Maricopa County
Air Quality Department

2005 Periodic Emissions Inventory for PM_{10}

for the

Maricopa County, Arizona, Nonattainment Area

MAY 2007

Foreword

This 2005 PM_{10} emissions inventory will serve as the basis for the Five Percent Plan projected 2007, 2008, and 2009 PM_{10} emissions inventories. A draft document was released for public review by the Maricopa County Air Quality Department (MCAQD) in January 2007. The present draft incorporates the comments submitted during a 30-day public comment period. Appendix 1 of this report summarizes comments received along with MCAQD's responses.

This document is also available electronically on the MCAQD website:
http://www.maricopa.gov/aq/divisions/planning_analysis/emissions_inventory/Default.aspx

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2005 PM_{10} Periodic Emission Inventory
for the Maricopa County, AZ Nonattainment Area

May 2007

Table of Contents

List of Tables

List of Figures

Appendices

1. Introduction

1.1 Overview

This 2005 periodic PM_{10} 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 PM_{10}.

PM_{10} is defined as particulate matter less than ten micrometers in diameter. This inventory includes primary emissions of PM_{10} and $PM_{2.5}$ as well as three particulate matter precursors: nitrogen oxides (NO_x), sulfur dioxides (SO_x) and ammonia (NH_3). 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 Air Quality Department (MCAQD) has primary responsibility for preparing and submitting the 2005 Periodic PM_{10} Emissions Inventory for Maricopa County. Point sources and the majority of area, and nonroad mobile source emission estimates were prepared by MCAQD. The Maricopa Association of Governments (MAG) prepared the emission estimates for onroad mobile, biogenic, and some area and nonroad mobile source categories. 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
Point Sources	Bob Downing MCAQD (602) 506-6790	Matt Poppen, Eric Raisanen and Dena Konopka MCAQD (602) 506-6790 Cathy Arthur, MAG (602) 254-6300
Area Sources	Matt Poppen, Eric Raisanen and Dena Konopka MCAQD (602) 506-6790 Cathy Arthur, MAG (602) 254-6300	Bob Downing MCAQD (602) 506-6790 Cathy Arthur, MAG (602) 254-6300
Nonroad Mobile Sources	Matt Poppen and Eric Raisanen MCAQD (602) 506-6790	Bob Downing and Dena Konopka MCAQD (602) 506-6790 Cathy Arthur, MAG (602) 254-6300
Onroad Mobile Sources	Cathy Arthur MAG (602) 254-6300	Bob Downing and Dena Konopka MCAQD (602) 506-6790
Biogenic Sources	Cathy Arthur MAG (602) 254-6300	Bob Downing and Dena Konopka MCAQD (602) 506-6790

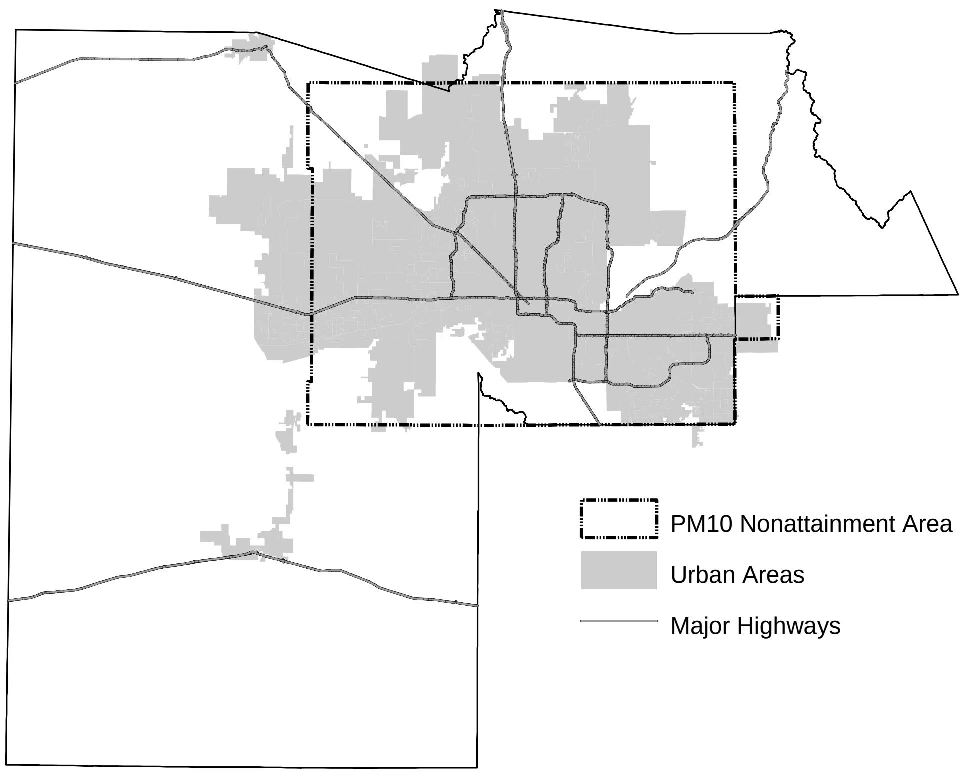
1.3 Temporal scope

Annual and typical daily emissions were estimated for the year 2005, for Maricopa County and the Maricopa County PM_{10} nonattainment area (NAA).

1.4 Geographic scope

This inventory includes emission estimates for Maricopa County and for the Maricopa County PM_{10} nonattainment area. Maricopa County encompasses approximately 9,223 square miles of land area, while the Maricopa County PM_{10} 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 PM_{10} nonattainment area is provided in Figure 1.4–1.

Figure 1.4–1. Map of Maricopa County and the PM_{10} 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 were apportioned to the nonattainment area using the ratio of total population 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, employment data, and single family/multi-family splits for calendar year 2004 (2005 data not yet available), 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 PM_{10} nonattainment area.

Demographic variable	Maricopa County	Within PM_{10} NAA	Percent within PM_{10} NAA
Total resident population	3,524,175	3,529,764	100.16%
Total non-resident population	256,205	279,937	109.26%
Total population:	**3,780,380**	**3,809,701**	**100.78%**
Retail employment	437,333	435,390	99.56%
Office employment	359,824	360,309	100.13%
Industrial employment	352,827	350,412	99.32%
Public employment	216,598	209,768	96.85%
Other employment	151,751	151,618	99.91%
Construction	53,774	53,432	99.36%
Work at Home	57,682	57,216	99.19%
Total employment:	**1,629,789**	**1,618,145**	**99.29%**
Single Family/Multi-Family Household Split:			
Single Family	75%		74%
Multi-Family	25%		26%

1.5.2 Land-use data

The most recent land-use data available from MAG was for the year 2004. The 2004 land-use data was assumed to be representative of 2005. Table 1.5–2 presents a summary of the land-use categories and acreage used to develop emission estimates for this inventory.

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
General/active open space (e.g., parks)	148,352	141,334	95.27%
Passive open space (e.g., mountain preserves)	1,748,816	377,814	21.60%
Golf courses	28,215	28,228	100.05%
Lakes	12,525	9,510	75.93%
Agriculture	465,833	223,627	48.01%
Vacant (e.g., developable land)	2,039,335	404,214	19.82%

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 which in 2005 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 (PM_{10}) 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 PM_{10} 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.

	Annual (tons/yr)					Typical day (lbs/day)				
Source Category	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**NH_3**	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**NH_3**
Electricity generation	313.86	313.20	1,914.79	51.58	198.06	1,887.5	1,883.5	11,016.1	318.7	1,107.5
Comm./inst. fuel combustion	4.90	4.88	58.20	2.82	2.53	28.7	28.6	358.1	17.1	14.0
Industrial fuel combustion	79.10	78.84	739.13	50.59	55.13	483.0	481.2	4,760.2	352.6	317.0
Food/agriculture	64.21	18.08				380.1	109.3			
Industrial processes	842.61	556.08	116.20	123.40	18.11	5,559.3	3,422.7	797.4	793.6	101.2
Manufacturing processes	9.17	8.95	15.00	0.02	0.16	69.2	67.0	82.4	0.1	1.0
Industrial road travel	729.71	294.90				4,945.5	2,035.9			
Waste disposal	69.62	59.45	27.55	56.53		397.6	330.3	151.4	310.6	
Emission reduction credits	1.80		9.80	0.16		9.9		53.7	0.9	
All Point Sources	**2,114.97**	**1,334.38**	**2,880.67**	**285.10**	**273.99**	**13,760.7**	**8,358.4**	**17,219.3**	**1,793.6**	**1,540.6**

Table 1.6–2. Summary of annual and typical daily emissions from point sources in the PM_{10} NAA.

	Annual (tons/yr)					Typical day (lbs/day)				
Source Category	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**NH_3**	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**NH_3**
Electricity generation	113.97	113.72	1,154.60	15.24	132.55	637.8	636.3	6,402.8	103.0	728.3
Comm./inst. fuel combustion	4.90	4.88	58.20	2.82	2.53	28.7	28.6	358.1	17.1	14.0
Industrial fuel combustion	40.67	40.53	614.09	46.35	28.75	267.3	266.2	4,009.2	325.4	171.8
Food/agriculture	27.83	7.87				172.3	50.7			
Industrial processes	670.39	420.49	116.20	123.40	12.41	4,585.5	2,932.0	797.4	793.6	69.9
Manufacturing processes	9.17	8.95	15.00	0.02	0.16	69.2	67.0	82.4	0.1	1.0
Industrial road travel	697.98	283.10				4,729.2	1,955.7			
Waste disposal	69.62	59.45	27.55	56.53		397.6	330.3	151.4	310.6	
Emission reduction credits	1.80		9.80	0.16		9.9		53.7	0.9	
All Point Sources	**1,636.33**	**938.98**	**1,995.44**	**244.52**	**176.40**	**10,897.6**	**6,266.8**	**11,854.9**	**1,550.7**	**984.9**

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 PM_{10} 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.

	Annual emissions (tons/yr)					Typical daily emissions (lbs/day)				
Category	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**NH_3**	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**NH_3**
Fuel combustion	694.01	677.85	6,801.33	435.23	27.55	5,968.4	5,754.4	43,000.7	2,805.4	176.6
Industrial processes	36,882.71	5,713.02	564.11	147.06	1,699.43	237,157.6	36,770.8	5,432.2	1,469.1	10,896.6
Waste treatment/disposal	142.64	108.81	28.35	6.14	1,310.85	1,198.1	945.1	227.4	34.0	7,182.7
Misc. area sources	136,892.15	67,831.62	15,659.58	4,291.61	17,026.53	856,409.2	449,431.2	105,201.4	28,831.5	97,343.4
All area sources:	**174,611.51**	**74,331.30**	**23,053.36**	**4,880.05**	**20,064.35**	**1,100,733.4**	**492,901.5**	**153,861.8**	**33,140.0**	**115,599.4**

Table 1.6–4. Summary of annual and typical daily emissions from area sources in the PM_{10} NAA.

	Annual emissions (tons/yr)					Typical daily emissions (lbs/day)				
Category	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**NH_3**	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**NH_3**
Fuel combustion	691.70	675.51	6,760.83	432.30	27.36	5,954.3	5,739.9	42,706.4	2,786.5	175.1
Industrial processes	35,266.82	5,555.90	563.60	147.05	1,687.89	226,765.3	35,741.7	5,428.5	1,469.1	10,822.7
Waste treatment/disposal	110.74	76.90	19.70	6.14	1,321.01	890.8	637.8	144.4	34.0	7,238.4
Misc. area sources	21,021.78	6,133.71	1,091.78	297.30	10,784.63	129,190.0	39,905.6	7,337.7	1,998.5	59,370.9
All area sources:	**57,091.05**	**12,442.02**	**8,435.92**	**882.80**	**13,820.89**	**362,800.5**	**82,025.0**	**55,616.9**	**6,288.1**	**77,607.1**

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 PM_{10} 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.

	Annual emissions (tons/yr)					Typical daily emissions (lbs/day)				
Category	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**NH_3**	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**NH_3**
Agricultural	39.21	38.03	386.34	5.95	0.73	251.4	243.8	2,476.5	38.2	4.7
Airport ground support	16.50	15.70	467.82	14.71		90.4	86.0	2,563.4	80.6	
Commercial	119.34	114.47	1,449.72	17.32	23.18	765.0	733.8	9,293.1	111.0	148.6
Construction and mining	1,354.26	1,311.26	16,016.62	287.07	31.22	8,681.1	8,405.5	102,670.7	1,840.2	200.1
Industrial	110.02	107.01	3,316.67	26.63	79.21	705.2	686.0	21,260.7	170.7	507.7
Lawn and garden	178.22	165.18	843.10	9.53	21.21	1,226.0	1,135.4	5,882.8	64.1	155.5
Pleasure craft	11.33	10.45	70.58	0.71	1.49	152.5	140.7	950.0	9.5	20.1
Railway maintenance	1.20	1.16	9.27	0.14	0.02	8.3	8.1	64.2	1.0	0.1
Recreational equipment	42.29	38.95	59.99	0.68	1.97	361.4	332.9	512.7	5.8	16.8
Aircraft	173.48	125.05	3,029.37	233.60		950.6	685.2	16,599.3	1,280.0	
Locomotives	74.45	65.28	2,955.24	173.18	4.57	407.9	357.7	16,193.1	948.9	25.0
All nonroad mobile sources:	**2,120.29**	**1,992.56**	**28,604.72**	**769.51**	**163.58**	**13,599.9**	**12,815.2**	**178,466.6**	**4,550.0**	**1,078.7**

Table 1.6–6. Annual and typical daily emissions from all nonroad mobile sources in the PM_{10} NAA.

	Annual emissions (tons/yr)					Typical daily emissions (lbs/day)				
Category	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**NH_3**	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**NH_3**
Agricultural	18.83	18.26	185.46	2.86	0.35	120.7	117.0	1,188.9	18.3	2.2
Airport ground support	16.50	15.70	467.82	14.71		90.4	86.0	2,563.4	80.6	
Commercial	118.48	113.65	1,439.36	17.20	23.01	759.5	728.5	9,226.7	110.2	147.5
Construction and mining	1,356.40	1,313.34	16,042.02	287.52	31.27	8,694.9	8,418.8	102,833.5	1,843.1	200.4
Industrial	109.23	106.25	3,292.98	26.44	78.64	700.2	681.1	21,108.8	169.5	504.1
Lawn and garden	178.50	165.44	844.44	9.54	21.24	1,227.9	1,137.2	5,892.2	64.2	155.8
Pleasure craft	8.60	7.94	53.59	0.54	1.13	115.8	106.9	721.4	7.2	15.2
Railway maintenance	1.20	1.17	9.29	0.14	0.02	8.3	8.1	64.3	1.0	0.1
Recreational equipment	8.89	8.19	12.61	0.14	0.41	76.0	70.0	107.8	1.2	3.5
Aircraft	157.68	114.15	2,929.27	225.69		864.0	625.5	16,050.8	1,236.7	
Locomotives	38.01	33.70	1,509.67	85.72	2.26	208.2	184.7	8,272.2	469.7	12.4
All nonroad mobile sources:	**2,012.32**	**1,897.78**	**26,786.52**	**670.50**	**158.33**	**12,866.0**	**12,163.8**	**168,029.9**	**4,001.8**	**1,041.4**

1.6.4 Onroad mobile sources

Emissions from onroad mobile sources were calculated for the PM_{10} 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 PM_{10} nonattainment area, respectively.

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

	Annual emissions (tons/yr)					Typical daily emissions (lbs/day)				
Category	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**NH_3**	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**NH_3**
Exhaust	1,092.00	1,007.00	66,187.00	1,611.00	3,011.00	5,982.0	5,516.0	362,669.0	8,827.0	16,496.0
Paved road fugitive dust	320.00	80.00				1,755.0	439.0			
Unpaved road fugitive dust	413.00	175.00				2,264.0	960.0			
Tire wear	14,619.00	200.00				80,104.0	1,098.0			
Brake wear	8,903.00	890.00				48,781.0	4,879.0			
All onroad mobile sources:	**25,347.00**	**2,352.00**	**66,187.00**	**1,611.00**	**3,011.00**	**138,886.0**	**12,892.0**	**362,669.0**	**8,827.0**	**16,496.0**

Table 1.6–8. Annual and typical daily emissions from all onroad mobile sources in the PM_{10} NAA.

	Annual emissions (tons/yr)					Typical daily emissions (lbs/day)				
Category	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**NH_3**	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**NH_3**
Exhaust	1,041.00	960.00	63,093.00	1,536.00	2,870.00	5,702.0	5,258.0	345,713.0	8,415.0	15,725.0
Paved road fugitive dust	305.00	76.00				1,673.0	418.0			
Unpaved road fugitive dust	394.00	167.00				2,158.0	915.0			
Tire wear	13,783.00	189.00				75,523.0	1,034.0			
Brake wear	8,490.00	849.00				46,519.0	4,652.0			
All onroad mobile sources:	**24,013.00**	**2,241.00**	**63,093.00**	**1,536.00**	**2,870.00**	**131,575.0**	**12,277.0**	**345,713.0**	**8,415.0**	**15,725.0**

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 PM_{10} nonattainment area. Emissions were estimated through MEGAN, a computer model developed by the ENVIRON corporation through a contract with the Maricopa Association of Governments (MAG). Annual and daily NO_x emissions from biogenic sources are shown in Table 1.6–9 for Maricopa County and the PM_{10} 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	3,321.00	18,197.0
PM_{10} NAA	1,048.00	5,745.0

1.6.6 All sources

Tables 1.6–10 and 1.6–11 provide summary totals of annual and typical daily emissions from all emission sources in Maricopa County and the PM_{10} nonattainment area, respectively.

Table 1.6–10. Annual and typical daily emissions from all sources in Maricopa County.

Section	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
Point Sources	2,114.97	1,334.38	2,880.67	285.10	273.99	13,760.7	8,358.4	17,219.3	1,793.6	1,540.6
Area Sources:										
Fuel combustion										
Industrial natural gas	16.51	16.51	308.43	1.30	6.81	105.9	105.9	1,977.1	8.3	43.7
Industrial fuel oil	247.82	247.82	3,443.60	329.29	14.18	1,588.6	1,588.6	22,074.4	2,110.8	90.9
Comm./ind. natural gas	60.15	60.15	1,146.39	4.72	3.79	385.6	385.6	7,348.6	30.3	24.3
Comm./ind. fuel oil	76.06	76.06	1,110.79	92.05	2.76	487.6	487.6	7,120.5	590.1	17.7
Residential natural gas	62.59	62.59	774.12	4.94		342.9	342.9	4,241.7	27.1	
Residential wood	230.85	214.69	17.35	2.67		3,057.6	2,843.6	229.8	35.3	
Residential fuel oil	0.01	0.01	0.66	0.26		0.2	0.2	8.7	3.4	
All combustion	694.01	677.85	6,801.33	435.23	27.55	5,968.4	5,754.4	43,000.7	2,805.4	176.6
Industrial Processes										
Chemical manufacturing	76.77	38.85	0.39	0.21	0.34	590.5	298.9	3.0	1.6	2.6
Food products										
Commercial cooking	1,527.98	1,416.96				8,395.5	7,785.5			
Grain handling	12.64	2.68				94.7	20.5			
Ammonia storage					1,695.98					10,871.7
Secondary metal prod.	10.95	9.27	4.53	0.05	1.34	79.0	66.3	25.0	0.4	10.3
Mineral processes (concrete batch, etc.)	431.60	222.71				3,030.4	1,517.2			
Mining & quarry (sand & gravel)	62.97	17.38				409.1	112.1			
Wood products	213.23	149.95				1,657.9	1,170.0			
Rubber/plastics mfg.	365.26	236.52				2,809.7	1,819.4			
Fabricated metal mfg.	138.96	119.88				1,579.3	1,404.1			
Residential const.	12,135.60	1,213.56				77,792.3	7,779.2			
Commercial const.	11,491.21	1,149.12				73,661.6	7,366.2			
Road construction	7,307.35	730.73				46,842.0	4,684.2			
Construction – other	2,806.46	280.65				17,990.2	1,799.0			
Electric equip. mfg.	5.24	3.25	0.01	4.59	0.96	40.3	25.0	0.1	35.3	7.4
ADEQ portables	101.70	42.18	554.60	142.20		844.2	389.8	5,377.5	1,431.7	
Unpaved road travel	170.49	65.45				1,138.8	436.2			
Industrial proc. NEC	24.31	13.87	4.58	0.01	0.80	202.0	97.3	26.7	0.0	4.6
All Ind. Processes	36,882.71	5,713.02	564.11	147.06	1,699.43	237,157.6	36,770.8	5,432.2	1,469.1	10,896.6
Waste Treatment/Disp.										
On-site incineration	0.15	0.10	2.54	0.03		1.6	1.1	19.9	0.3	
Open burning	56.15	56.15	15.16			550.9	550.9	148.4		
Landfills	6.79	4.05	6.50	1.11		39.5	23.5	36.3	6.3	
POTWs					1,310.85					7,182.7
Other waste	79.55	48.51	4.15	5.01		606.0	369.6	22.8	27.5	
All Waste Treat/Disp.	142.64	108.81	28.35	6.14	1,310.85	1,198.1	945.1	227.4	34.0	7,182.7
Misc. Area Sources										
Wildfires	70,882.24	60,792.24	15,639.50	4,288.25	3,279.25	475,719.7	408,001.6	104,963.1	28,780.2	22,008.4
Prescribed fires	0.06	0.06	0.05	0.01	0.00	120.0	120.0	93.0	25.5	7.5
Structure fires	22.53	22.53	2.92			123.8	123.8	16.0		
Vehicle fires	26.41	26.41	1.06			144.7	144.7	5.8		
Aircraft engine testing	0.15	0.12	4.61	1.89		1.1	0.9	35.4	14.5	
Tilling	2,913.73	437.06				30,241.4	4,536.2			
Harvesting	145.48	21.82				3,489.9	523.5			
Unpaved agri. roads	2,041.71	204.17				13,087.9	1,308.8			
Cotton ginning	0.08	0.02				0.6	0.2			
Fertilizer application					2,278.14					12,483.0
Livestock	645.27	70.98			10,429.53	3,535.7	388.9			57,148.1
Crematories	0.96	0.64	11.45	1.46		7.4	4.9	88.0	11.3	
Accidental releases	1.03	1.03				5.6	5.6			
Humans					1,039.60					5,696.5
Leaf blowers fugitive	841.66	317.65				4,611.8	1,740.6			
Offroad rec. vehicles fugitive dust	9,994.00	999.00				54,764.0	5,476.0			
Travel on unpaved parking lots	4,888.00	489.00				26,781.0	2,678.0			
Windblown dust	44,488.84	4,448.88				243,774.4	24,377.4			
All Misc. Area Sources	136,892.15	67,831.62	15,659.58	4,291.61	17,026.53	856,409.2	449,431.2	105,201.4	28,831.5	97,343.4
All Area Sources:	174,611.51	74,331.30	23,053.36	4,880.05	20,064.35	1,100,733.4	492,901.5	153,861.8	33,140.0	115,599.4

Table 1.6–10 (continued). Annual and typical daily emissions from all sources in Maricopa County.

Section	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
Nonroad Sources:										
Agricultural equipment	39.21	38.03	386.34	5.95	0.73	251.4	243.8	2,476.5	38.2	4.7
Airport GSE	16.50	15.70	467.82	14.71		90.4	86.0	2,563.4	80.6	
Commercial equipment	119.34	114.47	1,449.72	17.32	23.18	765.0	733.8	9,293.1	111.0	148.6
Construction and mining equipment	1,354.26	1,311.26	16,016.62	287.07	31.22	8,681.1	8,405.5	102,670.7	1,840.2	200.1
Industrial equipment	110.02	107.01	3,316.67	26.63	79.21	705.2	686.0	21,260.7	170.7	507.7
Lawn and garden equipment	178.22	165.18	843.10	9.53	21.21	1,226.0	1,135.4	5,882.8	64.1	155.5
Pleasure craft	11.33	10.45	70.58	0.71	1.49	152.5	140.7	950.0	9.5	20.1
Railway maintenance equipment	1.20	1.16	9.27	0.14	0.02	8.3	8.1	64.2	1.0	0.1
Recreational equipment	42.29	38.95	59.99	0.68	1.97	361.4	332.9	512.7	5.8	16.8
Aircraft	173.48	125.05	3,029.37	233.60		950.6	685.2	16,599.3	1,280.0	
Locomotives	74.45	65.28	2,955.24	173.18	4.57	407.9	357.7	16,193.1	948.9	25.0
All Nonroad Sources	2,120.29	1,992.56	28,604.72	769.51	163.58	13,599.9	12,815.2	178,466.6	4,550.0	1,078.7
Onroad Sources:										
Exhaust	1,092.00	1,007.00	66,187.00	1,611.00	3,011.00	5,982.0	5,516.0	362,669.0	8,827.0	16,496.0
Tire wear	320.00	80.00				1,755.0	439.0			
Brake wear	413.00	175.00				2,264.0	960.0			
Paved road fugitive dust	14,619.00	200.00				80,104.0	1,098.0			
Unpaved road fugitive dust	8,903.00	890.00				48,781.0	4,879.0			
All Mobile Sources:	25,347.00	2,352.00	66,187.00	1,611.00	3,011.00	138,886.0	12,892.0	362,669.0	8,827.0	16,496.0
Biogenic Sources:			3,321.00					18,197.0		
TOTAL, All Sources:	204,193.77	80,010.24	124,046.75	7,545.67	23,512.92	1,266,980.1	526,967.1	730,413.7	48,310.6	134,714.6

Table 1.6–11. Annual and typical daily emissions from all sources in the PM_{10} nonattainment area.

