Appendix 5.7.
12. **FUEL PROGRAM: 4** Indicates that the model is to be run with user-supplied gasoline sulfur levels. The following four lines include 32 numbers, the first 16 listing the average gasoline sulfur value in parts per million for the years 2000 through 2015 and the second 16 indicate the maximum gasoline sulfur content vehicles of model year 2000 through 2015 will be exposed. For the purposes of this analysis, the gasoline data from 2002 were examined and the average sampled sulfur values during that time period were entered for all time periods. Similarly, the gasoline data for all of 2002 was examined and the maximum sulfur value during that time period was entered for each model year of 2000 through 2015. Those values were 52.5 for average sulfur content and 338.0 ppm for a maximum sulfur content. For the monthly MOBILE6.2 analyses incorporated into this analysis, the average monthly sulfur content from the Arizona Department of Weights and Measures data table were used for the average sulfur value while the 338.0 ppm estimate was used for each month as the maximum sulfur content.
13. **OXYGENATED FUELS: 0.500 0.500 0.019 0.031 1** indicates that the 50 percent of the gasoline sold during the time period modeled used MTBE as an oxygenate and 50 percent of the gasoline used ethanol as an oxygenate. The average MTBE content was 1.9 percent by weight and the average ethanol content was 3.1 percent by weight. The number “1” indicates that no RVP waiver has been granted to allow for the “splash” blending of ethanol oxygenates. Since the Arizona Department of Weights and Measures did not collect oxygenate data for the first three months of 2002, this estimate was based upon the average of the gasolines used in the periodic ozone (summer season) and periodic carbon monoxide (winter season) inventories. For the monthly MOBILE6.2 analyses incorporated into this analysis, the average monthly oxygenate content from the Arizona Department of Weights and Measures data table were used, with the exception of

January through March 2003. For those months, an average of the months November and December were used.

5.5.3 Model outputs

MOBILE6.2 was executed with the inputs described above to obtain composite emission factors in grams per mile (g/mi) for exhaust PM₁₀, PM_{2.5}, NO_x, SO₂, and NH₃. These values were obtained for the eight vehicle classes described in section 5.1 for the various speeds as described in item 6 of the Scenario section. The emission factors generated for the 2002 ozone season are presented in the following section. Representative output runs are contained in Appendix 5.2. These values were then used in developing emission estimates.

5.5.4 Summary of emission factors

Refer to Tables 5.5–1 through 5.5–10 for the emission factors developed for each vehicle class, facility, and area type.

5.5.5 Emission estimates

MOBILE6.2 was used to generate emission factors for vehicle class, facility, and area type. Daily VMT (DVMT) for an annual average day (Tables 5.2–1 and 5.2–2) was then multiplied by the VMT mix by vehicle class and the appropriate onroad emission factor to calculate onroad emission estimates on a kilogram per day (kg/day) basis. VMT mix refers to the fraction of total onroad vehicle miles of travel from a particular vehicle type. For example, since the EPA MOBILE6.2 model estimates that 45.1 percent of onroad VMT was from light duty gasoline vehicles, the VMT Mix value for LDGVs is 0.451. An example calculation for ammonia is given below, reflecting light duty gasoline vehicles on interstates, freeways, and expressways in area type 1 (see Table 5-4J):

$$\begin{aligned}
 \text{NH}_3 \text{ emissions} &= \text{DMVT} \times \text{VMT mix} \times \text{VOC emission factor} \div \text{unit conversion factor} \\
 (\text{kg/day}) & & & (\text{g/mi}) & & (\text{g/kg}) \\
 &= 1,129,051 \times 0.451 \times 0.1002 \div 1,000 \\
 &= 51 \text{ kg NH}_3/\text{day}
 \end{aligned}$$

$$\begin{aligned}
 \text{NH}_3 \text{ emissions} &= \text{NH}_3 \text{ emissions} \div \text{unit conversion factor} \\
 (\text{lb/day}) & & (\text{kg/day}) & & (\text{kg/lb}) \\
 &= 51 \text{ kg} \div 0.4536 \\
 &= 112 \text{ lb NH}_3/\text{day}
 \end{aligned}$$

Tables 5.5–3 through 5.5–7 show daily VMT data, associated speed estimates, MOBILE6.2 emission factors, and the calculated PM₁₀, PM_{2.5}, NO_x, SO₂, and NH₃ emissions for each vehicle class, facility, and area type for the PM₁₀ nonattainment area. Similarly, Tables 5.5–8 through 5.5–12 show daily VMT data, associated speed estimates, MOBILE6.2 emission factors, and the calculated PM₁₀, PM_{2.5}, NO_x, SO₂, and NH₃ emissions for each vehicle class, facility, and area type for all of Maricopa County.

Calculations for and brake wear, tire wear were much simpler and involved the multiplication of the total VMT for the area examined by a single emission factor that does not vary by facility type, vehicle type, or speed. For brake wear, the emission factor is 0.0125 grams per mile of PM₁₀ and 0.0053 grams per mile of PM_{2.5}. For tire wear, the emission factor is 0.0097 grams per mile of PM₁₀ and 0.0024 grams per mile of PM_{2.5}.

Table 5.5-3. Daily PM₁₀ emissions in the PM₁₀ nonattainment area by facility type, vehicle class and area type (excludes fugitive dust).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
INTERSTATE, FREEWAY, and EXPRESSWAY	LDGV with VMT mix of 45.1%	1	59.7	0.0050	1,129,051	5.6	2.5
		2	60.3	0.0050	9,046,583	45.0	20.4
		3	63.2	0.0050	6,240,489	31.0	14.1
		4	64.8	0.0050	4,525,653	22.5	10.2
		5	64.2	0.0050	3,416,224	17.0	7.7
	LDGT1 with VMT mix of 28.2%	1	59.7	0.0061	1,129,051	4.3	1.9
		2	60.3	0.0061	9,046,583	34.3	15.6
		3	63.2	0.0061	6,240,489	23.7	10.7
		4	64.8	0.0061	4,525,653	17.2	7.8
		5	64.2	0.0061	3,416,224	13.0	5.9
	LDGT2 with VMT mix of 11.2%	1	59.7	0.0107	1,129,051	3.0	1.3
		2	60.3	0.0107	9,046,583	23.8	10.8
		3	63.2	0.0107	6,240,489	16.4	7.5
		4	64.8	0.0107	4,525,653	11.9	5.4
		5	64.2	0.0107	3,416,224	9.0	4.1
	HDGV with VMT mix of 3.6%	1	59.7	0.0673	1,129,051	6.0	2.7
		2	60.3	0.0673	9,046,583	47.8	21.7
		3	63.2	0.0673	6,240,489	33.0	14.9
		4	64.8	0.0673	4,525,653	23.9	10.8
		5	64.2	0.0673	3,416,224	18.0	8.2
LDDV with VMT mix of 0.2%	1	59.7	0.1700	1,129,051	0.9	0.4	
	2	60.3	0.1700	9,046,583	7.5	3.4	
	3	63.2	0.1700	6,240,489	5.1	2.3	
	4	64.8	0.1700	4,525,653	3.7	1.7	
	5	64.2	0.1700	3,416,224	2.8	1.3	
LDDT with VMT mix of 2.2%	1	59.7	0.1256	1,129,051	6.8	3.1	
	2	60.3	0.1256	9,046,583	54.1	24.5	
	3	63.2	0.1256	6,240,489	37.3	16.9	
	4	64.8	0.1256	4,525,653	27.1	12.3	
	5	64.2	0.1256	3,416,224	20.4	9.3	
HDDV with VMT mix of 9.1%	1	59.7	0.3597	1,129,051	81.4	36.9	
	2	60.3	0.3597	9,046,583	652.0	295.8	
	3	63.2	0.3597	6,240,489	449.8	204.0	
	4	64.8	0.3597	4,525,653	326.2	148.0	
	5	64.2	0.3597	3,416,224	246.2	111.7	
MC with VMT mix of 0.5%	1	59.7	0.0206	1,129,051	0.3	0.1	
	2	60.3	0.0206	9,046,583	2.1	1.0	
	3	63.2	0.0206	6,240,489	1.4	0.7	
	4	64.8	0.0206	4,525,653	1.0	0.5	
	5	64.2	0.0206	3,416,224	0.8	0.4	

Table 5.5-3. Daily PM₁₀ emissions in the PM₁₀ nonattainment area by facility type, vehicle class and area type (excludes fugitive dust) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
		1	30.3	0.0051	1,087,462	5.5	2.5
PRINCIPAL	LDGV	2	34.4	0.0050	8,834,531	43.9	19.9
ARTERIAL	with VMT	3	36.1	0.0050	9,795,953	48.7	22.1
&	mix of	4	39.0	0.0050	6,923,412	34.4	15.6
MINOR	45.1%	5	42.6	0.0050	3,494,642	17.4	7.9
ARTERIAL		1	30.3	0.0062	1,087,462	4.2	1.9
	LDGT1	2	34.4	0.0061	8,834,531	33.5	15.2
	with VMT	3	36.1	0.0061	9,795,953	37.2	16.9
	mix of	4	39.0	0.0061	6,923,412	26.3	11.9
	28.2%	5	42.6	0.0061	3,494,642	13.3	6.0
		1	30.3	0.0108	1,087,462	2.9	1.3
	LDGT2	2	34.4	0.0107	8,834,531	23.3	10.5
	with VMT	3	36.1	0.0107	9,795,953	25.8	11.7
	mix of	4	39.0	0.0107	6,923,412	18.2	8.3
	11.2%	5	42.6	0.0107	3,494,642	9.2	4.2
		1	30.3	0.0673	1,087,462	5.7	2.6
	HDGV	2	34.4	0.0673	8,834,531	46.7	21.2
	with VMT	3	36.1	0.0673	9,795,953	51.7	23.5
	mix of	4	39.0	0.0673	6,923,412	36.6	16.6
	3.6%	5	42.6	0.0673	3,494,642	18.5	8.4
		1	30.3	0.1700	1,087,462	0.9	0.4
	LDDV	2	34.4	0.1700	8,834,531	7.3	3.3
	with VMT	3	36.1	0.1700	9,795,953	8.1	3.7
	mix of	4	39.0	0.1700	6,923,412	5.7	2.6
	0.2%	5	42.6	0.1700	3,494,642	2.9	1.3
		1	30.3	0.1256	1,087,462	6.5	2.9
	LDDT	2	34.4	0.1256	8,834,531	52.8	24.0
	with VMT	3	36.1	0.1256	9,795,953	58.6	26.6
	mix of	4	39.0	0.1256	6,923,412	41.4	18.8
	2.2%	5	42.6	0.1256	3,494,642	20.9	9.5
		1	30.3	0.3597	1,087,462	78.4	35.6
	HDDV	2	34.4	0.3597	8,834,531	636.8	288.8
	with VMT	3	36.1	0.3597	9,795,953	706.0	320.3
	mix of	4	39.0	0.3597	6,923,412	499.0	226.4
	9.1%	5	42.6	0.3597	3,494,642	251.9	114.3
		1	30.3	0.0207	1,087,462	0.3	0.1
	MC	2	34.4	0.0206	8,834,531	2.0	0.9
	with VMT	3	36.1	0.0206	9,795,953	2.3	1.0
	mix of	4	39.0	0.0206	6,923,412	1.6	0.7
	0.5%	5	42.6	0.0206	3,494,642	0.8	0.4

Table 5.5–3. Daily PM₁₀ emissions in the PM₁₀ nonattainment area by facility type, vehicle class and area type (excludes fugitive dust) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
COLLECTOR		1	18.2	0.0054	1,046,993	5.6	2.5
	LDGV	2	19.1	0.0054	2,727,290	14.6	6.6
	with VMT	3	24.4	0.0053	1,694,159	8.9	4.0
	mix of	4	24.7	0.0053	872,616	4.6	2.1
	45.1%	5	28.2	0.0052	1,678,942	8.7	3.9
		1	18.2	0.0063	1,046,993	4.1	1.9
	LDGT1	2	19.1	0.0063	2,727,290	10.7	4.8
	with VMT	3	24.4	0.0063	1,694,159	6.6	3.0
	mix of	4	24.7	0.0063	872,616	3.4	1.6
	28.2%	5	28.2	0.0062	1,678,942	6.5	2.9
		1	18.2	0.0109	1,046,993	2.8	1.3
	LDGT2	2	19.1	0.0109	2,727,290	7.3	3.3
	with VMT	3	24.4	0.0108	1,694,159	4.5	2.0
	mix of	4	24.7	0.0108	872,616	2.3	1.1
	11.2%	5	28.2	0.0108	1,678,942	4.5	2.0
		1	18.2	0.0671	1,046,993	5.5	2.5
	HDGV	2	19.1	0.0671	2,727,290	14.4	6.5
	with VMT	3	24.4	0.0672	1,694,159	8.9	4.1
	mix of	4	24.7	0.0672	872,616	4.6	2.1
	3.6%	5	28.2	0.0672	1,678,942	8.9	4.0
		1	18.2	0.1700	1,046,993	0.9	0.4
	LDDV	2	19.1	0.1700	2,727,290	2.2	1.0
	with VMT	3	24.4	0.1700	1,694,159	1.4	0.6
	mix of	4	24.7	0.1700	872,616	0.7	0.3
	0.2%	5	28.2	0.1700	1,678,942	1.4	0.6
	1	18.2	0.1256	1,046,993	6.3	2.8	
LDDT	2	19.1	0.1256	2,727,290	16.3	7.4	
with VMT	3	24.4	0.1256	1,694,159	10.1	4.6	
mix of	4	24.7	0.1256	872,616	5.2	2.4	
2.2%	5	28.2	0.1256	1,678,942	10.0	4.6	
	1	18.2	0.3597	1,046,993	75.5	34.2	
HDDV	2	19.1	0.3597	2,727,290	196.6	89.2	
with VMT	3	24.4	0.3597	1,694,159	122.1	55.4	
mix of	4	24.7	0.3597	872,616	62.9	28.5	
9.1%	5	28.2	0.3597	1,678,942	121.0	54.9	
	1	18.2	0.0208	1,046,993	0.2	0.1	
MC	2	19.1	0.0208	2,727,290	0.6	0.3	
with VMT	3	24.4	0.0207	1,694,159	0.4	0.2	
mix of	4	24.7	0.0207	872,616	0.2	0.1	
0.5%	5	28.2	0.0207	1,678,942	0.4	0.2	

Table 5.5–3. Daily PM₁₀ emissions in the PM₁₀ nonattainment area by facility type, vehicle class and area type (excludes fugitive dust) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
LOCAL		1	12.9	0.0054	195,247	1.0	0.5
	LDGV	2	12.9	0.0054	1,991,136	10.7	4.8
	with VMT	3	12.9	0.0054	2,564,545	13.8	6.2
	mix of	4	12.9	0.0054	1,689,510	9.1	4.1
	45.1%	5	12.9	0.0054	1,077,562	5.8	2.6
		1	12.9	0.0063	195,247	0.8	0.3
	LDGT1	2	12.9	0.0063	1,991,136	7.8	3.5
	with VMT	3	12.9	0.0063	2,564,545	10.1	4.6
	mix of	4	12.9	0.0063	1,689,510	6.6	3.0
	28.2%	5	12.9	0.0063	1,077,562	4.2	1.9
		1	12.9	0.0109	195,247	0.5	0.2
	LDGT2	2	12.9	0.0109	1,991,136	5.3	2.4
	with VMT	3	12.9	0.0109	2,564,545	6.9	3.1
	mix of	4	12.9	0.0109	1,689,510	4.5	2.1
	11.2%	5	12.9	0.0109	1,077,562	2.9	1.3
		1	12.9	0.0671	195,247	1.0	0.5
	HDGV	2	12.9	0.0671	1,991,136	10.5	4.8
	with VMT	3	12.9	0.0671	2,564,545	13.5	6.1
	mix of	4	12.9	0.0671	1,689,510	8.9	4.0
	3.6%	5	12.9	0.0671	1,077,562	5.7	2.6
		1	12.9	0.1700	195,247	0.2	0.1
	LDDV	2	12.9	0.1700	1,991,136	1.6	0.7
	with VMT	3	12.9	0.1700	2,564,545	2.1	1.0
	mix of	4	12.9	0.1700	1,689,510	1.4	0.6
	0.2%	5	12.9	0.1700	1,077,562	0.9	0.4
	1	12.9	0.1256	195,247	1.2	0.5	
LDDT	2	12.9	0.1256	1,991,136	11.9	5.4	
with VMT	3	12.9	0.1256	2,564,545	15.3	7.0	
mix of	4	12.9	0.1256	1,689,510	10.1	4.6	
2.2%	5	12.9	0.1256	1,077,562	6.4	2.9	
	1	12.9	0.3597	195,247	14.1	6.4	
HDDV	2	12.9	0.3597	1,991,136	143.5	65.1	
with VMT	3	12.9	0.3597	2,564,545	184.8	83.8	
mix of	4	12.9	0.3597	1,689,510	121.8	55.2	
9.1%	5	12.9	0.3597	1,077,562	77.7	35.2	
	1	12.9	0.0208	195,247	0.0	0.0	
MC	2	12.9	0.0208	1,991,136	0.5	0.2	
with VMT	3	12.9	0.0208	2,564,545	0.6	0.3	
mix of	4	12.9	0.0208	1,689,510	0.4	0.2	
0.5%	5	12.9	0.0208	1,077,562	0.3	0.1	

Table 5.5-4. Daily PM_{2.5} emissions in the PM₁₀ nonattainment area by facility type, vehicle class and area type (excludes fugitive dust.

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
INTERSTATE, FREEWAY, and EXPRESSWAY	LDGV with VMT mix of 45.1%	1	59.7	0.0046	1,129,051	5.2	2.3
		2	60.3	0.0046	9,046,583	41.4	18.8
		3	63.2	0.0046	6,240,489	28.5	12.9
		4	64.8	0.0046	4,525,653	20.7	9.4
		5	64.2	0.0046	3,416,224	15.6	7.1
	LDGT1 with VMT mix of 28.2%	1	59.7	0.0056	1,129,051	3.9	1.8
		2	60.3	0.0056	9,046,583	31.5	14.3
		3	63.2	0.0056	6,240,489	21.7	9.9
		4	64.8	0.0056	4,525,653	15.8	7.2
		5	64.2	0.0056	3,416,224	11.9	5.4
LDGT2 with VMT mix of 11.2%	1	59.7	0.0087	1,129,051	2.4	1.1	
	2	60.3	0.0087	9,046,583	19.4	8.8	
	3	63.2	0.0087	6,240,489	13.4	6.1	
	4	64.8	0.0087	4,525,653	9.7	4.4	
	5	64.2	0.0087	3,416,224	7.3	3.3	
HDGV with VMT mix of 3.6%	1	59.7	0.0569	1,129,051	5.0	2.3	
	2	60.3	0.0569	9,046,583	40.4	18.3	
	3	63.2	0.0569	6,240,489	27.9	12.6	
	4	64.8	0.0569	4,525,653	20.2	9.2	
	5	64.2	0.0569	3,416,224	15.3	6.9	
LDDV with VMT mix of 0.2%	1	59.7	0.1567	1,129,051	0.9	0.4	
	2	60.3	0.1567	9,046,583	6.9	3.1	
	3	63.2	0.1567	6,240,489	4.7	2.2	
	4	64.8	0.1567	4,525,653	3.4	1.6	
	5	64.2	0.1567	3,416,224	2.6	1.2	
LDDT with VMT mix of 2.2%	1	59.7	0.1159	1,129,051	6.2	2.8	
	2	60.3	0.1159	9,046,583	49.9	22.6	
	3	63.2	0.1159	6,240,489	34.4	15.6	
	4	64.8	0.1159	4,525,653	25.0	11.3	
	5	64.2	0.1159	3,416,224	18.9	8.6	
HDDV with VMT mix of 9.1%	1	59.7	0.3325	1,129,051	75.2	34.1	
	2	60.3	0.3325	9,046,583	602.7	273.4	
	3	63.2	0.3325	6,240,489	415.8	188.6	
	4	64.8	0.3325	4,525,653	301.5	136.8	
	5	64.2	0.3325	3,416,224	227.6	103.2	
MC with VMT mix of 0.5%	1	59.7	0.0143	1,129,051	0.2	0.1	
	2	60.3	0.0143	9,046,583	1.5	0.7	
	3	63.2	0.0143	6,240,489	1.0	0.5	
	4	64.8	0.0143	4,525,653	0.7	0.3	
	5	64.2	0.0143	3,416,224	0.5	0.2	

Table 5.5-4. Daily PM_{2.5} emissions in the PM₁₀ nonattainment area by facility type, vehicle class and area type (excludes fugitive dust) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
		1	30.3	0.0047	1,087,462	5.1	2.3
PRINCIPAL	LDGV	2	34.4	0.0046	8,834,531	40.4	18.3
ARTERIAL	with VMT	3	36.1	0.0046	9,795,953	44.8	20.3
&	mix of	4	39.0	0.0046	6,923,412	31.7	14.4
MINOR	45.1%	5	42.6	0.0046	3,494,642	16.0	7.2
ARTERIAL		1	30.3	0.0056	1,087,462	3.8	1.7
	LDGT1	2	34.4	0.0056	8,834,531	30.8	14.0
	with VMT	3	36.1	0.0056	9,795,953	34.1	15.5
	mix of	4	39.0	0.0056	6,923,412	24.1	10.9
	28.2%	5	42.6	0.0056	3,494,642	12.2	5.5
		1	30.3	0.0088	1,087,462	2.4	1.1
	LDGT2	2	34.4	0.0087	8,834,531	18.9	8.6
	with VMT	3	36.1	0.0087	9,795,953	21.0	9.5
	mix of	4	39.0	0.0087	6,923,412	14.8	6.7
	11.2%	5	42.6	0.0087	3,494,642	7.5	3.4
		1	30.3	0.0568	1,087,462	4.8	2.2
	HDGV	2	34.4	0.0568	8,834,531	39.4	17.9
	with VMT	3	36.1	0.0569	9,795,953	43.7	19.8
	mix of	4	39.0	0.0569	6,923,412	30.9	14.0
	3.6%	5	42.6	0.0569	3,494,642	15.6	7.1
		1	30.3	0.1567	1,087,462	0.8	0.4
	LDDV	2	34.4	0.1567	8,834,531	6.7	3.0
	with VMT	3	36.1	0.1567	9,795,953	7.4	3.4
	mix of	4	39.0	0.1567	6,923,412	5.3	2.4
	0.2%	5	42.6	0.1567	3,494,642	2.7	1.2
		1	30.3	0.1159	1,087,462	6.0	2.7
	LDDT	2	34.4	0.1159	8,834,531	48.8	22.1
	with VMT	3	36.1	0.1159	9,795,953	54.1	24.5
	mix of	4	39.0	0.1159	6,923,412	38.2	17.3
	2.2%	5	42.6	0.1159	3,494,642	19.3	8.7
		1	30.3	0.3325	1,087,462	72.5	32.9
	HDDV	2	34.4	0.3325	8,834,531	588.6	267.0
	with VMT	3	36.1	0.3325	9,795,953	652.7	296.0
	mix of	4	39.0	0.3325	6,923,412	461.3	209.2
	9.1%	5	42.6	0.3325	3,494,642	232.8	105.6
		1	30.3	0.0144	1,087,462	0.2	0.1
	MC	2	34.4	0.0143	8,834,531	1.4	0.6
	with VMT	3	36.1	0.0143	9,795,953	1.6	0.7
	mix of	4	39.0	0.0143	6,923,412	1.1	0.5
	0.5%	5	42.6	0.0143	3,494,642	0.6	0.3