Section	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
Point Sources	1,636.33	938.98	1,995.44	244.52	176.40	10,897.6	6,266.8	11,854.9	1,550.7	984.9
Area Sources:										
Fuel combustion										
Industrial natural gas	16.40	16.40	306.33	1.29	6.77	104.7	104.7	1,955.5	8.2	43.2
Industrial fuel oil	246.14	246.14	3,420.18	327.05	14.08	1,577.8	1,577.8	21,924.3	2,096.5	90.3
Comm./ind. natural gas	59.72	59.72	1,138.13	4.69	3.77	381.5	381.5	7,270.0	30.0	24.1
Comm./ind. fuel oil	75.51	75.51	1,102.80	91.39	2.74	484.1	484.1	7,069.2	585.8	17.6
Residential natural gas	62.69	62.69	775.35	4.95		343.5	343.5	4,248.5	27.1	
Residential wood	231.22	215.04	17.38	2.67		3,062.5	2,848.2	230.1	35.4	
Residential fuel oil	0.01	0.01	0.66	0.26		0.2	0.2	8.7	3.4	
All combustion	691.70	675.51	6,760.83	432.30	27.36	5,954.3	5,739.9	42,706.4	2,786.5	175.1
Industrial Processes										
Chemical manufacturing	76.25	38.59	0.38	0.21	0.34	586.5	296.8	3.0	1.6	2.6
Food products										
Commercial cooking	1,539.90	1,428.01				8,461.0	7,846.2			
Grain handling	12.64	2.68				94.7	20.5			
Ammonia storage					1,684.45					10,797.8
Secondary metal prod.	10.95	9.27	4.53	0.05	1.34	79.0	66.3	25.0	0.4	10.3
Mineral processes (concrete batch, etc.)	430.89	222.17				3,024.9	1,513.0			
Mining & quarry (sand & gravel)	54.77	15.52				347.6	98.2			
Wood products	211.78	148.93				1,646.6	1,162.0			
Rubber/plastics mfg.	362.77	234.91				2,790.6	1,807.0			
Fabricated metal mfg.	138.01	119.06				1,568.6	1,394.5			
Residential const.	11,331.99	1,133.20				72,641.0	7,264.1			
Commercial const.	11,085.55	1,108.55				71,061.2	7,106.1			
Road construction	7,236.42	723.64				46,387.3	4,638.7			
Construction – other	2,475.89	247.59				15,871.1	1,587.1			
Electric equip. mfg.	5.24	3.25	0.01	4.59	0.96	40.3	25.0	0.1	35.3	7.4
ADEQ portables	101.70	42.18	554.60	142.20		844.2	389.8	5,377.5	1,431.7	
Unpaved road travel	167.78	64.48				1,118.8	429.0			
Industrial proc. NEC	24.29	13.86	4.08	0.01	0.80	201.9	97.2	22.9	0.0	4.6
All Ind. Processes	35,266.82	5,555.90	563.60	147.05	1,687.89	226,765.3	35,741.7	5,428.5	1,469.1	10,822.7
Waste Treatment/Disp.										
On-site incineration	0.15	0.10	2.54	0.03		1.6	1.1	19.9	0.3	
Open burning	24.24	24.24	6.51			243.6	243.6	65.3		
Landfills	6.79	4.05	6.50	1.11		39.5	23.5	36.3	6.3	
POTWs					1,321.01					7,238.4
Other waste	79.55	48.51	4.15	5.01		606.0	369.6	22.8	27.5	
All Waste Treat/Disp.	110.74	76.90	19.70	6.14	1,321.01	890.8	637.8	144.4	34.0	7,238.4
Misc. Area Sources										
Wildfires	4,860.02	4,168.20	1,072.32	294.02	224.84	32,617.6	27,974.5	7,196.8	1,973.3	1,509.0
Prescribed fires	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0
Structure fires	22.56	22.56	2.92			124.0	124.0	16.1		
Vehicle fires	26.45	26.45	1.06			145.0	145.0	5.8		
Aircraft engine testing	0.15	0.12	4.61	1.89		1.1	0.9	35.4	14.5	
Tilling	1,228.67	184.30				12,797.0	1,919.6			
Harvesting	58.99	8.85				1,420.8	213.1			
Unpaved agri. roads	910.64	91.06				5,837.4	583.7			
Cotton ginning	0.09	0.02				0.7	0.2			
Fertilizer application					1,093.74					5,993.1
Livestock	520.84	57.29			8,418.39	2,853.9	313.9			46,128.1
Crematories	0.91	0.61	10.87	1.39		7.0	4.7	83.6	10.7	
Accidental releases	1.03	1.03				5.6	5.6			
Humans					1,047.67					5,740.6
Leaf blowers fugitive	843.00	318.16				4,619.2	1,743.3			
Offroad rec. vehicles fugitive dust	2,159.00	216.00				11,830.0	1,184.0			
Travel on unpaved parking lots	3,009.00	301.00				16,490.0	1,649.0			
Windblown dust	7,380.43	738.04				40,440.7	4,044.1			
All Misc. Area Sources	21,021.78	6,133.71	1,091.78	297.30	10,784.63	129,190.0	39,905.6	7,337.7	1,998.5	59,370.9
All Area Sources:	57,091.05	12,442.02	8,435.92	882.80	13,820.89	362,800.5	82,025.0	55,616.9	6,288.1	77,607.1

Table 1.6–11 (continued). Annual and typical daily emissions from all sources in the PM_{10} nonattainment area.

	Annual emissions (tons/yr)					Typical daily emissions (lbs/day)				
Section	PM_{10}	$PM_{2.5}$	NO_x	SO_x	NH_3	PM_{10}	$PM_{2.5}$	NO_x	SO_x	NH_3
Nonroad Sources:										
Agricultural equipment	18.83	18.26	185.46	2.86	0.35	120.7	117.0	1,188.9	18.3	2.2
Airport GSE	16.50	15.70	467.82	14.71		90.4	86.0	2,563.4	80.6	
Commercial equipment	118.48	113.65	1,439.36	17.20	23.01	759.5	728.5	9,226.7	110.2	147.5
Construction and mining equipment	1,356.40	1,313.34	16,042.02	287.52	31.27	8,694.9	8,418.8	102,833.5	1,843.1	200.4
Industrial equipment	109.23	106.25	3,292.98	26.44	78.64	700.2	681.1	21,108.8	169.5	504.1
Lawn and garden equipment	178.50	165.44	844.44	9.54	21.24	1,227.9	1,137.2	5,892.2	64.2	155.8
Pleasure craft	8.60	7.94	53.59	0.54	1.13	115.8	106.9	721.4	7.2	15.2
Railway maintenance equipment	1.20	1.17	9.29	0.14	0.02	8.3	8.1	64.3	1.0	0.1
Recreational equipment	8.89	8.19	12.61	0.14	0.41	76.0	70.0	107.8	1.2	3.5
Aircraft	157.68	114.15	2,929.27	225.69		864.0	625.5	16,050.8	1,236.7	
Locomotives	38.01	33.70	1,509.67	85.72	2.26	208.2	184.7	8,272.2	469.7	12.4
All Nonroad Sources:	2,012.32	1,897.78	26,786.52	670.50	158.33	12,866.0	12,163.8	168,029.9	4,001.8	1,041.4
Onroad Sources:										
Exhaust	1,041.00	960.00	63,093.00	1,536.00	2,870.00	5,702.0	5,258.0	345,713.0	8,415.0	15,725.0
Tire wear	305.00	76.00				1,673.0	418.0			
Brake wear	394.00	167.00				2,158.0	915.0			
Paved road fugitive dust	13,783.00	189.00				75,523.0	1,034.0			
Unpaved road fugitive dust	8,490.00	849.00				46,519.0	4,652.0			
All Mobile Sources:	24,013.00	2,241.00	63,093.00	1,536.00	2,870.00	131,575.0	12,277.0	345,713.0	8,415.0	15,725.0
Biogenic Sources:			1,048.00					5,745.0		
TOTAL, All Sources:	84,752.70	17,519.78	101,358.87	3,333.82	17,025.62	518,139.1	112,732.6	586,959.7	20,255.6	95,358.4

1.7 Response to public review of draft inventory

MCAQD released a draft 2005 PM_{10} emissions inventory for public review and comment on January 23, 2007. The public review period for the draft inventory ended on March 1, 2007. MCAQD evaluated the comments received on the draft PM_{10} emissions inventory and prepared written responses to these comments. A full listing of each comment with MCAQD's and other responsible agencies' responses are available in Appendix 1. As a result of these comments, and along with further QA/QC work by MCAQD and partner agencies, the emission estimates in this report have been revised.

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2. Point Sources

2.1 Introduction and scope

This inventory of PM_{10} 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 PM_{10} nonattainment area (NAA) as a commitment under the current PM_{10} 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 2005. 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)

Since 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 which in 2005 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 (PM_{10}) or ammonia compounds (NH_x).

For the Pinal County portion of the PM_{10} non-attainment area, the standard point source definition (70 TPY of PM_{10}) was applied. No additional point sources met this reporting threshold.

Additionally, EPA guidance requires emission inventories prepared for SIP development purposes to consider point sources with 25 miles of the non-attainment area boundary. For these sources, the traditional "major source" threshold definitions for attainment areas were applied. No additional point sources met this reporting threshold.

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.

PM_{10} is defined as particulate matter less than ten micrometers in diameter. This inventory includes primary emissions of PM_{10} and $PM_{2.5}$ as well as three particulate matter precursors:

nitrogen oxides (NO_x), sulfur dioxides (SO_x) and ammonia (NH_3). This point source inventory includes annual and typical daily emissions of PM_{10}, $PM_{2.5}$, NO_x, SO_x, and NH_3 for 2005. A description and map of the PM_{10} nonattainment area are provided in Chapter 1. Questions concerning point source emissions may be directed to Bob Downing of MCAQD at (602) 506-6790.

Several tables have been constructed to provide the point source emissions and category totals. Table 2.2–1 provides an alphabetical list of all point sources and their location. Table 2.4–1 shows the 2005 annual and typical day emissions of PM_{10}, $PM_{2.5}$, NO_x, SO_x and NH_3 for those point sources which reported emissions of any of these pollutants broken out by facility. Tables 2.6–1 summarize point source emissions by source category for the county and PM nonattainment area, respectively. 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

The Maricopa County Air Quality Department (MCAQD) identified point sources within Maricopa County through its electronic permit system database, EMS, and the 2005 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 2002 periodic inventory was compiled.

A total of 173 stationary point sources were identified using the emission thresholds described in Section 2.1. Of these 173 facilities, 151 sources (listed in Table 2.2–1) reported emissions of PM_{10}, NO_x, SO_x, and/or ammonia – 140 within the PM_{10} nonattainment area, and 11 outside the PM_{10} NAA. There are no additional point sources within the 25-mile boundary around the PM_{10} 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 contains an alphabetical list of all point sources, including a unique business identification number, NAICS industry classification code, business name, and physical address.

Table 2.2–1. Name and location of all point sources.

ID #	NAICS	Business name	Address	City	ZIP	
1074	221320	23rd Ave Wastewater Treatment Plant	2470 S 22nd Ave	Phoenix	85009	
1075	221320	91st Ave Wastewater Treatment Plant	5615 S 91st Ave	Tolleson	85353	
1387	332312	Able Steel Fabricators	4150 E Quartz Cir	Mesa	85215	
1952	423110	Adesa Phoenix LLC	400 N Beck Ave	Chandler	85226	
245	337122	AF Lorts Manufacturing Company	8120 W Harrison St	Tolleson	85353	
35541	33121	Allied Tube and Conduit	2525 N 27th Ave	Phoenix	85009	
1834	518210	American Express IPC Facility	3151 W Behrend Dr	Phoenix	85027	
31637	115111	Anderson Clayton Corp-Valencia Gin	25500 W Southern Ave	Buckeye	85326	
3313	221112	APS West Phx Power Plant	4606 W Hadley St	Phoenix	85043	
3938	332812	Arizona Galvanizing Inc	15775 Elwood St	Goodyear	85338	
36772	212321	Arizona Materials	3636 S 43rd Ave	Phoenix	85009	
4364	61131	Arizona State University	1551 S Rural Rd	Tempe	85287	
334	311211	Bay State Milling Co	421 S 99th Ave	Tolleson	85353	
74058	321918	Biltmore Shutters Inc	1138 W Watkins St	Phoenix	85007	
43124	313230	Bonded Logic Inc	411 E Ray Rd	Chandler	85225	
458	32191	Bryant Industries Inc	788 W Illini St	Phoenix	85041	
217	327123	Building Products Co	4850 W Buckeye Rd	Phoenix	85043	
56105	33711	Burdette Cabinet Co Inc	3941 N Higley Rd	Mesa	85215	
1218	562212	Butterfield Station Facility	40404 S 99th Ave	Mobile	85239	
3442	493190	Caljet	125 N 53rd Ave	Phoenix	85043	
60598	337211	Case Furniture & Design LLC	4645 W Polk St	Phoenix	85043	
1318	321991	Cavco Industries Inc (Litchfield)	1366 S Litchfield Rd	Goodyear	85338	
1317	321991	Cavco Industries Inc (S. 35th Ave.)	2602 S 35th Ave	Phoenix	85009	
1316	321991	Cavco Industries LLC/Durango Plant	2502 W Durango St	Phoenix	85009	
4401	32732	Cemex Construction Materials	6500 N 115th Ave	Glendale	85323	
1267	32732	Cemex Mesa Plants No #61 & #71	1901 N Alma School Rd	Mesa	85201	
1268	212321	Cemex Usa (107th Ave.)	24004 N 107th Ave	Sun City	85373	
1266	212321	Cemex Usa (W. Indian School Rd.)	11701 W Indian School	Phoenix	85063	
1310	32311	Century Graphics LLC	2960 Grand Ave	Phoenix	85017	
3976	33711	Cholla Custom Cabinets Inc	1727 E Deer Valley Dr	Phoenix	85024	
61573	212322	Circle H Sand & Rock	6400 S El Mirage Rd	Tolleson	85353	
35819	562212	City of Chandler Landfill	3850 S McQueen Rd	Chandler	85249	
38731	321991	Clayton Homes-El Mirage	12345 W Butler Dr	El Mirage	85335	
113723	212321	Contractors Landfill & Recycling	2425 N Center St	Mesa	85201	
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	
1389	541380	DaimlerChrysler Arizona Proving Grounds	33040 N 203rd Ave	Wittmann	85361	
130	331512	Dolphin Inc	740 S 59th Ave	Phoenix	85043	
48771	32739	Eagle Roofing Products	4602 W Elwood St	Phoenix	85043	
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	
1505	32191	Executive Door	3939 W Clarendon Ave	Phoenix	85019	
1488	115111	Farmer's Gin Inc	8400 S Turner Rd	Buckeye	85326	*
27728	334413	Flipchip International LLC	3701 E University Dr	Phoenix	85034	
881	334413	Freescale Semiconductor Inc (Alma School)	1300 N Alma School Rd	Chandler	85224	
1109	334413	Freescale Semiconductor Inc (Elliott Rd.)	2100 E Elliot Rd	Tempe	85284	
44439	221112	Gila River Power Station	1250 E Watermelon Rd	Gila Bend	85337	*
73110	424910	Glenn Weinberger Topsoil Inc	39500 S 99th Ave	Maricopa Co.	85239	
508	337122	Golden Eagle Manufacturing	601 S 65th Ave	Phoenix	85043	
1418	326299	Goodrich Aircraft Interior Products	3414 S 5th St	Phoenix	85040	
699	212321	Hanson Aggregates of Arizona (S. 51st Ave.)	4002 S 51st Ave	Phoenix	85043	

* = Facility is outside the PM_{10} nonattainment area.

Table 2.2–1. Name and location of all point sources (continued).

ID #	NAICS	Business name	Address	City	ZIP	
4498	212321	Hanson Aggregates of Arizona (W. Indian School)	33500 W Indian School	Phoenix	85340	*
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	
1059	336412	Honeywell Engines Sys & Service Phx R&O	1944 E Sky Harbor Cir	Phoenix	85034	
247	336413	Honeywell Engines Systems Accessories	1300 W Warner Rd	Tempe	85284	
355	336412	Honeywell-Engines Systems & Services	111 S 34th St	Phoenix	85034	
403	331316	Hydro Aluminum North America Inc	249 S 51st Ave	Phoenix	85043	
777	32614	Insulfoam	3401 W Cocopah St	Phoenix	85009	
3966	334413	Intel Corp-Ocotillo Campus (Fab 12 & 22)	4500 S Dobson Rd	Chandler	85248	
725	212321	Kilauea Crushers Inc	Hwy 74	Wickenburg	85358	*
341	325991	L & M Laminates & Marble	813 E University Dr	Phoenix	85034	
96886	337122	Legends Furniture	10300 W Buckeye Rd	Tolleson	85353	
43063	221112	LSP Arlington Valley LLC	39027 W Elliot Rd	Arlington	85322	*
3300	92811	Luke AFB - 56Th Fighter Wing	14002 W Marauder St	Glendale	85309	
744	331513	M E Global Inc	5857 S Kyrene Rd	Tempe	85283	
1248	325991	Maax Spas Arizona	25605 S Arizona Ave	Chandler	85248	
31261	21231	Madison Granite Supplies	30600 N 23rd Ave	Phoenix	85027	
44092	32732	Maricopa Ready Mix (Litchfield)	4405 S Litchfield Rd	Phoenix	85338	
40470	32732	Maricopa Ready Mix (Sun City)	10800 W Rose Garden	Sun City	85373	
353	326199	Marlam Industries Inc	834 E Hammond Ln	Phoenix	85034	
289	115111	Martori Farms	51040 W Valley Rd	Aguila	85320	*
62	33711	Mastercraft Cabinets Inc	305 S Brooks	Mesa	85202	
3326	325991	Mesa Fully Formed Inc	1111 S Sirrine St	Mesa	85210	
1415	212321	Mesa Materials Inc (Broadway)	7845 W Broadway Rd	Phoenix	85043	
1414	212321	Mesa Materials Inc (Higley)	3410 N Higley Rd	Mesa	85205	
44186	221112	Mesquite Generating Station	37625 W Elliot Rd	Arlington	85322	*
1875	334413	Microchip Technology Inc	1200 S 52nd St	Tempe	85281	
226	32739	Monier Lifetile LLC	1832 S 51st Ave	Phoenix	85043	
34197	327420	National Gypsum Co	1414 E Hadley St	Phoenix	85034	
910	334412	Neltec Inc	1420 W 12th Pl	Tempe	85281	
73084	337122	New Directions Incorporated	402 S 63rd Ave	Phoenix	85009	
43530	221112	New Harquahala Generating Co	2530 N 491st Ave	Tonopah	85354	*
1879	562212	Northwest Regional Landfill	19401 W Deer Valley	Surprise	85374	
1331	337122	Oak Canyon Manufacturing Inc	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	
528	322211	Packaging Corporation of America Inc	441 S 53rd Ave	Phoenix	85043	
98	221113	Palo Verde Nuclear Generating Station	5801 S Wintersburg Rd	Tonopah	85354	*
428	115111	Paloma Gin Properties LLC	I-8	Gila Bend	85337	*
733	811412	Pan-Glo Services	2401 W Sherman St	Phoenix	85009	
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	
1154	33992	Ping Inc	2201 W Desert Cove Ave	Phoenix	85029	
92072	212313	Pioneer Landscaping Materials	23044 N 7th St	Phoenix	85024	
148	331528	Presto Casting Co	5440 W Missouri Ave	Glendale	85301	
60889	811198	Purcells 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	
50299	713910	Quintero Area Water System	16752 W St Rt 74	Peoria	85382	

* = Facility is outside the PM_{10} nonattainment area.

Table 2.2–1. Name and location of all point sources (continued).

ID #	NAICS	Business name	Address	City	ZIP	
537	327999	Red Mountain Mining Inc	4520 N Power Rd	Mesa	85215	
42956	221112	Redhawk Generating Facility	11600 S 363rd Ave	Arlington	85322	*
303	332431	Rexam Beverage Can Company	211 N 51st Ave	Phoenix	85043	
63	212321	Rinker Materials (El Mirage)	8635 N El Mirage Rd	El Mirage	85335	
260	212321	Rinker Materials (S. 19th Ave.)	3640 S 19th Ave	Phoenix	85009	
64781	212313	Rinker Materials (S. 59th Ave.)	5605 S 59th Ave	Laveen	85339	
213	212321	Rinker Materials (W. Glendale)	11920 W Glendale Ave	Glendale	85307	
4318	32732	River Ranch Plant #40	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	5020 S 36th St	Phoenix	85040	
3315	221112	Santan Generating Station	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	
4175	424710	SFPP LP Phoenix Terminal	49 N 53rd Ave	Phoenix	85043	
50422	336413	Simula Safety Systems Inc	7822 S 46th St	Phoenix	85044	
27933	562212	Skunk Creek Landfill	3165 W Happy Valley	Phoenix	85027	
331	321999	Smurfit Stone Container Corp	6900 W Northern Ave	Glendale	85303	
46277	321999	Southwest Forest Products Inc	2828 S 35th Ave	Phoenix	85009	
3316	221112	SRP Agua Fria Generating Station	7302 W Northern Ave	Glendale	85303	
3317	221112	SRP Kyrene Generating Station	7005 S Kyrene Rd	Tempe	85283	
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	
4400	334413	Sumco Southwest Corporation	19801 N Tatum Blvd	Phoenix	85050	
378	212321	Sun Land Materials	6950 W Southern Ave	Laveen	85339	
281	212321	Sun State Rock & Materials	11500 W Beardsley Rd	Sun City	85373	
101	31161	Sunland Beef Company	651 S 91st Ave	Tolleson	85353	
31643	562212	SW Reg Municipal Solid Waste Landfill	24427 S Hwy 85	Buckeye	85326	
249	336411	The Boeing Company	5000 E McDowell Rd	Mesa	85215	
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	
1211	337122	Trendwood Inc (E. University)	261 E University Dr	Phoenix	85004	
1210	337122	Trendwood Inc (S. 15th Ave.)	2402 S 15th Ave	Phoenix	85007	
37546	32739	Trenwyth Industries	4626 N 42nd Ave	Phoenix	85019	
42915	322299	U S Greenfiber-Phoenix	601 S 55th Ave	Phoenix	85043	
234	311514	United Dairymen of Arizona	2008 S Hardy Dr	Tempe	85282	
53	32739	Utility Vault Co	411 E Frye Rd	Chandler	85225	
2	32412	Vulcan Materials Co (115th Ave.)	14521 N 115th Ave	El Mirage	85335	
90	32732	Vulcan Materials Co (43rd Ave.)	4830 S 43rd Ave	Phoenix	85041	
344	212321	Vulcan Materials Co (W. Indian School Rd.)	11923 W Indian School	Avondale	85039	
174	325998	W R Meadows of Az Inc	4220 S Sarival Ave	Goodyear	85338	
36676	311119	Western Milling	310 S 24th Ave	Phoenix	85009	
141	424910	Western Organics Inc	2807 S 27th Ave	Phoenix	85009	
398	212321	Wickenburg Facility	44605 Grand Ave	Wickenburg	85390	
20706	32614	Wincup Holdings Inc	7980 W Buckeye Rd	Phoenix	85043	
1382	33711	Woodcase Fine Cabinetry Inc	3255 W Osborn Rd	Phoenix	85017	

* = Facility is outside the PM_{10} nonattainment area.

2.3 Procedures for estimating emissions from point sources

Annual and typical daily emission estimates were determined from annual source emission reports, MCAQD 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.

MCAQD distributes annual emissions survey forms to nearly all facilities for which MCAQD 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 MCAQD.

After a facility has submitted an annual emissions report to MCAQD, emissions inventory staff checks 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. MCAQD 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 Calculation of $PM_{2.5}$ emissions

For all county-permitted sources that submitted an annual emission inventory report, all process-level emissions for PM_{10}, NO_x, SO_x, and NH_3 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 PM_{10} controls, emission factors for $PM_{2.5}$ published by the California Air Resources Board (CARB, 2004) were used where available.
3. For all other processes (where neither of the above resources provided guidance), $PM_{2.5}$ was assumed equal to PM_{10} as a conservative estimate.

2.3.2 *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.

In prior years, EPA guidance (US EPA, 2003b) recommended using a default RE value of 80%. More recently, a workgroup consisting of emissions inventory staff from state, local and EPA offices convened to review existing rule effectiveness (RE) guidance, and develop consensus recommendation for improvements to this guidance. This work resulted in the development of questionnaires for point and area sources, which identify control program factors most likely to affect RE.

MCAQD applied this revised approach (US EPA, 2005, Appendix B) to controlled processes reported by facilities on their annual emission reports. The quantification of RE was performed for three groups of industrial processes:

- For manually controlled processes that are regulated by Maricopa County Rule 316 (Nonmetallic Mineral Processing), EPA's non-point source guidance was applied to determine the rule effectiveness of County Rule 316. Results showed an overall rule effectiveness of 54.36%; see Appendix 2.2 for details.
- For most other processes that claimed emissions reductions through the use of a control device, EPA's point source guidance was applied to determine the effectiveness of the reported capture and control efficiencies. Calculations were performed separately for Title V and non-Title V sources. Application of the 2005 EPA guidance resulted in overall RE values of 90.55% (for Title V processes) and 87.95% (for non-Title V). A sample questionnaire and documentation of calculations for these processes is included in Appendix 2.3.

Section 2.3.4 contains a detailed description of the application of RE for a specific process. The following sections illustrate how emission estimates were obtained for the Maricopa County-permitted sources listed in Table 2.2–1.