Table 5.5–4. Daily PM_{2.5} emissions in the PM₁₀ nonattainment area by facility type, vehicle class and area type (excludes fugitive dust) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
COLLECTOR		1	18.2	0.0050	1,046,993	5.2	2.4
	LDGV	2	19.1	0.0050	2,727,290	13.6	6.1
	with VMT	3	24.4	0.0049	1,694,159	8.3	3.7
	mix of	4	24.7	0.0048	872,616	4.2	1.9
	45.1%	5	28.2	0.0048	1,678,942	8.0	3.6
		1	18.2	0.0058	1,046,993	3.8	1.7
	LDGT1	2	19.1	0.0058	2,727,290	9.8	4.5
	with VMT	3	24.4	0.0057	1,694,159	6.0	2.7
	mix of	4	24.7	0.0057	872,616	3.1	1.4
	28.2%	5	28.2	0.0057	1,678,942	6.0	2.7
		1	18.2	0.0089	1,046,993	2.3	1.0
	LDGT2	2	19.1	0.0089	2,727,290	6.0	2.7
	with VMT	3	24.4	0.0089	1,694,159	3.7	1.7
	mix of	4	24.7	0.0089	872,616	1.9	0.9
	11.2%	5	28.2	0.0088	1,678,942	3.6	1.6
		1	18.2	0.0566	1,046,993	4.7	2.1
	HDGV	2	19.1	0.0566	2,727,290	12.1	5.5
	with VMT	3	24.4	0.0567	1,694,159	7.5	3.4
	mix of	4	24.7	0.0567	872,616	3.9	1.8
	3.6%	5	28.2	0.0567	1,678,942	7.5	3.4
		1	18.2	0.1567	1,046,993	0.8	0.4
	LDDV	2	19.1	0.1567	2,727,290	2.1	0.9
	with VMT	3	24.4	0.1567	1,694,159	1.3	0.6
	mix of	4	24.7	0.1567	872,616	0.7	0.3
	0.2%	5	28.2	0.1567	1,678,942	1.3	0.6
	1	18.2	0.1159	1,046,993	5.8	2.6	
LDDT	2	19.1	0.1159	2,727,290	15.1	6.8	
with VMT	3	24.4	0.1159	1,694,159	9.3	4.2	
mix of	4	24.7	0.1159	872,616	4.8	2.2	
2.2%	5	28.2	0.1159	1,678,942	9.3	4.2	
	1	18.2	0.3325	1,046,993	69.8	31.6	
HDDV	2	19.1	0.3325	2,727,290	181.7	82.4	
with VMT	3	24.4	0.3325	1,694,159	112.9	51.2	
mix of	4	24.7	0.3325	872,616	58.1	26.4	
9.1%	5	28.2	0.3325	1,678,942	111.9	50.7	
	1	18.2	0.0145	1,046,993	0.2	0.1	
MC	2	19.1	0.0145	2,727,290	0.4	0.2	
with VMT	3	24.4	0.0144	1,694,159	0.3	0.1	
mix of	4	24.7	0.0144	872,616	0.1	0.1	
0.5%	5	28.2	0.0144	1,678,942	0.3	0.1	

Table 5.5–4. Daily PM_{2.5} emissions in the PM₁₀ nonattainment area by facility type, vehicle class and area type (excludes fugitive dust) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
LOCAL		1	12.9	0.0050	195,247	1.0	0.4
	LDGV	2	12.9	0.0050	1,991,136	9.9	4.5
	with VMT	3	12.9	0.0050	2,564,545	12.7	5.8
	mix of	4	12.9	0.0050	1,689,510	8.4	3.8
	45.1%	5	12.9	0.0050	1,077,562	5.4	2.4
		1	12.9	0.0058	195,247	0.7	0.3
	LDGT1	2	12.9	0.0058	1,991,136	7.2	3.3
	with VMT	3	12.9	0.0058	2,564,545	9.3	4.2
	mix of	4	12.9	0.0058	1,689,510	6.1	2.8
	28.2%	5	12.9	0.0058	1,077,562	3.9	1.8
		1	12.9	0.0089	195,247	0.4	0.2
	LDGT2	2	12.9	0.0089	1,991,136	4.4	2.0
	with VMT	3	12.9	0.0089	2,564,545	5.6	2.5
	mix of	4	12.9	0.0089	1,689,510	3.7	1.7
	11.2%	5	12.9	0.0089	1,077,562	2.4	1.1
		1	12.9	0.0566	195,247	0.9	0.4
	HDTV	2	12.9	0.0566	1,991,136	8.8	4.0
	with VMT	3	12.9	0.0566	2,564,545	11.4	5.2
	mix of	4	12.9	0.0566	1,689,510	7.5	3.4
	3.6%	5	12.9	0.0566	1,077,562	4.8	2.2
	1	12.9	0.1567	195,247	0.1	0.1	
LDDV	2	12.9	0.1567	1,991,136	1.5	0.7	
with VMT	3	12.9	0.1567	2,564,545	1.9	0.9	
mix of	4	12.9	0.1567	1,689,510	1.3	0.6	
0.2%	5	12.9	0.1567	1,077,562	0.8	0.4	
	1	12.9	0.1159	195,247	1.1	0.5	
LDDT	2	12.9	0.1159	1,991,136	11.0	5.0	
with VMT	3	12.9	0.1159	2,564,545	14.2	6.4	
mix of	4	12.9	0.1159	1,689,510	9.3	4.2	
2.2%	5	12.9	0.1159	1,077,562	5.9	2.7	
	1	12.9	0.3325	195,247	13.0	5.9	
HDDV	2	12.9	0.3325	1,991,136	132.7	60.2	
with VMT	3	12.9	0.3325	2,564,545	170.9	77.5	
mix of	4	12.9	0.3325	1,689,510	112.6	51.1	
9.1%	5	12.9	0.3325	1,077,562	71.8	32.6	
	1	12.9	0.0145	195,247	0.0	0.0	
MC	2	12.9	0.0145	1,991,136	0.3	0.1	
with VMT	3	12.9	0.0145	2,564,545	0.4	0.2	
mix of	4	12.9	0.0145	1,689,510	0.3	0.1	
0.5%	5	12.9	0.0145	1,077,562	0.2	0.1	

Table 5.5–5. Daily NO_x emissions in the PM₁₀ nonattainment area by facility type, vehicle class and area type.

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
INTERSTATE, FREEWAY, and EXPRESSWAY	LDGV with VMT mix of 45.1%	1	59.7	0.964	1,129,051	1,082.0	490.8
		2	60.3	0.966	9,046,583	8,686.1	3,940.0
		3	63.2	0.968	6,240,489	6,001.1	2,722.1
		4	64.8	0.968	4,525,653	4,352.1	1,974.1
		5	64.2	0.968	3,416,224	3,285.2	1,490.2
	LDGT1 with VMT mix of 28.2%	1	59.7	1.188	1,129,051	834.6	378.6
		2	60.3	1.191	9,046,583	6,700.8	3,039.5
		3	63.2	1.193	6,240,489	4,630.1	2,100.2
		4	64.8	1.193	4,525,653	3,357.8	1,523.1
		5	64.2	1.193	3,416,224	2,534.7	1,149.7
	LDGT2 with VMT mix of 11.2%	1	59.7	1.486	1,129,051	412.6	187.2
		2	60.3	1.488	9,046,583	3,312.5	1,502.5
		3	63.2	1.490	6,240,489	2,287.9	1,037.8
		4	64.8	1.490	4,525,653	1,659.2	752.6
		5	64.2	1.490	3,416,224	1,252.5	568.1
	HDGV with VMT mix of 3.6%	1	59.7	5.537	1,129,051	490.6	222.5
		2	60.3	5.560	9,046,583	3,947.2	1,790.5
		3	63.2	5.575	6,240,489	2,730.3	1,238.4
		4	64.8	5.575	4,525,653	1,980.0	898.1
		5	64.2	5.575	3,416,224	1,494.6	678.0
LDDV with VMT mix of 0.2%	1	59.7	1.787	1,129,051	9.8	4.4	
	2	60.3	1.832	9,046,583	80.4	36.5	
	3	63.2	1.862	6,240,489	56.4	25.6	
	4	64.8	1.862	4,525,653	40.9	18.5	
	5	64.2	1.862	3,416,224	30.8	14.0	
LDDT with VMT mix of 2.2%	1	59.7	1.180	1,129,051	63.4	28.8	
	2	60.3	1.210	9,046,583	521.2	236.4	
	3	63.2	1.230	6,240,489	365.5	165.8	
	4	64.8	1.230	4,525,653	265.0	120.2	
	5	64.2	1.230	3,416,224	200.1	90.8	
HDDV with VMT mix of 9.1%	1	59.7	23.357	1,129,051	5,284.2	2,396.9	
	2	60.3	23.825	9,046,583	43,187.5	19,589.8	
	3	63.2	24.130	6,240,489	30,173.0	13,686.5	
	4	64.8	24.130	4,525,653	21,881.7	9,925.5	
	5	64.2	24.130	3,416,224	16,517.6	7,492.4	
MC with VMT mix of 0.5%	1	59.7	1.680	1,129,051	21.3	9.7	
	2	60.3	1.699	9,046,583	172.8	78.4	
	3	63.2	1.710	6,240,489	120.0	54.4	
	4	64.8	1.710	4,525,653	87.0	39.5	
	5	64.2	1.710	3,416,224	65.7	29.8	

Table 5.5–5. Daily NO_x emissions in the PM₁₀ nonattainment area by facility type, vehicle class and area type (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
		1	30.3	0.900	1,087,462	972.9	441.3
PRINCIPAL	LDGV	2	34.4	0.883	8,834,531	7,755.4	3,517.9
ARTERIALS	with VMT	3	36.1	0.883	9,795,953	8,600.4	3,901.1
&	mix of	4	39.0	0.884	6,923,412	6,080.5	2,758.1
MINOR	45.1%	5	42.6	0.893	3,494,642	3,101.1	1,406.7
ARTERIALS		1	30.3	1.088	1,087,462	736.1	333.9
	LDGT1	2	34.4	1.076	8,834,531	5,914.5	2,682.8
	with VMT	3	36.1	1.078	9,795,953	6,568.5	2,979.5
	mix of	4	39.0	1.080	6,923,412	4,650.5	2,109.5
	28.2%	5	42.6	1.092	3,494,642	2,374.8	1,077.2
		1	30.3	1.380	1,087,462	369.2	167.5
	LDGT2	2	34.4	1.366	8,834,531	2,969.5	1,346.9
	with VMT	3	36.1	1.368	9,795,953	3,296.2	1,495.2
	mix of	4	39.0	1.369	6,923,412	2,331.2	1,057.4
	11.2%	5	42.6	1.382	3,494,642	1,187.7	538.7
		1	30.3	4.426	1,087,462	377.7	171.3
	HDGV	2	34.4	4.573	8,834,531	3,170.5	1,438.1
	with VMT	3	36.1	4.635	9,795,953	3,563.3	1,616.3
	mix of	4	39.0	4.738	6,923,412	2,574.5	1,167.8
	3.6%	5	42.6	4.868	3,494,642	1,335.1	605.6
		1	30.3	1.005	1,087,462	5.3	2.4
	LDDV	2	34.4	0.997	8,834,531	42.7	19.4
	with VMT	3	36.1	1.002	9,795,953	47.6	21.6
	mix of	4	39.0	1.017	6,923,412	34.1	15.5
	0.2%	5	42.6	1.056	3,494,642	17.9	8.1
		1	30.3	0.658	1,087,462	34.1	15.5
	LDDT	2	34.4	0.653	8,834,531	274.7	124.6
	with VMT	3	36.1	0.657	9,795,953	306.3	138.9
	mix of	4	39.0	0.666	6,923,412	219.5	99.6
	2.2%	5	42.6	0.692	3,494,642	115.1	52.2
		1	30.3	13.045	1,087,462	2,842.5	1,289.4
	HDDV	2	34.4	12.970	8,834,531	22,959.1	10,414.2
	with VMT	3	36.1	13.024	9,795,953	25,565.2	11,596.4
	mix of	4	39.0	12.429	6,923,412	17,242.6	7,821.3
	9.1%	5	42.6	12.827	3,494,642	8,981.9	4,074.2
		1	30.3	1.172	1,087,462	14.3	6.5
	MC	2	34.4	1.209	8,834,531	120.1	54.5
	with VMT	3	36.1	1.220	9,795,953	134.3	60.9
	mix of	4	39.0	1.238	6,923,412	96.4	43.7
	0.5%	5	42.6	1.257	3,494,642	49.4	22.4

Table 5.5–5. Daily NO_x emissions in the PM₁₀ nonattainment area by facility type, vehicle class and area type (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
COLLECTOR		1	18.2	1.037	1,046,993	1,079.1	489.5
	LDGV	2	19.1	1.021	2,727,290	2,768.3	1,255.7
	with VMT	3	24.4	0.950	1,694,159	1,599.7	725.6
	mix of	4	24.7	0.947	872,616	821.3	372.5
	45.1%	5	28.2	0.914	1,678,942	1,525.8	692.1
		1	18.2	1.223	1,046,993	796.8	361.4
	LDGT1	2	19.1	1.207	2,727,290	2,047.9	928.9
	with VMT	3	24.4	1.136	1,694,159	1,197.1	543.0
	mix of	4	24.7	1.133	872,616	614.9	278.9
	28.2%	5	28.2	1.101	1,678,942	1,149.6	521.5
		1	18.2	1.548	1,046,993	398.7	180.9
	LDGT2	2	19.1	1.528	2,727,290	1,025.4	465.1
	with VMT	3	24.4	1.440	1,694,159	600.0	272.2
	mix of	4	24.7	1.436	872,616	308.2	139.8
	11.2%	5	28.2	1.396	1,678,942	576.6	261.6
		1	18.2	4.004	1,046,993	328.9	149.2
	HDGV	2	19.1	4.031	2,727,290	862.8	391.3
	with VMT	3	24.4	4.217	1,694,159	560.7	254.3
	mix of	4	24.7	4.226	872,616	289.4	131.3
	3.6%	5	28.2	4.356	1,678,942	574.0	260.4
		1	18.2	1.172	1,046,993	6.0	2.7
	LDDV	2	19.1	1.151	2,727,290	15.2	6.9
	with VMT	3	24.4	1.057	1,694,159	8.7	3.9
	mix of	4	24.7	1.053	872,616	4.5	2.0
	0.2%	5	28.2	1.019	1,678,942	8.3	3.8
	1	18.2	0.770	1,046,993	38.4	17.4	
LDDT	2	19.1	0.756	2,727,290	98.2	44.5	
with VMT	3	24.4	0.693	1,694,159	55.9	25.4	
mix of	4	24.7	0.691	872,616	28.7	13.0	
2.2%	5	28.2	0.668	1,678,942	53.4	24.2	
	1	18.2	14.028	1,046,993	2,942.9	1,334.9	
HDDV	2	19.1	13.815	2,727,290	7,549.4	3,424.4	
with VMT	3	24.4	12.843	1,694,159	4,359.7	1,977.6	
mix of	4	24.7	12.800	872,616	2,238.1	1,015.2	
9.1%	5	28.2	12.450	1,678,942	4,188.5	1,899.9	
	1	18.2	1.030	1,046,993	12.1	5.5	
MC	2	19.1	1.039	2,727,290	31.9	14.5	
with VMT	3	24.4	1.101	1,694,159	21.0	9.5	
mix of	4	24.7	1.107	872,616	10.9	4.9	
0.5%	5	28.2	1.148	1,678,942	21.7	9.8	

Table 5.5–5. Daily NO_x emissions in the PM₁₀ nonattainment area by facility type, vehicle class and area type (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
LOCAL		1	12.9	1.173	195,247	227.7	103.3
	LDGV	2	12.9	1.173	1,991,136	2,321.7	1,053.1
	with VMT	3	12.9	1.173	2,564,545	2,990.3	1,356.4
	mix of	4	12.9	1.173	1,689,510	1,970.0	893.6
	45.1%	5	12.9	1.173	1,077,562	1,256.4	569.9
		1	12.9	1.362	195,247	165.5	75.1
	LDGT1	2	12.9	1.362	1,991,136	1,687.4	765.4
	with VMT	3	12.9	1.362	2,564,545	2,173.3	985.8
	mix of	4	12.9	1.362	1,689,510	1,431.8	649.5
	28.2%	5	12.9	1.362	1,077,562	913.2	414.2
		1	12.9	1.721	195,247	82.6	37.5
	LDGT2	2	12.9	1.721	1,991,136	842.8	382.3
	with VMT	3	12.9	1.721	2,564,545	1,085.5	492.4
	mix of	4	12.9	1.721	1,689,510	715.1	324.4
	11.2%	5	12.9	1.721	1,077,562	456.1	206.9
		1	12.9	3.820	195,247	58.5	26.5
	HDGV	2	12.9	3.820	1,991,136	596.8	270.7
	with VMT	3	12.9	3.820	2,564,545	768.7	348.7
	mix of	4	12.9	3.820	1,689,510	506.4	229.7
	3.6%	5	12.9	3.820	1,077,562	323.0	146.5
	1	12.9	1.330	195,247	1.3	0.6	
LDDV	2	12.9	1.330	1,991,136	12.8	5.8	
with VMT	3	12.9	1.330	2,564,545	16.5	7.5	
mix of	4	12.9	1.330	1,689,510	10.9	4.9	
0.2%	5	12.9	1.330	1,077,562	6.9	3.2	
	1	12.9	0.875	195,247	8.1	3.7	
LDDT	2	12.9	0.875	1,991,136	83.0	37.6	
with VMT	3	12.9	0.875	2,564,545	106.8	48.5	
mix of	4	12.9	0.875	1,689,510	70.4	31.9	
2.2%	5	12.9	0.875	1,077,562	44.9	20.4	
	1	12.9	15.660	195,247	612.7	277.9	
HDDV	2	12.9	15.660	1,991,136	6,248.1	2,834.1	
with VMT	3	12.9	15.660	2,564,545	8,047.4	3,650.3	
mix of	4	12.9	15.660	1,689,510	5,301.6	2,404.8	
9.1%	5	12.9	15.660	1,077,562	3,381.3	1,533.8	
	1	12.9	0.990	195,247	2.2	1.0	
MC	2	12.9	0.990	1,991,136	22.2	10.1	
with VMT	3	12.9	0.990	2,564,545	28.5	12.9	
mix of	4	12.9	0.990	1,689,510	18.8	8.5	
0.5%	5	12.9	0.990	1,077,562	12.0	5.4	

Table 5.5–6. Sulfur dioxide (gaseous) emissions in the PM₁₀ nonattainment area by facility type, vehicle class and area type.

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
		1	59.7	0.0119	1,129,051	13.4	6.1
INTERSTATE, FREEWAY, and EXPRESSWAY	LDGV with VMT mix of 45.1%	2	60.3	0.0119	9,046,583	107.0	48.5
		3	63.2	0.0119	6,240,489	73.8	33.5
		4	64.8	0.0119	4,525,653	53.5	24.3
		5	64.2	0.0119	3,416,224	40.4	18.3
		1	59.7	0.0151	1,129,051	10.6	4.8
	LDGT1 with VMT mix of 28.2%	2	60.3	0.0151	9,046,583	85.0	38.5
3		63.2	0.0151	6,240,489	58.6	26.6	
4		64.8	0.0151	4,525,653	42.5	19.3	
5		64.2	0.0151	3,416,224	32.1	14.6	
1		59.7	0.0198	1,129,051	5.5	2.5	
	LDGT2 with VMT mix of 11.2%	2	60.3	0.0198	9,046,583	44.1	20.0
3		63.2	0.0198	6,240,489	30.4	13.8	
4		64.8	0.0198	4,525,653	22.0	10.0	
5		64.2	0.0198	3,416,224	16.6	7.5	
1		59.7	0.0298	1,129,051	2.6	1.2	
	HDGV with VMT mix of 3.6%	2	60.3	0.0298	9,046,583	21.2	9.6
3		63.2	0.0298	6,240,489	14.6	6.6	
4		64.8	0.0298	4,525,653	10.6	4.8	
5		64.2	0.0298	3,416,224	8.0	3.6	
1		59.7	0.0637	1,129,051	0.3	0.2	
	LDDV with VMT mix of 0.2%	2	60.3	0.0637	9,046,583	2.8	1.3
3		63.2	0.0637	6,240,489	1.9	0.9	
4		64.8	0.0637	4,525,653	1.4	0.6	
5		64.2	0.0637	3,416,224	1.1	0.5	
1		59.7	0.0910	1,129,051	4.9	2.2	
	LDDT with VMT mix of 2.2%	2	60.3	0.0910	9,046,583	39.2	17.8
3		63.2	0.0910	6,240,489	27.0	12.3	
4		64.8	0.0910	4,525,653	19.6	8.9	
5		64.2	0.0910	3,416,224	14.8	6.7	
1		59.7	0.2770	1,129,051	62.7	28.4	
	HDDV with VMT mix of 9.1%	2	60.3	0.2770	9,046,583	502.1	227.8
3		63.2	0.2770	6,240,489	346.4	157.1	
4		64.8	0.2770	4,525,653	251.2	113.9	
5		64.2	0.2770	3,416,224	189.6	86.0	
1		59.7	0.0057	1,129,051	0.1	0.0	
	MC with VMT mix of 0.5%	2	60.3	0.0057	9,046,583	0.6	0.3
3		63.2	0.0057	6,240,489	0.4	0.2	
4		64.8	0.0057	4,525,653	0.3	0.1	
5		64.2	0.0057	3,416,224	0.2	0.1	

Table 5.5–6. Sulfur dioxide (gaseous) emissions in the PM₁₀ nonattainment area by facility type, vehicle class and area type (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
		1	30.3	0.0119	1,087,462	12.9	5.8
PRINCIPAL	LDGV	2	34.4	0.0119	8,834,531	104.5	47.4
ARTERIAL	with VMT	3	36.1	0.0119	9,795,953	115.9	52.6
&	mix of	4	39.0	0.0119	6,923,412	81.9	37.1
MINOR	45.1%	5	42.6	0.0119	3,494,642	41.3	18.7
ARTERIAL		1	30.3	0.0151	1,087,462	10.2	4.6
	LDGT1	2	34.4	0.0151	8,834,531	83.0	37.6
	with VMT	3	36.1	0.0151	9,795,953	92.0	41.7
	mix of	4	39.0	0.0151	6,923,412	65.0	29.5
	28.2%	5	42.6	0.0151	3,494,642	32.8	14.9
		1	30.3	0.0198	1,087,462	5.3	2.4
	LDGT2	2	34.4	0.0198	8,834,531	43.0	19.5
	with VMT	3	36.1	0.0198	9,795,953	47.7	21.6
	mix of	4	39.0	0.0198	6,923,412	33.7	15.3
	11.2%	5	42.6	0.0198	3,494,642	17.0	7.7
		1	30.3	0.0298	1,087,462	2.5	1.2
	HDTV	2	34.4	0.0298	8,834,531	20.7	9.4
	with VMT	3	36.1	0.0298	9,795,953	22.9	10.4
	mix of	4	39.0	0.0298	6,923,412	16.2	7.3
	3.6%	5	42.6	0.0298	3,494,642	8.2	3.7
		1	30.3	0.0637	1,087,462	0.3	0.2
	LDDV	2	34.4	0.0637	8,834,531	2.7	1.2
	with VMT	3	36.1	0.0637	9,795,953	3.0	1.4
	mix of	4	39.0	0.0637	6,923,412	2.1	1.0
	0.2%	5	42.6	0.0637	3,494,642	1.1	0.5
		1	30.3	0.0910	1,087,462	4.7	2.1
	LDDT	2	34.4	0.0910	8,834,531	38.3	17.4
	with VMT	3	36.1	0.0910	9,795,953	42.4	19.3
	mix of	4	39.0	0.0910	6,923,412	30.0	13.6
	2.2%	5	42.6	0.0910	3,494,642	15.1	6.9
		1	30.3	0.2770	1,087,462	60.4	27.4
	HDDV	2	34.4	0.2770	8,834,531	490.4	222.4
	with VMT	3	36.1	0.2770	9,795,953	543.7	246.6
	mix of	4	39.0	0.2770	6,923,412	384.3	174.3
	9.1%	5	42.6	0.2770	3,494,642	194.0	88.0
		1	30.3	0.0057	1,087,462	0.1	0.0
	MC	2	34.4	0.0057	8,834,531	0.6	0.3
	with VMT	3	36.1	0.0057	9,795,953	0.6	0.3
	mix of	4	39.0	0.0057	6,923,412	0.4	0.2
	0.5%	5	42.6	0.0057	3,494,642	0.2	0.1

Table 5.5–6. Sulfur dioxide (gaseous) emissions in the PM₁₀ nonattainment area by facility type, vehicle class and area type (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
COLLECTOR		1	18.2	0.0118	1,046,993	12.3	5.6
	LDGV	2	19.1	0.0118	2,727,290	32.0	14.5
	with VMT	3	24.4	0.0118	1,694,159	19.9	9.0
	mix of	4	24.7	0.0118	872,616	10.2	4.6
	45.1%	5	28.2	0.0118	1,678,942	19.7	8.9
		1	18.2	0.0151	1,046,993	9.8	4.5
	LDGT1	2	19.1	0.0151	2,727,290	25.6	11.6
	with VMT	3	24.4	0.0151	1,694,159	15.9	7.2
	mix of	4	24.7	0.0151	872,616	8.2	3.7
	28.2%	5	28.2	0.0151	1,678,942	15.8	7.2
		1	18.2	0.0198	1,046,993	5.1	2.3
	LDGT2	2	19.1	0.0198	2,727,290	13.3	6.0
	with VMT	3	24.4	0.0198	1,694,159	8.3	3.7
	mix of	4	24.7	0.0198	872,616	4.3	1.9
	11.2%	5	28.2	0.0198	1,678,942	8.2	3.7
		1	18.2	0.0299	1,046,993	2.5	1.1
	HDGV	2	19.1	0.0299	2,727,290	6.4	2.9
	with VMT	3	24.4	0.0299	1,694,159	4.0	1.8
	mix of	4	24.7	0.0299	872,616	2.0	0.9
	3.6%	5	28.2	0.0299	1,678,942	3.9	1.8
		1	18.2	0.0637	1,046,993	0.3	0.1
	LDDV	2	19.1	0.0637	2,727,290	0.8	0.4
	with VMT	3	24.4	0.0637	1,694,159	0.5	0.2
	mix of	4	24.7	0.0637	872,616	0.3	0.1
	0.2%	5	28.2	0.0637	1,678,942	0.5	0.2
	1	18.2	0.0910	1,046,993	4.5	2.1	
LDDT	2	19.1	0.0910	2,727,290	11.8	5.4	
with VMT	3	24.4	0.0910	1,694,159	7.3	3.3	
mix of	4	24.7	0.0910	872,616	3.8	1.7	
2.2%	5	28.2	0.0910	1,678,942	7.3	3.3	
	1	18.2	0.2770	1,046,993	58.1	26.4	
HDDV	2	19.1	0.2770	2,727,290	151.4	68.7	
with VMT	3	24.4	0.2770	1,694,159	94.0	42.7	
mix of	4	24.7	0.2770	872,616	48.4	22.0	
9.1%	5	28.2	0.2770	1,678,942	93.2	42.3	
	1	18.2	0.0057	1,046,993	0.1	0.0	
MC	2	19.1	0.0057	2,727,290	0.2	0.1	
with VMT	3	24.4	0.0057	1,694,159	0.1	0.0	
mix of	4	24.7	0.0057	872,616	0.1	0.0	
0.5%	5	28.2	0.0057	1,678,942	0.1	0.0	

Table 5.5–6. Sulfur dioxide (gaseous) emissions in the PM₁₀ nonattainment area by facility type, vehicle class and area type (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
LOCAL		1	12.9	0.0118	195,247	2.3	1.0
	LDGV	2	12.9	0.0118	1,991,136	23.4	10.6
	with VMT	3	12.9	0.0118	2,564,545	30.1	13.6
	mix of	4	12.9	0.0118	1,689,510	19.8	9.0
	45.1%	5	12.9	0.0118	1,077,562	12.6	5.7
		1	12.9	0.0151	195,247	1.8	0.8
	LDGT1	2	12.9	0.0151	1,991,136	18.7	8.5
	with VMT	3	12.9	0.0151	2,564,545	24.1	10.9
	mix of	4	12.9	0.0151	1,689,510	15.9	7.2
	28.2%	5	12.9	0.0151	1,077,562	10.1	4.6
		1	12.9	0.0198	195,247	1.0	0.4
	LDGT2	2	12.9	0.0198	1,991,136	9.7	4.4
	with VMT	3	12.9	0.0198	2,564,545	12.5	5.7
	mix of	4	12.9	0.0198	1,689,510	8.2	3.7
	11.2%	5	12.9	0.0198	1,077,562	5.2	2.4
		1	12.9	0.0299	195,247	0.5	0.2
	HDGV	2	12.9	0.0299	1,991,136	4.7	2.1
	with VMT	3	12.9	0.0299	2,564,545	6.0	2.7
	mix of	4	12.9	0.0299	1,689,510	4.0	1.8
	3.6%	5	12.9	0.0299	1,077,562	2.5	1.1
		1	12.9	0.0637	195,247	0.1	0.0
	LDDV	2	12.9	0.0637	1,991,136	0.6	0.3
	with VMT	3	12.9	0.0637	2,564,545	0.8	0.4
	mix of	4	12.9	0.0637	1,689,510	0.5	0.2
	0.2%	5	12.9	0.0637	1,077,562	0.3	0.2
	1	12.9	0.0910	195,247	0.8	0.4	
LDDT	2	12.9	0.0910	1,991,136	8.6	3.9	
with VMT	3	12.9	0.0910	2,564,545	11.1	5.0	
mix of	4	12.9	0.0910	1,689,510	7.3	3.3	
2.2%	5	12.9	0.0910	1,077,562	4.7	2.1	
	1	12.9	0.2770	195,247	10.8	4.9	
HDDV	2	12.9	0.2770	1,991,136	110.5	50.1	
with VMT	3	12.9	0.2770	2,564,545	142.3	64.6	
mix of	4	12.9	0.2770	1,689,510	93.8	42.5	
9.1%	5	12.9	0.2770	1,077,562	59.8	27.1	
	1	12.9	0.0057	195,247	0.0	0.0	
MC	2	12.9	0.0057	1,991,136	0.1	0.1	
with VMT	3	12.9	0.0057	2,564,545	0.2	0.1	
mix of	4	12.9	0.0057	1,689,510	0.1	0.0	
0.5%	5	12.9	0.0057	1,077,562	0.1	0.0	

Table 5.5–7. Daily ammonia emissions in the PM₁₀ nonattainment area by facility type, vehicle class and area type.

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
INTERSTATE, FREEWAY, and EXPRESSWAY	LDGV with VMT mix of 45.1%	1	59.7	0.1002	1,129,051	112.4	51.0
		2	60.3	0.1002	9,046,583	901.0	408.7
		3	63.2	0.1002	6,240,489	621.5	281.9
		4	64.8	0.1002	4,525,653	450.7	204.4
		5	64.2	0.1002	3,416,224	340.2	154.3
	LDGT1 with VMT mix of 28.2%	1	59.7	0.0983	1,129,051	69.0	31.3
		2	60.3	0.0983	9,046,583	553.2	250.9
		3	63.2	0.0983	6,240,489	381.6	173.1
		4	64.8	0.0983	4,525,653	276.7	125.5
		5	64.2	0.0983	3,416,224	208.9	94.8
	LDGT2 with VMT mix of 11.2%	1	59.7	0.0973	1,129,051	27.0	12.3
		2	60.3	0.0973	9,046,583	216.5	98.2
		3	63.2	0.0973	6,240,489	149.4	67.8
		4	64.8	0.0973	4,525,653	108.3	49.1
		5	64.2	0.0973	3,416,224	81.8	37.1
	HDGV with VMT mix of 3.6%	1	59.7	0.0451	1,129,051	4.0	1.8
		2	60.3	0.0451	9,046,583	32.0	14.5
		3	63.2	0.0451	6,240,489	22.1	10.0
		4	64.8	0.0451	4,525,653	16.0	7.3
		5	64.2	0.0451	3,416,224	12.1	5.5
LDDV with VMT mix of 0.2%	1	59.7	0.0068	1,129,051	0.0	0.0	
	2	60.3	0.0068	9,046,583	0.3	0.1	
	3	63.2	0.0068	6,240,489	0.2	0.1	
	4	64.8	0.0068	4,525,653	0.1	0.1	
	5	64.2	0.0068	3,416,224	0.1	0.1	
LDDT with VMT mix of 2.2%	1	59.7	0.0068	1,129,051	0.4	0.2	
	2	60.3	0.0068	9,046,583	2.9	1.3	
	3	63.2	0.0068	6,240,489	2.0	0.9	
	4	64.8	0.0068	4,525,653	1.5	0.7	
	5	64.2	0.0068	3,416,224	1.1	0.5	
HDDV with VMT mix of 9.1%	1	59.7	0.0270	1,129,051	6.1	2.8	
	2	60.3	0.0270	9,046,583	48.9	22.2	
	3	63.2	0.0270	6,240,489	33.8	15.3	
	4	64.8	0.0270	4,525,653	24.5	11.1	
	5	64.2	0.0270	3,416,224	18.5	8.4	
MC with VMT mix of 0.5%	1	59.7	0.0113	1,129,051	0.1	0.1	
	2	60.3	0.0113	9,046,583	1.1	0.5	
	3	63.2	0.0113	6,240,489	0.8	0.4	
	4	64.8	0.0113	4,525,653	0.6	0.3	
	5	64.2	0.0113	3,416,224	0.4	0.2	

Table 5.5–7. Daily ammonia emissions in the PM₁₀ nonattainment area by facility type, vehicle class and area type (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
		1	30.3	0.1002	1,087,462	108.3	49.1
PRINCIPAL	LDGV	2	34.4	0.1002	8,834,531	879.9	399.1
ARTERIAL	with VMT	3	36.1	0.1002	9,795,953	975.6	442.5
&	mix of	4	39.0	0.1002	6,923,412	689.5	312.8
MINOR	45.1%	5	42.6	0.1002	3,494,642	348.0	157.9
ARTERIAL		1	30.3	0.0983	1,087,462	66.5	30.2
	LDGT1	2	34.4	0.0983	8,834,531	540.2	245.0
	with VMT	3	36.1	0.0983	9,795,953	599.0	271.7
	mix of	4	39.0	0.0983	6,923,412	423.4	192.0
	28.2%	5	42.6	0.0983	3,494,642	213.7	96.9
		1	30.3	0.0973	1,087,462	26.0	11.8
	LDGT2	2	34.4	0.0973	8,834,531	211.5	95.9
	with VMT	3	36.1	0.0973	9,795,953	234.5	106.4
	mix of	4	39.0	0.0973	6,923,412	165.7	75.2
	11.2%	5	42.6	0.0973	3,494,642	83.6	37.9
		1	30.3	0.0451	1,087,462	3.8	1.7
	HDGV	2	34.4	0.0451	8,834,531	31.3	14.2
	with VMT	3	36.1	0.0451	9,795,953	34.7	15.7
	mix of	4	39.0	0.0451	6,923,412	24.5	11.1
	3.6%	5	42.6	0.0451	3,494,642	12.4	5.6
		1	30.3	0.0068	1,087,462	0.0	0.0
	LDDV	2	34.4	0.0068	8,834,531	0.3	0.1
	with VMT	3	36.1	0.0068	9,795,953	0.3	0.1
	mix of	4	39.0	0.0068	6,923,412	0.2	0.1
	0.2%	5	42.6	0.0068	3,494,642	0.1	0.1
		1	30.3	0.0068	1,087,462	0.4	0.2
	LDDT	2	34.4	0.0068	8,834,531	2.9	1.3
	with VMT	3	36.1	0.0068	9,795,953	3.2	1.4
	mix of	4	39.0	0.0068	6,923,412	2.2	1.0
	2.2%	5	42.6	0.0068	3,494,642	1.1	0.5
		1	30.3	0.0270	1,087,462	5.9	2.7
	HDDV	2	34.4	0.0270	8,834,531	47.8	21.7
	with VMT	3	36.1	0.0270	9,795,953	53.0	24.0
	mix of	4	39.0	0.0270	6,923,412	37.5	17.0
	9.1%	5	42.6	0.0270	3,494,642	18.9	8.6
		1	30.3	0.0113	1,087,462	0.1	0.1
	MC	2	34.4	0.0113	8,834,531	1.1	0.5
	with VMT	3	36.1	0.0113	9,795,953	1.2	0.6
	mix of	4	39.0	0.0113	6,923,412	0.9	0.4
	0.5%	5	42.6	0.0113	3,494,642	0.4	0.2

Table 5.5–7. Daily ammonia emissions in the PM₁₀ nonattainment area by facility type, vehicle class and area type (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
COLLECTOR		1	18.2	0.1002	1,046,993	104.3	47.3
	LDGV	2	19.1	0.1002	2,727,290	271.6	123.2
	with VMT	3	24.4	0.1002	1,694,159	168.7	76.5
	mix of	4	24.7	0.1002	872,616	86.9	39.4
	45.1%	5	28.2	0.1002	1,678,942	167.2	75.8
		1	18.2	0.0983	1,046,993	64.0	29.0
	LDGT1	2	19.1	0.0983	2,727,290	166.8	75.6
	with VMT	3	24.4	0.0983	1,694,159	103.6	47.0
	mix of	4	24.7	0.0983	872,616	53.4	24.2
	28.2%	5	28.2	0.0983	1,678,942	102.7	46.6
		1	18.2	0.0973	1,046,993	25.1	11.4
	LDGT2	2	19.1	0.0973	2,727,290	65.3	29.6
	with VMT	3	24.4	0.0973	1,694,159	40.6	18.4
	mix of	4	24.7	0.0973	872,616	20.9	9.5
	11.2%	5	28.2	0.0973	1,678,942	40.2	18.2
		1	18.2	0.0451	1,046,993	3.7	1.7
	HDGV	2	19.1	0.0451	2,727,290	9.7	4.4
	with VMT	3	24.4	0.0451	1,694,159	6.0	2.7
	mix of	4	24.7	0.0451	872,616	3.1	1.4
	3.6%	5	28.2	0.0451	1,678,942	5.9	2.7
		1	18.2	0.0068	1,046,993	0.0	0.0
	LDDV	2	19.1	0.0068	2,727,290	0.1	0.0
	with VMT	3	24.4	0.0068	1,694,159	0.1	0.0
	mix of	4	24.7	0.0068	872,616	0.0	0.0
	0.2%	5	28.2	0.0068	1,678,942	0.1	0.0
	1	18.2	0.0068	1,046,993	0.3	0.2	
LDDT	2	19.1	0.0068	2,727,290	0.9	0.4	
with VMT	3	24.4	0.0068	1,694,159	0.5	0.2	
mix of	4	24.7	0.0068	872,616	0.3	0.1	
2.2%	5	28.2	0.0068	1,678,942	0.5	0.2	
	1	18.2	0.0270	1,046,993	5.7	2.6	
HDDV	2	19.1	0.0270	2,727,290	14.8	6.7	
with VMT	3	24.4	0.0270	1,694,159	9.2	4.2	
mix of	4	24.7	0.0270	872,616	4.7	2.1	
9.1%	5	28.2	0.0270	1,678,942	9.1	4.1	
	1	18.2	0.0113	1,046,993	0.1	0.1	
MC	2	19.1	0.0113	2,727,290	0.3	0.2	
with VMT	3	24.4	0.0113	1,694,159	0.2	0.1	
mix of	4	24.7	0.0113	872,616	0.1	0.1	
0.5%	5	28.2	0.0113	1,678,942	0.2	0.1	

Table 5.5–7. Daily ammonia emissions in the PM₁₀ nonattainment by facility type, vehicle class and area type (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
LOCAL		1	12.9	0.1002	195,247	19.4	8.8
	LDGV	2	12.9	0.1002	1,991,136	198.3	90.0
	with VMT	3	12.9	0.1002	2,564,545	255.4	115.9
	mix of	4	12.9	0.1002	1,689,510	168.3	76.3
	45.1%	5	12.9	0.1002	1,077,562	107.3	48.7
		1	12.9	0.0983	195,247	11.9	5.4
	LDGT1	2	12.9	0.0983	1,991,136	121.8	55.2
	with VMT	3	12.9	0.0983	2,564,545	156.8	71.1
	mix of	4	12.9	0.0983	1,689,510	103.3	46.9
	28.2%	5	12.9	0.0983	1,077,562	65.9	29.9
		1	12.9	0.0973	195,247	4.7	2.1
	LDGT2	2	12.9	0.0973	1,991,136	47.7	21.6
	with VMT	3	12.9	0.0973	2,564,545	61.4	27.8
	mix of	4	12.9	0.0973	1,689,510	40.4	18.3
	11.2%	5	12.9	0.0973	1,077,562	25.8	11.7
		1	12.9	0.0451	195,247	0.7	0.3
	HDGV	2	12.9	0.0451	1,991,136	7.0	3.2
	with VMT	3	12.9	0.0451	2,564,545	9.1	4.1
	mix of	4	12.9	0.0451	1,689,510	6.0	2.7
	3.6%	5	12.9	0.0451	1,077,562	3.8	1.7
		1	12.9	0.0068	195,247	0.0	0.0
	LDDV	2	12.9	0.0068	1,991,136	0.1	0.0
	with VMT	3	12.9	0.0068	2,564,545	0.1	0.0
	mix of	4	12.9	0.0068	1,689,510	0.1	0.0
	0.2%	5	12.9	0.0068	1,077,562	0.0	0.0
	1	12.9	0.0068	195,247	0.1	0.0	
LDDT	2	12.9	0.0068	1,991,136	0.6	0.3	
with VMT	3	12.9	0.0068	2,564,545	0.8	0.4	
mix of	4	12.9	0.0068	1,689,510	0.5	0.2	
2.2%	5	12.9	0.0068	1,077,562	0.3	0.2	
	1	12.9	0.0270	195,247	1.1	0.5	
HDDV	2	12.9	0.0270	1,991,136	10.8	4.9	
with VMT	3	12.9	0.0270	2,564,545	13.9	6.3	
mix of	4	12.9	0.0270	1,689,510	9.1	4.1	
9.1%	5	12.9	0.0270	1,077,562	5.8	2.6	
	1	12.9	0.0113	195,247	0.0	0.0	
MC	2	12.9	0.0113	1,991,136	0.3	0.1	
with VMT	3	12.9	0.0113	2,564,545	0.3	0.1	
mix of	4	12.9	0.0113	1,689,510	0.2	0.1	
0.5%	5	12.9	0.0113	1,077,562	0.1	0.1	