2.3.3 *Example 1: 91st Ave. Wastewater Treatment Plant*

One of the processes at this municipal wastewater treatment plant is a flare that burns off captured methane (digester gas). The firm provided the following information used to calculate emissions from the flare:

Calculation of annual PM_{10} emissions from flare:

Annual PM_{10} emissions (lbs) = Volume of material processed annually × AP–42 emission factor
= 234.02 MMCF/yr × 24.43 lb PM_{10} / million cu. ft (MMCF)
= 5,717 lbs PM_{10}/yr

Calculation of annual $PM_{2.5}$ emissions:

CARB (2004) provides an uncontrolled $PM_{2.5}$: PM_{10} ratio of 0.6842 for SCC 50100410, Landfill Dump: Waste Gas Destruction: Waste Gas Flare. This ratio was used to derive annual $PM_{2.5}$ emissions from the flare:

Annual $PM_{2.5}$ emissions (lbs) = Annual PM_{10} emissions × $PM_{2.5}$: PM_{10} ratio
= 5,717 lbs PM_{10}/yr × 0.6842
= 3,912 lbs $PM_{2.5}$/yr

Calculation of typical daily emissions:

The 91st Ave. Wastewater Treatment Plant provided seasonal operating data for each process. Typical daily emissions are calculated based on the daily and annual operating schedule, as follows:

Typical daily emissions (lbs/day) = Annual emissions ÷ (days/week × weeks/year)
= 5,717 lbs PM_{10}/yr ÷ (7 days/wk × 52 wks/yr)
= 15.7 lbs PM_{10}/day

2.3.4 Example 2: River Ranch Plant #40

The example below demonstrates the steps involved in calculating emissions and the application of rule effectiveness. The example below shows how PM_{10} emissions were calculated for a single process, aggregate delivery to ground storage for River Ranch Plant, a concrete batching facility:

Uncontrolled emissions (lbs/yr) = Annual throughput × emission factor
= 256,110 tons × 0.0033 lbs PM_{10}/ton
= 845.2 lb PM_{10}/yr

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 watering (typically assumed to control 70%) to control PM_{10} emissions. Thus total controlled emissions are calculated as follows:

Controlled emissions (lbs/yr) = Uncontrolled emissions × [1 – (% capture efficiency × % control effectiveness)]
= 845.2 lbs × [1 – (100% capture × 70% control)]
= 845.2 lbs × 0.30
= 253.5 lb PM_{10}/yr

This total was reported on the facility's annual emissions inventory as actual PM_{10} 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 2.3.2, a value of 54.36% RE was applied to this process. Thus the total annual emissions including RE was calculated as:

Annual emissions reflecting RE = Uncontrolled emissions × [1 – (capture efficiency × control efficiency × RE)]
= 845.2 lbs PM_{10} /yr × [1 – (100% × 70% × 54.36%)]
= 845.2 lbs × 0.6195
= 523.6 lbs PM_{10}/yr

<u>Calculation of typical daily emissions</u>:
Typical daily emissions were derived from annual emissions, using operating schedule data as follows:

Typical daily emissions (lbs/day) = Annual emissions (reflecting RE) ÷ (days/week × weeks/year)
= 523.6 lbs/yr ÷ (5 days/wk × 52 wks/yr)
= 2.0 lbs PM_{10}/day

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 PM_{10} nonattainment area. Sources for which rule effectiveness has been applied (for PM_{10} 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 PM_{10} nonattainment area:

ID #	Business name		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
1074	23rd Ave Wastewater Treatment Plant		1.28	0.90	4.18	7.24	0.08	7.0	5.0	23.0	39.8	0.5
1075	91st Ave Wastewater Treatment Plant		11.37	7.88	14.75	46.42	0.00	62.5	43.3	81.0	255.0	0.0
1387	Able Steel Fabricators	*	0.23	0.21				1.8	1.6			
1952	Adesa Phoenix LLC		0.01	0.01	0.11	0.00	0.01	0.1	0.1	0.8	0.0	0.1
245	AF Lorts Manufacturing Company	*	6.47	5.17	0.02	0.00	0.00	49.8	39.8	0.2	0.0	0.0
35541	Allied Tube and Conduit		0.01	0.01	0.11	0.00	0.01	0.1	0.1	0.9	0.0	0.1
1834	American Express IPC Facility		0.77	0.77	11.01	0.72	0.03	4.3	4.2	60.5	4.0	0.1
31637	Anderson Clayton Corp-Valencia Gin	*	16.97	4.39	0.05	0.00		93.2	24.1	0.3	0.0	
3313	APS West Phx Power Plant		54.59	51.06	518.91	5.61	97.63	300.0	280.6	2,851.1	30.8	536.5
3938	Arizona Galvanizing Inc	*	9.44	5.75	2.84	0.02	0.27	51.9	31.6	15.6	0.1	1.5
36772	Arizona Materials	*	15.43	6.33				98.9	40.6			
4364	Arizona State University		1.67	1.67	11.66	0.17	1.95	9.2	9.2	64.1	0.9	10.7
334	Bay State Milling Co	*	6.46	3.33				49.7	25.6			
74058	Biltmore Shutters Inc		0.01	0.01				0.1	0.1			
43124	Bonded Logic Inc	*	9.48	9.48	0.19	0.00	0.02	73.0	73.0	1.5	0.0	0.1
458	Bryant Industries Inc	*	1.24	0.99				9.5	7.6			
217	Building Products Co	*	14.52	4.73	5.34	11.42	0.02	83.7	28.2	29.8	62.7	0.2
56105	Burdette Cabinet Co Inc		0.04	0.04				0.3	0.3			
1218	Butterfield Station Facility	*	30.45	21.76	2.08	0.45	0.00	233.5	166.9	13.3	2.6	0.0
3442	Caljet		0.00	0.00	1.38	0.00	0.04	0.0	0.0	7.6	0.0	0.2
60598	Case Furniture & Design LLC	*	3.08	2.28				19.7	14.6			
1318	Cavco Industries Inc (Litchfield)	*	0.84	0.67				6.4	5.2			
1317	Cavco Industries Inc (S. 35th Ave.)	*	0.09	0.09				0.7	0.7			
1316	Cavco Industries LLC/Durango Plant	*	0.53	0.42				4.1	3.2			
4401	Cemex Construction Materials	*	17.45	7.50				95.9	41.2			
1267	Cemex Mesa Plants No #61 & #71	*	29.29	13.63	61.69	0.65	0.14	160.9	74.9	338.9	3.5	0.8
1268	Cemex USA (107th Ave.)	*	33.87	17.45				186.1	95.9			
1266	Cemex USA (W. Indian School Rd.)	*	28.57	12.87				157.0	70.7			
1310	Century Graphics LLC		0.00	0.00	0.06	0.00	0.01	0.0	0.0	0.4	0.0	0.0
3976	Cholla Custom Cabinets Inc		0.09	0.07	0.10	0.00		0.7	0.5	0.7	0.0	
61573	Circle H Sand & Rock	*	8.33	3.40	12.82	0.84	0.03	62.8	25.7	98.6	6.5	0.2
35819	City of Chandler Landfill	*	3.16	2.22	6.57	1.04		17.4	12.2	36.1	5.7	
38731	Clayton Homes-El Mirage	*	0.20	0.18				1.5	1.4			
113723	Contractors Landfill & Recycling	*	13.47	4.02	2.80	0.18	0.01	103.6	31.0	21.5	1.4	0.0
399	Coreslab Structures (Ariz) Inc	*	21.58	8.33				166.0	64.1			
1198	Courier Graphics Corp		0.03	0.03	0.37	0.00	0.03	0.2	0.2	2.4	0.0	0.2
4368	Craftsmen In Wood Mfg	*	5.17	4.26	0.07	0.00	0.01	39.7	32.7	0.5	0.0	0.0
1389	DaimlerChrysler Arizona Proving Grounds		138.77	40.52	0.14	0.00		762.5	222.7	1.3	0.0	
130	Dolphin Inc	*	10.47	9.80	2.27	0.05	0.20	82.1	76.9	17.4	0.4	1.6
48771	Eagle Roofing Products	*	5.91	5.50	1.82	0.01	0.17	37.9	35.3	11.7	0.1	1.1
3305	Earthgrains Baking Companies Inc	*	3.61	0.28	2.06	0.01	0.19	23.1	1.8	13.2	0.1	1.2
26	Empire Machinery Co	*	0.90	0.89	33.25	0.33	0.50	5.7	5.6	192.7	2.5	2.7
1505	Executive Door	*	3.21	2.73				24.7	21.0			
27728	Flipchip International LLC		0.03	0.03	0.44	0.00	0.11	0.2	0.2	2.4	0.0	0.6
881	Freescale Semiconductor Inc (Alma School)	*	0.91	0.91	6.92	0.63	1.35	6.8	6.8	95.4	22.1	7.4
1109	Freescale Semiconductor Inc (Elliott Rd.)	*	0.32	0.32	3.11	0.03	0.65	2.1	2.1	22.1	0.5	3.6
73110	Glenn Weinberger Topsoil Inc	*	15.20	4.60	0.08	0.01	0.00	104.1	30.6	0.4	0.0	0.0
508	Golden Eagle Manufacturing	*	5.65	4.90	0.03	0.00	0.00	43.4	37.7	0.2	0.0	0.0
1418	Goodrich Aircraft Interior Products		0.05	0.04	0.58	0.00	0.03	0.4	0.3	4.4	0.0	0.2
699	Hanson Aggregates of Arizona	*	97.66	43.60	5.64	2.30		735.8	329.7	43.4	17.7	
31565	Henry Products Inc		0.04	0.04	0.55	0.00	0.05	0.3	0.3	4.2	0.0	0.4
529	Highland Products Inc		0.15	0.15	1.98	0.01	0.18	1.2	1.2	15.2	0.1	1.4

* = 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}	$PM_{2.5}$	NO_x	SO_x	NH_3	PM_{10}	$PM_{2.5}$	NO_x	SO_x	NH_3
3536	Holsum Bakery Inc		0.21	0.21	2.71	0.02	0.25	1.6	1.6	20.9	0.1	1.9
1059	Honeywell Engines Sys & Service Phx R&O	*	0.45	1.15	1.52	0.43	0.09	2.8	7.3	8.8	2.8	0.5
247	Honeywell Engines Systems Accessories		0.42	0.42	10.39	0.23	0.15	2.3	2.3	57.1	1.2	0.8
355	Honeywell-Engines Systems & Services	*	4.21	4.00	64.78	12.82	1.27	23.5	22.2	355.9	70.4	7.5
403	Hydro Aluminum North America Inc	*	15.01	14.26	11.95	0.48	0.98	96.2	91.4	76.6	3.1	6.3
777	Insulfoam		0.12	0.12	1.63	0.01	0.15	0.8	0.8	10.4	0.1	0.9
3966	Intel Corp-Ocotillo Campus (Fab 12/22)	*	2.21	1.79	24.87	0.37	6.08	20.7	18.4	259.1	10.1	33.7
341	L & M Laminates & Marble		0.04	0.03				0.3	0.2			
96886	Legends Furniture		0.49	0.43				3.8	3.3			
3300	Luke AFB - 56th Fighter Wing		0.82	0.82	9.37	0.23	0.40	5.4	5.4	59.5	1.5	2.2
744	M E Global Inc	*	69.70	67.40	40.38	11.43	0.50	531.3	514.1	304.5	87.9	3.3
1248	Maax Spas Arizona	*	0.42	0.30				3.2	2.3			
31261	Madison Granite Supplies	*	11.28	3.86	31.84	15.05	0.07	86.8	29.7	244.9	115.8	0.6
44092	Maricopa Ready Mix (Litchfield)	*	9.83	4.87				75.4	37.4			
40470	Maricopa Ready Mix (Sun City)	*	11.06	5.08				84.9	39.0			
353	Marlam Industries Inc	*	2.56	1.81	0.04	0.00	0.00	19.7	14.0	0.3	0.0	0.0
62	Mastercraft Cabinets Inc		0.04	0.03	0.13	0.00	0.01	0.3	0.2	1.0	0.0	0.1
3326	Mesa Fully Formed Inc	*	1.31	1.04				10.0	8.0			
1415	Mesa Materials Inc (Broadway)	*	13.77	4.15	9.52	10.54	0.01	105.9	31.9	73.2	81.1	0.1
1414	Mesa Materials Inc (Higley)	*	14.71	4.23	7.02	6.59	0.01	113.1	32.5	54.0	50.7	0.1
1875	Microchip Technology Inc	*	1.75	1.23	6.36	0.09	0.65	11.6	8.7	62.8	2.3	3.6
226	Monier Lifetile LLC	*	1.56	1.09	0.54	0.00	0.10	10.0	7.0	3.4	0.0	0.6
34197	National Gypsum Co	*	18.75	11.90	17.96	17.40	1.58	129.1	79.0	118.8	112.1	10.2
910	Neltec Inc	*	0.18	0.18	10.73	0.01	0.22	1.0	1.0	59.0	0.1	1.2
73084	New Directions Incorporated	*	1.88	1.60				14.5	12.3			
1879	Northwest Regional Landfill	*	31.52	22.51	8.75	0.92	0.02	241.8	173.0	66.0	6.2	0.1
1331	Oak Canyon Manufacturing Inc	*	0.03	0.02				0.2	0.2			
3953	Oakcraft Inc	*	0.11	0.09	0.14	0.00	0.01	0.7	0.6	1.1	0.0	0.1
27925	Oasis Bedroom Co	*	0.17	0.15				1.3	1.1			
52382	Ocotillo Power Plant		9.54	8.98	97.46	0.55	9.79	52.4	49.3	535.5	3.0	53.8
528	Packaging Corporation of America Inc		1.05	1.05	13.88	0.08	1.26	8.1	8.1	106.8	0.6	9.7
733	Pan-Glo Services		0.05	0.05	0.72	0.00	0.07	0.4	0.4	5.5	0.0	0.5
1341	Penn Racquet Sports Inc	*	20.35	15.15	5.17	0.03	0.47	156.6	116.5	39.7	0.2	3.6
1014	Phoenix Brick Yard	*	26.36	11.33	10.27	26.21		149.5	65.0	56.4	144.0	
562	Phoenix Newspapers Inc		0.02	0.02	0.59	0.00	0.02	0.1	0.1	16.4	0.0	0.1
1154	Ping Inc	*	0.22	0.20	0.17	0.00	0.02	1.7	1.5	0.9	0.0	0.1
92072	Pioneer Landscaping Materials	*	29.94	10.55				189.6	66.9			
148	Presto Casting Co	*	0.26	0.21	1.19	0.07	0.10	2.0	1.6	9.1	0.5	0.8
60889	Purcells Western States Tire	*	9.70	6.88	0.16	0.00	0.01	74.6	52.9	1.2	0.0	0.1
1030	Quebecor World-Phoenix Division		0.20	0.20	1.76	0.02	0.16	1.3	1.3	11.3	0.1	1.0
44182	Quincy Joist Company		0.60	0.60				4.6	4.6			
50299	Quintero Area Water System		0.94	0.93	13.39	0.88	0.03	5.2	5.2	74.1	4.9	0.2
537	Red Mountain Mining Inc	*	17.48	6.23	8.46	0.56	0.02	127.5	45.9	65.0	4.3	0.2
303	Rexam Beverage Can Company		0.40	0.40	5.22	0.03	0.48	2.2	2.2	28.7	0.2	2.6
63	Rinker Materials (El Mirage)	*	10.85	5.43	0.25	0.09	0.02	69.5	34.8	1.6	0.6	0.1
260	Rinker Materials (S. 19th Ave.)	*	70.27	31.73	4.90	17.67	0.11	450.5	203.4	31.4	113.3	0.7
64781	Rinker Materials (S. 59th Ave.)	*	21.14	8.57	29.20	1.88	0.07	135.5	54.9	187.2	12.1	0.4
213	Rinker Materials (W. Glendale)	*	52.88	22.32	7.44	16.46	0.05	339.0	143.1	47.7	105.5	0.3
4318	River Ranch Plant #40	*	57.50	29.81				442.3	229.3			
759	Rogers Corp/Advanced Circuit Matls.		0.14	0.14	1.33	0.01	0.09	0.8	0.8	7.3	0.1	0.5
1437	Sanmina Phoenix Division		0.09	0.09	1.24	0.01	1.25	0.6	0.6	8.0	0.0	8.0
3315	Santan Generating Station		45.32	43.81	220.66	6.19	17.71	249.0	240.7	1,212.4	34.0	97.3

* = Source for which rule effectiveness has been applied.

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

			Annual (tons/yr)					Typical day (lbs/day)				
ID #	Business name		PM_{10}	$PM_{2.5}$	NO_x	SO_x	NH_3	PM_{10}	$PM_{2.5}$	NO_x	SO_x	NH_3
266	Schuff Steel Co	*	9.20	7.87	10.46	0.69	0.02	70.8	60.5	80.5	5.3	0.2
246	Schult Homes	*	9.12	8.13				70.1	62.6			
4175	SFPP LP Phoenix Terminal		0.34	0.33	6.64	0.02		1.9	1.8	36.5	0.1	
50422	Simula Safety Systems Inc		0.01	0.01	0.08	0.00	0.01	0.0	0.0	0.5	0.0	0.0
27933	Skunk Creek Landfill	*	54.62	50.85	1.83	1.08		300.1	279.4	10.1	5.9	
331	Smurfit Stone Container Corp	*	7.28	7.27	10.81	0.71	0.03	56.0	55.9	83.1	5.5	0.2
46277	Southwest Forest Products Inc		1.37	1.36	19.51	1.28	0.05	10.6	10.5	150.1	9.9	0.3
3316	SRP Agua Fria Generating Station		6.65	6.65	352.99	0.56	8.05	36.6	36.6	1,939.5	3.1	44.2
3317	SRP Kyrene Generating Station		15.52	15.18	47.07	1.92	8.83	85.3	83.4	258.6	10.5	48.5
4131	ST Microelectronics		0.31	0.31	4.02	0.02	0.37	1.7	1.7	22.1	0.1	2.0
1444	Staco Architectural Roof Tile	*	0.32	0.22	0.07	0.00	0.01	2.4	1.7	0.6	0.0	0.1
582	Stone Creek Inc	*	0.04	0.03				0.3	0.3			
4400	Sumco Southwest Corporation	*	0.79	0.54	11.19	0.02	0.67	4.4	3.0	61.5	0.1	3.7
378	Sun Land Materials	*	2.87	1.39	10.57	0.69	0.02	22.1	10.7	81.3	5.3	0.2
281	Sun State Rock & Materials	*	9.65	3.14	32.09	1.56	0.07	61.8	20.1	205.7	10.0	0.5
101	Sunland Beef Company	*	10.28	5.21	11.19	0.07	5.85	66.9	34.4	85.4	0.5	34.3
31643	SW Reg Municipal Solid Waste Landfill	*	30.29	16.04	6.35	0.42		194.2	102.8	40.7	2.7	
249	The Boeing Company		0.20	0.20	3.17	0.09	0.13	1.5	1.5	24.2	0.7	1.0
552	Thornwood Furniture Mfg	*	2.62	2.50				20.2	19.2			
363	Thunderbird Furniture	*	1.72	1.37	0.03	0.00	0.00	13.2	10.6	0.3	0.0	0.0
56	TPAC A Division of Kiewit Western Co	*	15.02	5.78	1.77	0.01	0.16	115.6	44.4	13.6	0.1	1.2
1211	Trendwood Inc (E. University)	*	0.01	0.00				0.0	0.0			
1210	Trendwood Inc (S. 15th Ave.)	*	0.05	0.05				0.4	0.4			
37546	Trenwyth Industries		0.01	0.01	0.09	0.00	0.01	0.1	0.1	0.8	0.0	0.1
42915	U S Greenfiber-Phoenix	*	5.85	4.15				32.1	22.8			
234	United Dairymen of Arizona	*	28.40	9.81	16.60	0.25	2.87	156.1	53.9	91.2	1.4	15.7
53	Utility Vault Co	*	4.01	1.41	2.36	0.15	0.01	30.9	10.8	18.1	1.2	0.0
2	Vulcan Materials Co (115th Ave.)	*	45.01	22.74	10.85	7.35	0.00	344.5	174.2	69.5	47.1	0.0
90	Vulcan Materials Co (43rd Ave.)	*	78.89	39.40	5.88	1.18		605.7	302.6	45.2	9.0	
344	Vulcan Materials Co (W. Indian School)	*	28.37	15.47				217.0	118.4			
174	W R Meadows of Az Inc		0.01	0.01	0.14	0.00	0.01	0.1	0.1	1.7	0.0	0.2
36676	Western Milling		5.42	4.46	0.96	0.30		41.7	34.3	7.4	2.3	
141	Western Organics Inc	*	24.38	23.59				154.9	148.8			
398	Wickenburg Facility	*	15.70	6.68	5.65	0.37	0.01	118.6	50.6	43.5	2.9	0.1
20706	Wincup Holdings Inc		1.01	1.01	13.24	0.08	1.21	5.5	5.5	72.8	0.4	6.6
1382	Woodcase Fine Cabinetry Inc	*	0.24	0.19				1.8	1.4			
	Emission reduction credits (See section 2.5)		1.80		9.80	0.16		9.9		53.7	0.9	
	PM_{10} NAA Total:		1,634.53	938.98	1,985.64	244.36	176.40	10,897.6	6,266.8	11,854.9	1,550.7	984.9

Facilities outside the PM_{10} nonattainment area:

			Annual (tons/yr)					Typical day (lbs/day)				
ID #	Business name		PM_{10}	$PM_{2.5}$	NO_x	SO_x	NH_3	PM_{10}	$PM_{2.5}$	NO_x	SO_x	NH_3
1488	Farmer's Gin Inc	*	14.81	4.42	0.60	0.00		81.4	24.3	3.3	0.0	
44439	Gila River Power Station	*	139.32	134.01	353.59	10.35	19.44	893.9	859.9	2277.8	66.5	124.7
4498	Hanson Aggregates of Arizona (W. Indian School Rd.)	*	14.12	5.80	16.90	1.11	0.04	108.7	44.6	130.0	8.5	0.3
725	Kilauea Crushers Inc	*	31.06	11.23				199.1	72.0			
43063	LSP Arlington Valley LLC		16.21	16.15	51.81	2.99	0.70	125.2	124.8	406.5	23.9	5.4
289	Martori Farms	*	11.09	3.00	0.05	0.00	0.00	69.7	19.2	0.3	0.0	0.0
44186	Mesquite Generating Station		55.00	48.83	210.54	14.59	19.78	302.6	268.7	1162.6	80.6	108.7
43530	New Harquahala Generating Co		34.55	34.48	24.10	1.83	26.04	189.8	189.4	132.4	10.0	143.1
98	Palo Verde Nuclear Generating Station	*	115.36	106.30	82.56	1.27	5.96	633.8	317.4	453.6	7.0	32.7
428	Paloma Gin Properties LLC	*	12.97	3.83	0.08	0.00	0.01	71.2	21.1	0.4	0.0	0.0
42956	Redhawk Generating Facility		34.15	27.35	145.02	8.44	25.62	187.7	150.3	797.4	46.4	140.8
	Total outside PM_{10} NAA:		478.64	395.41	885.24	40.59	97.59	2,863.2	2,091.7	5,364.4	242.9	555.7
	Grand total:		2,114.97	1,334.38	2,880.67	285.10	273.99	13,760.7	8,358.4	17,219.3	1,793.6	1,540.6

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.

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 MCAQD Rule 240 (Permit Requirements for New Major Sources and Major Modification to Existing Major Sources).

Table 2.5–1 provides a list of emission reduction credits for PM_{10}, NO_x, and SO_x. Only one previously operational facility maintains emission reduction credits that are still valid for inclusion in this report and the rate of progress plan.

Table 2.5–1. Emission reduction credits.

ID	Facility	Emission reduction credits (tons)		
		PM_{10}	NO_x	SO_x
1151	Freescale Semiconductor, Inc. (formerly Motorola Mesa)	1.80	9.80	0.16

2.6 Summary of point source emissions

Tables 2.6–1 and 2.6–2 provide an overview of source category contributions to point source emissions for Maricopa County and the PM_{10} nonattainment area.

Table 2.6–1. Maricopa County annual and typical daily point source emissions, by source category.

	Annual (tons/yr)					Typical day (lbs/day)				
Source Category	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**NH_3**	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**NH_3**
Electricity generation	313.86	313.20	1,914.79	51.58	198.06	1,887.5	1,883.5	11,016.1	318.7	1,107.5
Comm./inst. fuel combustion	4.90	4.88	58.20	2.82	2.53	28.7	28.6	358.1	17.1	14.0
Industrial fuel combustion	79.10	78.84	739.13	50.59	55.13	483.0	481.2	4,760.2	352.6	317.0
Food/agriculture	64.21	18.08				380.1	109.3			
Industrial processes	842.61	556.08	116.20	123.40	18.11	5,559.3	3,422.7	797.4	793.6	101.2
Manufacturing processes	9.17	8.95	15.00	0.02	0.16	69.2	67.0	82.4	0.1	1.0
Industrial road travel	729.71	294.90				4,945.5	2,035.9			
Waste disposal	69.62	59.45	27.55	56.53		397.6	330.3	151.4	310.6	
Emission reduction credits	1.80		9.80	0.16		9.9		53.7	0.9	
ALL POINT SOURCES:	**2,114.97**	**1,334.38**	**2,880.67**	**285.10**	**273.99**	**13,760.7**	**8,358.4**	**17,219.3**	**1,793.6**	**1,540.6**

Table 2.6–2. PM_{10} nonattainment area annual and typical daily point source emissions, by source category.

	Annual (tons/yr)					Typical day (lbs/day)				
Source Category	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**NH_3**	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**NH_3**
Electricity generation	113.97	113.72	1,154.60	15.24	132.55	637.8	636.3	6,402.8	103.0	728.3
Comm./inst. fuel combustion	4.90	4.88	58.20	2.82	2.53	28.7	28.6	358.1	17.1	14.0
Industrial fuel combustion	40.67	40.53	614.09	46.35	28.75	267.3	266.2	4,009.2	325.4	171.8
Food/agriculture	27.83	7.87				172.3	50.7			
Industrial processes	670.39	420.49	116.20	123.40	12.41	4,585.5	2,932.0	797.4	793.6	69.9
Manufacturing processes	9.17	8.95	15.00	0.02	0.16	69.2	67.0	82.4	0.1	1.0
Industrial road travel	697.98	283.10				4,729.2	1,955.7			
Waste disposal	69.62	59.45	27.55	56.53		397.6	330.3	151.4	310.6	
Emission reduction credits	1.80		9.80	0.16		9.9		53.7	0.9	
ALL POINT SOURCES:	**1,636.33**	**938.98**	**1,995.44**	**244.52**	**176.40**	**10,897.6**	**6,266.8**	**11,854.9**	**1,550.7**	**984.9**

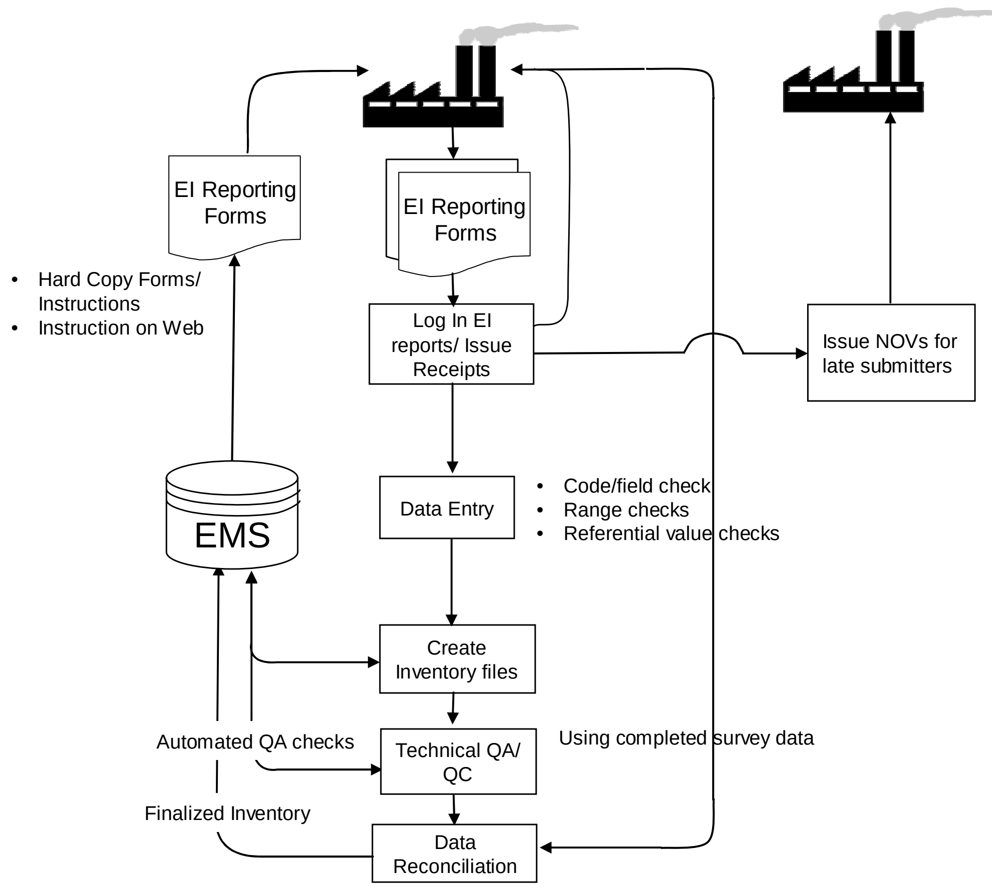
2.7 Quality assurance / quality control procedures

2.7.1 Emission survey preparation and data collection

The MCAQD's Emissions Inventory (EI) Unit annually collects point source criteria pollutant emission data from sources in the county. MCAQD 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 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 MCAQD for the year 2005 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 2005 annual emissions report.

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

2.8 References

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US EPA, 2003. 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, 2005. 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. Revised Nov. 2005. Available at: http://www.epa.gov/ttn/chief/eidocs/eiguid/

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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 MCAQD'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. MCAQD 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
	Fuel combustion:	
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
	Industrial processes:	
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
2311010000	Residential construction	3.3.9
2311020000	Commercial construction	3.3.9
2311030000	Road construction	3.3.9
n/a	Other 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 (NEC)	3.3.13
	Waste treatment and disposal:	
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 / disposal	3.4.5
	Miscellaneous area sources:	
2810001000	Wildfires and brush fires	3.5.1.1
n/a	Prescribed fires	3.5.1.2

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

SCC Code	Category Description	Section
	Miscellaneous area sources: (continued)	
2810030000	Structure fires	3.5.1.3
2810050000	Vehicle fires	3.5.1.4
2810040000	Engine testing	3.5.1.5
2801000003	Tilling	3.5.2.1
2801000005	Harvesting	3.5.2.2
n/a	Travel on unpaved agricultural roads	3.5.2.3
2801000000	Cotton ginning	3.5.2.4
2801700000	Fertilizer application	3.5.2.5
2805000000	Livestock	3.5.3
2850000000	Health services	3.5.4
2830000000	Accidental releases	3.5.5
2810010000	Humans	3.5.6
n/a	Leaf blower fugitive dust	3.5.7
n/a	Offroad recreational vehicle fugitive dust	3.5.8
n/a	Unpaved parking lots fugitive dust	3.5.9
2730100000	Windblown dust	3.5.10

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 three 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.

	Sales by end user category (in MMCF/yr)					
Natural gas supplier	**Electric Utilities**	**Industrial**	**Commercial/ Institutional**	**Residential**	**Transport***	**Other***
Southwest Gas	n/a	2,459.27	13,968.02	15,364.45	5,151.97	836.01
City of Mesa	n/a	108.99	1,367.49	1,106.08	8.74	114.58
El Paso	148,506.64	185.58	n/a	n/a	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 2005. 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:

County area-source industrial natural gas usage	=	Total reported industrial natural gas sales	–	Industrial point source natural gas usage
	=	8,865.13 MMCF	–	4,540.37 MMCF
	=	4,324.16 MMCF		

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 2005.

Annual emissions for the county and the PM_{10} 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 PM_{10} emissions from external natural gas combustion:

Annual PM_{10} emissions from external natural gas combustion	=	External industrial natural gas usage (MMCF)	×	PM_{10} emission factor for external natural gas combustion (lb/MMCF)	÷	2,000 lb/ton
	=	4,257.47	×	7.6	÷	2,000
	=	16.18 tons PM_{10}/yr				

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) PM_{10}	$PM_{2.5}$	NO_x	SO_x	NH_3	Annual emissions (tons/yr) PM_{10}	$PM_{2.5}$	NO_x	SO_x	NH_3
External	98.44	4,257.47	7.6	7.6	100	0.6	3.2	16.18	16.18	212.87	1.28	6.81
Internal	1.56	67.29	10.0	10.0	2840	0.6	n/a	0.34	0.34	95.55	0.02	n/a
Total:	**100.00**	**4,324.16**						**16.51**	**16.51**	**308.43**	**1.30**	**6.81**

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

PM_{10} typical daily emissions from industrial natural gas	=	Annual PM_{10} emissions (tons/yr)	÷ (days/week × wks/yr)	× 2,000 lbs/ton
	=	16.51	÷ (6 × 52)	× 2,000
	=	105.9 lbs PM_{10}/day		

Annual and typical daily emissions within the PM_{10} 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).

Emissions from area-source industrial natural gas combustion in the PM_{10} NAA	= Annual county PM_{10} emissions (tons/yr)	× NAA:County Industrial employment ratio	
	= 16.51	× 0.9932	
	= 16.40 tons PM_{10}/yr		

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

	Annual emissions (tons/yr)					Typical daily emissions (lbs/day)				
Geographic area	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**NH_3**	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**NH_3**
Maricopa County	16.51	16.51	308.43	1.30	6.81	105.9	105.9	1,977.1	8.3	43.7
PM_{10} NAA	16.40	16.40	306.33	1.29	6.77	104.7	104.7	1,955.5	8.2	43.2

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, 2006a) to Maricopa County.

To derive industrial fuel oil usage in Maricopa County, reported Arizona state-level sales of high-sulfur diesel for 2005 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.

State industrial fuel oil sales other than high-sulfur diesel	= Reported state total industrial fuel oil sales	– Reported state high-sulfur diesel sales
(in thousand gallons, or Mgal)	= 84,519 Mgal	– 431 Mgal
	= 84,088 Mgal/yr	

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 (0.70), as determined by data from the US Census Bureau (2006b) to estimate annual Maricopa County-level industrial fuel oil sales, as follows:

Maricopa County industrial fuel oil sales	= Arizona state industrial fuel oil sales less high-sulfur diesel	× Maricopa County:State industrial employment ratio
	= 84,088 Mgal	× 0.70
	= 58,466.39 Mgal/yr	

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:

Maricopa County area source fuel oil sales	= Maricopa County industrial fuel oil sales	– Fuel oil used by industrial nonroad mobile equipment	– Fuel oil used by industrial stationary point sources
	= 58,466.39 Mgal	– 9,928.15 Mgal	– 3,090.77 Mgal
	= 45,447.461 Mgal/yr		

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 in 2005 (shown in Table 3.2–4 below).

Annual emissions for the county and the PM_{10} 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 PM_{10} emissions from external fuel oil combustion:

Annual PM_{10} emissions from external industrial fuel oil combustion	=	External industrial fuel oil sales (Mgal)	×	PM_{10} emission factor for external fuel oil combustion (lb/Mgal)	÷	2,000 lb/ton
	=	35,453.565	×	2	÷	2,000
	=	35.45 tons PM_{10}/yr				

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) PM_{10}	$PM_{2.5}$	NO_x	SO_x	NH_3	Annual emissions (tons/yr) PM_{10}	$PM_{2.5}$	NO_x	SO_x	NH_3
External	78.01	35,453.565	2.0	2.0	24	7.39	0.8	35.45	35.45	425.44	130.91	14.18
Internal	21.99	9,993.897	42.5	42.5	604	39.70	–	212.37	212.37	3,018.16	198.38	0.00
Totals:	**100.00**	**45,447.461**						**247.82**	**247.82**	**3,443.60**	**329.29**	**14.18**

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):

PM_{10} typical daily emissions from industrial fuel oil	= Annual PM_{10} emissions (tons/yr)	÷ (days/week × wks/yr)	× 2,000 lbs/ton
	= 247.82	÷ (6 × 52)	× 2,000
	= 1,588.6 lbs PM_{10}/day		

Annual and typical daily emissions in the PM_{10} 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).

PM_{10} NAA emissions from area source industrial fuel oil combustion	= Annual county PM_{10} emissions	× NAA:County industrial employment ratio
	= 247.82 tons/yr	× 0.9932
	= 246.14 tons PM_{10}/yr	

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

Geographic area	Annual emissions (tons/yr) PM_{10}	$PM_{2.5}$	NO_x	SO_x	NH_3	Typical daily emissions (lbs/day) PM_{10}	$PM_{2.5}$	NO_x	SO_x	NH_3
Maricopa County	247.82	247.82	3,443.60	329.29	14.18	1,588.6	1,588.6	22,074.4	2,110.8	90.9
PM_{10} NAA	246.14	246.14	3,420.18	327.05	14.08	1,577.8	1,577.8	21,924.3	2,096.5	90.3

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 2005. 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:

County area-source C&I natural gas usage	=	Reported C&I natural gas sales	–	C&I point source natural gas usage
	=	16,286.09 MMCF	–	538.85 MMCF
	=	15,747.24 MMCF		

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 2005.

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 PM_{10} emissions from external natural gas combustion:

Annual PM_{10} emissions from external natural gas combustion	= External C&I natural gas usage (MMCF)	×	PM_{10} emission factor for external natural gas combustion (lb/MMCF)	÷ 2,000 lb/ton
	= 15,485.18	×	7.6	÷ 2,000
	= 58.84 tons PM_{10}/yr			

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) PM_{10}	$PM_{2.5}$	NO_x	SO_x	NH_3	Annual emissions (tons/yr) PM_{10}	$PM_{2.5}$	NO_x	SO_x	NH_3
External	98.34	15,485.18	7.6	7.6	100	0.6	0.49	58.84	58.84	774.26	4.65	3.79
Internal	1.66	262.06	10.0	10.0	2840	0.6	n/a	1.31	1.31	372.13	0.08	n/a
Total:	**100.00**							**60.15**	**60.15**	**1,146.39**	**4.72**	**3.79**

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

PM_{10} typical daily emissions from C&I natural gas	= Annual PM_{10} emissions (tons/yr)	÷ (days/week × wks/yr)	×	2,000 lbs/ton
	= 60.15	÷ (6 × 52)	×	2,000
	= 385.6 lbs/day			

Annual and typical daily emissions within the PM_{10} 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).

Emissions from area-source C&I natural gas combustion in the PM_{10} NAA	= Annual county PM_{10} emissions (tons/yr)	× NAA:County C&I employment ratio
	= 60.15	× 0.9928
	= 59.72 tons PM_{10}/yr	

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

	Annual emissions (tons/yr)					Typical daily emissions (lbs/day)				
Geographic area	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**NH_3**	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**NH_3**
Maricopa County	60.15	60.15	1,146.39	4.72	3.79	385.6	385.6	7,348.6	30.3	24.3
PM_{10} NAA	59.72	59.72	1,138.13	4.69	3.77	381.5	381.5	7,270.0	30.0	24.1

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, 2006b) to Maricopa County.

To derive commercial/institutional fuel oil usage in Maricopa County, reported Arizona state-level sales of high-sulfur diesel for 2005 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.

State C&I fuel oil sales other than high-sulfur diesel (in thousand gallons, or Mgal)	= Reported state total C&I fuel oil sales	– Reported state high-sulfur diesel sales
	= 20,645 Mgal	– 0 Mgal
	= 20,645 Mgal/yr	

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 (0.80), as determined by data from the US Census Bureau (2006b) to estimate annual Maricopa County-level commercial/institutional fuel oil sales, as follows:

Maricopa County C&I fuel oil sales	= Arizona state C&I fuel oil sales less high-sulfur diesel	× Maricopa County:state commercial/ institutional employment ratio
	= 20,645 Mgal	× 0.80
	= 16,532.52 Mgal/yr	

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:

Annual Maricopa County commercial/institutional area-source fuel oil sales	= Maricopa County C&I fuel oil sales	– Fuel oil used by C&I nonroad mobile equipment	– Fuel oil used by C&I stationary point sources
	= 16,532.52 Mgal	– 6,092.013 Mgal	– 140.591 Mgal
	= 10,299.912 Mgal/yr		

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 in 2005 (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 PM_{10} emissions from external fuel oil combustion:

Annual PM_{10} emissions from external fuel oil combustion	=	External C&I fuel oil sales (Mgal)	×	PM_{10} emission factor for external fuel oil combustion (lb/Mgal)	÷	2,000 lb/ton
	=	6,895.711	×	1.08	÷	2,000
	=	3.72 tons PM_{10}/yr				

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) PM_{10}	$PM_{2.5}$	NO_x	SO_x	NH_3	Annual emissions (tons/yr) PM_{10}	$PM_{2.5}$	NO_x	SO_x	NH_3
External	66.95	6,895.711	1.08	1.08	24	7.1	0.8	3.72	3.72	82.75	24.48	2.76
Internal	33.05	3,404.121	42.5	42.5	604	39.7	–	72.34	72.34	1,028.04	67.57	0.00
Total:	**100.00**	**10,299.912**						**76.06**	**76.06**	**1,110.79**	**92.05**	**2.76**

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):

Typical daily PM_{10} emissions from C&I fuel oil combustion	=	Annual PM_{10} emissions (tons/yr)	÷ (days/week × wks/yr)	× 2,000 lbs/ton
	=	76.06	÷ (6 × 52)	× 2,000
	=	487.6 lbs/day		

Annual and typical daily emissions within the PM_{10} 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).

PM_{10} NAA emissions from area source C&I fuel oil combustion	=	Annual county PM_{10} emissions (tons/yr)	×	NAA:County C&I employment ratio
	=	76.06	×	0.9928
	=	75.51 tons PM_{10}/yr		

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

Geographic area	Annual emissions (tons/yr) PM_{10}	$PM_{2.5}$	NO_x	SO_x	NH_3	Typical daily emissions (lbs/day) PM_{10}	$PM_{2.5}$	NO_x	SO_x	NH_3
Maricopa County	76.06	76.06	1,110.79	92.05	2.76	487.6	487.6	7,120.5	590.1	17.7
PM_{10} NAA	75.51	75.51	1,102.80	91.39	2.74	484.1	484.1	7,069.2	585.8	17.6

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**

Annual PM_{10} emissions from residential natural gas combustion	=	Residential natural gas annual sales (MMCF)	×	Residential natural gas emission factor for PM_{10} (lbs/MMCF)	÷	2,000 lbs/ton
	=	16,470.54	×	7.6	÷	2,000
	=	62.59 tons PM_{10}/yr				

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:

Typical daily PM_{10} emissions from residential natural gas combustion	=	Annual PM_{10} emissions	×	2,000 lbs/ton	÷	days/yr
	=	62.59 tons/yr	×	2, 000	÷	365
	=	342.9 lbs PM_{10}/day				

Annual and typical daily residential natural gas emissions in the PM_{10} nonattainment area are calculated by multiplying county-level emissions by the percentage of total residential population in the PM_{10} nonattainment area as follows:

Annual PM_{10} emissions from residential natural gas combustion in the NAA	=	County annual emissions	×	Percentage of residential population in the NAA
	=	62.59	×	100.16%
	=	62.69 tons PM_{10}/yr		

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

	Annual emissions (tons/yr)				Typical daily emissions (lbs/day)			
Geographic area	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**
Maricopa County	62.59	62.59	774.12	4.94	342.9	342.9	4,241.7	27.1
PM_{10} NAA	62.69	62.69	775.35	4.95	343.5	343.5	4,248.5	27.1

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 (2006c) by the ratio of county to state households that report use of wood for heating from the US Census Bureau (2006a). The latest available data on residential wood use for household heating from the US Department of Energy is for the calendar year 2003. 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 2003 data is assumed to be representative of 2005 emissions.

Maricopa County residential wood usage (cords/yr)	= Arizona residential wood usage (cords/yr)	×	Ratio of county:state households using wood for heat
	= 304,000	×	1,449 / 41,213
	= 10,701 cords/yr		

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).

County residential wood usage (tons/yr)	= County wood usage (cords)	× avg. ft^3 wood/cord	× Wood density (lbs/ ft^3)	÷ 2,000 lbs/ton
	= 10,701	× 79	× 31.57	÷ 2,000
	= 13,344.06 tons			

Annual emissions from residential wood combustion are calculated by multiplying the tons of wood used by the PM_{10} emission factor for residential woodstoves and fireplaces from US EPA (2001d), Table 2.4-1:

Annual PM_{10} emissions from residential wood combustion (tons/yr)	= Residential wood usage (tons)	× PM_{10} emission factor (lbs/ton)	÷ 2,000 lbs/ton
	= 13,344.06	× 34.6	÷ 2,000
	= 230.85 tons PM_{10}/yr		

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
13,344.06	34.6	32.2	2.6	0.4	230.85	214.69	17.35	2.67

*$PM_{2.5}$ is assumed to be 93% of PM_{10} (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 Department of Commerce (ADOC, 2006) indicated that there were seven months (April–October, totaling 214 days) in 2005 where no heating degree days were recorded. Assuming that no wood burning activity took place during those months, that leaves 151 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:

Typical daily PM_{10} emissions from residential wood combustion (lbs/day)	= Annual PM_{10} emissions	× 2,000 lbs/ton	÷ number of days wood burning occurred
	= 230.85	× 2,000	÷ 151
	= 3,057.6 lbs PM_{10}/day		

Annual and typical daily emissions within the PM_{10} nonattainment area (NAA) are calculated by multiplying county totals by the ratio of residential population in the nonattainment area to the residential population in the county. See Section 1.5.1 for a further discussion of the population used.

NAA annual emissions from residential wood combustion (tons/yr)	=	County annual emissions (tons/yr)	×	NAA:county residential population ratio
	=	230.85	×	1.0016
	=	231.22 tons PM_{10}/yr		

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

	Annual emissions (tons/yr)				Typical daily emissions (lbs/day)			
Geographic area	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**
Maricopa County	230.85	214.69	17.35	2.67	3,057.6	2,843.6	229.8	35.3
PM_{10} NAA	231.22	215.04	17.38	2.67	3,062.5	2,848.2	230.1	35.4

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 (2006a):

Maricopa County residential fuel oil usage (Mgal/yr)	=	Arizona residential fuel oil use (Mgal/yr)	×	Ratio of county:state households reporting fuel oil use
	=	340	×	490 / 1,813
	=	91.89 Mgal/yr		

Using 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.

	Emission factors (lb/Mgal)				Annual emissions (tons/yr)				Typical daily emissions (lbs/day)			
Geographic area	**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	0.01	0.01	0.66	0.26	0.2	0.2	8.7	3.4
PM_{10} NAA	0.4	0.4	18	7.1	0.01	0.01	0.66	0.26	0.2	0.2	8.7	3.4

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 PM_{10} 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
Industrial natural gas	16.51	16.51	308.43	1.30	6.81	105.9	105.9	1,977.1	8.3	43.7
Industrial fuel oil	247.82	247.82	3,443.60	329.29	14.18	1,588.6	1,588.6	22,074.4	2,110.8	90.9
Comm./inst. natural gas	60.15	60.15	1,146.39	4.72	3.79	385.6	385.6	7,348.6	30.3	24.3
Comm./inst. fuel oil	76.06	76.06	1,110.79	92.05	2.76	487.6	487.6	7,120.5	590.1	17.7
Residential natural gas	62.59	62.59	774.12	4.94		342.9	342.9	4,241.7	27.1	
Residential wood	230.85	214.69	17.35	2.67		3,057.6	2,843.6	229.8	35.3	
Residential fuel oil	0.01	0.01	0.66	0.26		0.2	0.2	8.7	3.4	
Total:	**694.01**	**677.85**	**6,801.33**	**435.23**	**27.55**	**5,968.4**	**5,754.4**	**43,000.7**	**2,805.4**	**176.6**

Table 3.2–16. Annual and typical daily emissions from all area-source fuel combustion for the PM_{10} 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
Industrial natural gas	16.40	16.40	306.33	1.29	6.77	104.7	104.7	1,955.5	8.2	43.2
Industrial fuel oil	246.14	246.14	3,420.18	327.05	14.08	1,577.8	1,577.8	21,924.3	2,096.5	90.3
Comm./inst. natural gas	59.72	59.72	1,138.13	4.69	3.77	381.5	381.5	7,270.0	30.0	24.1
Comm./inst. fuel oil	75.51	75.51	1,102.80	91.39	2.74	484.1	484.1	7,069.2	585.8	17.6
Residential natural gas	62.69	62.69	775.35	4.95		343.5	343.5	4,248.5	27.1	
Residential wood	231.22	215.04	17.38	2.67		3,062.5	2,848.2	230.1	35.4	
Residential fuel oil	0.01	0.01	0.66	0.26		0.2	0.2	8.7	3.4	
Total:	**691.70**	**675.51**	**6,760.83**	**432.30**	**27.36**	**5,954.3**	**5,739.9**	**42,706.4**	**2,786.5**	**175.1**

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 (2006b) 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 2004 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
32532	Pesticide & Other Agricultural Chemical mfg.	0–19	10
32552	Adhesive mfg.	100–249	175
32591	Printing Ink mfg.	250–499	375
324122	Asphalt Shingle & Coating Materials mfg.	20–99	60
325188	All Other Basic Inorganic Chemical mfg.	100–249	175
325412	Pharmaceutical Preparation mfg.	500–999	750
325510	Paint & Coating mfg.	20–99	60
325611	Soap & Other Detergent mfg.	20–99	60
325991	Custom Compounding of Purchased Resins	100–249	175
325998	All Other Miscellaneous Chemical Product & Preparation mfg.	20–99	60
424690	Other Chemical & Allied Products Merchant Wholesalers	968	968
Total:			**2,868**

Since there were no point sources in this category, area-source employment estimate is used to "scale up" emissions reported from those facilities surveyed in 2005 as follows:

Area-source PM_{10} emissions from chemical mfg.

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

$$= \frac{34.26 \text{ tons of } PM_{10}\text{/yr}}{1{,}280 \text{ employees}} \times 2{,}868 \text{ employees}$$

$$= 76.77 \text{ tons } PM_{10}\text{/yr}$$

PM_{10} 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:

Typical daily PM_{10} emissions from chemical mfg.

$$= \frac{\text{Annual emissions (tons/yr)}}{\text{Days/week} \times \text{Weeks/year}} \times \frac{2{,}000 \text{ lbs}}{\text{ton}}$$

$$= \frac{76.77}{5 \times 52} \times 2{,}000$$

$$= 590.5 \text{ lbs } PM_{10}\text{/day}$$

Annual and typical daily emissions for the PM_{10} 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.)

PM_{10} emissions from area-source chemical mfg. in the PM_{10} NAA (tons/yr)

$$= \text{Annual Maricopa County emissions} \times \text{NAA:county ratio of industrial employment}$$

$$= 76.77 \text{ tons/yr} \times .9932$$

$$= 76.25 \text{ tons } PM_{10}\text{/yr}$$

Table 3.3–2 summarizes annual and typical daily emissions from chemical manufacturing in both Maricopa County and the PM_{10} 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	NHx	PM_{10}	$PM_{2.5}$	NO_x	SO_x	NHx
Maricopa County	76.77	38.85	0.39	0.21	0.34	590.5	298.9	3.0	1.6	2.6
PM_{10} NAA	76.25	38.59	0.38	0.21	0.34	586.5	296.8	3.0	1.6	2.6

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, 2006) 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 MCAQD's eating and drinking establishments permit database indicated that 10,238 restaurants operated in Maricopa County in 2005. 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 2005 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	1,481
Fast food	15.35	1,571
Family	3.64	372
Seafood	0.61	62
Steak & barbecue	1.15	118
Unrelated restaurant types e.g., lunchroom, bars,…	64.79	6,633
All restaurants	100.00	10,238

Using the number of restaurants for each restaurant type, along with the default emission factors and equations from EPA (2006), 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	155.64	150.88
Underfired charbroilers	1,071.56	1,035.86
Deep fat fryers	0.00	0.00
Flat griddles	282.14	214.43
Clamshell griddles	18.64	15.79
Totals:	**1,527.98**	**1,416.96**

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	855.2	829.0
Underfired charbroilers	5,887.7	5,691.5
Deep fat fryers	0.0	0.0
Flat griddles	1,550.2	1,178.2
Clamshell griddles	102.4	86.5
Totals:	**8,395.5**	**7,785.5**

Annual and typical daily emissions for the PM$_{10}$ nonattainment area were calculated by multiplying the Maricopa County emission totals by the percentage population within the nonattainment area of 100.78%. (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 PM$_{10}$ NAA.

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

	Maricopa County				PM$_{10}$ nonattainment area			
	Annual emissions (tons/yr)		Typical daily emissions (lbs/day)		Annual emissions (tons/yr)		Typical daily emissions (lbs/day)	
Equipment type	PM$_{10}$	PM$_{2.5}$	PM$_{10}$	PM$_{2.5}$	PM$_{10}$	PM$_{2.5}$	PM$_{10}$	PM$_{2.5}$
Chain-driven charbroilers	155.64	150.88	855.2	829.0	156.86	152.05	861.9	835.5
Underfired charbroilers	1,071.56	1,035.86	5,887.7	5,691.5	1,079.92	1,043.94	5,933.6	5,735.9
Deep fat fryers	0.00	0.00	0.0	0.0	0.00	0.0	0.0	0.0
Flat griddles	282.14	214.43	1,550.2	1,178.2	284.34	216.10	1,562.3	1,187.4
Clamshell griddles	18.64	15.79	102.4	86.8	18.79	15.91	103.2	87.4
Totals:	**1,527.98**	**1,416.96**	**8,395.5**	**7,785.5**	**1,539.90**	**1,428.01**	**8,461.0**	**7,846.2**

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 PM$_{10}$ 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.

	Annual emissions (tons/yr)		Typical daily emissions (lbs/day)	
Area	PM$_{10}$	PM$_{2.5}$	PM$_{10}$	PM$_{2.5}$
Maricopa County	12.64	2.68	94.7	20.5
PM$_{10}$ NAA	12.64	2.68	94.7	20.5

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, 312) as reported by the 2004 County Business Patterns (US Census Bureau, 2006b). 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:

Annual NH_3 emissions from ammonia cold storage (tons/yr)	= Number of employees in relevant industries (from CBP)	× NH_3 emission factor (lb/employee-yr)	÷ 2,000 lbs/ton
	= 8,213	× 413	÷ 2,000
	= 1,695.98 tons NH_3/yr		

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

Typical daily NH_3 emissions (lbs/day)	= Annual emissions (tons/yr)	× 2,000 lbs/ton	÷ (weeks/year × days/week)
	= 1,695.98	× 2,000	÷ (52 × 6)
	= 10.871.7 lbs NH_3/day		

Annual and typical daily emissions for the PM_{10} nonattainment area are calculated by multiplying Maricopa County emissions by the ratio of County industrial employment that occurs in the PM_{10} nonattainment area. (See Section 1.5.1 for a discussion of employment data).

Annual NH_3 emissions from ammonia cold storage in the PM_{10} NAA (tons/yr)	= Annual county emissions (tons/yr)	× NAA:County Industrial employment ratio
	= 1,695.98	× 0.9932
	= 1,684.45 tons NH_3/yr	

Table 3.3–8. Annual and typical daily NH_3 emissions from ammonia cold storage.