Table 5.5–8. Daily PM₁₀ Emissions in Maricopa County by facility type, vehicle class and area type (excludes fugitive dust).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
INTERSTATE, FREEWAY, and EXPRESSWAY		1	59.7	0.0050	1,129,051	5.6	2.5
	LDGV	2	60.3	0.0050	9,046,583	45.0	20.4
	with VMT	3	63.2	0.0050	6,240,489	31.0	14.1
	mix of	4	64.8	0.0050	4,525,653	22.5	10.2
	45.1%	5	64.2	0.0050	5,662,224	28.1	12.8
		1	59.7	0.0061	1,129,051	4.3	1.9
	LDGT1	2	60.3	0.0061	9,046,583	34.3	15.6
	with VMT	3	63.2	0.0061	6,240,489	23.7	10.7
	mix of	4	64.8	0.0061	4,525,653	17.2	7.8
	28.2%	5	64.2	0.0061	5,662,224	21.5	9.7
		1	59.7	0.0107	1,129,051	3.0	1.3
	LDGT2	2	60.3	0.0107	9,046,583	23.8	10.8
	with VMT	3	63.2	0.0107	6,240,489	16.4	7.5
	mix of	4	64.8	0.0107	4,525,653	11.9	5.4
	11.2%	5	64.2	0.0107	5,662,224	14.9	6.8
		1	59.7	0.0673	1,129,051	6.0	2.7
	HDGV	2	60.3	0.0673	9,046,583	47.8	21.7
	with VMT	3	63.2	0.0673	6,240,489	33.0	14.9
	mix of	4	64.8	0.0673	4,525,653	23.9	10.8
	3.6%	5	64.2	0.0673	5,662,224	29.9	13.6
		1	59.7	0.1700	1,129,051	0.9	0.4
	LDDV	2	60.3	0.1700	9,046,583	7.5	3.4
	with VMT	3	63.2	0.1700	6,240,489	5.1	2.3
	mix of	4	64.8	0.1700	4,525,653	3.7	1.7
	0.2%	5	64.2	0.1700	5,662,224	4.7	2.1
		1	59.7	0.1256	1,129,051	6.8	3.1
	LDDT	2	60.3	0.1256	9,046,583	54.1	24.5
	with VMT	3	63.2	0.1256	6,240,489	37.3	16.9
	mix of	4	64.8	0.1256	4,525,653	27.1	12.3
	2.2%	5	64.2	0.1256	5,662,224	33.9	15.4
		1	59.7	0.3597	1,129,051	81.4	36.9
	HDDV	2	60.3	0.3597	9,046,583	652.0	295.8
	with VMT	3	63.2	0.3597	6,240,489	449.8	204.0
	mix of	4	64.8	0.3597	4,525,653	326.2	148.0
	9.1%	5	64.2	0.3597	5,662,224	408.1	185.1
		1	59.7	0.0206	1,129,051	0.3	0.1
	MC	2	60.3	0.0206	9,046,583	2.1	1.0
	with VMT	3	63.2	0.0206	6,240,489	1.4	0.7
	mix of	4	64.8	0.0206	4,525,653	1.0	0.5
	0.5%	5	64.2	0.0206	5,662,224	1.3	0.6

Table 5.5–8. Daily PM₁₀ Emissions in Maricopa County by facility type, vehicle class and area type (excludes fugitive dust) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
		1	30.3	0.0051	1,087,462	5.5	2.5
PRINCIPAL	LDGV	2	34.4	0.0050	8,834,531	43.9	19.9
ARTERIAL	with VMT	3	36.1	0.0050	9,795,953	48.7	22.1
&	mix of	4	39.0	0.0050	6,923,412	34.4	15.6
MINOR	45.1%	5	42.6	0.0050	3,738,642	18.6	8.4
ARTERIAL		1	30.3	0.0062	1,087,462	4.2	1.9
	LDGT1	2	34.4	0.0061	8,834,531	33.5	15.2
	with VMT	3	36.1	0.0061	9,795,953	37.2	16.9
	mix of	4	39.0	0.0061	6,923,412	26.3	11.9
	28.2%	5	42.6	0.0061	3,738,642	14.2	6.4
		1	30.3	0.0108	1,087,462	2.9	1.3
	LDGT2	2	34.4	0.0107	8,834,531	23.3	10.5
	with VMT	3	36.1	0.0107	9,795,953	25.8	11.7
	mix of	4	39.0	0.0107	6,923,412	18.2	8.3
	11.2%	5	42.6	0.0107	3,738,642	9.8	4.5
		1	30.3	0.0673	1,087,462	5.7	2.6
	HDTV	2	34.4	0.0673	8,834,531	46.7	21.2
	with VMT	3	36.1	0.0673	9,795,953	51.7	23.5
	mix of	4	39.0	0.0673	6,923,412	36.6	16.6
	3.6%	5	42.6	0.0673	3,738,642	19.7	9.0
		1	30.3	0.1700	1,087,462	0.9	0.4
	LDDV	2	34.4	0.1700	8,834,531	7.3	3.3
	with VMT	3	36.1	0.1700	9,795,953	8.1	3.7
	mix of	4	39.0	0.1700	6,923,412	5.7	2.6
	0.2%	5	42.6	0.1700	3,738,642	3.1	1.4
		1	30.3	0.1256	1,087,462	6.5	2.9
	LDDT	2	34.4	0.1256	8,834,531	52.8	24.0
	with VMT	3	36.1	0.1256	9,795,953	58.6	26.6
	mix of	4	39.0	0.1256	6,923,412	41.4	18.8
	2.2%	5	42.6	0.1256	3,738,642	22.4	10.1
		1	30.3	0.3597	1,087,462	78.4	35.6
	HDDV	2	34.4	0.3597	8,834,531	636.8	288.8
	with VMT	3	36.1	0.3597	9,795,953	706.0	320.3
	mix of	4	39.0	0.3597	6,923,412	499.0	226.4
	9.1%	5	42.6	0.3597	3,738,642	269.5	122.2
		1	30.3	0.0207	1,087,462	0.3	0.1
	MC	2	34.4	0.0206	8,834,531	2.0	0.9
	with VMT	3	36.1	0.0206	9,795,953	2.3	1.0
	mix of	4	39.0	0.0206	6,923,412	1.6	0.7
	0.5%	5	42.6	0.0206	3,738,642	0.9	0.4

Table 5.5–8. Daily PM₁₀ Emissions in Maricopa County by facility type, vehicle class and area type (excludes fugitive dust) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
COLLECTOR		1	18.2	0.0054	1,046,993	5.6	2.5
	LDGV	2	19.1	0.0054	2,727,290	14.6	6.6
	with VMT	3	24.4	0.0053	1,694,159	8.9	4.0
	mix of	4	24.7	0.0053	872,616	4.6	2.1
	45.1%	5	28.2	0.0052	2,390,942	12.4	5.6
		1	18.2	0.0063	1,046,993	4.1	1.9
	LDGT1	2	19.1	0.0063	2,727,290	10.7	4.8
	with VMT	3	24.4	0.0063	1,694,159	6.6	3.0
	mix of	4	24.7	0.0063	872,616	3.4	1.6
	28.2%	5	28.2	0.0062	2,390,942	9.2	4.2
		1	18.2	0.0109	1,046,993	2.8	1.3
	LDGT2	2	19.1	0.0109	2,727,290	7.3	3.3
	with VMT	3	24.4	0.0108	1,694,159	4.5	2.0
	mix of	4	24.7	0.0108	872,616	2.3	1.1
	11.2%	5	28.2	0.0108	2,390,942	6.4	2.9
		1	18.2	0.0671	1,046,993	5.5	2.5
	HDGV	2	19.1	0.0671	2,727,290	14.4	6.5
	with VMT	3	24.4	0.0672	1,694,159	8.9	4.1
	mix of	4	24.7	0.0672	872,616	4.6	2.1
	3.6%	5	28.2	0.0672	2,390,942	12.6	5.7
		1	18.2	0.1700	1,046,993	0.9	0.4
	LDDV	2	19.1	0.1700	2,727,290	2.2	1.0
	with VMT	3	24.4	0.1700	1,694,159	1.4	0.6
	mix of	4	24.7	0.1700	872,616	0.7	0.3
	0.2%	5	28.2	0.1700	2,390,942	2.0	0.9
	1	18.2	0.1256	1,046,993	6.3	2.8	
LDDT	2	19.1	0.1256	2,727,290	16.3	7.4	
with VMT	3	24.4	0.1256	1,694,159	10.1	4.6	
mix of	4	24.7	0.1256	872,616	5.2	2.4	
2.2%	5	28.2	0.1256	2,390,942	14.3	6.5	
	1	18.2	0.3597	1,046,993	75.5	34.2	
HDDV	2	19.1	0.3597	2,727,290	196.6	89.2	
with VMT	3	24.4	0.3597	1,694,159	122.1	55.4	
mix of	4	24.7	0.3597	872,616	62.9	28.5	
9.1%	5	28.2	0.3597	2,390,942	172.3	78.2	
	1	18.2	0.0208	1,046,993	0.2	0.1	
MC	2	19.1	0.0208	2,727,290	0.6	0.3	
with VMT	3	24.4	0.0207	1,694,159	0.4	0.2	
mix of	4	24.7	0.0207	872,616	0.2	0.1	
0.5%	5	28.2	0.0207	2,390,942	0.6	0.3	

Table 5.5–8. Daily PM₁₀ Emissions in Maricopa County by facility type, vehicle class and area type (excludes fugitive dust) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
LOCAL		1	12.9	0.0054	195,247	1.0	0.5
	LDGV	2	12.9	0.0054	1,991,136	10.7	4.8
	with VMT	3	12.9	0.0054	2,564,545	13.8	6.2
	mix of	4	12.9	0.0054	1,689,510	9.1	4.1
	45.1%	5	12.9	0.0054	1,422,562	7.6	3.5
		1	12.9	0.0063	195,247	0.8	0.3
	LDGT1	2	12.9	0.0063	1,991,136	7.8	3.5
	with VMT	3	12.9	0.0063	2,564,545	10.1	4.6
	mix of	4	12.9	0.0063	1,689,510	6.6	3.0
	28.2%	5	12.9	0.0063	1,422,562	5.6	2.5
		1	12.9	0.0109	195,247	0.5	0.2
	LDGT2	2	12.9	0.0109	1,991,136	5.3	2.4
	with VMT	3	12.9	0.0109	2,564,545	6.9	3.1
	mix of	4	12.9	0.0109	1,689,510	4.5	2.1
	11.2%	5	12.9	0.0109	1,422,562	3.8	1.7
		1	12.9	0.0671	195,247	1.0	0.5
	HDTV	2	12.9	0.0671	1,991,136	10.5	4.8
	with VMT	3	12.9	0.0671	2,564,545	13.5	6.1
	mix of	4	12.9	0.0671	1,689,510	8.9	4.0
	3.6%	5	12.9	0.0671	1,422,562	7.5	3.4
		1	12.9	0.1700	195,247	0.2	0.1
	LDDV	2	12.9	0.1700	1,991,136	1.6	0.7
	with VMT	3	12.9	0.1700	2,564,545	2.1	1.0
	mix of	4	12.9	0.1700	1,689,510	1.4	0.6
	0.2%	5	12.9	0.1700	1,422,562	1.2	0.5
	1	12.9	0.1256	195,247	1.2	0.5	
LDDT	2	12.9	0.1256	1,991,136	11.9	5.4	
with VMT	3	12.9	0.1256	2,564,545	15.3	7.0	
mix of	4	12.9	0.1256	1,689,510	10.1	4.6	
2.2%	5	12.9	0.1256	1,422,562	8.5	3.9	
	1	12.9	0.3597	195,247	14.1	6.4	
HDDV	2	12.9	0.3597	1,991,136	143.5	65.1	
with VMT	3	12.9	0.3597	2,564,545	184.8	83.8	
mix of	4	12.9	0.3597	1,689,510	121.8	55.2	
9.1%	5	12.9	0.3597	1,422,562	102.5	46.5	
	1	12.9	0.0208	195,247	0.0	0.0	
MC	2	12.9	0.0208	1,991,136	0.5	0.2	
with VMT	3	12.9	0.0208	2,564,545	0.6	0.3	
mix of	4	12.9	0.0208	1,689,510	0.4	0.2	
0.5%	5	12.9	0.0208	1,422,562	0.3	0.2	

Table 5.5–9. Daily PM_{2.5} emissions in Maricopa County by facility type, vehicle class and area type (excludes fugitive dust).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
INTERSTATE, FREEWAY, and EXPRESSWAY		1	59.7	0.0046	1,129,051	5.2	2.3
	LDGV	2	60.3	0.0046	9,046,583	41.4	18.8
	with VMT	3	63.2	0.0046	6,240,489	28.5	12.9
	mix of	4	64.8	0.0046	4,525,653	20.7	9.4
	45.1%	5	64.2	0.0046	5,662,224	25.9	11.7
		1	59.7	0.0056	1,129,051	3.9	1.8
	LDGT1	2	60.3	0.0056	9,046,583	31.5	14.3
	with VMT	3	63.2	0.0056	6,240,489	21.7	9.9
	mix of	4	64.8	0.0056	4,525,653	15.8	7.2
	28.2%	5	64.2	0.0056	5,662,224	19.7	8.9
		1	59.7	0.0087	1,129,051	2.4	1.1
	LDGT2	2	60.3	0.0087	9,046,583	19.4	8.8
	with VMT	3	63.2	0.0087	6,240,489	13.4	6.1
	mix of	4	64.8	0.0087	4,525,653	9.7	4.4
	11.2%	5	64.2	0.0087	5,662,224	12.1	5.5
		1	59.7	0.0569	1,129,051	5.0	2.3
	HDGV	2	60.3	0.0569	9,046,583	40.4	18.3
	with VMT	3	63.2	0.0569	6,240,489	27.9	12.6
	mix of	4	64.8	0.0569	4,525,653	20.2	9.2
	3.6%	5	64.2	0.0569	5,662,224	25.3	11.5
	1	59.7	0.1567	1,129,051	0.9	0.4	
LDDV	2	60.3	0.1567	9,046,583	6.9	3.1	
with VMT	3	63.2	0.1567	6,240,489	4.7	2.2	
mix of	4	64.8	0.1567	4,525,653	3.4	1.6	
0.2%	5	64.2	0.1567	5,662,224	4.3	2.0	
	1	59.7	0.1159	1,129,051	6.2	2.8	
LDDT	2	60.3	0.1159	9,046,583	49.9	22.6	
with VMT	3	63.2	0.1159	6,240,489	34.4	15.6	
mix of	4	64.8	0.1159	4,525,653	25.0	11.3	
2.2%	5	64.2	0.1159	5,662,224	31.2	14.2	
	1	59.7	0.3325	1,129,051	75.2	34.1	
HDDV	2	60.3	0.3325	9,046,583	602.7	273.4	
with VMT	3	63.2	0.3325	6,240,489	415.8	188.6	
mix of	4	64.8	0.3325	4,525,653	301.5	136.8	
9.1%	5	64.2	0.3325	5,662,224	377.2	171.1	
	1	59.7	0.0143	1,129,051	0.2	0.1	
MC	2	60.3	0.0143	9,046,583	1.5	0.7	
with VMT	3	63.2	0.0143	6,240,489	1.0	0.5	
mix of	4	64.8	0.0143	4,525,653	0.7	0.3	
0.5%	5	64.2	0.0143	5,662,224	0.9	0.4	

Table 5.5–9. Daily PM_{2.5} emissions in Maricopa County by facility type, vehicle class and area type (excludes fugitive dust).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
PRINCIPAL ARTERIAL & MINOR ARTERIAL		1	30.3	0.0047	1,087,462	5.1	2.3
	LDGV	2	34.4	0.0046	8,834,531	40.4	18.3
	with VMT	3	36.1	0.0046	9,795,953	44.8	20.3
	mix of	4	39.0	0.0046	6,923,412	31.7	14.4
	45.1%	5	42.6	0.0046	3,738,642	17.1	7.8
LDGT1		1	30.3	0.0056	1,087,462	3.8	1.7
	LDGT1	2	34.4	0.0056	8,834,531	30.8	14.0
	with VMT	3	36.1	0.0056	9,795,953	34.1	15.5
	mix of	4	39.0	0.0056	6,923,412	24.1	10.9
	28.2%	5	42.6	0.0056	3,738,642	13.0	5.9
LDGT2		1	30.3	0.0088	1,087,462	2.4	1.1
	LDGT2	2	34.4	0.0087	8,834,531	18.9	8.6
	with VMT	3	36.1	0.0087	9,795,953	21.0	9.5
	mix of	4	39.0	0.0087	6,923,412	14.8	6.7
	11.2%	5	42.6	0.0087	3,738,642	8.0	3.6
HDGV		1	30.3	0.0568	1,087,462	4.8	2.2
	HDGV	2	34.4	0.0568	8,834,531	39.4	17.9
	with VMT	3	36.1	0.0569	9,795,953	43.7	19.8
	mix of	4	39.0	0.0569	6,923,412	30.9	14.0
	3.6%	5	42.6	0.0569	3,738,642	16.7	7.6
LDDV		1	30.3	0.1567	1,087,462	0.8	0.4
	LDDV	2	34.4	0.1567	8,834,531	6.7	3.0
	with VMT	3	36.1	0.1567	9,795,953	7.4	3.4
	mix of	4	39.0	0.1567	6,923,412	5.3	2.4
	0.2%	5	42.6	0.1567	3,738,642	2.8	1.3
LDDT		1	30.3	0.1159	1,087,462	6.0	2.7
	LDDT	2	34.4	0.1159	8,834,531	48.8	22.1
	with VMT	3	36.1	0.1159	9,795,953	54.1	24.5
	mix of	4	39.0	0.1159	6,923,412	38.2	17.3
	2.2%	5	42.6	0.1159	3,738,642	20.6	9.4
HDDV		1	30.3	0.3325	1,087,462	72.5	32.9
	HDDV	2	34.4	0.3325	8,834,531	588.6	267.0
	with VMT	3	36.1	0.3325	9,795,953	652.7	296.0
	mix of	4	39.0	0.3325	6,923,412	461.3	209.2
	9.1%	5	42.6	0.3325	3,738,642	249.1	113.0
MC		1	30.3	0.0144	1,087,462	0.2	0.1
	MC	2	34.4	0.0143	8,834,531	1.4	0.6
	with VMT	3	36.1	0.0143	9,795,953	1.6	0.7
	mix of	4	39.0	0.0143	6,923,412	1.1	0.5
	0.5%	5	42.6	0.0143	3,738,642	0.6	0.3

Table 5.5–9. Daily PM_{2.5} emissions in Maricopa County by facility type, vehicle class and area type (excludes fugitive dust).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)	
COLLECTOR		1	18.2	0.0050	1,046,993	5.2	2.4	
		LDGV	2	19.1	0.0050	2,727,290	13.6	6.1
		with VMT	3	24.4	0.0049	1,694,159	8.3	3.7
		mix of	4	24.7	0.0048	872,616	4.2	1.9
		45.1%	5	28.2	0.0048	2,390,942	11.4	5.2
	LDGT1	1	18.2	0.0058	1,046,993	3.8	1.7	
		2	19.1	0.0058	2,727,290	9.8	4.5	
		with VMT	3	24.4	0.0057	1,694,159	6.0	2.7
		mix of	4	24.7	0.0057	872,616	3.1	1.4
		28.2%	5	28.2	0.0057	2,390,942	8.5	3.8
	LDGT2	1	18.2	0.0089	1,046,993	2.3	1.0	
		2	19.1	0.0089	2,727,290	6.0	2.7	
		with VMT	3	24.4	0.0089	1,694,159	3.7	1.7
		mix of	4	24.7	0.0089	872,616	1.9	0.9
		11.2%	5	28.2	0.0088	2,390,942	5.2	2.3
	HDGV	1	18.2	0.0566	1,046,993	4.7	2.1	
		2	19.1	0.0566	2,727,290	12.1	5.5	
		with VMT	3	24.4	0.0567	1,694,159	7.5	3.4
		mix of	4	24.7	0.0567	872,616	3.9	1.8
		3.6%	5	28.2	0.0567	2,390,942	10.6	4.8
	LDDV	1	18.2	0.1567	1,046,993	0.8	0.4	
		2	19.1	0.1567	2,727,290	2.1	0.9	
		with VMT	3	24.4	0.1567	1,694,159	1.3	0.6
		mix of	4	24.7	0.1567	872,616	0.7	0.3
		0.2%	5	28.2	0.1567	2,390,942	1.8	0.8
LDDT	1	18.2	0.1159	1,046,993	5.8	2.6		
	2	19.1	0.1159	2,727,290	15.1	6.8		
	with VMT	3	24.4	0.1159	1,694,159	9.3	4.2	
	mix of	4	24.7	0.1159	872,616	4.8	2.2	
	2.2%	5	28.2	0.1159	2,390,942	13.2	6.0	
HDDV	1	18.2	0.3325	1,046,993	69.8	31.6		
	2	19.1	0.3325	2,727,290	181.7	82.4		
	with VMT	3	24.4	0.3325	1,694,159	112.9	51.2	
	mix of	4	24.7	0.3325	872,616	58.1	26.4	
	9.1%	5	28.2	0.3325	2,390,942	159.3	72.3	
MC	1	18.2	0.0145	1,046,993	0.2	0.1		
	2	19.1	0.0145	2,727,290	0.4	0.2		
	with VMT	3	24.4	0.0144	1,694,159	0.3	0.1	
	mix of	4	24.7	0.0144	872,616	0.1	0.1	
	0.5%	5	28.2	0.0144	2,390,942	0.4	0.2	