Geographic area	Annual emissions (tons/yr)	Typical daily emissions (lbs/day)
Maricopa County	1,695.98	10,871.7
PM_{10} NAA	1,684.45	10,797.8

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 PM_{10} nonattainment area, total emission values for the county and the PM_{10} 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	10.95	9.27	4.53	0.05	1.34	79.0	66.3	25.0	0.4	10.3
PM_{10} NAA	10.95	9.27	4.53	0.05	1.34	79.0	66.3	25.0	0.4	10.3

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 were derived from annual emission reports from permitted facilities. Since all permitted facilities in this category were surveyed in 2005, 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. 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.

Typical daily emissions are calculated based on the operating schedule data reported by surveyed facilities. Annual and typical daily emissions for the PM_{10} nonattainment area were derived based on the location data of the individual facilities. County permitted portable sources with no location data were assumed to operate within the PM_{10} nonattainment area as a conservative estimate.

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

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

Geographic area	Annual emissions (tons/yr)		Typical daily emissions (lbs/day)	
	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$
Maricopa County	431.60	222.71	3,030.4	1,517.2
PM_{10} NAA	430.89	222.17	3,024.9	1,513.0

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 PM_{10} nonattainment area were identified using information on the location of each permitted facility. County permitted portable sources with no location data were assumed to operate within the PM_{10} nonattainment area as a conservative estimate. 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.

Geographic Area	Annual emissions (tons/yr)		Typical daily emissions (lbs/day)	
	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$
Maricopa County	62.97	17.38	409.1	112.1
PM_{10} NAA	54.77	15.52	347.6	98.2

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 (2006b) 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 2004 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	7430	7430
337---	Furniture and related products manufacturing	7342	7342
Total:			**14,772**

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 wood products	= Total employment (from US Census' County Business Patterns)	–	Employment at point sources (from annual emission reports)
	= 14,772	–	4,216
	= 10,556 employees		

Annual emissions are calculated by "scaling up" area-source emissions reported from those facilities surveyed in 2005 as follows:

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

$$\text{Area-source } PM_{10} \text{ emissions from wood products} = \frac{51.792 \text{ tons of } PM_{10}\text{/yr}}{2{,}564 \text{ employees}} \times 10{,}556 \text{ employees}$$

$$= 213.23 \text{ tons } PM_{10}\text{/yr}$$

Typical daily emissions are calculated in the same method as annual emissions, only using surveyed daily emissions instead of annual totals. Annual and typical daily emissions for the PM_{10} 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.)

PM_{10} emissions from area-source wood products in the PM_{10} NAA (tons/yr)	= Annual Maricopa County emissions	×	NAA:county ratio of industrial employment
	= 213.23 tons/yr	×	.9932
	= 211.78 tons PM_{10}/yr		

Table 3.3–13 summarizes annual and typical daily emissions from wood products manufacturing in both Maricopa County and the PM_{10} nonattainment area.

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

	Annual emissions (tons/yr)		Typical daily emissions (lbs/day)	
Geographic Area	**PM_{10}**	**$PM_{2.5}$**	**PM_{10}**	**$PM_{2.5}$**
Maricopa County	213.23	149.95	1,657.9	1,170.0
PM_{10} NAA	211.78	148.93	1,646.6	1,162.0

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 (2006b) 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 2004 employment, were used. Where CBP employment estimates were presented as a range, the midpoint values were 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
322130	Paperboard Mills	0 – 19	10
323116	Manifold Business Forms Printing		375
325991	Custom Compounding of Purchased Resins	100 – 249	175
326122	Plastics Pipe & Pipe Fitting Mfg.	250 – 499	375
32613	Laminated Plastics Plate, Sheet (except Packaging), & Shape Mfg.	0 – 19	10
32614	Polystyrene Foam Product Mfg.		316
326160	Plastics Bottle Mfg.		161
32619	Other Plastics Product Mfg.		4,117
326212	Tire Retreading	20 – 99	60
32622	Rubber & Plastics Hoses & Belting Mfg.	20 – 99	60
326299	All Other Rubber Product Mfg.	100 – 249	175
327991	Cut Stone & Stone Product Mfg.		411
333415	HVAC Equipment Mfg.	500 – 999	750
336612	Boat Building	0 – 19	10
33992	Sporting & Athletic Goods Mfg.		1,212
423930	Recyclable Material Merchant Wholesalers		503
Total:			**8,720**

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 rubber & plastic product manufacturing = Total employment (from US Census' County Business Patterns) – Employment at point sources (from annual emission reports)

= 8,720 – 2,536

= 6,184 employees

This area-source employment estimate is used to "scale up" emissions reported from those facilities surveyed in 2005 as follows:

$$\text{Total area-source } PM_{10} \text{ emissions from rubber/plastic product mfg.} = \frac{\text{Emissions from surveyed area sources}}{\text{Employment at surveyed area sources}} \times \text{Total area-source employment}$$

$$= \frac{66.09 \text{ tons of } PM_{10}/\text{yr}}{1{,}119 \text{ employees}} \times 6{,}184 \text{ employees}$$

$$= 365.26 \text{ tons } PM_{10}/\text{yr}$$

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:

$$\text{Typical daily } PM_{10} \text{ emissions from rubber \& plastic manufacturing} = \frac{\text{Annual emissions (tons/yr)}}{\text{Days/week} \times \text{Weeks/year}} \times \frac{2{,}000 \text{ lbs}}{\text{ton}}$$

$$= \frac{365.26}{5 \times 52} \times 2{,}000$$

$$= 2{,}809.7 \text{ lbs } PM_{10}/\text{day}$$

Annual and typical daily emissions for the PM_{10} 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.)

PM_{10} emissions from area-source plastic/rubber in the PM_{10} NAA (tons/yr) = Annual Maricopa County emissions × NAA:county ratio of industrial employment

= 365.26 tons PM_{10}/yr × 0.9932

= 362.77 tons PM_{10}/yr

Table 3.3–15 summarizes annual and typical daily emissions from rubber/plastic products manufacturing in both Maricopa County and the PM_{10} nonattainment area.

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

	Annual emissions (tons/yr)		Typical daily emissions (lbs/day)	
Geographic Area	**PM_{10}**	**$PM_{2.5}$**	**PM_{10}**	**$PM_{2.5}$**
Maricopa County	365.26	236.52	2,809.7	1,819.4
PM_{10} NAA	362.77	234.91	2,790.6	1,807.0

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 (2006b) 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 2004 employment were used. CBP employment data for NAICS code 332* (fabricated metal products manufacturing) indicated that there were 13,400 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:

Total area-source employment in fab. metal products	= Total employment (from US Census' County Business Patterns)	–	Employment at point sources (from annual emission reports)
	= 13,400	–	691
	= 12,709 employees		

Annual emissions are calculated by "scaling up" area-source emissions reported from those facilities surveyed in 2005 as follows:

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

$$\text{Area-source } PM_{10} \text{ emissions from fab. metal products} = \frac{12.519 \text{ tons of } PM_{10}/\text{yr}}{1{,}145 \text{ employees}} \times 12{,}709 \text{ employees}$$

$$= 138.96 \text{ tons } PM_{10}/\text{yr}$$

Typical daily emissions are calculated in the same method as annual emissions, only using surveyed daily emissions instead of annual totals. Annual and typical daily emissions for the PM_{10} 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.)

PM_{10} emissions from area-source fab. metal prod. in the PM_{10} NAA (tons/yr)	= Annual Maricopa County emissions	×	NAA:County ratio of industrial employment
	= 138.96 tons/yr	×	0.9932
	= 138.01 tons PM_{10}/yr		

Table 3.3–16 summarizes annual and typical daily emissions from fabricated metal products manufacturing in both Maricopa County and the PM_{10} nonattainment area.

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

Geographic Area	Annual emissions (tons/yr) PM_{10}	Annual emissions (tons/yr) $PM_{2.5}$	Typical daily emissions (lbs/day) PM_{10}	Typical daily emissions (lbs/day) $PM_{2.5}$
Maricopa County	138.96	119.88	1,579.3	1,404.1
PM_{10} NAA	138.01	119.06	1,568.6	1,394.5

3.3.9 Construction

Maricopa County's air quality permits database was used to identify all dust control permits issued during 2005. A total of 5,257 permits were issued, comprising a total of 68,664 acres (Table 3.3–17). Data requested on each dust control permit application includes the project type and acreage. It was assumed there is no unpermitted earthmoving activity.

Table 3.3–17. 2005 Maricopa County dust control permits issued, by type.

Dust Control Permit Project Type	Reported Acres
Residential	47,324.4
Commercial	10,163.0
Road construction	4,247.5
Trenching	470.3
Demolition	584.3
Weed control	177.7
Site prep / land development	5,607.0
Temp. storage yard	89.3
Totals:	**68,663.5**

The Western Regional Air Partnership (WRAP) Fugitive Dust Handbook (WRAP, 2006a) provides different emission factors for residential (single-family houses and apartment buildings), nonresidential, road, and general construction. MCAQD used the WRAP suggested emission factors except for the following activities:

- The WRAP Fugitive Dust Handbook recommended using 0.42 ton PM_{10}/acre-month for road construction to account for the large amount of dirt moved during the construction of roadways. However, the South Coast Air Quality Management District (SCAQMD) and the Clark County Department of Air Quality and Environmental Management estimated a percentage of their road construction projects did not involved large-scale earthmoving activities and therefore they used an average emission factor for road construction (.1895 ton PM_{10}/acre-month and 0.265 ton PM_{10}/acre-month, respectively). Because Maricopa County and Clark County have similar population growth, climatic, and PM_{10} sources, MCAQD used the Clark County road construction emission factor of 0.265 tons/acre-month to estimate emissions from road construction projects (Clark County, 2001).

- Specific emission factors were not available in the WRAP Fugitive Dust Handbook for trenching, demolition, weed control, and temporary storage yard activities; thus, the general construction emission factor of 0.11 tons PM_{10}/acre-month was used to estimate emissions from these activities.

Information was not readily available regarding the breakout of residential construction activity between single-family and multi-family residential construction; thus, acreage for residential construction was allocated based on single-family and multi-family household percentages (See Section 1.5.1 for single-family and multi-family household percentages used).

Estimates for the duration of house and apartment construction were obtained from EIIP guidance (US EPA, 2002). Estimates for the duration of nonresidential construction and road construction were obtained from the WRAP Fugitive Dust Handbook (WRAP, 2006a). No estimates for the duration of trenching, demolition, weed control, site prep/land development, and temporary storage yard activities were available; thus, MCAQD assumed the following:

- 1-month duration for trenching, demolition, and weed control.
- 8-month duration for site prep/land development activities (weighted average of residential and commercial duration) because the duration depends on the project type and size.
- 12-month duration for temporary storage yard activities because these activities are frequently associated with road construction.

The average duration of construction activity and emission factors for each project type are shown below in Table 3.3–18.

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

Project Type	Average Duration (months)	Emission factor (tons PM_{10}/ acre-month)
Residential: single-family	6	0.032
Residential: multi-family	12	0.11
Commercial	11	0.19
Road construction	12	0.265
Trenching	1	0.11
Demolition	1	0.11
Weed control	1	0.11
Site prep / land development	8	0.11
Temp. storage yard	12	0.11

County-wide annual uncontrolled PM_{10} emissions for each construction category were then calculated as follows:

Annual uncontrolled PM_{10} emissions = total acres/yr × no. months × emission factor (tons of PM_{10}/acre-month)

Example:
Annual uncontrolled PM_{10} emissions from single-family residential construction = 35,493.3 acres/yr × 6 months × 0.032 tons PM_{10}/acre-month

= 6,814.72 tons PM_{10}/yr

A control efficiency of 90% was applied to the uncontrolled emissions calculations. A recent rule effectiveness study by Maricopa County (contained in Appendix 2.2) indicates a 51% compliance rate with Maricopa County Rule 310 on dust control at construction sites. Thus, an overall control effectiveness of 44.1% (= 90% × 49%) was applied. Controlled PM_{10} emissions were calculated as follows:

Annual controlled PM_{10} emissions = Uncontrolled PM_{10} emissions (tons/yr) × [1 – (control efficiency × rule effectiveness)]

Example:

Annual controlled PM_{10} emissions from single-family residential construction	=6,814.72 tons × [1 – (90% control × 51% rule effectiveness)]
	=3,686.76 tons PM_{10}/yr

$PM_{2.5}$ emissions were calculated as 10% of PM_{10} emissions (WRAP, 2006a). Table 3.3–19 summarizes the calculations for each construction category.

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

Project Type	Total acre-months	Emission factor (tons/acre-month)	Uncontrolled PM_{10}	Controlled PM_{10}	Controlled $PM_{2.5}$
Residential: single-family	212,960.0	0.032	6,814.72	3,686.76	368.68
Residential: multi-unit	141,973.3	0.11	15,617.07	8,448.83	844.88
Commercial	111,793.1	0.19	21,240.69	11,491.21	1,149.12
Road construction	50,970.2	0.265	13,507.11	7,307.35	730.73
Trenching	470.3	0.11	51.73	27.99	2.80
Demolition	584.3	0.11	64.27	34.77	3.48
Weed control	177.7	0.11	19.55	10.58	1.06
Site prep/land development	44,855.8	0.11	4,934.13	2,669.37	266.94
Temporary storage yard	1,071.5	0.11	117.86	63.76	6.38
Totals:			**62,367.14**	**33,740.62**	**3,374.06**

Dust control permit site location data was used to determine construction activity that occurred in the Maricopa County PM_{10} nonattainment area. The same average duration of construction activity and emission factors used to estimate Maricopa County emissions (see Table 3.3–18) were applied to construction activity in the Maricopa County PM_{10} nonattainment area. Table 3.3–20 summarizes Maricopa County PM_{10} nonattainment area construction activity and calculations for each project type.

Table 3.3–20. Annual emissions from construction (tons/yr) for the Maricopa County portion of PM_{10} NAA.

Project Type	Total Acres	Total acre-months	EF (tons/ acre-month)	Uncontrolled PM_{10}	Controlled PM_{10}	Controlled $PM_{2.5}$
Residential: single-family	32,631.6	195,789.5	0.032	6,265.26	3,389.51	338.95
Residential: multi-unit	10,877.2	130,526.3	0.11	14,357.90	7,767.62	776.76
Commercial	9,740.3	107,143.0	0.19	20,357.16	11,013.23	1,101.32
Road construction	4,199.2	50,390.8	0.265	13,353.55	7,224.27	722.43
Trenching	450.5	450.5	0.11	49.56	26.81	2.68
Demolition	580.6	580.6	0.11	63.86	34.55	3.46
Weed control	177.7	177.7	0.11	19.55	10.58	1.06
Site prep/land development	4,905.6	39,244.6	0.11	4,316.90	2,335.44	233.54
Temporary storage yard	89.3	1,071.48	0.11	117.86	63.76	6.38
Totals:	**63,652.0**			**58,901.61**	**31,865.77**	**3,186.58**

The Pinal County Air Quality Department (PCAQD) provided construction emission estimates for the Pinal County portion of the PM_{10} nonattainment. PCAQD estimated that 1.3 percent of the Pinal County construction activity occurred in the Pinal County portion of the PM_{10} nonattainment area, thus, annual and typical daily emission for the Pinal County portion of the PM_{10} nonattainment area was calculated by multiplying the Pinal County emission totals by 1.3 percent. PCAQD estimates incorporated the same average duration of construction activity, emission factors, control efficiency, and rule effectiveness as Maricopa County's estimates.

Table 3.3–21. Annual emissions from construction (tons/yr) for the Pinal County portion of the PM_{10} NAA.

Project Type	PM_{10}	$PM_{2.5}$
Residential: single-family	22.29	2.23
Residential: multi-family	152.56	15.26
Commercial	72.32	7.23
Road construction	12.15	1.21
Trenching	0.02	0.00
Demolition	0.00	0.00
Weed control	0.00	0.00
Site prep/land development	0.00	0.00
Temporary storage yard	4.72	0.47
Totals:	**264.08**	**26.41**

It was assumed that construction activity occurs 6 days per week and evenly throughout the year. Thus, typical daily emissions were calculated by dividing annual emissions by 312 (6 days/wk × 52 wks/yr).

Table 3.3–22. Annual and typical daily emissions from construction.

	Maricopa County				PM_{10} NAA			
	Annual emissions (tons/yr)		Typical daily emissions (lbs/day)		Annual emissions (tons/yr)		Typical daily emissions (lbs/day)	
Construction Type	**PM_{10}**	**$PM_{2.5}$**	**PM_{10}**	**$PM_{2.5}$**	**PM_{10}**	**$PM_{2.5}$**	**PM_{10}**	**$PM_{2.5}$**
Residential	12,135.60	1,213.56	77,792.3	7,779.2	11,331.99	1,133.20	72,641.0	7,264.1
Commercial	11,491.21	1,149.12	73,661.6	7,366.2	11,085.55	1,108.55	71,061.2	7,106.1
Road construction	7,307.35	730.73	46,842.0	4,684.2	7,236.42	723.64	46,387.3	4,638.7
Construction - other*	2,806.46	280.65	17,990.2	1,799.0	2,475.89	247.59	15,871.1	1,587.1
Total	**33,740.62**	**3,374.06**	**216,286.0**	**21,628.6**	**32,129.85**	**3,212.98**	**205,960.6**	**20,596.1**

*Includes: trenching, demolition, weed control, site prep/land development, and temp. storage yd.

3.3.10 Electrical equipment manufacturing

Emissions from electric equipment manufacturing 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 PM_{10} nonattainment area, emission totals for both areas are equal. Annual and typical daily emissions are shown in Table 3.3–23.

Table 3.3–23. Annual and typical daily emissions from area-source electric equipment manufacturing.

	Annual emissions (tons/yr)					Typical daily emissions (lbs/day)				
Geographic area	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**NH_3**	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**NH_3**
Maricopa County	5.24	3.25	0.01	4.59	0.96	40.3	25.0	0.1	35.3	7.4
PM_{10} NAA	5.24	3.25	0.01	4.59	0.96	40.3	25.0	0.1	35.3	7.4

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. MCAQD requested information from ADEQ for all ADEQ-permitted sources that reported any activity in Maricopa County during 2002. Annual total emissions for most pollutants were provided, along with information on the facility type, and information on the location of the site(s) 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:	D.G.Huskin Construction 1000677			
Permit type:	Portable crushing/screening plant			
Operating schedule:	Operated from 5/31-6/29 Gila Bend SR 85 (Maricopa Co.); 6/30-8/30 Buckeye SR 85 (Maricopa Co.) 9/1-10/24 Cordes Jct I-17 (Yavapai Co.), 10/25-11/09 Williams SR 64 (Coconino Co.) and 11/10-12/31 Parker SR 95 (La Paz Co.)			
Total annual emissions:	**PM_{10}**	**$PM_{2.5}$** [1]	**NO_x**	**SO_x**
(tons/yr)	1.415	0.708	10.067	4.062

1. $PM_{2.5}$ was assumed to be 50% of reported PM_{10} for crushing/screening operations.

Using this information, calculations were made to determine:

Total operating days in 2005: 216 = 1 (May) + 30 (June) + … + 31 (Dec.)
Total operating days in Maricopa County: 92 = 1 (May) + 30 (June) + … + 30 (Aug.)

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:

$$\text{Annual } PM_{10} \text{ emissions in Maricopa County} = \text{Total annual emissions (tons/yr)} \times \frac{\text{operating days in Maricopa County}}{\text{total operating days in 2002}}$$

$$= 1.415 \times \frac{92}{216}$$

$$= 0.61 \text{ tons } PM_{10}/\text{yr}$$

Typical daily emissions were then calculated as follows:

$$\text{Typical daily emissions (lbs/day)} = \frac{\text{total emissions attributable to activity in Maricopa County}}{\text{number of operating days in Maricopa County}} \times \frac{2{,}000 \text{ lbs}}{\text{ton}}$$

$$= \frac{0.61 \text{ tons}}{92 \text{ days}} \times \frac{2{,}000 \text{ lbs}}{\text{ton}}$$

$$= 13.2 \text{ lbs } PM_{10}/\text{day}$$

Table 3.3–24 summarizes the annual and typical daily emissions for all ADEQ-permitted portable sources that operated within Maricopa County at some point during 2005. Since no precise location data was not available for all permits, all emissions are conservatively assumed to have originated within the PM_{10} nonattainment area, therefore emissions in Maricopa County and the PM_{10} nonattainment area are equal.

Table 3.3–24. Emissions from ADEQ-permitted portable sources.

	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
Total:	101.70	42.18	554.60	142.20	844.2	389.8	5,377.5	1,431.7

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. PM_{10} 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 PM_{10} using a ratio derived from California Air Resources Board's (CARB) PM2.5 Fraction Table (CARB, 2006).

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 PM_{10} nonattainment area were determined from the site locations of each facility.

Table 3.3–25. Annual and typical daily emissions from paved and unpaved road travel at industrial facilities.

	Annual emissions (tons/yr)		Typical daily emissions (lbs/day)	
Geographic area	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$
Maricopa County	170.49	65.45	1,138.8	436.2
PM_{10} NAA	167.78	64.48	1,118.8	429.0

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. Emissions for the PM_{10} nonattainment area are based on the location of the facilities that report other industrial processes.

Table 3.3–26. **Annual and typical daily emissions from other industrial processes not elsewhere classified.**

	Annual emissions (tons/yr)					Typical daily emissions (lbs/day)				
Geographic area	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**NH_3**	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**NH_3**
Maricopa County	24.31	13.87	4.58	0.01	0.80	202.0	97.3	26.7	<0.1	4.6
PM_{10} NAA	24.29	13.86	4.08	0.01	0.80	201.9	97.2	22.9	<0.1	4.6

3.3.14 Summary of all area-source industrial processes

Tables 3.3–27 and 3.3–28 provide a summary of annual and typical daily emissions from all industrial sources, for Maricopa County and the PM_{10} nonattainment area, respectively.

Table 3.3–27. Annual and typical daily emissions from all area-source industrial processes in Maricopa County.

	Annual emissions (tons/yr)				
Source category	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**NH_3**
Chemical manufacturing	76.77	38.85	0.39	0.21	0.34
Commercial cooking	1,527.98	1,416.96			
Grain handling/processing	12.64	2.68			
Ammonia cold storage					1,695.98
Secondary metal production	10.95	9.27	4.53	0.05	1.34
Non-metallic mineral processes	431.60	222.71			
Mining and quarrying	62.97	17.38			
Wood product manufacturing.	213.23	149.95			
Rubber/plastic product manufacturing	365.26	236.52			
Fabricated metal product manufacturing	138.96	119.88			
Residential construction	12,135.60	1,213.56			
Commercial construction	11,491.21	1,149.12			
Road construction	7,307.35	730.73			
Other construction	2,806.46	280.65			
Electrical equipment manufacturing	5.24	3.25	0.01	4.59	0.96
ADEQ-permitted portable sources	101.70	42.18	554.60	142.20	
Road travel at industrial sites	170.49	65.45			
Industrial processes NEC	24.31	13.87	4.58	0.01	0.80
All industrial processes:	**36,882.71**	**5,713.02**	**564.11**	**147.06**	**1,699.43**

	Typical daily emissions (lbs/day)				
Source category	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**NH_3**
Chemical manufacturing	590.5	298.9	3.0	1.6	2.6
Commercial cooking	8,395.5	7,785.5			
Grain handling/processing	94.7	20.5			
Ammonia cold storage					10,871.7
Secondary metal production	79.0	66.3	25.0	0.4	10.3
Non-metallic mineral processes	3,030.4	1,517.2			
Mining and quarrying	409.1	112.1			
Wood product manufacturing.	1,657.9	1,170.0			
Rubber/plastic product manufacturing	2,809.7	1,819.4			
Fabricated metal product manufacturing	1,579.3	1,404.1			
Residential construction	77,792.3	7,779.2			
Commercial construction	73,661.6	7,366.2			
Road construction	46,842.0	4,684.2			
Other construction	17,990.2	1,799.0			
Electrical equipment manufacturing	40.3	25.0	0.1	35.3	7.4
ADEQ-permitted portable sources	844.2	389.8	5,377.5	1,431.7	
Road travel at industrial sites	1,138.8	436.2			
Industrial processes NEC	202.0	97.3	26.7	<0.1	4.6
All industrial processes:	**237,157.6**	**36,770.8**	**5,432.2**	**1,469.1**	**10,896.2**

Table 3.3–28. Annual and typical daily emissions from all area-source industrial processes in the PM_{10} NAA.

	Annual emissions (tons/yr)				
Source category	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**NH_3**
Chemical manufacturing	76.25	38.59	0.38	0.21	0.34
Commercial cooking	1,539.90	1,428.01			
Grain handling/processing	12.64	2.68			
Ammonia cold storage					1,684.45
Secondary metal production	10.95	9.27	4.53	0.05	1.34
Non-metallic mineral processes	430.89	222.17			
Mining and quarrying	54.77	15.52			
Wood product manufacturing.	211.78	148.93			
Rubber/plastic product manufacturing	362.77	234.91			
Fabricated metal product manufacturing	138.01	119.06			
Residential construction	11,331.99	1,133.20			
Commercial construction	11,085.55	1,108.55			
Road construction	7,236.42	723.64			
Other construction	2,475.89	247.59			
Electrical equipment manufacturing	5.24	3.25	0.01	4.59	0.96
ADEQ-permitted portable sources	101.70	42.18	554.60	142.20	
Road travel at industrial sites	167.78	64.48			
Industrial processes NEC	24.29	13.86	4.08	0.01	0.80
All industrial processes:	**35,266.82**	**5,555.90**	**563.60**	**147.05**	**1,687.89**

	Typical daily emissions (lbs/day)				
Source category	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**NH_3**
Chemical manufacturing	586.5	296.8	3.0	1.6	2.6
Commercial cooking	8,461.0	7,846.2			
Grain handling/processing	94.7	20.5			
Ammonia cold storage					10,797.8
Secondary metal production	79.0	66.3	25.0	0.4	10.3
Non-metallic mineral processes	3,024.9	1,513.0			
Mining and quarrying	347.6	98.2			
Wood product manufacturing.	1,646.6	1,162.0			
Rubber/plastic product manufacturing	2,790.6	1,807.0			
Fabricated metal product manufacturing	1,568.6	1,394.5			
Residential construction	72,641.0	7,264.1			
Commercial construction	71,061.2	7,106.1			
Road construction	46,387.3	4,638.7			
Other construction	15,871.1	1,587.1			
Electrical equipment manufacturing	40.3	25.0	0.1	35.3	7.4
ADEQ-permitted portable sources	844.2	389.8	5,377.5	1,431.7	
Road travel at industrial sites	1,118.8	429.0			
Industrial processes NEC	201.9	97.2	22.9	<0.1	4.6
All industrial processes:	**226,765.3**	**35,741.7**	**5,428.5**	**1,469.1**	**10,822.7**

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 2005.

Emissions from on-site incineration were determined from annual emission inventory reports. It is assumed that all incinerator emissions are accounted for, since all permitted incinerators received surveys in 2005. All surveyed facilities are located within the PM_{10} 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.