Table 5.5–9. Daily PM_{2.5} emissions in Maricopa County by facility type, vehicle class and area type (excludes fugitive dust).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
LOCAL		1	12.9	0.0050	195,247	1.0	0.4
	LDGV	2	12.9	0.0050	1,991,136	9.9	4.5
	with VMT	3	12.9	0.0050	2,564,545	12.7	5.8
	mix of	4	12.9	0.0050	1,689,510	8.4	3.8
	45.1%	5	12.9	0.0050	1,422,562	7.1	3.2
		1	12.9	0.0058	195,247	0.7	0.3
	LDGT1	2	12.9	0.0058	1,991,136	7.2	3.3
	with VMT	3	12.9	0.0058	2,564,545	9.3	4.2
	mix of	4	12.9	0.0058	1,689,510	6.1	2.8
	28.2%	5	12.9	0.0058	1,422,562	5.1	2.3
		1	12.9	0.0089	195,247	0.4	0.2
	LDGT2	2	12.9	0.0089	1,991,136	4.4	2.0
	with VMT	3	12.9	0.0089	2,564,545	5.6	2.5
	mix of	4	12.9	0.0089	1,689,510	3.7	1.7
	11.2%	5	12.9	0.0089	1,422,562	3.1	1.4
		1	12.9	0.0566	195,247	0.9	0.4
	HDGV	2	12.9	0.0566	1,991,136	8.8	4.0
	with VMT	3	12.9	0.0566	2,564,545	11.4	5.2
	mix of	4	12.9	0.0566	1,689,510	7.5	3.4
	3.6%	5	12.9	0.0566	1,422,562	6.3	2.9
	1	12.9	0.1567	195,247	0.1	0.1	
LDDV	2	12.9	0.1567	1,991,136	1.5	0.7	
with VMT	3	12.9	0.1567	2,564,545	1.9	0.9	
mix of	4	12.9	0.1567	1,689,510	1.3	0.6	
0.2%	5	12.9	0.1567	1,422,562	1.1	0.5	
	1	12.9	0.1159	195,247	1.1	0.5	
LDDT	2	12.9	0.1159	1,991,136	11.0	5.0	
with VMT	3	12.9	0.1159	2,564,545	14.2	6.4	
mix of	4	12.9	0.1159	1,689,510	9.3	4.2	
2.2%	5	12.9	0.1159	1,422,562	7.9	3.6	
	1	12.9	0.3325	195,247	13.0	5.9	
HDDV	2	12.9	0.3325	1,991,136	132.7	60.2	
with VMT	3	12.9	0.3325	2,564,545	170.9	77.5	
mix of	4	12.9	0.3325	1,689,510	112.6	51.1	
9.1%	5	12.9	0.3325	1,422,562	94.8	43.0	
	1	12.9	0.0145	195,247	0.0	0.0	
MC	2	12.9	0.0145	1,991,136	0.3	0.1	
with VMT	3	12.9	0.0145	2,564,545	0.4	0.2	
mix of	4	12.9	0.0145	1,689,510	0.3	0.1	
0.5%	5	12.9	0.0145	1,422,562	0.2	0.1	

Table 5.5–10. Daily NO_x emissions in Maricopa County by facility type, vehicle class and area type (annual average day).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
INTERSTATE, FREEWAY, and EXPRESSWAY		1	59.7	0.964	1,129,051	1,082.0	490.8
	LDGV	2	60.3	0.966	9,046,583	8,686.1	3,940.0
	with VMT	3	63.2	0.968	6,240,489	6,001.1	2,722.1
	mix of	4	64.8	0.968	4,525,653	4,352.1	1,974.1
	45.1%	5	64.2	0.968	5,662,224	5,445.0	2,469.9
		1	59.7	1.188	1,129,051	834.6	378.6
	LDGT1	2	60.3	1.191	9,046,583	6,700.8	3,039.5
	with VMT	3	63.2	1.193	6,240,489	4,630.1	2,100.2
	mix of	4	64.8	1.193	4,525,653	3,357.8	1,523.1
	28.2%	5	64.2	1.193	5,662,224	4,201.1	1,905.6
		1	59.7	1.486	1,129,051	412.6	187.2
	LDGT2	2	60.3	1.488	9,046,583	3,312.5	1,502.5
	with VMT	3	63.2	1.490	6,240,489	2,287.9	1,037.8
	mix of	4	64.8	1.490	4,525,653	1,659.2	752.6
	11.2%	5	64.2	1.490	5,662,224	2,075.9	941.6
		1	59.7	5.537	1,129,051	490.6	222.5
	HDGV	2	60.3	5.560	9,046,583	3,947.2	1,790.5
	with VMT	3	63.2	5.575	6,240,489	2,730.3	1,238.4
	mix of	4	64.8	5.575	4,525,653	1,980.0	898.1
	3.6%	5	64.2	5.575	5,662,224	2,477.3	1,123.7
	1	59.7	1.787	1,129,051	9.8	4.4	
LDDV	2	60.3	1.832	9,046,583	80.4	36.5	
with VMT	3	63.2	1.862	6,240,489	56.4	25.6	
mix of	4	64.8	1.862	4,525,653	40.9	18.5	
0.2%	5	64.2	1.862	5,662,224	51.1	23.2	
	1	59.7	1.180	1,129,051	63.4	28.8	
LDDT	2	60.3	1.210	9,046,583	521.2	236.4	
with VMT	3	63.2	1.230	6,240,489	365.5	165.8	
mix of	4	64.8	1.230	4,525,653	265.0	120.2	
2.2%	5	64.2	1.230	5,662,224	331.6	150.4	
	1	59.7	23.357	1,129,051	5,284.2	2,396.9	
HDDV	2	60.3	23.825	9,046,583	43,187.5	19,589.8	
with VMT	3	63.2	24.130	6,240,489	30,173.0	13,686.5	
mix of	4	64.8	24.130	4,525,653	21,881.7	9,925.5	
9.1%	5	64.2	24.130	5,662,224	27,377.0	12,418.2	
	1	59.7	1.680	1,129,051	21.3	9.7	
MC	2	60.3	1.699	9,046,583	172.8	78.4	
with VMT	3	63.2	1.710	6,240,489	120.0	54.4	
mix of	4	64.8	1.710	4,525,653	87.0	39.5	
0.5%	5	64.2	1.710	5,662,224	108.9	49.4	

Table 5.5–10. Daily NO_x emissions in Maricopa County by facility type, vehicle class and area type (annual average day) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
		1	30.3	0.900	1,087,462	972.9	441.3
PRINCIPAL	LDGV	2	34.4	0.883	8,834,531	7,755.4	3,517.9
ARTERIALS	with VMT	3	36.1	0.883	9,795,953	8,600.4	3,901.1
&	mix of	4	39.0	0.884	6,923,412	6,080.5	2,758.1
MINOR	45.1%	5	42.6	0.893	3,738,642	3,317.7	1,504.9
ARTERIALS		1	30.3	1.088	1,087,462	736.1	333.9
	LDGT1	2	34.4	1.076	8,834,531	5,914.5	2,682.8
	with VMT	3	36.1	1.078	9,795,953	6,568.5	2,979.5
	mix of	4	39.0	1.080	6,923,412	4,650.5	2,109.5
	28.2%	5	42.6	1.092	3,738,642	2,540.6	1,152.4
		1	30.3	1.380	1,087,462	369.2	167.5
	LDGT2	2	34.4	1.366	8,834,531	2,969.5	1,346.9
	with VMT	3	36.1	1.368	9,795,953	3,296.2	1,495.2
	mix of	4	39.0	1.369	6,923,412	2,331.2	1,057.4
	11.2%	5	42.6	1.382	3,738,642	1,270.6	576.3
		1	30.3	4.426	1,087,462	377.7	171.3
	HDGV	2	34.4	4.573	8,834,531	3,170.5	1,438.1
	with VMT	3	36.1	4.635	9,795,953	3,563.3	1,616.3
	mix of	4	39.0	4.738	6,923,412	2,574.5	1,167.8
	3.6%	5	42.6	4.868	3,738,642	1,428.3	647.9
		1	30.3	1.005	1,087,462	5.3	2.4
	LDDV	2	34.4	0.997	8,834,531	42.7	19.4
	with VMT	3	36.1	1.002	9,795,953	47.6	21.6
	mix of	4	39.0	1.017	6,923,412	34.1	15.5
	0.2%	5	42.6	1.056	3,738,642	19.1	8.7
		1	30.3	0.658	1,087,462	34.1	15.5
	LDDT	2	34.4	0.653	8,834,531	274.7	124.6
	with VMT	3	36.1	0.657	9,795,953	306.3	138.9
	mix of	4	39.0	0.666	6,923,412	219.5	99.6
	2.2%	5	42.6	0.692	3,738,642	123.2	55.9
		1	30.3	13.045	1,087,462	2,842.5	1,289.4
	HDDV	2	34.4	12.970	8,834,531	22,959.1	10,414.2
	with VMT	3	36.1	13.024	9,795,953	25,565.2	11,596.4
	mix of	4	39.0	12.429	6,923,412	17,242.6	7,821.3
	9.1%	5	42.6	12.827	3,738,642	9,609.0	4,358.7
		1	30.3	1.172	1,087,462	14.3	6.5
	MC	2	34.4	1.209	8,834,531	120.1	54.5
	with VMT	3	36.1	1.220	9,795,953	134.3	60.9
	mix of	4	39.0	1.238	6,923,412	96.4	43.7
	0.5%	5	42.6	1.257	3,738,642	52.8	24.0

Table 5.5–10. Daily NO_x emissions in Maricopa County by facility type, vehicle class and area type (annual average day) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
COLLECTOR		1	18.2	1.037	1,046,993	1,079.1	489.5
	LDGV	2	19.1	1.021	2,727,290	2,768.3	1,255.7
	with VMT	3	24.4	0.950	1,694,159	1,599.7	725.6
	mix of	4	24.7	0.947	872,616	821.3	372.5
	45.1%	5	28.2	0.914	2,390,942	2,172.8	985.6
		1	18.2	1.223	1,046,993	796.8	361.4
	LDGT1	2	19.1	1.207	2,727,290	2,047.9	928.9
	with VMT	3	24.4	1.136	1,694,159	1,197.1	543.0
	mix of	4	24.7	1.133	872,616	614.9	278.9
	28.2%	5	28.2	1.101	2,390,942	1,637.1	742.6
		1	18.2	1.548	1,046,993	398.7	180.9
	LDGT2	2	19.1	1.528	2,727,290	1,025.4	465.1
	with VMT	3	24.4	1.440	1,694,159	600.0	272.2
	mix of	4	24.7	1.436	872,616	308.2	139.8
	11.2%	5	28.2	1.396	2,390,942	821.2	372.5
		1	18.2	4.004	1,046,993	328.9	149.2
	HDGV	2	19.1	4.031	2,727,290	862.8	391.3
	with VMT	3	24.4	4.217	1,694,159	560.7	254.3
	mix of	4	24.7	4.226	872,616	289.4	131.3
	3.6%	5	28.2	4.356	2,390,942	817.4	370.8
		1	18.2	1.172	1,046,993	6.0	2.7
	LDDV	2	19.1	1.151	2,727,290	15.2	6.9
	with VMT	3	24.4	1.057	1,694,159	8.7	3.9
	mix of	4	24.7	1.053	872,616	4.5	2.0
	0.2%	5	28.2	1.019	2,390,942	11.8	5.4
	1	18.2	0.770	1,046,993	38.4	17.4	
LDDT	2	19.1	0.756	2,727,290	98.2	44.5	
with VMT	3	24.4	0.693	1,694,159	55.9	25.4	
mix of	4	24.7	0.691	872,616	28.7	13.0	
2.2%	5	28.2	0.668	2,390,942	76.0	34.5	
	1	18.2	14.028	1,046,993	2,942.9	1,334.9	
HDDV	2	19.1	13.815	2,727,290	7,549.4	3,424.4	
with VMT	3	24.4	12.843	1,694,159	4,359.7	1,977.6	
mix of	4	24.7	12.800	872,616	2,238.1	1,015.2	
9.1%	5	28.2	12.450	2,390,942	5,964.8	2,705.6	
	1	18.2	1.030	1,046,993	12.1	5.5	
MC	2	19.1	1.039	2,727,290	31.9	14.5	
with VMT	3	24.4	1.101	1,694,159	21.0	9.5	
mix of	4	24.7	1.107	872,616	10.9	4.9	
0.5%	5	28.2	1.148	2,390,942	30.9	14.0	

Table 5.5–10. Daily NO_x emissions in Maricopa County by facility type, vehicle class and area type (annual average day) (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
LOCAL		1	12.9	1.173	195,247	227.7	103.3
	LDGV	2	12.9	1.173	1,991,136	2,321.7	1,053.1
	with VMT	3	12.9	1.173	2,564,545	2,990.3	1,356.4
	mix of	4	12.9	1.173	1,689,510	1,970.0	893.6
	45.1%	5	12.9	1.173	1,422,562	1,658.7	752.4
		1	12.9	1.362	195,247	165.5	75.1
	LDGT1	2	12.9	1.362	1,991,136	1,687.4	765.4
	with VMT	3	12.9	1.362	2,564,545	2,173.3	985.8
	mix of	4	12.9	1.362	1,689,510	1,431.8	649.5
	28.2%	5	12.9	1.362	1,422,562	1,205.5	546.8
		1	12.9	1.721	195,247	82.6	37.5
	LDGT2	2	12.9	1.721	1,991,136	842.8	382.3
	with VMT	3	12.9	1.721	2,564,545	1,085.5	492.4
	mix of	4	12.9	1.721	1,689,510	715.1	324.4
	11.2%	5	12.9	1.721	1,422,562	602.1	273.1
		1	12.9	3.820	195,247	58.5	26.5
	HDGV	2	12.9	3.820	1,991,136	596.8	270.7
	with VMT	3	12.9	3.820	2,564,545	768.7	348.7
	mix of	4	12.9	3.820	1,689,510	506.4	229.7
	3.6%	5	12.9	3.820	1,422,562	426.4	193.4
	1	12.9	1.330	195,247	1.3	0.6	
LDDV	2	12.9	1.330	1,991,136	12.8	5.8	
with VMT	3	12.9	1.330	2,564,545	16.5	7.5	
mix of	4	12.9	1.330	1,689,510	10.9	4.9	
0.2%	5	12.9	1.330	1,422,562	9.2	4.2	
	1	12.9	0.875	195,247	8.1	3.7	
LDDT	2	12.9	0.875	1,991,136	83.0	37.6	
with VMT	3	12.9	0.875	2,564,545	106.8	48.5	
mix of	4	12.9	0.875	1,689,510	70.4	31.9	
2.2%	5	12.9	0.875	1,422,562	59.3	26.9	
	1	12.9	15.660	195,247	612.7	277.9	
HDDV	2	12.9	15.660	1,991,136	6,248.1	2,834.1	
with VMT	3	12.9	15.660	2,564,545	8,047.4	3,650.3	
mix of	4	12.9	15.660	1,689,510	5,301.6	2,404.8	
9.1%	5	12.9	15.660	1,422,562	4,463.9	2,024.8	
	1	12.9	0.990	195,247	2.2	1.0	
MC	2	12.9	0.990	1,991,136	22.2	10.1	
with VMT	3	12.9	0.990	2,564,545	28.5	12.9	
mix of	4	12.9	0.990	1,689,510	18.8	8.5	
0.5%	5	12.9	0.990	1,422,562	15.8	7.2	

Table 5.5–11. Daily sulfur dioxide (gaseous) emissions in Maricopa County by facility type, vehicle class and area type.

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)	
INTERSTATE, FREEWAY, and EXPRESSWAY		1	59.7	0.0119	1,129,051	13.4	6.1	
		2	60.3	0.0119	9,046,583	107.0	48.5	
		with VMT	3	63.2	0.0119	6,240,489	73.8	33.5
		mix of	4	64.8	0.0119	4,525,653	53.5	24.3
		45.1%	5	64.2	0.0119	5,662,224	67.0	30.4
	LDGT1	1	59.7	0.0151	1,129,051	10.6	4.8	
		2	60.3	0.0151	9,046,583	85.0	38.5	
		with VMT	3	63.2	0.0151	6,240,489	58.6	26.6
		mix of	4	64.8	0.0151	4,525,653	42.5	19.3
		28.2%	5	64.2	0.0151	5,662,224	53.2	24.1
	LDGT2	1	59.7	0.0198	1,129,051	5.5	2.5	
		2	60.3	0.0198	9,046,583	44.1	20.0	
		with VMT	3	63.2	0.0198	6,240,489	30.4	13.8
		mix of	4	64.8	0.0198	4,525,653	22.0	10.0
		11.2%	5	64.2	0.0198	5,662,224	27.6	12.5
	HDGV	1	59.7	0.0298	1,129,051	2.6	1.2	
		2	60.3	0.0298	9,046,583	21.2	9.6	
		with VMT	3	63.2	0.0298	6,240,489	14.6	6.6
		mix of	4	64.8	0.0298	4,525,653	10.6	4.8
		3.6%	5	64.2	0.0298	5,662,224	13.2	6.0
LDDV	1	59.7	0.0637	1,129,051	0.3	0.2		
	2	60.3	0.0637	9,046,583	2.8	1.3		
	with VMT	3	63.2	0.0637	6,240,489	1.9	0.9	
	mix of	4	64.8	0.0637	4,525,653	1.4	0.6	
	0.2%	5	64.2	0.0637	5,662,224	1.7	0.8	
LDDT	1	59.7	0.0910	1,129,051	4.9	2.2		
	2	60.3	0.0910	9,046,583	39.2	17.8		
	with VMT	3	63.2	0.0910	6,240,489	27.0	12.3	
	mix of	4	64.8	0.0910	4,525,653	19.6	8.9	
	2.2%	5	64.2	0.0910	5,662,224	24.5	11.1	
HDDV	1	59.7	0.2770	1,129,051	62.7	28.4		
	2	60.3	0.2770	9,046,583	502.1	227.8		
	with VMT	3	63.2	0.2770	6,240,489	346.4	157.1	
	mix of	4	64.8	0.2770	4,525,653	251.2	113.9	
	9.1%	5	64.2	0.2770	5,662,224	314.3	142.6	
MC	1	59.7	0.0057	1,129,051	0.1	0.0		
	2	60.3	0.0057	9,046,583	0.6	0.3		
	with VMT	3	63.2	0.0057	6,240,489	0.4	0.2	
	mix of	4	64.8	0.0057	4,525,653	0.3	0.1	
	0.5%	5	64.2	0.0057	5,662,224	0.4	0.2	

Table 5.5–11. Daily sulfur dioxide (gaseous) emissions in Maricopa County by facility type, vehicle class and area type (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
PRINCIPAL ARTERIAL & MINOR ARTERIAL		1	30.3	0.0119	1,087,462	12.9	5.8
	LDGV	2	34.4	0.0119	8,834,531	104.5	47.4
	with VMT	3	36.1	0.0119	9,795,953	115.9	52.6
	mix of	4	39.0	0.0119	6,923,412	81.9	37.1
	45.1%	5	42.6	0.0119	3,738,642	44.2	20.1
		1	30.3	0.0151	1,087,462	10.2	4.6
	LDGT1	2	34.4	0.0151	8,834,531	83.0	37.6
	with VMT	3	36.1	0.0151	9,795,953	92.0	41.7
	mix of	4	39.0	0.0151	6,923,412	65.0	29.5
	28.2%	5	42.6	0.0151	3,738,642	35.1	15.9
		1	30.3	0.0198	1,087,462	5.3	2.4
	LDGT2	2	34.4	0.0198	8,834,531	43.0	19.5
	with VMT	3	36.1	0.0198	9,795,953	47.7	21.6
	mix of	4	39.0	0.0198	6,923,412	33.7	15.3
	11.2%	5	42.6	0.0198	3,738,642	18.2	8.3
		1	30.3	0.0298	1,087,462	2.5	1.2
	HDGV	2	34.4	0.0298	8,834,531	20.7	9.4
	with VMT	3	36.1	0.0298	9,795,953	22.9	10.4
	mix of	4	39.0	0.0298	6,923,412	16.2	7.3
	3.6%	5	42.6	0.0298	3,738,642	8.7	4.0
		1	30.3	0.0637	1,087,462	0.3	0.2
	LDDV	2	34.4	0.0637	8,834,531	2.7	1.2
	with VMT	3	36.1	0.0637	9,795,953	3.0	1.4
	mix of	4	39.0	0.0637	6,923,412	2.1	1.0
	0.2%	5	42.6	0.0637	3,738,642	1.2	0.5
		1	30.3	0.0910	1,087,462	4.7	2.1
	LDDT	2	34.4	0.0910	8,834,531	38.3	17.4
	with VMT	3	36.1	0.0910	9,795,953	42.4	19.3
	mix of	4	39.0	0.0910	6,923,412	30.0	13.6
	2.2%	5	42.6	0.0910	3,738,642	16.2	7.3
		1	30.3	0.2770	1,087,462	60.4	27.4
	HDDV	2	34.4	0.2770	8,834,531	490.4	222.4
	with VMT	3	36.1	0.2770	9,795,953	543.7	246.6
	mix of	4	39.0	0.2770	6,923,412	384.3	174.3
	9.1%	5	42.6	0.2770	3,738,642	207.5	94.1
		1	30.3	0.0057	1,087,462	0.1	0.0
	MC	2	34.4	0.0057	8,834,531	0.6	0.3
	with VMT	3	36.1	0.0057	9,795,953	0.6	0.3
	mix of	4	39.0	0.0057	6,923,412	0.4	0.2
	0.5%	5	42.6	0.0057	3,738,642	0.2	0.1

Table 5.5–11. Daily sulfur dioxide (gaseous) emissions in Maricopa County by facility type, vehicle class and area type (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
COLLECTOR		1	18.2	0.0118	1,046,993	12.3	5.6
	LDGV	2	19.1	0.0118	2,727,290	32.0	14.5
	with VMT	3	24.4	0.0118	1,694,159	19.9	9.0
	mix of	4	24.7	0.0118	872,616	10.2	4.6
	45.1%	5	28.2	0.0118	2,390,942	28.0	12.7
		1	18.2	0.0151	1,046,993	9.8	4.5
	LDGT1	2	19.1	0.0151	2,727,290	25.6	11.6
	with VMT	3	24.4	0.0151	1,694,159	15.9	7.2
	mix of	4	24.7	0.0151	872,616	8.2	3.7
	28.2%	5	28.2	0.0151	2,390,942	22.5	10.2
		1	18.2	0.0198	1,046,993	5.1	2.3
	LDGT2	2	19.1	0.0198	2,727,290	13.3	6.0
	with VMT	3	24.4	0.0198	1,694,159	8.3	3.7
	mix of	4	24.7	0.0198	872,616	4.3	1.9
	11.2%	5	28.2	0.0198	2,390,942	11.6	5.3
		1	18.2	0.0299	1,046,993	2.5	1.1
	HDGV	2	19.1	0.0299	2,727,290	6.4	2.9
	with VMT	3	24.4	0.0299	1,694,159	4.0	1.8
	mix of	4	24.7	0.0299	872,616	2.0	0.9
	3.6%	5	28.2	0.0299	2,390,942	5.6	2.5
		1	18.2	0.0637	1,046,993	0.3	0.1
	LDDV	2	19.1	0.0637	2,727,290	0.8	0.4
	with VMT	3	24.4	0.0637	1,694,159	0.5	0.2
	mix of	4	24.7	0.0637	872,616	0.3	0.1
	0.2%	5	28.2	0.0637	2,390,942	0.7	0.3
	1	18.2	0.0910	1,046,993	4.5	2.1	
LDDT	2	19.1	0.0910	2,727,290	11.8	5.4	
with VMT	3	24.4	0.0910	1,694,159	7.3	3.3	
mix of	4	24.7	0.0910	872,616	3.8	1.7	
2.2%	5	28.2	0.0910	2,390,942	10.4	4.7	
	1	18.2	0.2770	1,046,993	58.1	26.4	
HDDV	2	19.1	0.2770	2,727,290	151.4	68.7	
with VMT	3	24.4	0.2770	1,694,159	94.0	42.7	
mix of	4	24.7	0.2770	872,616	48.4	22.0	
9.1%	5	28.2	0.2770	2,390,942	132.7	60.2	
	1	18.2	0.0057	1,046,993	0.1	0.0	
MC	2	19.1	0.0057	2,727,290	0.2	0.1	
with VMT	3	24.4	0.0057	1,694,159	0.1	0.0	
mix of	4	24.7	0.0057	872,616	0.1	0.0	
0.5%	5	28.2	0.0057	2,390,942	0.2	0.1	

Table 5.5–11. Daily sulfur dioxide (gaseous) emissions in Maricopa County by facility type, vehicle class and area type (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
LOCAL		1	12.9	0.0118	195,247	2.3	1.0
	LDGV	2	12.9	0.0118	1,991,136	23.4	10.6
	with VMT	3	12.9	0.0118	2,564,545	30.1	13.6
	mix of	4	12.9	0.0118	1,689,510	19.8	9.0
	45.1%	5	12.9	0.0118	1,422,562	16.7	7.6
		1	12.9	0.0151	195,247	1.8	0.8
	LDGT1	2	12.9	0.0151	1,991,136	18.7	8.5
	with VMT	3	12.9	0.0151	2,564,545	24.1	10.9
	mix of	4	12.9	0.0151	1,689,510	15.9	7.2
	28.2%	5	12.9	0.0151	1,422,562	13.4	6.1
		1	12.9	0.0198	195,247	1.0	0.4
	LDGT2	2	12.9	0.0198	1,991,136	9.7	4.4
	with VMT	3	12.9	0.0198	2,564,545	12.5	5.7
	mix of	4	12.9	0.0198	1,689,510	8.2	3.7
	11.2%	5	12.9	0.0198	1,422,562	6.9	3.1
		1	12.9	0.0299	195,247	0.5	0.2
	HDGV	2	12.9	0.0299	1,991,136	4.7	2.1
	with VMT	3	12.9	0.0299	2,564,545	6.0	2.7
	mix of	4	12.9	0.0299	1,689,510	4.0	1.8
	3.6%	5	12.9	0.0299	1,422,562	3.3	1.5
		1	12.9	0.0637	195,247	0.1	0.0
	LDDV	2	12.9	0.0637	1,991,136	0.6	0.3
	with VMT	3	12.9	0.0637	2,564,545	0.8	0.4
	mix of	4	12.9	0.0637	1,689,510	0.5	0.2
	0.2%	5	12.9	0.0637	1,422,562	0.4	0.2
	1	12.9	0.0910	195,247	0.8	0.4	
LDDT	2	12.9	0.0910	1,991,136	8.6	3.9	
with VMT	3	12.9	0.0910	2,564,545	11.1	5.0	
mix of	4	12.9	0.0910	1,689,510	7.3	3.3	
2.2%	5	12.9	0.0910	1,422,562	6.2	2.8	
	1	12.9	0.2770	195,247	10.8	4.9	
HDDV	2	12.9	0.2770	1,991,136	110.5	50.1	
with VMT	3	12.9	0.2770	2,564,545	142.3	64.6	
mix of	4	12.9	0.2770	1,689,510	93.8	42.5	
9.1%	5	12.9	0.2770	1,422,562	79.0	35.8	
	1	12.9	0.0057	195,247	0.0	0.0	
MC	2	12.9	0.0057	1,991,136	0.1	0.1	
with VMT	3	12.9	0.0057	2,564,545	0.2	0.1	
mix of	4	12.9	0.0057	1,689,510	0.1	0.0	
0.5%	5	12.9	0.0057	1,422,562	0.1	0.0	

Table 5.5–12. Daily ammonia emissions in Maricopa County by facility type, vehicle class and area type.

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
INTERSTATE, FREEWAY, and EXPRESSWAY	LDGV with VMT mix of 45.1%	1	59.7	0.1002	1,129,051	112.4	51.0
		2	60.3	0.1002	9,046,583	901.0	408.7
		3	63.2	0.1002	6,240,489	621.5	281.9
		4	64.8	0.1002	4,525,653	450.7	204.4
		5	64.2	0.1002	5,662,224	563.9	255.8
	LDGT1 with VMT mix of 28.2%	1	59.7	0.0983	1,129,051	69.0	31.3
		2	60.3	0.0983	9,046,583	553.2	250.9
		3	63.2	0.0983	6,240,489	381.6	173.1
		4	64.8	0.0983	4,525,653	276.7	125.5
		5	64.2	0.0983	5,662,224	346.2	157.1
	LDGT2 with VMT mix of 11.2%	1	59.7	0.0973	1,129,051	27.0	12.3
		2	60.3	0.0973	9,046,583	216.5	98.2
		3	63.2	0.0973	6,240,489	149.4	67.8
		4	64.8	0.0973	4,525,653	108.3	49.1
		5	64.2	0.0973	5,662,224	135.5	61.5
	HDGV with VMT mix of 3.6%	1	59.7	0.0451	1,129,051	4.0	1.8
		2	60.3	0.0451	9,046,583	32.0	14.5
		3	63.2	0.0451	6,240,489	22.1	10.0
		4	64.8	0.0451	4,525,653	16.0	7.3
		5	64.2	0.0451	5,662,224	20.0	9.1
	LDDV with VMT mix of 0.2%	1	59.7	0.0068	1,129,051	0.0	0.0
		2	60.3	0.0068	9,046,583	0.3	0.1
		3	63.2	0.0068	6,240,489	0.2	0.1
		4	64.8	0.0068	4,525,653	0.1	0.1
		5	64.2	0.0068	5,662,224	0.2	0.1
LDDT with VMT mix of 2.2%	1	59.7	0.0068	1,129,051	0.4	0.2	
	2	60.3	0.0068	9,046,583	2.9	1.3	
	3	63.2	0.0068	6,240,489	2.0	0.9	
	4	64.8	0.0068	4,525,653	1.5	0.7	
	5	64.2	0.0068	5,662,224	1.8	0.8	
HDDV with VMT mix of 9.1%	1	59.7	0.0270	1,129,051	6.1	2.8	
	2	60.3	0.0270	9,046,583	48.9	22.2	
	3	63.2	0.0270	6,240,489	33.8	15.3	
	4	64.8	0.0270	4,525,653	24.5	11.1	
	5	64.2	0.0270	5,662,224	30.6	13.9	
MC with VMT mix of 0.5%	1	59.7	0.0113	1,129,051	0.1	0.1	
	2	60.3	0.0113	9,046,583	1.1	0.5	
	3	63.2	0.0113	6,240,489	0.8	0.4	
	4	64.8	0.0113	4,525,653	0.6	0.3	
	5	64.2	0.0113	5,662,224	0.7	0.3	

Table 5.5–12. Daily ammonia emissions in Maricopa County by facility type, vehicle class and area type (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
PRINCIPAL ARTERIAL & MINOR ARTERIAL		1	30.3	0.1002	1,087,462	108.3	49.1
	LDGV	2	34.4	0.1002	8,834,531	879.9	399.1
	with VMT	3	36.1	0.1002	9,795,953	975.6	442.5
	mix of	4	39.0	0.1002	6,923,412	689.5	312.8
	45.1%	5	42.6	0.1002	3,738,642	372.3	168.9
		1	30.3	0.0983	1,087,462	66.5	30.2
	LDGT1	2	34.4	0.0983	8,834,531	540.2	245.0
	with VMT	3	36.1	0.0983	9,795,953	599.0	271.7
	mix of	4	39.0	0.0983	6,923,412	423.4	192.0
	28.2%	5	42.6	0.0983	3,738,642	228.6	103.7
		1	30.3	0.0973	1,087,462	26.0	11.8
	LDGT2	2	34.4	0.0973	8,834,531	211.5	95.9
	with VMT	3	36.1	0.0973	9,795,953	234.5	106.4
	mix of	4	39.0	0.0973	6,923,412	165.7	75.2
	11.2%	5	42.6	0.0973	3,738,642	89.5	40.6
		1	30.3	0.0451	1,087,462	3.8	1.7
	HDGV	2	34.4	0.0451	8,834,531	31.3	14.2
	with VMT	3	36.1	0.0451	9,795,953	34.7	15.7
	mix of	4	39.0	0.0451	6,923,412	24.5	11.1
	3.6%	5	42.6	0.0451	3,738,642	13.2	6.0
		1	30.3	0.0068	1,087,462	0.0	0.0
	LDDV	2	34.4	0.0068	8,834,531	0.3	0.1
	with VMT	3	36.1	0.0068	9,795,953	0.3	0.1
	mix of	4	39.0	0.0068	6,923,412	0.2	0.1
	0.2%	5	42.6	0.0068	3,738,642	0.1	0.1
		1	30.3	0.0068	1,087,462	0.4	0.2
	LDDT	2	34.4	0.0068	8,834,531	2.9	1.3
	with VMT	3	36.1	0.0068	9,795,953	3.2	1.4
	mix of	4	39.0	0.0068	6,923,412	2.2	1.0
	2.2%	5	42.6	0.0068	3,738,642	1.2	0.5
		1	30.3	0.0270	1,087,462	5.9	2.7
	HDDV	2	34.4	0.0270	8,834,531	47.8	21.7
	with VMT	3	36.1	0.0270	9,795,953	53.0	24.0
	mix of	4	39.0	0.0270	6,923,412	37.5	17.0
	9.1%	5	42.6	0.0270	3,738,642	20.2	9.2
		1	30.3	0.0113	1,087,462	0.1	0.1
	MC	2	34.4	0.0113	8,834,531	1.1	0.5
	with VMT	3	36.1	0.0113	9,795,953	1.2	0.6
	mix of	4	39.0	0.0113	6,923,412	0.9	0.4
	0.5%	5	42.6	0.0113	3,738,642	0.5	0.2

Table 5.5–12. Daily ammonia emissions in Maricopa County by facility type, vehicle class and area type (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
COLLECTOR		1	18.2	0.1002	1,046,993	104.3	47.3
	LDGV	2	19.1	0.1002	2,727,290	271.6	123.2
	with VMT	3	24.4	0.1002	1,694,159	168.7	76.5
	mix of	4	24.7	0.1002	872,616	86.9	39.4
	45.1%	5	28.2	0.1002	2,390,942	238.1	108.0
		1	18.2	0.0983	1,046,993	64.0	29.0
	LDGT1	2	19.1	0.0983	2,727,290	166.8	75.6
	with VMT	3	24.4	0.0983	1,694,159	103.6	47.0
	mix of	4	24.7	0.0983	872,616	53.4	24.2
	28.2%	5	28.2	0.0983	2,390,942	146.2	66.3
		1	18.2	0.0973	1,046,993	25.1	11.4
	LDGT2	2	19.1	0.0973	2,727,290	65.3	29.6
	with VMT	3	24.4	0.0973	1,694,159	40.6	18.4
	mix of	4	24.7	0.0973	872,616	20.9	9.5
	11.2%	5	28.2	0.0973	2,390,942	57.2	26.0
		1	18.2	0.0451	1,046,993	3.7	1.7
	HDGV	2	19.1	0.0451	2,727,290	9.7	4.4
	with VMT	3	24.4	0.0451	1,694,159	6.0	2.7
	mix of	4	24.7	0.0451	872,616	3.1	1.4
	3.6%	5	28.2	0.0451	2,390,942	8.5	3.8
		1	18.2	0.0068	1,046,993	0.0	0.0
	LDDV	2	19.1	0.0068	2,727,290	0.1	0.0
	with VMT	3	24.4	0.0068	1,694,159	0.1	0.0
	mix of	4	24.7	0.0068	872,616	0.0	0.0
	0.2%	5	28.2	0.0068	2,390,942	0.1	0.0
	1	18.2	0.0068	1,046,993	0.3	0.2	
LDDT	2	19.1	0.0068	2,727,290	0.9	0.4	
with VMT	3	24.4	0.0068	1,694,159	0.5	0.2	
mix of	4	24.7	0.0068	872,616	0.3	0.1	
2.2%	5	28.2	0.0068	2,390,942	0.8	0.4	
	1	18.2	0.0270	1,046,993	5.7	2.6	
HDDV	2	19.1	0.0270	2,727,290	14.8	6.7	
with VMT	3	24.4	0.0270	1,694,159	9.2	4.2	
mix of	4	24.7	0.0270	872,616	4.7	2.1	
9.1%	5	28.2	0.0270	2,390,942	12.9	5.9	
	1	18.2	0.0113	1,046,993	0.1	0.1	
MC	2	19.1	0.0113	2,727,290	0.3	0.2	
with VMT	3	24.4	0.0113	1,694,159	0.2	0.1	
mix of	4	24.7	0.0113	872,616	0.1	0.1	
0.5%	5	28.2	0.0113	2,390,942	0.3	0.1	

Table 5.5–12. Daily ammonia emissions in Maricopa County by facility type, vehicle class and area type (continued).

Facility type	Vehicle class	Area type	Speed (mph)	Emission factor (g/mi)	DVMT (miles)	Emissions (lb/day)	Emissions (kg/day)
LOCAL		1	12.9	0.1002	195,247	19.4	8.8
	LDGV	2	12.9	0.1002	1,991,136	198.3	90.0
	with VMT	3	12.9	0.1002	2,564,545	255.4	115.9
	mix of	4	12.9	0.1002	1,689,510	168.3	76.3
	45.1%	5	12.9	0.1002	1,422,562	141.7	64.3
		1	12.9	0.0983	195,247	11.9	5.4
	LDGT1	2	12.9	0.0983	1,991,136	121.8	55.2
	with VMT	3	12.9	0.0983	2,564,545	156.8	71.1
	mix of	4	12.9	0.0983	1,689,510	103.3	46.9
	28.2%	5	12.9	0.0983	1,422,562	87.0	39.5
		1	12.9	0.0973	195,247	4.7	2.1
	LDGT2	2	12.9	0.0973	1,991,136	47.7	21.6
	with VMT	3	12.9	0.0973	2,564,545	61.4	27.8
	mix of	4	12.9	0.0973	1,689,510	40.4	18.3
	11.2%	5	12.9	0.0973	1,422,562	34.1	15.4
		1	12.9	0.0451	195,247	0.7	0.3
	HDGV	2	12.9	0.0451	1,991,136	7.0	3.2
	with VMT	3	12.9	0.0451	2,564,545	9.1	4.1
	mix of	4	12.9	0.0451	1,689,510	6.0	2.7
	3.6%	5	12.9	0.0451	1,422,562	5.0	2.3
		1	12.9	0.0068	195,247	0.0	0.0
	LDDV	2	12.9	0.0068	1,991,136	0.1	0.0
	with VMT	3	12.9	0.0068	2,564,545	0.1	0.0
	mix of	4	12.9	0.0068	1,689,510	0.1	0.0
	0.2%	5	12.9	0.0068	1,422,562	0.0	0.0
	1	12.9	0.0068	195,247	0.1	0.0	
LDDT	2	12.9	0.0068	1,991,136	0.6	0.3	
with VMT	3	12.9	0.0068	2,564,545	0.8	0.4	
mix of	4	12.9	0.0068	1,689,510	0.5	0.2	
2.2%	5	12.9	0.0068	1,422,562	0.5	0.2	
	1	12.9	0.0270	195,247	1.1	0.5	
HDDV	2	12.9	0.0270	1,991,136	10.8	4.9	
with VMT	3	12.9	0.0270	2,564,545	13.9	6.3	
mix of	4	12.9	0.0270	1,689,510	9.1	4.1	
9.1%	5	12.9	0.0270	1,422,562	7.7	3.5	
	1	12.9	0.0113	195,247	0.0	0.0	
MC	2	12.9	0.0113	1,991,136	0.3	0.1	
with VMT	3	12.9	0.0113	2,564,545	0.3	0.1	
mix of	4	12.9	0.0113	1,689,510	0.2	0.1	
0.5%	5	12.9	0.0113	1,422,562	0.2	0.1	

5.6 Summary of particulate emissions from onroad mobile sources

Tables 5.6–1 through 5.6–10 summarize the calculated particulate emissions for the pollutants PM₁₀, PM_{2.5}, NO_x, SO₂, and NH₃ by vehicle class, area, and facility type. Annual and average daily emissions from onroad mobile sources for all of Maricopa County for 2002 are shown below in Table 5.6–1, while Table 5.6–2 presents these data for the PM₁₀ nonattainment area. Tables 5.6–3 through 5.6–12 provide more detailed breakouts of emissions by facility type, area type, and vehicle type for each pollutant.

Table 5.6–1. Annual and average daily emissions from all onroad mobile sources for Maricopa County.

	Annual emissions (tons/yr)					Average daily emissions (lbs/day)				
	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
Exhaust	1,285	1,176	79,572	1,183	2,544	7,039	6,446	436,006	6,479	13,937
Paved road fugitive dust	20,046	2,374				109,838	13,007			
Unpaved road fugitive dust	9,562	1,432				52,392	7,846			
Tire wear	287	71				1,574	390			
Brake wear	370	157				2,028	860			
Total:	31,550	5,210	79,572	1,183	2,544	172,872	28,550	436,006	6,479	13,937

Table 5.6–2. Annual and average daily emissions from all onroad mobile sources for the PM₁₀ nonattainment area.

	Annual emissions (tons/yr)					Average daily emissions (lbs/day)				
	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃	PM ₁₀	PM _{2.5}	NO _x	SO _x	NH ₃
Exhaust	1,223	1,120	75,307	1,125	2,418	6,700	6,135	412,639	6,166	13,250
Paved road fugitive dust	19,241	2,276				105,431	12,474			
Unpaved road fugitive dust	9,142	1,369				50,093	7,502			
Tire wear	273	68				1,497	370			
Brake wear	352	149				1,929	818			
Total:	30,231	4,982	75,307	1,125	2,418	165,649	27,300	412,639	6,166	13,250

Table 5.6–3. Daily PM₁₀ emissions (kg/day) in the PM₁₀ NAA by facility type, area type and vehicle class (annual average, excluding fugitive dust particulate matter).

Facility type	Area	Vehicle Class								TOTAL
	Type	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	
INTERSTATE, FREEWAY, and EXPRESSWAY	1	20.4	15.6	10.8	21.7	3.4	24.5	295.8	1.0	393.1
	2	14.1	10.7	7.5	14.9	2.3	16.9	204.0	0.7	271.2
	3	10.2	7.8	5.4	10.8	1.7	12.3	148.0	0.5	196.6
	4	7.7	5.9	4.1	8.2	1.3	9.3	111.7	0.4	148.4
	5	1.9	1.3	2.7	0.4	3.1	36.9	0.1	0.0	46.5
	Total	54.3	41.3	30.4	56.1	11.7	99.9	759.6	2.4	1,055.8
PRINCIPAL ARTERIAL and MINOR ARTERIAL	1	19.9	15.2	10.5	21.2	3.3	24.0	288.8	0.9	383.9
	2	22.1	16.9	11.7	23.5	3.7	26.6	320.3	1.0	425.6
	3	15.6	11.9	8.3	16.6	2.6	18.8	226.4	0.7	300.8
	4	7.9	6.0	4.2	8.4	1.3	9.5	114.3	0.4	151.8
	5	1.9	1.3	2.6	0.4	2.9	35.6	0.1	0.0	44.8
	Total	67.4	51.3	37.3	70.0	13.8	114.4	949.8	3.1	1,307.0
COLLECTOR	1	6.6	4.8	3.3	6.5	1.0	7.4	89.2	0.3	119.2
	2	4.0	3.0	2.0	4.1	0.6	4.6	55.4	0.2	74.0
	3	2.1	1.6	1.1	2.1	0.3	2.4	28.5	0.1	38.1
	4	3.9	2.9	2.0	4.0	0.6	4.6	54.9	0.2	73.2
	5	1.9	1.3	2.5	0.4	2.8	34.2	0.1	0.0	43.2
	Total	18.6	13.6	10.9	17.1	5.4	53.1	228.1	0.7	347.6
LOCAL	1	4.8	3.5	2.4	4.8	0.7	5.4	65.1	0.2	87.0
	2	6.2	4.6	3.1	6.1	1.0	7.0	83.8	0.3	112.1
	3	4.1	3.0	2.1	4.0	0.6	4.6	55.2	0.2	73.8
	4	2.6	1.9	1.3	2.6	0.4	2.9	35.2	0.1	47.1
	5	0.3	0.2	0.5	0.1	0.5	6.4	0.0	0.0	8.1
	Total	18.2	13.3	9.4	17.6	3.3	26.2	239.4	0.8	328.1
GRAND TOTALS:		158.4	119.5	88.0	160.7	34.3	293.7	2,176.9	7.0	3,038.5

Table 5.6–4. Daily PM_{2.5} emissions (kg/day) in the PM₁₀ NAA by facility type, area type and vehicle class (annual average, excluding fugitive dust particulate matter).