	Annual emissions (tons/yr)				Typical daily emissions (lbs/day)			
Geographic area	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**
Maricopa County	0.15	0.10	2.54	0.03	1.6	1.1	19.9	0.3
PM_{10} NAA	0.15	0.10	2.54	0.03	1.6	1.1	19.9	0.3

3.4.2 Open burning

Emissions from controlled open burning are regulated by Maricopa County Air Pollution Control Regulations Rule 314 (Open Outdoor Fires), 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 2005. A total of 73 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:

$$\begin{array}{l}\text{Total ditch -}\\ \text{bank/fencerows}\end{array} = 1{,}504{,}852 \text{ linear ft (reported)} \times \frac{50 \text{ burn permits issued}}{29 \text{ permits with data}} = 2{,}594{,}572 \text{ linear ft}$$

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

Table 3.4–2. 2005 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	1,504,852	29	50	2,594,572
Land clearance	Acres	5	1	7	35
Land clearance	Piles	37	2	7	130
Air curtain	Material Burned	70	7	7	70
Tumbleweeds	Piles	20	3	4	27

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 PM_{10} (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 Maricopa County emission inventory and information from MCAQD's open burn program staff:

- 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.
- Air curtain destructors burn between 7–10 tons of material per day. (MCAQD, 2006).

To calculate the annual amount of material burned on ditch banks and fence rows in Maricopa County, MCAQD 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:

Material burned from ditchbanks and fence rows $= \frac{\text{2,594,572 ft length}}{\text{43,560 ft}^2\text{ / acre}} \times \text{7 ft width} \times \text{3.2 tons/acre} \times \text{2 times/yr}$

$= \text{2,668 tons material burned/yr}$

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, all calculated emissions estimates were increased 2.31 times based on complaints received in 2006 for open or illegal outside burning (169 complaints received; 169 complaints/73 open burn permits = 2.31).

Annual PM_{10} emissions from ditchbank and fence row burning = Total material burned × emission factor × unit conversion factor

= 2,668 tons × 15 lbs/ton × 1 ton / 2,000 lbs

= 20.01 tons/yr

Total annual PM_{10} emissions including unpermitted burning = Calculated emissions from permit data + unpermitted burning adjustment factor

= 20.02 tons/yr × 2.32

= 46.44 tons PM_{10}/yr

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	2,668.4	46.43	46.43	12.38
Land clearance	526.4	9.61	9.61	2.44
Air curtain	70.0	0.49	0.49	0.32
Tumbleweeds	2.67	0.07	0.07	0.01
Totals:		**56.15**	**56.15**	**15.16**

Annual emissions for the nonattainment area are calculated by multiplying the percentage of agricultural and/or vacant land use located in the PM_{10} 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 PM_{10} nonattainment area.

Table 3.4–5. Surrogate land-use classes, ratios, and annual emissions from open burning in the PM_{10} NAA.

Category	Surrogate land use categories	2004 NAA:county land-use ratio	Emissions (tons/yr) PM_{10}	$PM_{2.5}$	NO_x
Ditchbank/fencerow	Agriculture	48.01 %	22.29	22.29	5.94
Land clearance	Vacant	19.82 %	1.82	1.82	048
Air curtain	Agriculture and vacant	25.06 %	0.12	0.12	0.08
Tumbleweeds	Agriculture and vacant	25.06 %	0.02	0.02	0.00
Totals:			**24.24**	**24.24**	**6.51**

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 January).

PM_{10} typical daily emissions for Maricopa County are derived as follows:

$$\text{Typical daily } PM_{10} \text{ emissions} = \frac{\text{annual } PM_{10} \text{ emissions (tons/yr)} \times 2000 \text{ lbs/ton}}{\text{(burn days/week)} \times \text{(burn weeks/year)}}$$

$$\text{Typical daily } PM_{10} \text{ emissions from ditchbank/ fence row burning} = \frac{46.43 \text{ tons/yr} \times 2000 \text{ lbs/ton}}{5 \text{ days/wk} \times 39 \text{ wks/yr}}$$

$$= 476.2 \text{ lbs } PM_{10}\text{/day}$$

Typical daily emissions for the PM_{10} 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 PM_{10} nonattainment area.

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

	Maricopa County (lbs/day)			PM_{10} nonattainment area (lbs/day)		
Category	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**PM_{10}**	**$PM_{2.5}$**	**NO_x**
Ditchbank/fencerow	476.2	476.2	127.0	228.6	228.6	61.0
Land clearance	70.5	70.5	28.8	14.0	14.0	3.7
Air curtain	3.7	3.7	2.5	0.9	0.9	0.6
Tumbleweeds	0.5	0.5	0.1	0.1	0.1	0.0
Totals:	**550.9**	**550.9**	**148.4**	**243.6**	**243.6**	**65.3**

3.4.3 Landfills

Emissions from municipal solid waste (MSW) landfills come from uncontrolled landfill gas emissions as well as from cover operations and combustion from control measures, such as a flare. Total emissions were calculated from annual emissions inventory reports from all landfills located within the county. Five MSW landfills (Butterfield Station, City Of Chandler Landfill, Northwest Regional Landfill, Skunk Creek Landfill and Southwest Regional Municipal Solid Waste Landfill) are considered point sources and are reported in Chapter 2. All other MSW landfills are reported here as area-source landfills.

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

	Annual emissions (tons/yr)				Typical daily emissions (lbs/day)			
Geographic area	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**
Maricopa County	6.79	4.05	6.50	1.11	39.5	23.5	36.3	6.3
PM_{10} NAA	6.79	4.05	6.50	1.11	39.5	23.5	36.3	6.3

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. NH_3 emissions from publicly-owned treatment works (POTWs).

Geographic area	**2005 Population**	**NH_3 emission factor (lbs/10^6 gals treated)**	**Annual NH_3 emissions (tons/yr)**	**Typical daily NH_3 emissions (lbs/day)**
Maricopa County	3,780,380	19.0	1,310.85	7,182.72
PM_{10} NAA	3,809,701	19.0	1,321.01	7,238.4

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 PM_{10} nonattainment area, therefore emissions for Maricopa County and the PM_{10} NAA are equal.

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

	Annual emissions (tons/yr)				Typical daily emissions (lbs/day)			
Geographic area	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**
Maricopa County	79.55	48.51	4.15	5.01	606.0	369.6	22.8	27.5
PM_{10} NAA	79.55	48.51	4.15	5.01	606.0	369.6	22.8	27.5

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 PM_{10} nonattainment area, respectively.

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

	Annual emissions (tons/yr)					Typical daily emissions (lbs/day)				
Category	**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	0.15	0.10	2.54	0.03		1.6	1.1	19.9	0.3	
Open burning	56.15	56.15	15.16			550.9	550.9	148.4		
Landfills	6.79	4.05	6.50	1.11		39.5	23.5	36.3	6.3	
POTWs					1,310.85					7,182.7
Other	79.55	48.51	4.15	5.01		606.0	369.6	22.8	27.5	
Total:	**142.64**	**108.81**	**28.35**	**6.14**	**1,310.85**	**1,198.1**	**945.1**	**227.4**	**34.0**	**7,182.7**

Table 3.4–11. Annual and typical daily emissions from all area-source waste disposal for the PM_{10} NAA.

	Annual emissions (tons/yr)					Typical daily emissions (lbs/day)				
Category	**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	0.15	0.10	2.54	0.03		1.6	1.1	19.9	0.3	
Open burning	24.24	24.24	6.51			243.6	243.6	65.3		
Landfills	6.79	4.05	6.50	1.11		39.5	23.5	36.3	6.3	
POTWs					1,321.01					7,238.4
Other	79.55	48.51	4.15	5.01		606.0	369.6	22.8	27.5	
Total:	**110.74**	**76.90**	**19.70**	**6.14**	**1,321.01**	**890.8**	**637.8**	**144.4**	**34.0**	**7,238.4**

3.5 Miscellaneous area sources

3.5.1 *Other combustion*

3.5.1.1 Wildfires

Federal and state records of individual vegetation fire events were collected from the Arizona State Land Department WildCAD database (ASLD, 2006a), and the United States Geological Survey GeoMAC Wildland Fire Support database (USGS, 2006). Only vegetation fires with reported acreage were used to estimate emissions from wildfires. Thirty-eight fires occurred within the PM_{10} nonattainment area, resulting in nearly 22,000 acres burned. The largest fire within the PM_{10} nonattainment area was the Bart fire which occurred in May 2006 and resulted in over 14,000 acres burned.

Fire activity records in the two databases were culled for duplicates by comparing incident names and incident dates. The acreage for fires located near the Maricopa County border where reviewed by Arizona State Land Department (ASLD) staff to ensure that only acres burned within Maricopa County were included in emission estimates. ASLD staff also reviewed acreage estimates for all fires with a discrepancy greater than 500 acres between data reported by ASLD and USGS. When fuel type data was missing from state and federal records, fuel type was obtained from Incident Status Summary, Form ICS-209 (USFSa, 2006). In the event that fire event-specific fuel type were not contained in federal or state data nor in the ICS-209 forms, then National Fire Danger Rating System (NFDRS) model descriptions of “sagebrush grass” or “California chaparral” were assigned based on guidance from Arizona State Land Department (ASLD, 2006b).

NFDRS model descriptions were assigned to each fire event based on the fuel type and then corresponding fuel loadings were assigned (WGA/WRAP, 2005). Estimates of the material burned were derived by multiplying the number of acres burned by the assigned fuel loading factor.

Table 3.5–1. Assigned NFDRS Model categories, fuel loading factors, and material burned.

NFDRS Model Description	Fuel Load (tons/acre)	Data	PM_{10} NAA	Maricopa County
California Chaparral	19.5	acres burned	14,634	187,864
		material burned (tons)	285,365	3,663,350
Intermediate Brush	15	acres burned	2,788	81,446
		material burned (tons)	41,820	1,221,690
Sagebrush Grass	4.5	acres burned	4,137	34,163
		material burned (tons)	18,618	153,736
Western Grasses (annual)	0.5	acres burned	213	12,447
		material burned (tons)	106	6,224
Total acres burned			21,772	315,921
Total material burned (tons)			345,909	5,044,999

Emission factors were obtained from the Western Regional Air Partnership's (WRAP) 2002 Fire Emission Inventory (WGA/WRAP, 2005). Emission factors are listed below in Table 3.5–2.

Table 3.5–2. Summary of emission factors for prescribed fire (lb/ton).

Wildfire Emission Factors	PM_{10}	$PM_{2.5}$	NO_x	SO_x	NH_3
Prescribed fire (Non-Piled)	28.1	24.1	6.2	1.7	1.3

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

Annual PM_{10} emissions from wildfires in Maricopa County

$$= \frac{\text{material burned} \times \text{emission factor (lbs/ton)}}{2{,}000 \text{ lbs/ton}}$$

$$= \frac{5{,}044{,}999 \text{ tons of material burned} \times 28.1 \text{ lbs } PM_{10}\text{/ton}}{2{,}000 \text{ lbs/ton}}$$

$$= 70{,}882.24 \text{ tons } PM_{10}\text{/yr}$$

Fire activity records included fire locations in latitude and longitude. This data was used to determine the number of acres burned inside of the nonattainment area. Estimates of the material burned were derived by multiplying the number of acres burned within the nonattainment area by the assigned fuel loading factor. Annual emissions from wildfires within the nonattainment area were then calculated by multiplying the material burned by the appropriate emission factor.

Annual PM_{10} emissions from wildfires within the PM_{10} NAA

$$= \frac{\text{material burned within the } PM_{10} \text{ NAA} \times \text{emission factor (lbs/ton)}}{2{,}000 \text{ lbs/ton}}$$

$$= \frac{345{,}909 \text{ tons of material burned} \times 28.1 \text{ lbs } PM_{10}\text{/ton}}{2{,}000 \text{ lbs/ton}}$$

$$= 4{,}860.0 \text{ tons } PM_{10}\text{/yr}$$

Table 3.5–3. Annual emissions from wildfires (tons/yr).

Geographic Area	Material Burned (tons)	Annual emissions (tons/yr)				
		PM_{10}	$PM_{2.5}$	NO_x	SO_x	NH_3
Maricopa County	5,044,999	70,882.24	60,792.24	15,639.50	4,288.25	3,279.25
PM_{10} NAA	345,909	4,860.02	4,168.20	1,072.32	294.02	224.84

Average daily emissions were estimated by dividing annual emissions by the number of burn days in 2005.

Average daily PM_{10} emissions from wildfires in Maricopa County

$$= \frac{70{,}882.24 \text{ tons } PM_{10}/\text{yr} \times 2{,}000 \text{ lbs/ton}}{298 \text{ days/yr}}$$

$$= 475{,}719.7 \text{ lbs } PM_{10}/\text{day}$$

Table 3.5–4. Average daily emissions from wildfires (lbs/day).

Geographic Area	Number of Burn Days	Avg daily emissions (lbs/day)				
		PM_{10}	$PM_{2.5}$	NO_x	SO_x	NH_3
Maricopa County	298	475,719.7	408,001.6	104,963.1	28,780.2	22,008.4
PM_{10} NAA		32,617.6	27,974.5	7,196.8	1,973.3	1,509.0

3.5.1.2 Prescribed fires

Prescribed fires data were obtained from the United States Forest Service (USFS, 2006b). The United States Forest Service reported that one prescribed fire occurred in Maricopa County in 2005. Three acres of piled fuels were burned in the Tonto National Forest on October 21, 2005. The burn occurred outside of the PM_{10} nonattainment area.

Prescribed fire emission factors were obtained from the Western Regional Air Partnership's (WRAP) 2002 Fire Emission Inventory (WGA/WRAP, 2005). The United States Forest Service estimated the fuel loading. Both are listed in Table 3.5–5. Estimates of the material burned in are derived by multiplying the number of acres burned by the appropriate fuel loading factor.

Table 3.5–5. Emission and fuel loading factors for prescribed fires.

Type of fire	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
Prescribed fire (piled Fuels)	3	5.0	8.0	8.0	6.2	1.7	.05

Annual emissions from prescribed fires in Maricopa County were calculated as follows.

Annual PM_{10} emissions from prescribed fires in Maricopa County

$$= \frac{\text{acres burned} \times \text{fuel loading factor} \times \text{emission factor (lbs/ton)}}{2{,}000 \text{ lbs/ton}}$$

$$= \frac{3 \text{ acres burned} \times 5.0 \text{ tons/acre} \times 8.0 \text{ lbs/ton}}{2{,}000 \text{ lbs/ton}}$$

$$= 0.06 \text{ tons } PM_{10}/\text{yr}$$

Because the prescribed fire occurred in the Tonto National Forest, which is located outside of the nonattainment area, emissions from prescribed fires within the nonattainment area were determined to be zero. It was assumed that the prescribed fire lasted one day. Thus, daily emissions from prescribed fires (lbs./day) are equal to annual emissions (tons/day) divided by 2000 lbs/ton.

Table 3.5–6. Annual and typical daily emissions from prescribed fires.

	Annual emissions (tons/yr)					Typical daily emission (lbs/day)				
Geographic Area	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**NH_3**	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**NH_3**
Maricopa County	0.06	0.06	0.05	0.01	0.00	120.0	120.0	93.0	25.5	7.5
PM_{10} NAA	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0

3.5.1.3 Structure fires

2005 structure fire data were obtained by surveying fire departments in Maricopa County and by querying Maricopa County's burn permit data base. Approximately 50 percent of the fire departments surveyed responded to the survey. Because actual fire data was only collected for a portion of the fire departments in Maricopa County, the number of structure fires reported were scaled up to the entire inventory area based on population. The most recent population estimates for Maricopa County were used to scale up the number of structure fires (DES, 2006). Five open burn permits were issued in 2005 for fire training; these were included in the total number of estimated structure fires for 2005. It was estimated that 3,628 structure fires occurred in Maricopa County in 2005.

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:

Material burned in structure fires (tons/yr) = 3,628 fires × 1.15 tons/fire

= 4,171.77 tons material burned/yr

Table 3.5–7. 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**
3,628	1.15	4,171.77	10.8	10.8	1.4	n/a	n/a

* All PM_{10} 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 3.5–7 (from US EPA, 2001e), as follows:

Annual PM_{10} emissions from structure fires Maricopa County = Quantity of material burned × emission factor × unit conversion factor

= 4,171.77 tons × 10.8 lbs/ton × (1 ton/2,000 lbs.)

= 22.53 tons PM_{10}/yr

Annual emissions for the PM_{10} nonattainment area were derived by multiplying Maricopa County annual emissions by the percentage of total residential population within the PM_{10} nonattainment area (100.16%), as shown in the example below. See Section 1.5.2 for a discussion of the population data used.

Annual PM_{10} emissions within the PM_{10} NAA	=	annual PM_{10} emissions for Maricopa County	×	percentage residential population within the NAA
	=	22.53 tons/yr	×	100.16%
	=	22.56 tons PM_{10}/yr		

Typical daily emissions for both Maricopa County and the PM_{10} 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:

$$\text{Typical daily } PM_{10} \text{ emissions from structure fires} = \frac{\text{annual } PM_{10} \text{ emissions (lbs)}}{7 \text{ days/wk} \times 52 \text{ weeks/yr}}$$

$$= \frac{45{,}060 \text{ lbs}}{364}$$

$$= 123.8 \text{ lbs/day}$$

Table 3.5–8. Annual and typical daily emissions from structure fires.

	Annual emissions (tons/yr)			Typical daily emissions (lbs/day)		
Geographic area	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**PM_{10}**	**$PM_{2.5}$**	**NO_x**
Maricopa County	22.53	22.53	2.92	123.8	123.8	16.0
PM_{10} NAA	22.56	22.56	2.92	124.0	124.0	16.1

3.5.1.4 Vehicle fires

2005 vehicle fire data were obtained by surveying fire departments in Maricopa County. Approximately 50 percent of the fire departments surveyed responded to the survey. Because actual fire data was only collected for a portion of the fire departments in Maricopa County, the number of vehicle fires reported were scaled up to the entire inventory area based on population. The most recent population estimates for Maricopa County were used to scale up the number of vehicle fires (DES, 2006). It was estimated that 2,113 vehicle fires occurred in Maricopa County in 2005.

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 (US EPA, 2000). 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 3.5–9 (US EPA, 1992).

Annual PM_{10} emissions from vehicle fires	=	annual number of vehicle fires	× fuel loading factor	× emission factor	× unit conversion factor
	=	2,113	× 0.25 tons/vehicle	× 100 lbs/ton	× (1 ton / 2,000 lbs)
	=	26.41 tons PM_{10}/yr			

Table 3.5–9. Estimated material burned, fuel loading factors, and emission factors for vehicle fires.

Vehicle fires	Fuel loading	Material	Emission factors (lbs/ton)				
reported	**factor (tons/fire)**	**burned (tons)**	**PM_{10}**	**$PM_{2.5}$***	**NO_x**	**SO_x**	**NH_3**
2,113	0.25	528.25	100	100	4	n/a	n/a

* All PM_{10} is assumed to be $PM_{2.5}$.

Annual emissions for the PM_{10} nonattainment area were derived by multiplying Maricopa County annual emissions by the percentage of total residential population within the PM_{10} nonattainment area (100.16%). See Section 1.5.1 for a discussion of the population data used.

Annual PM_{10} emissions from vehicle fires in the PM_{10} NAA	= annual PM_{10} emissions for Maricopa County	×	percentage of total residential population within the PM_{10} NAA
	= 26.41 tons/yr	×	100.16%
	= 26.45 tons/yr		

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 3.5–10 below.

Table 3.5–10. Annual and typical daily emissions from vehicle fires.

	Annual emissions (tons/yr)			Typical daily emissions (lbs/day)		
Geographic area	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**PM_{10}**	**$PM_{2.5}$**	**NO_x**
Maricopa County	26.41	26.41	1.06	144.7	144.7	5.8
PM_{10} NAA	26.45	26.45	1.06	145.0	145.0	5.8

3.5.1.5 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 PM_{10} nonattainment area, total emission values for the county and the PM_{10} NAA are equal. Results are shown in Table 3.5–11.

Table 3.5–11. Annual and typical daily emissions from engine testing.

	Annual emissions (tons/yr)				Typical daily emissions (lbs/day)			
Geographic area	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**
Maricopa County	0.15	0.12	4.61	1.89	1.1	0.9	35.4	14.5
PM_{10} NAA	0.15	0.12	4.61	1.89	1.1	0.9	35.4	14.5

3.5.2 Agricultural Activities

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, 2006). 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 PM_{10} / acre-pass)
k = Particle size multiplier (value of 0.15 for PM_{10})
s = Silt content of soil (percent) = 35.2% (URS and ERG, 2001)

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

Annual PM_{10} emissions from agricultural tillage were calculated for each crop category using the following equation (URS and ERG, 2001; Pollack *et al.*, 2003):

$$Tillage_{Crop} = EF \times AP_{Crop} \times A_{Crop} \times \text{ton} / 2{,}000 \text{ lb}$$

where:
$Tillage_{Crop}$ = Tillage emissions for each crop type (lbs PM_{10}),
EF = Tillage emission factor (lbs PM_{10}/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 PM_{10}/acre-pass
AP_{Cpttpm} 8.9 tillage passes for a cotton crop
A_{Cotton} 42,000 acres of cotton

$Tillage_{Cotton}$ = 6.10 lbs PM_{10} / acre-pass × 8.9 passes × 42,000 acres × ton/ 2,000 lb
= 1,140.09 tons PM_{10} / year

Table 3.5–12 lists crop types and acreage; typical number of land preparation operations and acre-passes; and annual uncontrolled PM_{10} emissions from agricultural tillage for Maricopa County.

Table 3.5–12. 2002 Maricopa County agricultural crop acreage, activity, and uncontrolled annual PM_{10} emissions.

Crop	Reported Acres	Annual land preparation operations	Acre-passes	Annual uncontrolled PM_{10} emissions (tons/yr)
Cotton	42,000	8.9	373,800	1,140.09
Corn	15,100	7.3	109,475	333.90
Wheat	18,200	3.1	55,510	169.31
Barley	12,500	2.1	25,625	78.16
Alfalfa (stand establishment)	21,750 (1)	5.1	109,838	335.00
Cantaloupe (fall)	6,400	16.1	102,880	313.78
Cantaloupe (spring)	8,900	15.0	133,634	407.58
Watermelon	3,400	13.7	46,410	141.55
Honeydew (fall)	700	16.1	11,253	34.32
Honeydew (summer)	1,500	12.5	18,750	57.19
Dry onion	700	11.1	7,757	23.66
Carrots	2,000	12.1	24,241	73.93
Broccoli	2,600	13.2	34,190	104.28
Grapefruit	220 (2)	5.0	1,100	3.36
Navel Oranges and miscellaneous	540 (2)	5.0	2,700	8.24
Valencia Oranges	360 (2)	5.0	1,800	5.49
Lemon	300 (2)	5.0	1,500	4.58
Tangerine	440 (2)	5.0	2,200	6.71
Total acreage:	**137,610**			**3,241.12**

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 PM_{10} nonattainment area, the agricultural PM_{10} 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 PM_{10} 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. URS/ERG derived net control efficiencies by multiplying a mid-point BMP control efficiency by a compliance factor and a relevancy factor for applicable crops. MCAQD has used the same mid-point BMP control efficiency and relevancy factor with a revised compliance factor of 59%, which was derived using latest EPA rule effectiveness guidance (US EPA, 2005) that supercedes the 80% “default” rule effectiveness (RE) value. (RE calculations for agricultural activities are included as Appendix 3.1). To estimate controlled tillage emissions from agricultural operations within the PM_{10} NAA, the mid-point net control efficiency for each BMP were applied to 48.01% (the percent of agricultural land in the PM_{10} NAA) of the uncontrolled annual PM_{10} emissions as follows:

Controlled annual tillage_{Crop} emissions	=	Annual uncontrolled PM_{10} emissions	×	(100% – mid-point net control efficiency_{crop})	×	% agricultural land in the PM_{10} NAA
Controlled annual tillage_{Cotton} emissions	=	1,140.09 tons PM_{10}/yr	×	(100% – 24.3%)	×	48.01%
	=	413.94 tons PM_{10}/yr				

The uncontrolled portion of tillage emissions from agricultural operations taking place outside the PM_{10} NAA but within Maricopa County were estimated by multiplying the uncontrolled annual PM_{10} emissions by the percent of agricultural land located within Maricopa County by outside of the PM_{10} NAA (100% – 48.01%) as follows:

Uncontrolled annual $tillage_{Crop}$ emissions	=	Uncontrolled annual PM_{10} emissions	×	51.99%
	=	1,140.09 tons PM_{10}/yr	×	51.99%
	=	592.73 tons PM_{10}/yr		

Controlled and uncontrolled emissions were then summed to estimate total annual PM_{10} emissions from agricultural tillage in Maricopa County. Results are shown in Table 3.5–13.

Table 3.5–13. Annual controlled PM_{10} emissions from agricultural tillage in Maricopa County.

		Annual PM_{10} emissions (tons/yr)		
Crop	**Net control efficiency**	**Controlled PM_{10} Emissions (within the PM_{10} NAA)**	**Uncontrolled PM_{10} emissions (outside the PM_{10} NAA)**	**Total PM_{10} (controlled + uncontrolled)**
Cotton	0.244	413.94	592.73	1006.67
Corn	0.244	121.23	173.59	294.82
Wheat	0.244	61.47	88.02	149.49
Barley	0.244	28.38	40.63	69.01
Alfalfa (stand establishment)	0.147	137.15	174.17	311.32
Cantaloupe (fall)	0.18	123.56	163.14	286.70
Cantaloupe (spring)	0.18	160.50	211.90	372.40
Watermelon	0.18	55.74	73.59	129.33
Honeydew (fall)	0.18	13.51	17.84	31.36
Honeydew (summer)	0.18	22.52	29.73	52.25
Dry onion	0.18	9.32	12.30	21.62
Carrots	0.18	29.11	38.44	67.55
Broccoli	0.18	41.06	54.21	95.28
Grapefruit	0.18	1.32	1.74	3.07
Navel oranges and miscellaneous	0.18	3.24	4.28	7.52
Valencia oranges	0.18	2.16	2.85	5.02
Lemon	0.18	1.80	2.38	4.18
Tangerine	0.18	2.64	3.49	6.13
Total		**1,228.67**	**1,685.06**	**2,913.73**

Annual $PM_{2.5}$ emissions from agricultural tillage were calculated by multiplying the total annual PM_{10} emissions by a conversion factor of 0.15 (WRAP, 2006b). Table 3.5–14 summarizes the 2005 PM_{10} and $PM_{2.5}$ emissions for Maricopa County and the PM_{10} NAA from agricultural tillage after the implementation of agricultural BMPs.

Table 3.5–14. Annual controlled PM_{10} and $PM_{2.5}$ emissions from agricultural tillage.