Facility type	Area	Vehicle Class								TOTAL
	Type	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	
INTERSTATE, FREEWAY, and EXPRESSWAY	1	18.8	14.3	8.8	18.3	3.1	22.6	273.4	0.7	360.0
	2	12.9	9.9	6.1	12.6	2.2	15.6	188.6	0.5	248.3
	3	9.4	7.2	4.4	9.2	1.6	11.3	136.8	0.3	180.1
	4	7.1	5.4	3.3	6.9	1.2	8.6	103.2	0.2	135.9
	5	1.8	1.1	2.3	0.4	2.8	34.1	0.1	0.0	42.6
	Total	50.0	37.8	24.8	47.4	10.8	92.3	702.1	1.7	966.9
PRINCIPAL ARTERIAL and MINOR ARTERIAL	1	18.3	14.0	8.6	17.9	3.0	22.1	267.0	0.6	351.5
	2	20.3	15.5	9.5	19.8	3.4	24.5	296.0	0.7	389.8
	3	14.4	10.9	6.7	14.0	2.4	17.3	209.2	0.5	275.5
	4	7.2	5.5	3.4	7.1	1.2	8.7	105.6	0.3	139.1
	5	1.7	1.1	2.2	0.4	2.7	32.9	0.1	0.0	41.0
	Total	62.0	47.0	30.4	59.2	12.7	105.6	878.0	2.1	1,196.9
COLLECTOR	1	6.1	4.5	2.7	5.5	0.9	6.8	82.4	0.2	109.2
	2	3.7	2.7	1.7	3.4	0.6	4.2	51.2	0.1	67.7
	3	1.9	1.4	0.9	1.8	0.3	2.2	26.4	0.1	34.8
	4	3.6	2.7	1.6	3.4	0.6	4.2	50.7	0.1	67.0
	5	1.7	1.0	2.1	0.4	2.6	31.6	0.1	0.0	39.6
	Total	17.1	12.3	9.0	14.4	5.0	49.1	210.8	0.5	318.3
LOCAL	1	4.5	3.3	2.0	4.0	0.7	5.0	60.2	0.1	79.7
	2	5.8	4.2	2.5	5.2	0.9	6.4	77.5	0.2	102.7
	3	3.8	2.8	1.7	3.4	0.6	4.2	51.1	0.1	67.7
	4	2.4	1.8	1.1	2.2	0.4	2.7	32.6	0.1	43.1
	5	0.3	0.2	0.4	0.1	0.5	5.9	0.0	0.0	7.4
	Total	16.8	12.2	7.7	14.8	3.0	24.2	221.3	0.5	300.6
GRAND TOTALS:		145.9	109.3	71.9	135.9	31.6	271.2	2,012.2	4.9	2,782.8

Table 5.6–5. Daily NO_x emissions (kg/day) in the PM₁₀ NAA by facility type, area type and vehicle class (annual average).

Facility type	Area Type	Vehicle Class								TOTAL
		LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	
INTERSTATE, FREEWAY, and EXPRESSWAY	1	490.8	378.6	187.2	222.5	4.4	28.8	2,396.9	9.7	3,718.9
	2	3,940.0	3,039.5	1,502.5	1,790.5	36.5	236.4	19,589.8	78.4	30,213.6
	3	2,722.1	2,100.2	1,037.8	1,238.4	25.6	165.8	13,686.5	54.4	21,030.8
	4	1,974.1	1,523.1	752.6	898.1	18.5	120.2	9,925.5	39.5	15,251.7
	5	1,490.2	1,149.7	568.1	678.0	14.0	90.8	7,492.4	29.8	11,512.9
	Total	10,617.2	8,191.1	4,048.2	4,827.5	99.0	642.0	53,091.1	211.7	81,727.8
PRINCIPAL ARTERIAL and MINOR ARTERIAL	1	441.3	333.9	167.5	171.3	2.4	15.5	1,289.4	6.5	2,427.7
	2	3,517.9	2,682.8	1,346.9	1,438.1	19.4	124.6	10,414.2	54.5	19,598.4
	3	3,901.1	2,979.5	1,495.2	1,616.3	21.6	138.9	11,596.4	60.9	21,809.9
	4	2,758.1	2,109.5	1,057.4	1,167.8	15.5	99.6	7,821.3	43.7	15,072.9
	5	1,406.7	1,077.2	538.7	605.6	8.1	52.2	4,074.2	22.4	7,785.1
	Total	12,025.1	9,182.9	4,605.7	4,999.1	67.0	430.8	35,195.4	188.0	66,694.0
COLLECTOR	1	489.5	361.4	180.9	149.2	2.7	17.4	1,334.9	5.5	2,541.5
	2	1,255.7	928.9	465.1	391.3	6.9	44.5	3,424.4	14.5	6,531.4
	3	725.6	543.0	272.2	254.3	3.9	25.4	1,977.6	9.5	3,811.5
	4	372.5	278.9	139.8	131.3	2.0	13.0	1,015.2	4.9	1,957.7
	5	692.1	521.5	261.6	260.4	3.8	24.2	1,899.9	9.8	3,673.2
	Total	3,535.4	2,633.7	1,319.5	1,186.5	19.3	124.5	9,652.0	44.2	18,515.2
LOCAL	1	103.3	75.1	37.5	26.5	0.6	3.7	277.9	1.0	525.5
	2	1,053.1	765.4	382.3	270.7	5.8	37.6	2,834.1	10.1	5,359.1
	3	1,356.4	985.8	492.4	348.7	7.5	48.5	3,650.3	12.9	6,902.5
	4	893.6	649.5	324.4	229.7	4.9	31.9	2,404.8	8.5	4,547.3
	5	569.9	414.2	206.9	146.5	3.2	20.4	1,533.8	5.4	2,900.3
	Total	3,976.3	2,889.9	1,443.4	1,022.2	22.0	142.1	10,700.9	38.0	20,234.7
GRAND TOTALS:		30,154.0	22,897.6	11,416.9	12,035.3	207.3	1,339.4	108,639.3	481.9	187,171.7

Table 5.6–6. Daily SO₂ emissions (kg/day) in the PM₁₀ NAA by facility type, area type and vehicle class (annual average).

Facility type	Area Type	Vehicle Class								TOTAL
		LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	
INTERSTATE, FREEWAY, and EXPRESSWAY	1	48.5	38.5	20.0	9.6	1.3	17.8	227.8	0.3	363.7
	2	33.5	26.6	13.8	6.6	0.9	12.3	157.1	0.2	250.9
	3	24.3	19.3	10.0	4.8	0.6	8.9	113.9	0.1	182.0
	4	18.3	14.6	7.5	3.6	0.5	6.7	86.0	0.1	137.4
	5	4.8	2.5	1.2	0.2	2.2	28.4	0.0	0.0	39.3
	Total	129.4	101.5	52.5	24.8	5.5	74.1	584.9	0.7	973.3
PRINCIPAL ARTERIAL and MINOR ARTERIAL	1	47.4	37.6	19.5	9.4	1.2	17.4	222.4	0.3	355.2
	2	52.6	41.7	21.6	10.4	1.4	19.3	246.6	0.3	393.9
	3	37.1	29.5	15.3	7.3	1.0	13.6	174.3	0.2	278.4
	4	18.7	14.9	7.7	3.7	0.5	6.9	88.0	0.1	140.5
	5	4.6	2.4	1.2	0.2	2.1	27.4	0.0	0.0	37.9
	Total	160.5	126.2	65.3	31.0	6.2	84.5	731.4	0.8	1,205.9
COLLECTOR	1	14.5	11.6	6.0	2.9	0.4	5.4	68.7	0.1	109.5
	2	9.0	7.2	3.7	1.8	0.2	3.3	42.7	0.0	68.0
	3	4.6	3.7	1.9	0.9	0.1	1.7	22.0	0.0	35.0
	4	8.9	7.2	3.7	1.8	0.2	3.3	42.3	0.0	67.4
	5	4.5	2.3	1.1	0.1	2.1	26.4	0.0	0.0	36.5
	Total	41.6	32.0	16.5	7.6	3.0	40.1	175.6	0.2	316.6
LOCAL	1	10.6	8.5	4.4	2.1	0.3	3.9	50.1	0.1	80.0
	2	13.6	10.9	5.7	2.7	0.4	5.0	64.6	0.1	103.0
	3	9.0	7.2	3.7	1.8	0.2	3.3	42.5	0.0	67.9
	4	5.7	4.6	2.4	1.1	0.2	2.1	27.1	0.0	43.3
	5	0.8	0.4	0.2	0.0	0.4	4.9	0.0	0.0	6.8
	Total	39.8	31.6	16.4	7.8	1.4	19.3	184.4	0.2	300.9
GRAND TOTALS:		371.3	291.3	150.8	71.2	16.1	217.9	1,676.2	1.9	2,796.7

Table 5.6–7. Daily ammonia emissions (kg/day) in the PM₁₀ NAA by facility type, area type and vehicle class (annual average).

Facility type	Area Type	Vehicle Class								TOTAL
		LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	
INTERSTATE, FREEWAY, and EXPRESSWAY	1	408.7	250.9	98.2	14.5	0.1	1.3	22.2	0.5	796.5
	2	281.9	173.1	67.8	10.0	0.1	0.9	15.3	0.4	549.5
	3	204.4	125.5	49.1	7.3	0.1	0.7	11.1	0.3	398.5
	4	154.3	94.8	37.1	5.5	0.1	0.5	8.4	0.2	300.8
	5	31.3	12.3	1.8	0.0	0.2	2.8	0.1	0.0	48.4
	Total	1,080.7	656.6	254.0	37.3	0.5	6.2	57.1	1.3	2,093.7
PRINCIPAL ARTERIAL and MINOR ARTERIAL	1	399.1	245.0	95.9	14.2	0.1	1.3	21.7	0.5	777.9
	2	442.5	271.7	106.4	15.7	0.1	1.4	24.0	0.6	862.5
	3	312.8	192.0	75.2	11.1	0.1	1.0	17.0	0.4	609.6
	4	157.9	96.9	37.9	5.6	0.1	0.5	8.6	0.2	307.7
	5	30.2	11.8	1.7	0.0	0.2	2.7	0.1	0.0	46.6
	Total	1,342.5	817.5	317.1	46.7	0.6	6.9	71.3	1.7	2,604.3
COLLECTOR	1	123.2	75.6	29.6	4.4	0.0	0.4	6.7	0.2	240.1
	2	76.5	47.0	18.4	2.7	0.0	0.2	4.2	0.1	149.2
	3	39.4	24.2	9.5	1.4	0.0	0.1	2.1	0.1	76.8
	4	75.8	46.6	18.2	2.7	0.0	0.2	4.1	0.1	147.8
	5	29.0	11.4	1.7	0.0	0.2	2.6	0.1	0.0	44.9
	Total	344.1	204.8	77.4	11.2	0.3	3.6	17.2	0.4	658.9
LOCAL	1	90.0	55.2	21.6	3.2	0.0	0.3	4.9	0.1	175.3
	2	115.9	71.1	27.8	4.1	0.0	0.4	6.3	0.1	225.8
	3	76.3	46.9	18.3	2.7	0.0	0.2	4.1	0.1	148.8
	4	48.7	29.9	11.7	1.7	0.0	0.2	2.6	0.1	94.9
	5	5.4	2.1	0.3	0.0	0.0	0.5	0.0	0.0	8.4
	Total	336.2	205.2	79.8	11.8	0.1	1.6	18.0	0.4	653.1
GRAND TOTALS:		3,103.4	1,884.1	728.4	106.9	1.5	18.3	163.6	3.8	6,010.0

Table 5.6–8. Daily PM₁₀ emissions (kg/day) in Maricopa County by facility type, area type and vehicle class (annual average, excluding fugitive dust particulate matter.)

Facility type	Area	Vehicle Class								
	Type	LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	TOTAL
INTERSTATE, FREEWAY, and EXPRESSWAY	1	20.4	15.6	10.8	21.7	3.4	24.5	295.8	1.0	393.1
	2	14.1	10.7	7.5	14.9	2.3	16.9	204.0	0.7	271.2
	3	10.2	7.8	5.4	10.8	1.7	12.3	148.0	0.5	196.6
	4	12.8	9.7	6.8	13.6	2.1	15.4	185.1	0.6	246.0
	5	1.9	1.3	2.7	0.4	3.1	36.9	0.1	0.0	46.5
	Total	59.4	45.2	33.1	61.5	12.6	106.0	833.0	2.7	1,153.4
PRINCIPAL ARTERIAL and MINOR ARTERIAL	1	19.9	15.2	10.5	21.2	3.3	24.0	288.8	0.9	383.9
	2	22.1	16.9	11.7	23.5	3.7	26.6	320.3	1.0	425.6
	3	15.6	11.9	8.3	16.6	2.6	18.8	226.4	0.7	300.8
	4	8.4	6.4	4.5	9.0	1.4	10.1	122.2	0.4	162.4
	5	1.9	1.3	2.6	0.4	2.9	35.6	0.1	0.0	44.8
	Total	67.9	51.7	37.6	70.6	13.9	115.0	957.8	3.1	1,317.6
COLLECTOR	1	6.6	4.8	3.3	6.5	1.0	7.4	89.2	0.3	119.2
	2	4.0	3.0	2.0	4.1	0.6	4.6	55.4	0.2	74.0
	3	2.1	1.6	1.1	2.1	0.3	2.4	28.5	0.1	38.1
	4	5.6	4.2	2.9	5.7	0.9	6.5	78.2	0.3	104.2
	5	1.9	1.3	2.5	0.4	2.8	34.2	0.1	0.0	43.2
	Total	20.2	14.9	11.8	18.8	5.7	55.1	251.4	0.8	378.6
LOCAL	1	4.8	3.5	2.4	4.8	0.7	5.4	65.1	0.2	87.0
	2	6.2	4.6	3.1	6.1	1.0	7.0	83.8	0.3	112.1
	3	4.1	3.0	2.1	4.0	0.6	4.6	55.2	0.2	73.8
	4	3.5	2.5	1.7	3.4	0.5	3.9	46.5	0.2	62.2
	5	0.3	0.2	0.5	0.1	0.5	6.4	0.0	0.0	8.1
	Total	19.0	13.9	9.8	18.4	3.4	27.2	250.7	0.8	343.2
GRAND TOTALS:		166.6	125.7	92.3	169.2	35.6	303.3	2,292.8	7.4	3,192.8

Table 5.6–9. Daily PM_{2.5} emissions (kg/day) in Maricopa County by facility type, area type and vehicle class (annual average, excluding fugitive dust particulate matter).

Facility type	Area Type	Vehicle Class								TOTAL
		LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	
INTERSTATE, FREEWAY, and EXPRESSWAY	1	18.8	14.3	8.8	18.3	3.1	22.6	273.4	0.7	360.0
	2	12.9	9.9	6.1	12.6	2.2	15.6	188.6	0.5	248.3
	3	9.4	7.2	4.4	9.2	1.6	11.3	136.8	0.3	180.1
	4	11.7	8.9	5.5	11.5	2.0	14.2	171.1	0.4	225.3
	5	1.8	1.1	2.3	0.4	2.8	34.1	0.1	0.0	42.6
	Total	54.6	41.4	27.0	52.0	11.6	97.9	770.0	1.9	1,056.3
PRINCIPAL ARTERIAL and MINOR ARTERIAL	1	18.3	14.0	8.6	17.9	3.0	22.1	267.0	0.6	351.5
	2	20.3	15.5	9.5	19.8	3.4	24.5	296.0	0.7	389.8
	3	14.4	10.9	6.7	14.0	2.4	17.3	209.2	0.5	275.5
	4	7.8	5.9	3.6	7.6	1.3	9.4	113.0	0.3	148.8
	5	1.7	1.1	2.2	0.4	2.7	32.9	0.1	0.0	41.0
	Total	62.5	47.4	30.6	59.7	12.8	106.2	885.3	2.1	1,206.6
COLLECTOR	1	6.1	4.5	2.7	5.5	0.9	6.8	82.4	0.2	109.2
	2	3.7	2.7	1.7	3.4	0.6	4.2	51.2	0.1	67.7
	3	1.9	1.4	0.9	1.8	0.3	2.2	26.4	0.1	34.8
	4	5.2	3.8	2.3	4.8	0.8	6.0	72.3	0.2	95.4
	5	1.7	1.0	2.1	0.4	2.6	31.6	0.1	0.0	39.6
	Total	18.7	13.5	9.7	15.9	5.3	50.9	232.3	0.6	346.8
LOCAL	1	4.5	3.3	2.0	4.0	0.7	5.0	60.2	0.1	79.7
	2	5.8	4.2	2.5	5.2	0.9	6.4	77.5	0.2	102.7
	3	3.8	2.8	1.7	3.4	0.6	4.2	51.1	0.1	67.7
	4	3.2	2.3	1.4	2.9	0.5	3.6	43.0	0.1	57.0
	5	0.3	0.2	0.4	0.1	0.5	5.9	0.0	0.0	7.4
	Total	17.6	12.7	8.0	15.5	3.1	25.1	231.7	0.6	314.4
GRAND TOTALS:		153.4	114.9	75.4	143.0	32.8	280.1	2,119.4	5.1	2,924.1

Table 5.6–10. Daily NO_x emissions(kg/day) in Maricopa County by facility type, area type and vehicle class (annual average).

Facility type	Area Type	Vehicle Class								TOTAL
		LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	
INTERSTATE, FREEWAY, and EXPRESSWAY	1	490.8	378.6	187.2	222.5	4.4	28.8	2,396.9	9.7	3,718.9
	2	3,940.0	3,039.5	1,502.5	1,790.5	36.5	236.4	19,589.8	78.4	30,213.6
	3	2,722.1	2,100.2	1,037.8	1,238.4	25.6	165.8	13,686.5	54.4	21,030.8
	4	1,974.1	1,523.1	752.6	898.1	18.5	120.2	9,925.5	39.5	15,251.7
	5	2,469.9	1,905.6	941.6	1,123.7	23.2	150.4	12,418.2	49.4	19,082.0
	Total	11,596.9	8,947.0	4,421.7	5,273.3	108.2	701.6	58,016.9	231.3	89,297.0
PRINCIPAL ARTERIAL and MINOR ARTERIAL	1	441.3	333.9	167.5	171.3	2.4	15.5	1,289.4	6.5	2,427.7
	2	3,517.9	2,682.8	1,346.9	1,438.1	19.4	124.6	10,414.2	54.5	19,598.4
	3	3,901.1	2,979.5	1,495.2	1,616.3	21.6	138.9	11,596.4	60.9	21,809.9
	4	2,758.1	2,109.5	1,057.4	1,167.8	15.5	99.6	7,821.3	43.7	15,072.9
	5	1,504.9	1,152.4	576.3	647.9	8.7	55.9	4,358.7	24.0	8,328.7
	Total	12,123.3	9,258.1	4,643.3	5,041.4	67.6	434.5	35,479.9	189.6	67,237.6
COLLECTOR	1	489.5	361.4	180.9	149.2	2.7	17.4	1,334.9	5.5	2,541.5
	2	1,255.7	928.9	465.1	391.3	6.9	44.5	3,424.4	14.5	6,531.4
	3	725.6	543.0	272.2	254.3	3.9	25.4	1,977.6	9.5	3,811.5
	4	372.5	278.9	139.8	131.3	2.0	13.0	1,015.2	4.9	1,957.7
	5	985.6	742.6	372.5	370.8	5.4	34.5	2,705.6	14.0	5,230.9
	Total	3,828.9	2,854.9	1,430.5	1,296.9	20.9	134.8	10,457.7	48.4	20,072.9
LOCAL	1	103.3	75.1	37.5	26.5	0.6	3.7	277.9	1.0	525.5
	2	1,053.1	765.4	382.3	270.7	5.8	37.6	2,834.1	10.1	5,359.1
	3	1,356.4	985.8	492.4	348.7	7.5	48.5	3,650.3	12.9	6,902.5
	4	893.6	649.5	324.4	229.7	4.9	31.9	2,404.8	8.5	4,547.3
	5	752.4	546.8	273.1	193.4	4.2	26.9	2,024.8	7.2	3,828.8
	Total	4,158.7	3,022.6	1,509.6	1,069.1	23.0	148.6	11,192.0	39.7	21,163.2
GRAND TOTALS:		31,707.9	24,082.5	12,005.2	12,680.7	219.7	1,419.5	115,146.4	509.0	197,770.7

Table 5.6–11. Daily SO₂ emissions (kg/day) in Maricopa County by facility type, area type and vehicle class (annual average).

Facility type	Area Type	Vehicle Class								TOTAL
		LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	
INTERSTATE, FREEWAY, and EXPRESSWAY	1	48.5	38.5	20.0	9.6	1.3	17.8	227.8	0.3	363.7
	2	33.5	26.6	13.8	6.6	0.9	12.3	157.1	0.2	250.9
	3	24.3	19.3	10.0	4.8	0.6	8.9	113.9	0.1	182.0
	4	30.4	24.1	12.5	6.0	0.8	11.1	142.6	0.2	227.7
	5	4.8	2.5	1.2	0.2	2.2	28.4	0.0	0.0	39.3
	Total	141.5	111.0	57.5	27.2	5.8	78.5	641.4	0.7	1,063.6
PRINCIPAL ARTERIAL and MINOR ARTERIAL	1	47.4	37.6	19.5	9.4	1.2	17.4	222.4	0.3	355.2
	2	52.6	41.7	21.6	10.4	1.4	19.3	246.6	0.3	393.9
	3	37.1	29.5	15.3	7.3	1.0	13.6	174.3	0.2	278.4
	4	20.1	15.9	8.3	4.0	0.5	7.3	94.1	0.1	150.3
	5	4.6	2.4	1.2	0.2	2.1	27.4	0.0	0.0	37.9
	Total	161.8	127.2	65.9	31.2	6.2	85.0	737.5	0.9	1,215.7
COLLECTOR	1	14.5	11.6	6.0	2.9	0.4	5.4	68.7	0.1	109.5
	2	9.0	7.2	3.7	1.8	0.2	3.3	42.7	0.0	68.0
	3	4.6	3.7	1.9	0.9	0.1	1.7	22.0	0.0	35.0
	4	12.7	10.2	5.3	2.5	0.3	4.7	60.2	0.1	96.0
	5	4.5	2.3	1.1	0.1	2.1	26.4	0.0	0.0	36.5
	Total	45.3	35.1	18.1	8.3	3.1	41.5	193.5	0.2	345.2
LOCAL	1	10.6	8.5	4.4	2.1	0.3	3.9	50.1	0.1	80.0
	2	13.6	10.9	5.7	2.7	0.4	5.0	64.6	0.1	103.0
	3	9.0	7.2	3.7	1.8	0.2	3.3	42.5	0.0	67.9
	4	7.6	6.1	3.1	1.5	0.2	2.8	35.8	0.0	57.1
	5	0.8	0.4	0.2	0.0	0.4	4.9	0.0	0.0	6.8
	Total	41.6	33.1	17.1	8.2	1.5	20.0	193.1	0.2	314.8
GRAND TOTALS:		390.3	306.4	158.6	74.9	16.6	224.9	1,765.5	2.0	2,939.2

Table 5.6–12. Daily ammonia emissions (kg/day) in Maricopa County by facility type, area type and vehicle class (annual average).

Facility type	Area Type	Vehicle Class								TOTAL
		LDGV	LDGT1	LDGT2	HDGV	LDDV	LDDT	HDDV	MC	
INTERSTATE, FREEWAY, and EXPRESSWAY	1	408.7	250.9	98.2	14.5	0.1	1.3	22.2	0.5	796.5
	2	281.9	173.1	67.8	10.0	0.1	0.9	15.3	0.4	549.5
	3	204.4	125.5	49.1	7.3	0.1	0.7	11.1	0.3	398.5
	4	255.8	157.1	61.5	9.1	0.1	0.8	13.9	0.3	498.6
	5	31.3	12.3	1.8	0.0	0.2	2.8	0.1	0.0	48.4
	Total	1,182.2	718.9	278.4	40.9	0.5	6.5	62.6	1.5	2,291.5
PRINCIPAL ARTERIAL and MINOR ARTERIAL	1	399.1	245.0	95.9	14.2	0.1	1.3	21.7	0.5	777.9
	2	442.5	271.7	106.4	15.7	0.1	1.4	24.0	0.6	862.5
	3	312.8	192.0	75.2	11.1	0.1	1.0	17.0	0.4	609.6
	4	168.9	103.7	40.6	6.0	0.1	0.5	9.2	0.2	329.2
	5	30.2	11.8	1.7	0.0	0.2	2.7	0.1	0.0	46.6
	Total	1,353.5	824.3	319.8	47.0	0.6	7.0	71.9	1.7	2,625.8
COLLECTOR	1	123.2	75.6	29.6	4.4	0.0	0.4	6.7	0.2	240.1
	2	76.5	47.0	18.4	2.7	0.0	0.2	4.2	0.1	149.2
	3	39.4	24.2	9.5	1.4	0.0	0.1	2.1	0.1	76.8
	4	108.0	66.3	26.0	3.8	0.0	0.4	5.9	0.1	210.5
	5	29.0	11.4	1.7	0.0	0.2	2.6	0.1	0.0	44.9
	Total	376.2	224.5	85.1	12.4	0.3	3.7	18.9	0.4	721.6
LOCAL	1	90.0	55.2	21.6	3.2	0.0	0.3	4.9	0.1	175.3
	2	115.9	71.1	27.8	4.1	0.0	0.4	6.3	0.1	225.8
	3	76.3	46.9	18.3	2.7	0.0	0.2	4.1	0.1	148.8
	4	64.3	39.5	15.4	2.3	0.0	0.2	3.5	0.1	125.3
	5	5.4	2.1	0.3	0.0	0.0	0.5	0.0	0.0	8.4
	Total	351.8	214.8	83.6	12.3	0.1	1.6	18.8	0.4	683.5
GRAND TOTALS:		3,263.7	1,982.5	766.9	112.6	1.6	18.8	172.3	4.0	6,322.4

5.7 Quality assurance process

5.7.1 VMT estimates

Normal quality assurance procedures, including extensive automated consistency checks, were used by ADOT in developing the 2002 HPMS data. These data were submitted to the Federal Highway Administration in October 2003.

5.7.2 Emission factor estimates

The quality assurance (QA) process performed on the MOBILE6.2 analyses included accuracy, completeness, and reasonableness checks. For accuracy and completeness, a system was used that included a two-layer, independent reviewer set-up. All hard copy and computer-based data entries as well as all calculations procedures were checked independently for accuracy and completeness by two different reviewers. Any errors found were corrected and the changes were then rechecked by the reviewers.

The entire onroad mobile source portion of the 2002 periodic particulate matter inventory was reviewed by MAG staff that did not directly participate in its development. All comments were addressed.

5.7.3 Quality review of 2002 draft particulate matter emissions inventory

The draft onroad mobile source portion of the 2002 periodic particulate matter emissions inventory was reviewed using published EPA quality review guidelines for base year emission inventories (EPA Document 450/4-91-022, September 1991). The procedural review (Levels I, II, and III) included checks for completeness, consistency, and the correct use of appropriate procedures.

As an additional QA check, the average miles per gallon estimate was derived using average annual daily VMT estimates and gasoline sales from ADOT. The results of that QA check may be found in Appendix 5.5.

5.8 References

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6. Biogenic Sources

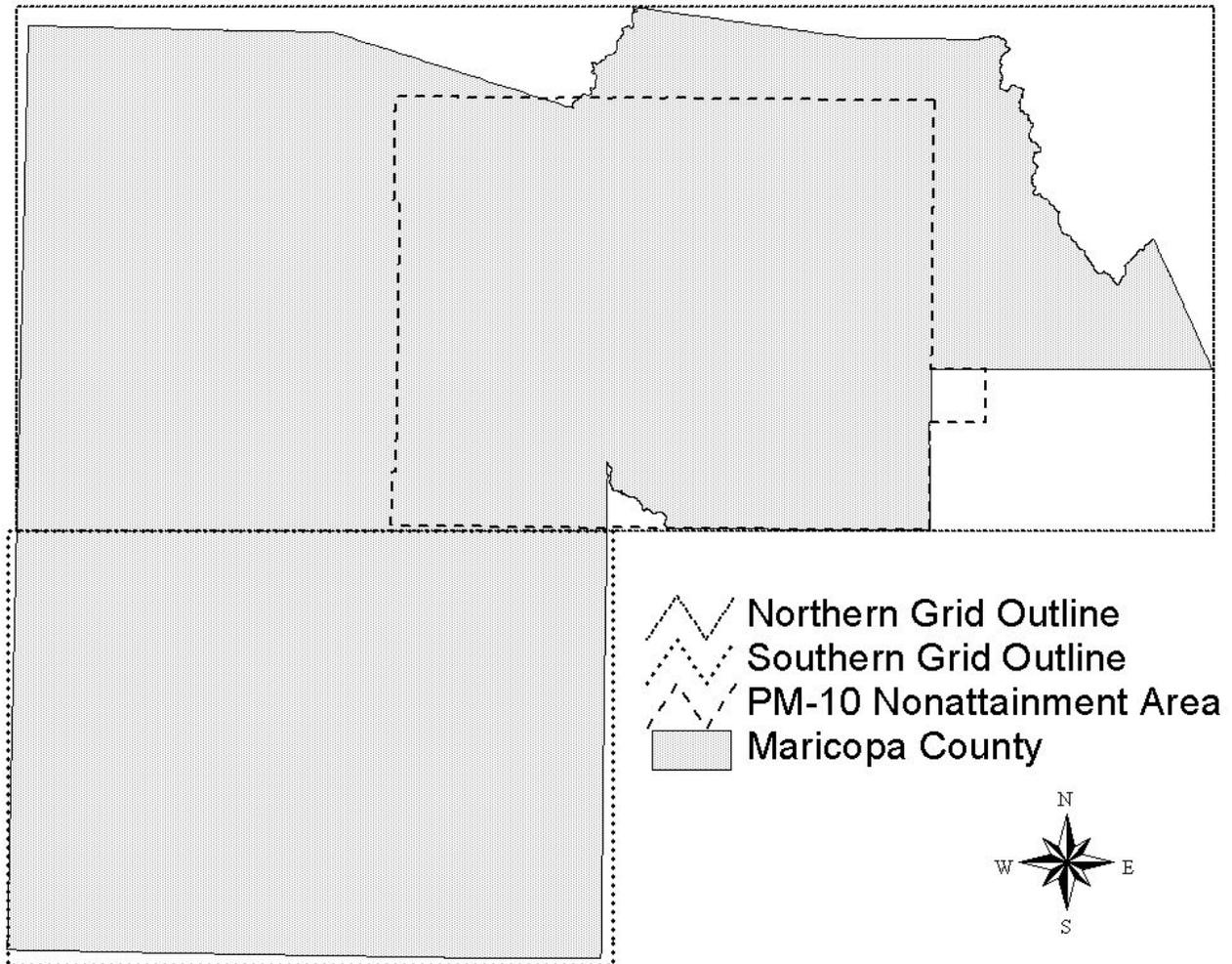
6.1 Introduction and scope

Biogenic source emission estimates have been calculated for PM precursors for use in the 2002 Periodic PM Inventory. These biogenic source emission estimates are for Maricopa County and the approximately 2,900 square-mile portion of the PM₁₀ nonattainment area within Maricopa County and a small portion of Pinal County. These emissions were estimated using a modified version of the UAM-BEIS 2 model called MAGBEIS2. MAGBEIS2 was developed for use in Maricopa County and is documented in Improvements to the Biogenic Emission Estimation Process for Maricopa County, STI, 1996. MAGBEIS2 main modifications to UAM-BEIS2 was the addition of procedures that allow for the input of user-supplied gridded land use and surface temperature data. These procedures included the development of a land-use preprocessor called MAGLAND2 to consolidate the MAG land-use data and to substitute data for missing or incomplete grid cells. The guiding principle used in the development of MAGBEIS2 was the replacement of some EPA defaults with locale-specific data, including: locale-specific land-use data, locale-specific biomass estimates, and the use of a taxonomic approach to develop local-specific emission factors. Overall, MAGBEIS2 constitutes an improvement over the EPA BEIS2 procedures, and is considered to provide reasonable estimates of the biogenic emissions in the study area. Among the chemical species included in MAGBEIS2, only NO_x is attributable to PM formation. Therefore, only NO_x emissions will be reported in this chapter.

6.2 Modeling domain adjustments

The emissions reported in the periodic inventory are for both the PM₁₀ nonattainment area and Maricopa County. Due to the irregular shape of the PM₁₀ nonattainment area and Maricopa County, it was not possible to use the PM₁₀ nonattainment area or county boundary as the modeling domain for the grid based MAGBEIS2 model. Two modeling domains were used to estimate biogenic emissions for the nonattainment area and Maricopa County. The modeling domains used in the present study are shown in Figure 6-1. The northern domain consists of 107 grid cells in the east-west direction and 47 grid cells in the north-south direction, with a uniform grid spacing of two kilometers. The northern domain encompassed the entire PM₁₀ nonattainment area. The southern domain encompassed the southern portion of Maricopa County and consisted of 54 grid cells in the east-west direction and 39 grid cells in the north-south direction, with a uniform grid spacing of two kilometers. Both domains are primarily located within Maricopa County, although small fractions of the modeling domains extend into other neighboring counties. The emissions estimated using the MAGBEIS2 model are for the rectangular modeling domain previously described. These estimates were adjusted to calculate the nonattainment area emissions and Maricopa County emissions through the use of ARCVIEW. ARCVIEW was used to remove the portions of the modeling domain outside of the Maricopa County area for the county emission estimates, and outside of the nonattainment area for the nonattainment area emission estimates.

Figure 6.2–1. PM₁₀ nonattainment area, Maricopa County, and biogenic modeling domains (northern & southern grid outlines).



6.3 Land-use categories

The most critical input for the biogenic emission modeling is the land-use data file. The most recent land-use information was incorporated into the EPA BELD3 land-use data to create a merged land-use data set. The most recent land-use data compiled by MAG included over 40 land-use types using 2000 information as listed in Table 6.3–1. MAG residential, commercial, water, and agricultural land-use categories were merged into the BELD3 USGS coniferous, deciduous, mixed forest, grassland, savanna, and shrubland land-use types, listed in Table 6.3–2, to create a county-wide composite land-use data set. The MAGLAND2 and MAGBEIS2 programs described in the 1996 study by STI and used in previous periodic ozone emission inventories had to be modified to accept the land-use categories from the merged BELD3/MAG 2000 land-use data set. Due to lack of information for the spatial distribution of the agricultural types in the BELD3/MAG 2000 land-use data there is only one category for agriculture. The agricultural emission factor was updated based on 2002 Maricopa County crop statistics.

Only BELD3 data was available for the portion of the PM₁₀ nonattainment area outside of Maricopa County.

Table 6.3–1. MAG 2000 land-use categories.

ID	Type	Assigned to	ID	Type	Assigned to
100	General Residential	Residential	510	Hotel, Motel or Resort	Commercial
110	Rural Residential	USGS Shrubland	520	Educational	Commercial
120	Estate Residential	USGS Shrubland	530	Institutional	Commercial
130	Large Lot Residential	Residential	540	Cemeteries	USGS Grassland
140	Medium Lot Residential	Residential	550	Public Facilities	Commercial
150	Small Lot Residential	Residential	560	Special Events	Commercial
160	Very Small Lot Residential	Residential	570	Other Employment Low	Nonemit
170	Medium Density Residential	Residential	580	Other Employment Medium	Commercial
180	High Density Residential	Residential	590	Other Employment High	Commercial
190	Very High Density Residential	Residential	600	General Transportation	Nonemit
200	General Commercial	Commercial	610	Transportation	Nonemit
210	Specialty Commercial	Commercial	611	Parking Structures	Nonemit
220	Neighborhood Retail Center	Commercial	612	Parking Surfaces	Nonemit
230	Community Commercial	Commercial	620	Airport	Nonemit
240	Regional Retail Center	Commercial	700	Recreation	not merged
250	Super-Regional Commercial	Commercial	710	Active Open Spaces	USGS Grassland
300	General Industrial	Commercial	720	Golf Courses	USGS Grassland
310	Warehouse/Distribution	Commercial	730	Dedicated Open Space	not merged
320	Industrial	Commercial	740	Water	Water
400	Office General	Commercial	750	Agriculture	Agriculture
410	Office Low Rise	Commercial	800	Multiple Use	Commercial
420	Office Mid Rise	Commercial	810	Business Park	Commercial
430	Office High Rise	Commercial	820	Mixed Use	Commercial
500	General Employment	Commercial	830	Planned Developments	Commercial
			900	Vacant	not merged

Table 6.3–2. Land-use categories from BELD3 used in the emission inventory.

<u>BELD3 Land-use category</u>
USGS_Coniferous
USGS_Deciduous
USGS_Mixed Forest
USGS_Grassland
USGS_Savanna
USGS_Shrubland

6.4 Derivation of emission factors

For each of the 11 consolidated land-use groups, MAGBEIS2 requires as input a standardized emission factor for oxides of nitrogen (NO_x). The emission factors selected for use in MAGBEIS2 are listed in Table 6.4–1. The commercial emission factor is identical to the one developed for the 1996 STI study. The “Agricultural” and “Residential” categories were adjusted based on updated data or assumptions described below.

Table 6.4-1. NO_x standardized emission factors, by land-use category.

Land-use category	NO_x emission factor (µg/m²·hr)
Commercial/Industrial	1.8 ^a
Residential/Schools/Churches	17.4 ^b
Agricultural	140.0 ^c
USGS Coniferous	2.0
USGS Deciduous	2.0
USGS Mixed Forest	2.0
USGS Grassland	27.0
Water	0.0 ^d
USGS Savanna	27.0
USGS Shrubland	57.8
Nonemitting	0.0

- a. US EPA emission factor for grass multiplied by the landscape fraction.
b. US EPA emission factor for commercial and industrial multiplied by the landscape fraction.
c. Based on locale-specific data.
d. US EPA-recommended values.

The development of the emission rate estimate for the “Agricultural” category utilized Arizona crop statistics for 2002 obtained for Maricopa County by land-use type as documented in AAAS (2002). These values are shown in Table 6.4-2. The acreage shown in this table were used to derive the percentages of these crop types relative to the total crop land-use area: Cotton - 25.04 percent, Alfalfa - 37.64 percent, Other Hay - 4.09 percent, Wheat - 7.42 percent, Barley - 9.27 percent, Corn - 0.11 percent, Vegetables - 10.91 percent, Citrus - 5.51 percent. These percentages, as fractions, were multiplied by the US EPA-reported standardized emission factors for NO_x for each crop type to get a composite emission factor for harvested cropland areas. The emission factor for “Citrus” is the same as that reported by EPA for orange. Since the 2000 MAG land-use data only contain a single agriculture category, MAG calculated a composite emission factor based on the land distribution fractions for harvested cropland and non-harvested croplands from the latest available Census of Agriculture, 1997.

Table 6.4-2. Maricopa County crop statistics for 2002.

Crop	Acres *	% of total
Cotton	45,900	25.04
Alfalfa	69,000	37.64
Other Hay	7,500	4.09
Wheat	13,600	7.42
Barley	17,000	9.27
Corn	200	0.11
Vegetables	20,000	10.91
Citrus	10,100	5.51
Total	183,300	100

* All values were derived from 2002 Arizona Agricultural Statistics, Arizona Agricultural Statistics Service, 2003.

Table 6.4-3 shows the total areas and percentages for harvested cropland and total cropland . This approach relies on the assumption that the changes occurring in harvested and non-harvested areas has not changed significantly since 1997. As a result, the emission factor for the new “Agricultural” category was computed by calculating a weighted average of the harvested cropland emission factor and the non-harvested (grassland) emission factor for NO_x.

Table 6.4-3. Distribution of harvested cropland and total cropland.

Category	Area* (acres)	Fraction (%)
Total cropland	340,563	100
Harvested cropland	296,150	87
Non-Harvested cropland	44,413	13

* USDA 1997 Census of Agriculture.

Maricopa County lies in the arid Sonoran desert. The residential/schools/churches emission factor used the EPA “desert cities” alternative splits which assumes that 70 percent of the urban land use is barren.

All emission factors for the BELD3 land-use types were taken from the EPA BEIS version 3.09 data set.

6.5 Meteorological inputs

Consistent with previous periodic inventories, for 1990 and onward, the meteorological episode day used was September 9, 1988. The procedures of selecting the episode day was in accordance with the EPA guidance documented in the User’s Guide to the Personal Computer Version of the Biogenic Emissions Inventory System (PC-BEIS), Version 2.0, EPA, 1991. Meteorological data are input to MAGBEIS2 from two separate files. The first file called “SURMET1” was created using observed data from the Sky Harbor Airport. The file includes the following meteorological fields:

- Opaque sky cover
- Total sky cover
- Fraction of sky occupied by the lowest level clouds and height of that cloud level
- Fraction of sky occupied by the second lowest level clouds and height of that cloud level
- Fraction of sky occupied by the third lowest level clouds and height of that cloud level

The above fields are used to determine the solar radiation fluxes in the current version of MAGBEIS2. The following fields in the data file are not used by the program but the format is reserved for the program to read successfully:

- Sea level pressure
- Wind direction
- Wind speed
- Surface temperature
- Dew point
- Station pressure

The second meteorological data file, “TEMPRTR”, consists of 24 hours per day of gridded surface temperature fields created from a UAM preprocessor program. TEMPRTR is in binary format and can be used as an input to UAM. Data used to generate the surface temperature fields were obtained from ten monitoring sites for the episode day. Table 6.5-1 presents more information about the ten monitoring sites for this analysis.

Table 6.5–1. Information for surface temperature monitoring sites.

Site ID	Station Name	Latitude	Longitude	Network*
AGUI	Aquila	33° 56' 48"	113° 11' 20"	AZMET
BCK1	Buckeye	33° 24' 00"	112° 41' 00"	AZMET
COOL	Coolidge	27° 22' 00"	109° 53' 00"	AZMET
DSTR	Desert Ridge	34° 06' 19"	112° 20' 49"	AZMET
ELOY	Eloy	32° 46' 26"	111° 33' 25"	AZMET
HARQ	Harquahala	33° 29' 00"	113° 07' 00"	AZMET
LITC	Litchfield	33° 28' 02"	112° 23' 53"	AZMET
MARI	Maricopa	33° 04' 07"	111° 58' 18"	AZMET
PALO	Paloma	32° 55' 36"	112° 53' 44"	AZMET
ENCA	Phx. Encanto	33° 28' 45"	112° 05' 47"	AZMET
PGRN	Phx. Greenway	33° 37' 17"	112° 06' 30"	AZMET
QUEE	Queen Creek	33° 15' 30"	111° 38' 30"	AZMET
WADD	Waddell	33° 37' 05"	112° 27' 35"	AZMET

*AZMET: The Arizona Meteorological Network, <http://ag.arizona.edu/azmet/>

6.6 Summary of emissions from biogenic sources

Total biogenic emissions for the Maricopa County 2002 periodic PM emission inventory are summarized in Tables 6.6–1 for both the Maricopa County and PM₁₀ nonattainment area.

Table 6.6–1. Summary of biogenic source NO_x emissions (annual and average day).

Geographic area	Annual emissions (metric tons/yr)	Annual emissions (tons/yr)	Season-day emissions (kg/day)	Average daily emissions (lbs/day)
Maricopa County	7,554	8,327	20,696	45,626
PM ₁₀ NAA	2,220	2,447	6,082	13,408

6.7 References

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