	Maricopa County (tons/yr)		PM_{10} NAA (tons/yr)	
Crop	**PM_{10}**	**$PM_{2.5}$**	**PM_{10}**	**$PM_{2.5}$**
Cotton	1,006.67	151.00	413.94	62.09
Corn	294.82	44.22	121.23	18.18
Wheat	149.49	22.42	61.47	9.22
Barley	69.01	10.35	28.38	4.26
Alfalfa (stand establishment)	311.32	46.70	137.15	20.57
Cantaloupe (fall)	286.70	43.00	123.56	18.53
Cantaloupe (spring)	372.40	55.86	160.50	24.07
Watermelon	129.33	19.40	55.74	8.36
Honeydew (fall)	31.36	4.70	13.51	2.03
Honeydew (summer)	52.25	7.84	22.52	3.38
Dry onion	21.62	3.24	9.32	1.40
Carrots	67.55	10.13	29.11	4.37
Broccoli	95.28	14.29	41.06	6.16
Grapefruit	3.07	0.46	1.32	0.20
Navel oranges and miscellaneous	7.52	1.13	3.24	0.49
Valencia oranges	5.02	0.75	2.16	0.32
Lemon	4.18	0.63	1.80	0.27
Tangerine	6.13	0.92	2.64	0.40
Total	**2,913.73**	**437.06**	**1,228.67**	**184.30**

Typical daily emissions for Maricopa County and the PM_{10} NAA were calculated by dividing the annual PM_{10} emissions by 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 3.5–15. 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 3.5–15. Controlled typical daily emissions from tillage in Maricopa County.

	Tillage operations (1)	Tillage operations	Daily emissions (lbs/day)	
Crop	**(months/yr)**	**(days/yr)**	**PM_{10}**	**$PM_{2.5}$**
Cotton	12	364	5,531.2	829.7
Corn	5	152	3,887.8	583.2
Wheat	8	243	1,232.1	184.8
Barley	8	243	568.8	85.3
Alfalfa (stand establishment)	3	91	6,842.2	1,026.3
Cantaloupe (fall)	6	182	3,150.5	472.6
Cantaloupe (spring)	6	182	4,092.3	613.8
Watermelon	6	182	1,421.2	213.2
Honeydew (fall)	6	182	344.6	51.7
Honeydew (summer)	6	182	574.2	86.1
Dry onion	6	182	237.5	35.6
Carrots	7	243	742.3	111.4
Broccoli	6	182	1,047.0	157.1
Grapefruit	3	91	67.4	10.1
Navel Oranges and misc.	3	91	165.4	24.8
Valencia Oranges	3	91	110.2	16.5
Lemon	3	91	91.9	13.8
Tangerine	3	91	134.7	20.2
Total			**30,241.4**	**4,536.2**

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

Typical daily emissions for the PM_{10} nonattainment area were calculated by dividing the annual PM_{10} emissions for the PM_{10} NAA by an estimated day per year of tillage operation by crop. Results are shown in Table 3.5–16.

Table 3.5–16. Controlled annual and typical daily emissions from tillage within the PM_{10} NAA.

	Typical daily emissions (lbs/day)	
Crop	**PM_{10}**	**$PM_{2.5}$**
Cotton	2,274.4	341.2
Corn	1,598.6	239.8
Wheat	506.6	76.0
Barley	233.9	35.1
Alfalfa (stand establishment)	3,014.3	452.2
Cantaloupe (fall)	1,357.8	203.7
Cantaloupe (spring)	1,763.7	264.6
Watermelon	612.5	91.9
Honeydew (fall)	148.5	22.3
Honeydew (summer)	247.5	37.1
Dry onion	102.4	15.4
Carrots	240.0	36.0
Broccoli	451.2	67.7
Grapefruit	29.0	4.4
Navel Oranges and miscellaneous	71.3	10.7
Valencia Oranges	47.5	7.1
Lemon	39.6	5.9
Tangerine	58.1	8.7
Total	**12,797.0**	**1,919.6**

3.5.2.2 Harvesting

Harvest emissions were estimated using crop-specific emission factors (CARB, 2003). The number of harvested acres by crop was obtained from the 2005 Arizona Agricultural Statistics Bulletin (AASS, 2006). Table 3.5–17 lists the crop types and associated PM_{10} emission factors used to calculate emissions from agricultural harvesting.

Annual PM_{10} emissions from agricultural harvesting were calculated using the following equation:

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

where:

harvest$_{Crop}$ = harvest emissions for each crop type (tons PM_{10}/yr)
EF_{Crop} = harvest emission factor (lbs PM_{10}/acre)
A_{Crop} = total number of reported acres for each crop type per year

Example:

EF_{Cotton} = 3.4 lbs PM_{10}/acre for cotton
A_{Cotton} = 41,900 acres of cotton

$$\text{Uncontrolled annual Harvest}_{Cotton}\text{ Emissions} = 3.4\ \text{lbs}\ PM_{10}/\text{acre} \times 41{,}900\ \text{acres} \times 1\ \text{ton}/2{,}000\ \text{lbs} = 71.23\ \text{tons}\ PM_{10}/\text{yr}$$

Table 3.5–17. Maricopa County harvested acres and emission factors.

Crop	PM_{10} emission factor (lb/acre-yr)	2005 Acreage	Uncontrolled Annual PM_{10} Emissions (tons/yr)
Cotton	3.4	41,900	71.23
Wheat	5.8	17,500	50.75
Barley	5.8	12,300	35.67
Alfalfa Hay	0.0	80,000	0.00
Other Hay	1.68	7,000	5.88
Corn	1.68	900	0.76
Broccoli	0.08	2,600	0.10
Dry Onions	1.68	700	0.59
Carrots	0.17	2,000	0.17
Summer Honeydews	0.08	1,500	0.06
Fall Honeydews	0.08	700	0.03
Spring Cantaloupe	0.08	8,900	0.36
Fall Cantaloupe	0.08	6,400	0.26
Watermelon	0.08	3,400	0.14
Grapefruit	0.08	1,100	0.04
Lemons	0.08	1,500	0.06
Valencia oranges	0.08	1,800	0.07
Navel, sweet, and miscellaneous	0.08	2,700	0.11
Tangerines	0.08	2,200	0.09
Total		**195,100**	**166.36**

In the Maricopa County PM_{10} nonattainment area, the agricultural PM_{10} 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 PM_{10} emissions generated from tillage and harvest, non-cropland, and cropland. Net control efficiencies from the implementation of agricultural BMPs were developed by URS and ERG (2001) 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. URS and ERG (2001) derived net control efficiencies by multiplying a mid-point BMP control efficiency by a compliance factor and a relevancy factor for applicable crops. MCAQD has used the same mid-point BMP control efficiency and relevancy factor with a revised compiance factor of 59% (from 80%). The revised compliance factor was derived using latest EPA rule effectiveness guidance (US EPA, 2005) which eliminates use of the 80% default rule effectiveness value (rule effectiveness calculations for agricultural activities are included as Appendix 3.1). To estimate controlled harvest emissions from agricultural operations taking place within the PM_{10} NAA, the mid-point net control efficiency for each BMP were applied to 48.01% of the uncontrolled annual emissions (the percent of agricultural land in the PM_{10} NAA) as follows:

Controlled annual harvest$_{Crop}$ emissions	=	annual uncontrolled PM_{10} emissions	×	(100% – mid-point net control efficiency$_{crop}$)	×	% agricultural land in PM_{10} NAA
Controlled annual harvest$_{Cotton}$ emissions from within the PM_{10} NAA	=	71.23 tons PM_{10}/yr	×	(100% – 27.2%)	×	48.01%
	=	24.88 tons PM_{10}/yr				

The uncontrolled portion of harvest emissions from agricultural operations outside the PM_{10} NAA but within Maricopa County were estimated by multiplying the uncontrolled annual PM_{10} emissions by the percent of agricultural land located within Maricopa County but outside of the PM_{10} NAA (100% – 48.01%) as follows:

Uncontrolled annual Harvest$_{Cotton}$ emission from outside the PM_{10} NAA	=	Uncontrolled PM_{10} emissions	×	51.99%
	=	71.23 tons PM_{10}/yr	×	51.99%
	=	37.03 tons PM_{10}/yr		

The total controlled and uncontrolled annual emissions were then summed to estimate total annual PM_{10} emissions from agricultural harvesting in Maricopa County as follows:

Total annual harvest$_{Cotton}$ emissions for Maricopa County	=	Uncontrolled annual harvest$_{Cotton}$ emissions from outside the PM_{10} NAA	+	Controlled annual harvest$_{Cotton}$ emissions from within the PM_{10}NAA
	=	37.03	+	24.88
	=	61.91 tons PM_{10}/yr		

Annual $PM_{2.5}$ emissions from agricultural harvesting were calculated by multiplying the annual PM_{10} emissions by a conversion factor of 0.15 (WRAP, 2006c).

Typical daily emissions for Maricopa County and the PM_{10} 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 3.5–19.

Table 3.5–18. Annual emissions from harvesting (tons/yr).

Crop	Uncontrolled PM_{10} (tons/yr)	Net control efficiency (%)	PM_{10} NAA (controlled)	Outside NAA (uncontrolled)	Maricopa County (controlled + uncontrolled)		PM_{10} NAA (controlled)
			PM_{10}	PM_{10}	PM_{10}	$PM_{2.5}$	$PM_{2.5}$
Cotton	71.23	27.2%	24.88	37.04	61.91	9.29	3.73
Wheat	50.75	25.0%	18.26	26.39	44.65	6.70	2.74
Barley	35.67	25.0%	12.84	18.55	31.38	4.71	1.93
Alfalfa Hay	0.00	29.5%	0.00	0.00	0.00	0.00	0.00
Other Hay	5.88	29.5%	1.99	3.06	5.05	0.76	0.30
Corn	0.76	25.0%	0.27	0.39	0.67	0.10	0.04
Broccoli	0.10	25.0%	0.04	0.05	0.09	0.01	0.01
Dry Onions	0.59	25.0%	0.21	0.31	0.52	0.08	0.03
Carrots	0.17	25.0%	0.06	0.09	0.15	0.02	0.01
Summer Honeydews	0.06	25.0%	0.02	0.03	0.05	0.01	0.00
Fall Honeydews	0.03	25.0%	0.01	0.01	0.02	0.00	0.00
Spring Cantaloupe	0.36	25.0%	0.13	0.19	0.31	0.05	0.02
Fall Cantaloupe	0.26	25.0%	0.09	0.13	0.23	0.03	0.01
Watermelon	0.14	25.0%	0.05	0.07	0.12	0.02	0.01
Grapefruit	0.04	25.0%	0.02	0.02	0.04	0.01	0.00
Lemons	0.06	25.0%	0.02	0.03	0.05	0.01	0.00
Valencia oranges	0.07	25.0%	0.03	0.04	0.06	0.01	0.00
Navel, sweet, and misc.	0.11	25.0%	0.04	0.06	0.10	0.01	0.01
Tangerines	0.09	25.0%	0.03	0.05	0.08	0.01	0.00
Total	**166.36**		**58.99**	**86.50**	**145.48**	**21.82**	**8.85**

Table 3.5–19. 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	143	865.9	129.9	348.0	52.19
Wheat	60	1488.4	223.3	608.8	91.32
Barley	60	1046.1	156.9	427.9	64.19
Alfalfa Hay	294	0.0	0.0	0.0	0.00
Other Hay	294	34.3	5.2	13.5	2.03
Corn	91	14.6	2.2	6.0	0.90
Broccoli	161	1.1	0.2	0.5	0.07
Dry Onions	70	14.8	2.2	6.0	0.91
Carrots	273	1.1	0.2	0.4	0.07
Summer Honeydews	61	1.7	0.3	0.7	0.11
Fall Honeydews	71	0.7	0.1	0.3	0.04
Spring Cantaloupe	72	8.7	1.3	3.6	0.53
Fall Cantaloupe	71	6.3	1.0	2.6	0.39
Watermelon	152	1.6	0.2	0.6	0.10
Grapefruit	304	0.3	0.0	0.1	0.02
Lemons	232	0.5	0.1	0.2	0.03
Valencia oranges	151	0.8	0.1	0.3	0.05
Navel, sweet, and misc.	102	1.9	0.3	0.8	0.11
Tangerines	151	1.0	0.2	0.4	0.06
Total		**3,489.9**	**523.5**	**1,420.8**	**213.1**

3.5.2.3 Travel on unpaved agricultural roads

Resuspended PM_{10} emissions from travel on unpaved agricultural roads were estimated using an unpaved road emission factor derived from AP-42 13.2.2 (US EPA, 2006b). The unpaved road emission factor equation is shown below:

Unpaved road emission factor (EF) (lb/VMT) $= k\,(s/12)^a(W/3)^b$

where:

s	=	surface material silt content	=	11.90% (MAG, 2000)
W	=	mean vehicle weight (tons)	=	2.80 (URS and ERG, 2001)
k	=	1.5 (PM_{10} constant) (US EPA, 2006b)		
a	=	0.9 (PM_{10} constant) (US EPA, 2006b)		
b	=	0.45 (PM_{10} constant) (US EPA, 2006b)		

Unpaved road emission factor (lb/VMT) $= 1.5\,(11.9/12)^{0.9}(2.8/3)^{0.45}$
$= 1.444$ lb/VMT

Emissions were estimated using farm vehicle activity data obtained from the Technical Support Document for Quantification of Agricultural Best Management Practices (URS and ERG, 2001). URS and ERG (2001) estimated average daily vehicle miles traveled per 1,000 acres to be 49.5 VMT.

Daily emissions from travel on unpaved agricultural roads were then estimated as follows:

Daily uncontrolled PM_{10} emissions from ag roads = unpaved road EF × VMT/1000 acres × 2005 harvested acres
= 1.444 lbs/VMT × 49.5 VMT/1000 acres × 195,100 acres
= 13,944.8 lbs/day

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. Two BMPs were quantified for unpaved road travel: 1) access restriction and 2) reduced vehicle speed. URS and ERG (2001) derived net control efficiencies by multiplying a mid-point BMP control efficieincy by a compliance factor and a relevancy factor for applicable crops. MCAQD has used the same mid-point BMP control efficiency and relevancy factor with a revised compliance factor of 59% (from 80%). The revised compliance factor was derived using latest EPA rule effectiveness guidance (US EPA, 2005) which eliminates use of the 80% default rule effectiveness value (rule effectiveness calculations for agricultural activities are included as Appendix 3.1). To estimated controlled emissions from travel on unpaved agricultural roads within the PM_{10} NAA, the mid-point net control efficiency for each BMP (12.4 % and 0.4%, respectively) were applied to 48.01 % (the percent of agricultural land in the PM_{10} NAA) of the uncontrolled daily PM_{10} emissions as follows:

Controlled daily unpaved ag road emissions within the NAA	= Daily uncontrolled PM_{10} emissions	×	(100%-mid-point net control efficiency)	×	% agricultural land in the PM_{10} NAA
	= 13,944.8 lbs/day	×	(100% – 12.8%)	×	48.01%
	= 5,838.0 lbs/day				

The uncontrolled portion of unpaved agricultural road emissions outside the PM_{10} NAA but within Maricopa County were estimated by multiplying uncontrolled daily PM_{10} emissions by the percent of agricultural land located within Maricopa County but outside of the PM_{10} NAA (100% – 48.01%) as follows:

Uncontrolled daily unpaved ag. road emissions from outside of the PM_{10} NAA	= Uncontrolled PM_{10} emissions × 51.99%
	= 13,944.8 lbs/day × 51.99%
	= 7,249.90 lbs/day

Total controlled and uncontrolled daily emissions were then summed to estimate total daily PM_{10} emissions from travel on unpaved agricultural roads in Maricopa County as follows:

Total daily unpaved ag road emissions for Maricopa County	= Uncontrolled daily unpaved ag road emissions from outside the PM_{10} NAA	+	Controlled daily unpaved ag road emissions from within the PM_{10} NAA
	= 7,249.90	+	5,838.0
	= 13,087.9 lbs PM_{10}/day		

Daily $PM_{2.5}$ emission from travel on unpaved agricultural unpaved roads were calculated by multiplying the daily PM_{10} emissions by a conversion factor of 0.10 (WRAP, 2006d).

Annual emissions for Maricopa County and the PM_{10} NAA were calculated by multiplying the daily emissions by the 312 (6 days per week × 52 weeks per year).

Table 3.5–20. Annual and typical daily emissions from travel on unpaved agricultural roads.

	Annual emissions (tons/yr)		**Typical daily emissions (lbs/day)**	
Geographic area	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$
Maricopa County (controlled + uncontrolled)	2,041.71	204.17	13,087.9	1,308.8
PM_{10} NAA (controlled)	910.64	91.06	5,837.4	583.7

3.5.2.4 Cotton ginning

Annual emissions from cotton ginning were derived from annual emission reports from permitted sources. There is only one small cotton gin operating in the County that is not addressed as a point source in Chapter 2.

Data from CARB's $PM_{2.5}$ Fraction Table (CARB, 2006) were used to calculate $PM_{2.5}$ emissions, assumed to be 28.6% of PM_{10} emissions. Since all cotton gins considered in this section are located within the PM_{10} nonattainment area, total emission values for the county and the PM_{10} NAA from cotton ginning are equal. Results are shown in Table 3.5–21.

Table 3.5–21. Annual and typical daily emissions from area-source cotton ginning.

	Annual emissions (tons/yr)		**Typical daily emissions (lbs/day)**	
Geographic area	$\mathbf{PM_{10}}$	$\mathbf{PM_{2.5}}$	$\mathbf{PM_{10}}$	$\mathbf{PM_{2.5}}$
Maricopa County	0.09	0.02	0.7	0.2
PM_{10} NAA	0.09	0.02	0.7	0.2

3.5.2.5 Fertilizer application

Annual NH_3 emissions from synthetic nitrogen fertilizers were calculated using the CMU Ammonia Model (CMU, 2004). The CMU Ammonia Model uses semiannual sales data for 2002 from the Association of American Plant Food Control Officials, which are available at the county-level. This information was combined with information from National Agricultural Statistics Service (NASS) crop calendars to estimate monthly fertilizer application rates for each county. County-wide results are shown in Table 3.5–22. Typical daily NH_3 emissions were derived by dividing annual emissions by 365 days/year.

Annual and typical daily emissions for the PM_{10} nonattainment area were derived by multiplying the county annual and typical daily emissions by the percentage of agricultural land located in the PM_{10} NAA (48.01%). See Section 1.5.2 for a discussion of the land-use data used.

Table 3.5–22. Annual and typical daily ammonia emissions from fertilizer application.

	Maricopa County		PM_{10} NAA	
Fertilizer Category	**Annual NH_3 Emissions (tons/year)**	**Daily NH_3 Emissions (lbs/day)**	**Annual NH_3 Emissions (tons/year)**	**Daily NH_3 Emissions (lbs/day)**
Anhydrous ammonia	70.66	387.2	33.92	185.9
Aqueous ammonia	3.75	20.5	1.80	9.9
Ammonium nitrate	0.00	0.0	0.00	0.0
Ammonium sulfate	74.41	407.7	35.72	195.7
Ammonium thiosulfate	0.00	0.0	0.00	0.0
Calcium ammonium nitrate	0.00	0.0	0.00	0.0
Nitrogen solutions	1,399.94	7670.9	672.11	3682.8
Urea	496.04	2718.0	238.15	1304.9
Diammonium phosphate	2.67	14.6	1.28	7.0
Monoammonium phosphate	71.76	393.2	34.45	188.8
Liquid ammonium polyphosphate	38.91	213.2	18.68	102.4
Potassium nitrate	0.95	5.2	0.46	2.5
Miscellaneous	119.05	652.3	57.16	313.2
Total	**2,278.14**	**12,483.0**	**1,093.74**	**5,993.1**

3.5.3 Livestock

Annual NH_3 emissions from livestock in Maricopa County were calculated using the CMU Ammonia Model (CMU, 2004). The CMU Ammonia Model developed by Carnegie Mellon University is a software application that generates ammonia emissions from many different sources for the continental United States. County-wide results are shown in Table 3.5–24. It was assumed that livestock emissions occur evenly throughout the year. Typical daily NH_3 emissions were derived by dividing annual emissions for Maricopa County by 365 days/year.

PM_{10} and $PM_{2.5}$ emissions estimates were derived using Maricopa County cattle inventory estimates for 2005 from Arizona Agricultural Statistics Bulletin (AASS, 2006) and emission factor for PM_{10} for dairy cattle, and feedlot cattle from the California Air Resources Board (CARB, 2004). $PM_{2.5}$ was presumed to be 11% of PM_{10} per WRAP Fugitive Dust Handbook (WRAP, 2006d).

The number of “cattle on feed” was not available from the Arizona Agricultural Statistics Bulletin (AASS, 2006) for 2005; therefore, 2004 numbers were used. Beef cows were excluded from the inventory as information provided by Arizona Agricultural Statistics staff (Coon, 2004) 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 PM_{10} emission estimates for livestock. The 2005 Maricopa County cattle inventory and applicable PM emission factors are contained in Table 3.5–23.

Table 3.5–23. Maricopa County cattle inventory and PM emission factors.

Animal type	Head	Emission factors: PM_{10} (lb/1000 head/day)	Emission factors: $PM_{2.5}/PM_{10}$ Ratio
Cattle on feed	5,000	28.9	0.11
Milk cows	105,000	6.7	0.11
Other cattle	93,000	28.9	0.11
Total	**203,000**		

Typical daily PM_{10} emissions from livestock in Maricopa County were calculated using the following formula:

Typical daily emissions (lbs/day) from dairy cattle = milk cow inventory (1,000 head) × emission factor (lbs PM_{10}/1,000 head/day)
= 105 × 6.7
= 703.5 lbs PM_{10}/day

It was assumed that livestock emissions occur evenly throughout the year. Annual PM_{10} and $PM_{2.5}$ emissions were derived by multiplying typical daily emissions for Maricopa County and the nonattainment area by 365 days/year.

MCAQD determined through GIS analysis of confined animal feeding operation (CAFO) locations and animal numbers in Maricopa County that 80.7% of CAFO animals are located within the nonattainment area. Therefore, annual and typical daily emissions for the nonattainment area were calculated by multiplying the Maricopa County emission totals by 80.7%.

Table 3.5–24 summarizes the annual and typical daily emissions from livestock for Maricopa County and the PM_{10} nonattainment area.

Table 3.5–24. Annual and typical daily emissions from livestock.

Geographic area	Annual emissions (tons/yr): PM_{10}	Annual: $PM_{2.5}$	Annual: NH_3	Typical daily emissions (lbs/day): PM_{10}	Typical daily: $PM_{2.5}$	Typical daily: NH_3
Maricopa County	645.27	70.98	10,429.53	3,535.7	388.9	57,148.1
PM_{10} NAA	520.84	57.29	8,418.39	2,853.9	313.9	46,128.1

3.5.4 Health services: crematories

Emissions from human and animal crematories were calculated from annual emissions inventory reports from all landfills located within the county. 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:

$$\text{Typical daily } PM_{10} \text{ emissions from crematories} = \frac{\text{Annual emissions (tons/yr)}}{\text{Days/week} \times \text{Weeks/yr}} \times \frac{2{,}000 \text{ lbs}}{\text{ton}}$$

$$= \frac{0.96}{5 \times 52} \times 2{,}000$$

$$= 7.4 \text{ lbs } PM_{10}\text{/day}$$

Annual and typical daily emissions for the PM_{10} nonattainment area were calculated by multiplying the Maricopa County emission totals by the percentage county permitted sources that are within the nonattainment area.

$$PM_{10} \text{ emissions from area-source crematories in the } PM_{10} \text{ NAA (tons/yr)} = \text{Annual Maricopa County emissions} \times \text{Percentage of crematories within the NAA}$$

$$= 0.96 \text{ tons/yr} \times .95$$

$$= 0.91 \text{ tons } PM_{10}\text{/yr}$$

Table 3.5–25 summarizes annual and typical daily emissions from crematories in both Maricopa County and the PM_{10} nonattainment area.

Table 3.5–25. Annual and typical daily emissions from crematories.

	Annual emissions (tons/yr)				Typical daily emissions (lbs/day)			
Geographic area	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**
Maricopa County	0.96	0.64	11.45	1.46	7.4	4.9	88.0	11.3
PM_{10} NAA	0.91	0.61	10.87	1.39	7.0	4.7	83.6	10.7

3.5.5 Accidental releases

As part of its air quality permit compliance program, MCAQD 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 1.03 tons of PM_{10} for the year 2005. (No accidental releases of NO_x, SO_x or NH_3 were reported). Accidental releases from point source facilities are included as part of their annual emissions totals (see chapter 2).

Typical daily emissions are calculated by summing reported releases and dividing the total by 365 days. Emissions in the PM_{10} nonattainment area are calculated based on locations of facilities that reported releases.

Table 3.5–26. Annual and typical daily emissions from accidental releases.

Geographic area	Annual emissions (tons/yr) PM_{10}	$PM_{2.5}$*	Typical daily emissions (lbs/day) PM_{10}	$PM_{2.5}$*
Maricopa County	1.03	1.03	5.6	5.6
PM_{10} NAA	1.03	1.03	5.6	5.6

* As a conservative estimate, all PM_{10} emissions are assumed to be $PM_{2.5}$.

3.5.6 Humans

A literature review by Battye et al. (1994) recommended 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 PM_{10} nonattainment areas (see section 1.5 for population information). Daily emissions were calculated by dividing annual values by 365.

Table 3.5–27. Annual and typical daily NH_3 emissions from human activity.

Geographic Area	Population	Emission factor (lbs/ person-yr)	Annual NH_3 emissions (tons/yr)	Typical daily NH_3 emissions (lbs/day)
Maricopa County	3,780,380	0.55	1,039.60	5,696.5
PM_{10} NAA	3,809,701	0.55	1,047.67	5,740.6

3.5.7 Leaf blower fugitive dust

Fugitive dust emissions from leaf blowers are the result of blowing loose material from the area being cleared by the leaf blowers. Exhaust emissions from gasoline powered leaf blowers are covered under the Nonroad mobile sources chapter of this report (see chapter 4). Fugitive dust emission estimates are developed with the use of three main sources: EPA's NONROAD model, California Air Resources Board report to legislature on leaf blowers (CARB, 2000), and a very recent research effort done by the University of Riverside (Fitz et al., 2005).

EPA's NONROAD model was used to develop estimates of the number of gasoline powered leaf blowers in Maricopa County, along with the average activity figures for those leaf blowers. Electric leaf blower population numbers were derived from the CARB report (2000) which indicates 60% of all leaf blowers sold are electric, as in the following equation:

Population of electric Leaf blowers	=	(gas-powered leaf blowers	÷	40%	[= all leaf blowers])	–	gas-powered leaf blowers
	=	(103,668	÷	0.4	[=259,170])	–	103,668
	=	155,502 units					

Fitz et al. (2005) developed emission factors for PM_{10} and $PM_{2.5}$ fugitive dust emissions from leaf blowers. For this report, the most conservative (highest) emission factors were chosen to estimate emissions. Given these two data sources, Table 3.5–28 lists the equipment population numbers, activity estimates and emission factors for leaf blowers in Maricopa County.

Table 3.5–28. Leaf blower equipment populations, activity levels and emission factors for Maricopa County.

Leaf blower description	Population	Activity (hrs/yr)	PM_{10} Emission factors (mg/m^2)	$PM_{2.5}$ Emission factors (mg/m^2)
Commercial 2-stroke gasoline	3,158	626	70	30
Commercial 4-stroke gasoline	1,548	626	70	30
Residential 2-stroke gasoline	94,072	10	70	30
Residential 4-stroke gasoline	4,890	10	70	30
Electric	155,502	10	130	40
Total	259,170	n/a	n/a	n/a

The CARB report (2000) estimates that approximately $1600m^2$ of surface can be cleared in one hour of leaf blower operation. Therefore, annual emission estimates are calculated by using the following formula, as in this example for electric leaf blowers:

$$\text{Annual } PM_{10} \text{ emissions from electric leaf blowers} = \text{Population} \times \underset{(hrs/yr)}{\text{Activity}} \times \underset{(mg/m^2)}{\text{Emission Factor}} \times \underset{(1600m^2)}{\text{area covered}} \div 1000g/mg \div 454g/lb \div 2000lb/ton$$

$$= 155{,}502 \times 10 \text{ hrs/yr} \times 130mg/m^2 \times 1600m^2/hr \div 1000g/mg \div 454g/lb \div 2000lb/ton$$

$$= 356.22 \text{ tons } PM_{10}/yr$$

Leaf blowers are assumed to operate seven days a week all year long. Typical daily emissions are estimated by dividing annual totals by 365 days per year. Emissions for the PM_{10} nonattainment area are allocated based on the ratio of resident population in the County to the nonattainment area (see Section 1.5 for information on population). Table 3.5–29 lists annual and daily fugitive emission from leaf blowers for Maricopa County and the PM_{10} nonattainment area.

Table 3.5–29. Annual and typical daily emissions from leaf blower fugitive dust.

	Annual emissions (tons/yr)		Typical daily emissions (lbs/day)	
Geographic area	**PM_{10}**	**$PM_{2.5}$**	**PM_{10}**	**$PM_{2.5}$**
Maricopa County	841.66	317.65	4,611.8	1,740.6
PM_{10} NAA	843.00	318.16	4,619.2	1,743.3

3.5.8 Offroad recreation vehicles fugitive dust

The EPA NONROAD model estimates exhaust emissions for offroad recreational vehicles. These emissions are included in the Nonroad Emissions category of the 2005 particulate inventory. Particulate emissions are also generated by recreational vehicles traveling on unpaved surfaces. For the 2005 periodic inventory, these emissions were estimated by MAG using mileage and activity data for offroad recreational vehicles in Maricopa County, from the EPA NONROAD model. The specific methodology, calculations, and assumptions for the calculation of fugitive dust emissions from offroad recreational vehicles traveling on unpaved surfaces are described below.

The EPA NONROAD model provides annual mileage and activity data for all terrain vehicles (ATV), all terrain cycles (ATC), and specialty vehicles/carts (SVC). The NONROAD activity and mileage estimates for Maricopa County in 2005 are shown in Table 3.5–30. The product of the mileage and the number of vehicles equals the annual VMT.

It was further assumed that 75% of the annual VMT is traveled on unpaved surfaces inside Maricopa County. The remaining 25% of the miles are assumed to be on paved surfaces and unpaved surfaces outside of Maricopa County. Multiplying the annual VMT by 75 percent and dividing by 365 produces the Daily VMTs on unpaved surfaces in Maricopa County as shown in Table 3.5–30.

Table 3.5–30. VMT for offroad recreational vehicles in Maricopa County.

Vehicle Type	Annual Mileage	Number of Vehicles	Annual VMT	Daily VMT inside Maricopa County
ATV	1,600	24,511	39,413,688	80,987
ATC	1,600	6,158	9,852,800	20,246
SVC	65	1,664	108,160	222

The daily VMTs were multiplied by the AP-42 emission factor for unpaved industrial roads, assuming silt content of 11.9% and a vehicle weight of one-half of a ton. The AP-42 emission factor for ATVs and ATCs is 272 grams per mile. This emission rate was reduced by 50%, to 136 grams per mile, for ATCs, to account for two wheels generating dust instead of four.

According to the November 2006 revision of AP-42, $PM_{2.5}$ emissions are 10 percent of PM_{10} emissions from unpaved roads. Therefore, the $PM_{2.5}$ emission rate for ATVs and ATCs is 27 grams per mile; and for SVCs, 14 grams per mile.

The PM_{10} and $PM_{2.5}$ emission rates were multiplied by the daily VMT by vehicle type to obtain total emissions attributable to offroad recreational vehicles traveling on unpaved surfaces in Maricopa County, as shown in Table 3.5–31.

Emissions for the PM_{10} nonattainment area were derived by applying GIS to MAG 2004 land use data to obtain the acreage of passive open space in the PM_{10} nonattainment area and in Maricopa County. Passive open space includes mountains and washes. The detailed calculations to derive the PM_{10} nonattainment area emissions are shown below:

Passive Open Space in the PM NAA: 377,814 acres
Passive Open Space in Maricopa County: 1,748,816 acres
Ratio of Passive Open Space in PM NAA vs. Maricopa County: 377,814/1,748,816 = 21.6%
PM NAA Emissions: 0.216 × Maricopa County Emissions

The application of the above methodology resulted in total emissions for offroad recreational vehicles traveling on unpaved surfaces in the PM_{10} nonattainment area, as shown in Table 3.5–31.

Table 3.5–31. Annual and typical daily emissions from offroad recreational vehicles traveling on unpaved surfaces.

	Annual emissions (tons/yr)		Typical daily emissions (lbs/day)	
Geographic area	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$
Maricopa County	9,994.00	999.00	54,764.0	5,476.0
PM_{10} NAA	2,159.00	216.00	11,830.0	1,184.0

3.5.9 Unpaved parking lots fugitive dust

Fugitive dust particulate emissions from vehicles traveling in unpaved parking areas were estimated by MAG based on the acres of disturbed land devoted to unpaved parking areas, estimated vehicle activity on unpaved parking areas, and emission rates from AP-42. The specific methodology, calculations, and assumptions for each component of the calculation are described below.

Acres of disturbed vacant land were estimated as follows: In the Phase I Windblown Dust Modeling for the Western Regional Air Partnership (ENVIRON, 2004), it was estimated that eight percent of the vacant land in core urban areas is disturbed and thirty percent of the land under development is disturbed. MAG used geographic information systems (GIS) and the 2004 MAG land use data, to estimate that there were 93,429 acres of vacant land in the core urbanized area and 60,357 acres of land under development in the PM_{10} nonattainment area. Multiplying the percentages above by these acreage estimates produces:

93,429 × 0.08 = 7,474 acres of vacant disturbed land in the urbanized core
60,357 × 0.30 = 18,107 acres of vacant disturbed land under development

Summing the urbanized core and developing acreages results in a total of 25,581 acres of vacant disturbed land in the PM_{10} nonattainment area. The 1995 microscale particulate emissions study (MAG, 1995) estimated that 24 percent of the disturbed vacant land is devoted to unpaved parking areas. Applying this assumption to the total acreage of vacant disturbed land results in a total of 6,139 acres of unpaved parking areas in the PM_{10} nonattainment area..

Vehicle activity on unpaved parking areas was estimated by assuming that each day, an average of 100 vehicles drive on each acre of unpaved parking area. One acre, if perfectly square, would have dimensions of about 212 × 212 feet. If the average vehicle travels one-half the distance from the center of the acre, each vehicle would travel an average of 106 feet or 0.02 miles per acre. Multiplying 100 vehicles per day times 0.02 miles produces 2 vehicle miles traveled (VMT) per acre per day. Multiplying 6,139 acres times 2 VMT per acre per day yields 12,278 VMT per day on unpaved parking areas in the PM_{10} nonattainment area.

Emission rates for unpaved parking areas were derived from the AP-42 equation for unpaved industrial roads, assuming 11.9 percent silt content and an average vehicle weight of three tons. The resultant PM_{10} emission rate is 609.23 grams per mile. The November 2006 revision to AP-42 indicates that the $PM_{2.5}$ emission rate is 10 percent of the PM_{10} emission rate or 60.92 grams per mile. Applying the emission rate to the VMT produces the total emissions from vehicles traveling on unpaved parking areas in the PM_{10} nonattainment area of 7,480 kg/day.

To estimate emissions for Maricopa County, GIS was applied to the 2004 MAG land use data to derive the total acres of vacant land in Maricopa County. The vacant land in Maricopa was estimated to be 1,642,255 acres. Removing the acres of vacant land in the Maricopa County portion of the PM_{10} nonattainment area (i.e., 397,080 acres) results in 1,642,255 vacant acres inside Maricopa County but outside the PM_{10} nonattainment area.

Assuming that one percent of the vacant acres outside the PM_{10} nonattainment area is disturbed (Clark County, 2006), and 24 percent of the disturbed vacant land is unpaved parking areas (MAG, 1995) results in 3,942 acres of unpaved parking areas outside the PM_{10} nonattainment area. Multiplying this by 2 VMT per acre, per day results in 7,884 VMT/day. Applying the same emission rate from AP-42 produces 4,803 kg/day of PM_{10} emissions due to unpaved parking areas located outside the PM_{10} nonattainment area.

To estimate Maricopa County emissions, the Pinal County portion needs to be removed from the PM_{10} nonattainment area emissions. The emissions in the Pinal County portion of the PM_{10} nonattainment area are assumed to be proportional to the acres of vacant land, derived using GIS and the 2004 MAG land use, as calculated below.

Vacant land in the Pinal County portion of the PM_{10} nonattainment area: 7,134 acres
Vacant land in the PM_{10} nonattainment area: 404,214
Ratio: 7,134/404,214 = 1.8%
Emissions attributable to the Pinal County portion: 7,480 kg/day × 0.018 = 135 kg/day

Adding the emissions inside and outside the PM_{10} nonattainment area (7,480 kg/day and 4,803 kg/day) and subtracting the emissions for the Pinal County portion (135 kg/day) produces total Maricopa County emissions attributable to vehicles traveling in unpaved parking areas of 12,148 kg/day. The results for the PM_{10} nonattainment area and Maricopa County are summarized in tons per year and lbs per day in Table 3.5–32.

Table 3.5–32. Annual and typical daily emissions from vehicles traveling in unpaved parking areas.

	Annual emissions (tons/yr)		Typical daily emissions (lbs/day)	
Geographic area	**PM_{10}**	**$PM_{2.5}$**	**PM_{10}**	**$PM_{2.5}$**
Maricopa County	4,888.00	489.00	26,781.0	2,678.0
PM_{10} NAA	3,009.00	301.00	16,490.0	1,649.0

3.5.10 Windblown dust

ENVIRON International corporation estimated windblown dust based on the computer model developed by Western Regional Air Partnership Regional Modeling Center (WRAP RMC). A full description of this modeling process is included as Appendix 3.2. Table 3.5–33 summarizes annual and typical daily emissions from windblown dust.

Table 3.5–33. Annual and typical daily emissions from fugitive windblown dust.

	Annual emissions (tons/yr)		Typical daily emissions (lbs/day)	
Geographic area	**PM_{10}**	**$PM_{2.5}$**	**PM_{10}**	**$PM_{2.5}$**
Maricopa County	44,488.84	4,448.88	243,774.4	24,377.4
PM_{10} NAA	7,380.43	738.04	40,440.7	4,044.1

3.5.11 Summary of all miscellaneous area sources

Tables 3.5–34 and 3.5–35 provide a summary of annual and typical daily emissions from all miscellaneous area sources, for Maricopa County and the PM_{10} nonattainment area, respectively.

Table 3.5–34. Annual and typical daily emissions from all miscellaneous area sources for Maricopa County.

	Annual emissions (tons/yr)					Typical daily emissions (lbs/day)				
Category	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**NH_3**	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**NH_3**
Wildfires	70,882.24	60,792.24	15,639.50	4,288.25	3,279.25	475,719.7	408,001.6	104,963.1	28,780.2	22,008.4
Prescribed fires	0.06	0.06	0.05	0.01	0.00	120.0	120.0	93.0	25.5	7.5
Structure fires	22.53	22.53	2.92			123.8	123.8	16.0		
Vehicle fires	26.41	26.41	1.06			144.7	144.7	5.8		
Engine testing	0.15	0.12	4.61	1.89		1.1	0.9	35.4	14.5	
Tilling	2,913.73	437.06				30,241.4	4,536.2			
Harvesting	145.48	21.82				3,489.9	523.5			
Unpaved ag roads	2,041.71	204.17				13,087.9	1,308.8			
Cotton ginning	0.09	0.02				0.7	0.2			
Fertilizer					2,278.14					12,483.0
Livestock	645.27	70.98			10,429.53	3,535.7	388.9			57,148.1
Crematories	0.96	0.64	11.45	1.46		7.4	4.9	88.0	11.3	
Accidental releases	1.03	1.03				5.6	5.6			
Humans					1,039.60					5,696.5
Leaf blowers dust	841.66	317.65				4,611.8	1,740.6			
Offroad rec dust	9,994.00	999.00				54,764.0	5,476.0			
Unpaved parking lots	4,888.00	489.00				26,781.0	2,678.0			
Windblown dust	44,488.84	4,448.88				243,774.4	24,377.4			
Total:	**136,892.15**	**67,831.62**	**15,659.58**	**4,291.61**	**17,026.53**	**856,409.2**	**449,431.2**	**105,201.4**	**28,831.5**	**97,343.4**

Table 3.5–35. Annual and typical daily emissions from all miscellaneous area sources for the PM_{10} NAA.

	Annual emissions (tons/yr)					Typical daily emissions (lbs/day)				
Category	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**NH_3**	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**NH_3**
Wildfires	4,860.02	4,168.2	1,072.32	294.02	224.84	32,617.6	27,974.5	7,196.8	1,973.3	1,509.0
Prescribed fires	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0
Structure fires	22.56	22.56	2.92			124.0	124.0	16.1		
Vehicle fires	26.45	26.45	1.06			145.0	145.0	5.8		
Engine testing	0.15	0.12	4.61	1.89		1.1	0.9	35.4	14.5	
Tilling	1,228.67	184.30				12,797.0	1,919.6			
Harvesting	58.99	8.85				1,420.8	213.1			
Unpaved ag roads	910.64	91.06				5,837.4	583.7			
Cotton ginning	0.09	0.02				0.7	0.2			
Fertilizer					1,093.74					5,993.1
Livestock	520.84	57.29			8,418.39	2,853.9	313.93			46,128.1
Crematories	0.91	0.61	10.87	1.39		7.0	4.7	83.6	10.7	
Accidental releases	1.03	1.03				5.6	5.6			
Humans					1,047.67					5,740.6
Leaf blowers dust	843.00	318.16				4619.2	1743.3			
Offroad rec dust	2,159.00	216.00				11,830.0	1,184.0			
Unpaved parking lots	3,009.00	301.00				16,490.0	1,649.0			
Windblown dust	7,380.43	738.04				40,440.7	4,044.1			
Total:	**21,021.78**	**6,133.71**	**1,091.78**	**297.30**	**10,784.63**	**129,190.0**	**39,905.6**	**7,337.7**	**1,998.5**	**59,370.9**

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 PM_{10} nonattainment area, respectively.

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

	Annual emissions (tons/yr)					Typical daily emissions (lbs/day)				
Category	**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	16.51	16.51	308.43	1.30	6.81	105.9	105.9	1,977.1	8.3	43.7
Industrial fuel oil	247.82	247.82	3,443.60	329.29	14.18	1,588.6	1,588.6	22,074.4	2,110.8	90.9
Comm./inst. natural gas	60.15	60.15	1,146.39	4.72	3.79	385.6	385.6	7,348.6	30.3	24.3
Comm./inst. fuel oil	76.06	76.06	1,110.79	92.05	2.76	487.6	487.6	7,120.5	590.1	17.7
Residential natural gas	62.59	62.59	774.12	4.94		342.9	342.9	4,241.7	27.1	
Residential wood	230.85	214.69	17.35	2.67		3,057.6	2,843.6	229.8	35.3	
Residential fuel oil	0.01	0.01	0.66	0.26		0.2	0.2	8.7	3.4	
All fuel combustion	**694.01**	**677.85**	**6,801.33**	**435.23**	**27.55**	**5,968.4**	**5,754.4**	**43,000.7**	**2,805.4**	**176.6**
Industrial Processes										
Chemical manufacturing	76.77	38.85	0.39	0.21	0.34	590.5	298.9	3.0	1.6	2.6
Commercial cooking	1,527.98	1,416.96				8,395.5	7,785.5			
Grain processing	12.64	2.68				94.7	20.5			
Cold storage					1,695.98					10,871.7
Secondary metal prod.	10.95	9.27	4.53	0.05	1.34	79.0	66.3	25.0	0.4	10.3
Mineral processes	431.60	222.71				3,030.4	1,517.2			
Mining & quarrying	62.97	17.38				409.1	112.1			
Wood product mfg.	213.23	149.95				1,657.9	1,170.0			
Rubber/plastic mfg.	365.26	236.52				2,809.7	1,819.4			
Fabricated metal mfg.	138.96	119.88				1,579.3	1,404.1			
Residential construction	12,135.60	1,213.56				77,792.3	7,779.2			
Commercial construction	11,491.21	1,149.12				73,661.6	7,366.2			
Road construction	7,307.35	730.73				46,842.0	4,684.2			
Other construction	2,806.46	280.65				17,990.2	1,799.0			
Electrical equip mfg.	5.24	3.25	0.01	4.59	0.96	40.3	25.0	0.1	35.3	7.4
ADEQ-permitted portable sources	101.70	42.18	554.60	142.20		844.2	389.8	5,377.5	1,431.7	
Road travel at industrial sites	170.49	65.45				1,138.8	436.2			
Industrial processes NEC	24.31	13.87	4.58	0.01	0.80	202.0	97.3	26.7	<0.1	4.6
All Industrial Processes	**36,882.71**	**5,713.02**	**564.11**	**147.06**	**1,699.43**	**237,157.6**	**36,770.8**	**5,432.2**	**1,469.1**	**10,896.6**
Waste Treatment/disposal										
On-site incineration	0.15	0.10	2.54	0.03		1.6	1.1	19.9	0.3	
Open burning	56.15	56.15	15.16			550.9	550.9	148.4		
Landfills	6.79	4.05	6.50	1.11		39.5	23.5	36.3	6.3	
POTWs					1,310.85					7,182.7
Other waste	79.55	48.51	4.15	5.01		606.0	369.6	22.8	27.5	
All Waste Treatment/ Disposal	**142.64**	**108.81**	**28.35**	**6.14**	**1,310.85**	**1,198.1**	**945.1**	**227.4**	**34.0**	**7,182.7**

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
Misc. Area Sources										
Wildfires fires	70,882.24	60,792.24	15,639.50	4,288.25	3,279.25	475,719.7	408,001.6	104,963.1	28,780.2	22,008.4
Prescribed fires	0.06	0.06	0.05	0.01	0.00	120.0	120.0	93.0	25.5	7.5
Structure fires	22.53	22.53	2.92			123.8	123.8	16.0		
Vehicle fires	26.41	26.41	1.06			144.7	144.7	5.8		
Engine testing	0.15	0.12	4.61	1.89		1.1	0.9	35.4	14.5	
Tilling	2,913.73	437.06				30,241.4	4,536.2			
Harvesting	145.48	21.82				3,489.9	523.5			
Unpaved ag roads	2,041.71	204.17				13,087.9	1,308.8			
Cotton ginning	0.09	0.02				0.7	0.2			
Fertilizer application					2,278.14					12,483.0
Livestock	645.27	70.98			10,429.53	3,535.7	388.93			57,148.1
Crematories	0.96	0.64	11.45	1.46		7.4	4.9	88.0	11.3	
Accidental releases	1.03	1.03				5.6	5.6			
Humans					1,039.60					5,696.5
Leaf blowers dust	841.66	317.65				4611.8	1740.6			
Offroad rec dust	9,994.00	999.00				54,764.0	5,476.0			
Unpaved park. lots	4,888.00	489.00				26,781.0	2,678.0			
Windblown dust	44,488.84	4,448.88				243,774.4	24,377.4			
All Misc. Sources	**136,892.15**	**67,831.62**	**15,659.58**	**4,291.61**	**17,026.53**	**856,409.2**	**449,431.2**	**105,201.4**	**28,831.5**	**97,343.4**
TOTAL, ALL AREA SOURCES	**174,611.51**	**74,331.30**	**23,053.36**	**4,880.05**	**20,064.35**	**1,100,733.4**	**492,901.5**	**153,861.8**	**33,140.0**	**115,599.4**

Table 3.6–2. Summary of annual and typical daily emissions from all area sources in the PM_{10} 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	16.40	16.40	306.33	1.29	6.77	104.7	104.7	1,955.5	8.2	43.2
Industrial fuel oil	246.14	246.14	3,420.18	327.05	14.08	1,577.8	1,577.8	21,924.3	2,096.5	90.3
Comm./inst. natural gas	59.72	59.72	1,138.13	4.69	3.77	381.5	381.5	7,270.0	30.0	24.1
Comm./inst. fuel oil	75.51	75.51	1,102.80	91.39	2.74	484.1	484.1	7,069.2	585.8	17.6
Residential natural gas	62.69	62.69	775.35	4.95		343.5	343.5	4,248.5	27.1	
Residential wood	231.22	215.04	17.38	2.67		3,062.5	2,848.2	230.1	35.4	
Residential fuel oil	0.01	0.01	0.66	0.26		0.2	0.2	8.7	3.4	
All fuel combustion	**691.70**	**675.51**	**6,760.83**	**432.30**	**27.36**	**5,954.3**	**5,739.9**	**42,706.4**	**2,786.5**	**175.1**
Industrial Processes										
Chemical manufacturing	76.25	38.59	0.38	0.21	0.34	586.5	296.8	3.0	1.6	2.6
Commercial cooking	1,539.90	1,428.01				8,461.0	7,846.2			
Grain processing	12.64	2.68				94.7	20.5			
Cold storage					1,684.45					10,797.8
Secondary metal prod.	10.95	9.27	4.53	0.05	1.34	79.0	66.3	25.0	0.4	10.3
Mineral processes	430.89	222.17				3,024.9	1,513.0			
Mining & quarrying	54.77	15.52				347.6	98.2			
Wood product mfg.	211.78	148.93				1,646.6	1,162.0			
Rubber/plastic mfg.	362.77	234.91				2,790.6	1,807.0			
Fabricated metal mfg.	138.01	119.06				1,568.6	1,394.5			
Residential construction	11,331.99	1,133.20				72,641.0	7,264.1			
Commercial construction	11,085.55	1,108.55				71,061.2	7,106.1			
Road construction	7,236.42	723.64				46,387.3	4,638.7			
Other construction	2,475.89	247.59				15,871.1	1,587.1			
Electrical equip mfg	5.24	3.25	0.01	4.59	0.96	40.3	25.0	0.1	35.3	7.4
ADEQ-permitted portable sources	101.70	42.18	554.60	142.20		844.2	389.8	5,377.5	1,431.7	
Road travel at industrial sites	167.78	64.48				1,118.8	429.0			
Industrial processes NEC	24.29	13.86	4.08	0.01	0.80	201.9	97.2	22.9	<0.1	4.6
All Industrial Processes	**35,266.82**	**5,555.90**	**563.60**	**147.05**	**1,687.89**	**226,765.3**	**35,741.7**	**5,428.5**	**1,469.1**	**10,822.7**

Table 3.6–2. Summary of annual and typical daily emissions from all area sources in the PM_{10} NAA.

	Annual emissions (tons/yr)					Typical daily emissions (lbs/day)				
Category	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**NH_3**	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**NH_3**
Fuel Combustion										
Waste Treatment/disposal										
On-site incineration	0.15	0.10	2.54	0.03		1.6	1.1	19.9	0.3	
Open burning	24.24	24.24	6.51			243.6	243.6	65.3		
Landfills	6.79	4.05	6.50	1.11		39.5	23.5	36.3	6.3	
POTWs					1,321.01					7,238.4
Other waste	79.55	48.51	4.15	5.01		606.0	369.6	22.8	27.5	
All Waste Treatment/ Disposal	**110.74**	**76.90**	**19.70**	**6.14**	**1,321.01**	**890.8**	**637.8**	**144.4**	**34.0**	**7,238.4**
Misc. Area Sources										
Wildfires	4,860.02	4,168.2	1,072.32	294.02	224.84	32,617.6	27,974.5	7,196.8	1,973.3	1,509.0
Prescribed fires	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0
Structure fires	22.56	22.56	2.92			124.0	124.0	16.1		
Vehicle fires	26.45	26.45	1.06			145.0	145.0	5.8		
Engine testing	0.15	0.12	4.61	1.89		1.1	0.9	35.4	14.5	
Tilling	1,228.67	184.30				12,797.0	1,919.6			
Harvesting	58.99	8.85				1,420.8	213.1			
Unpaved ag roads	910.64	91.06				5,837.4	583.7			
Cotton ginning	0.09	0.02				0.7	0.2			
Fertilizer application					1,093.74					5,993.1
Livestock	520.84	57.29			8,418.39	2,853.9	313.9			46,128.1
Crematories	0.91	0.61	10.87	1.39		7.0	4.7	83.6	10.7	
Accidental releases	1.03	1.03				5.6	5.6			
Humans					1,047.67					5,740.6
Leaf blowers dust	843.00	318.16				4,619.2	1,743.3			
Offroad rec dust	2,159.00	216.00				11,830.0	1,184.0			
Unpaved park. lots	3,009.00	301.00				16,490.0	1,649.0			
Windblown dust	7,380.43	738.04				40,440.7	4,044.1			
All Misc. Sources	**21,021.78**	**6,133.71**	**1,091.78**	**297.30**	**10,784.63**	**129,190.0**	**39,905.6**	**7,337.7**	**1,998.5**	**59,370.9**
TOTAL, ALL AREA SOURCES:	**57,091.05**	**12,442.02**	**8,435.92**	**882.80**	**13,820.89**	**362,800.5**	**82,025.0**	**55,616.9**	**6,288.1**	**77,607.1**

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 2005 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 2005 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.

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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 (not present in Maricopa County);
- 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 (not present in Maricopa County);
- Aircraft, such as jet and piston engines; and
- Locomotives, such as switching and line haul trains.

Emission calculations for all nonroad mobile sources except aircraft, airport ground support equipment and locomotives are derived from EPA's NONROAD2005 model (Core version 2005a, Feb. 2006). Aircraft and airport ground support equipment emission calculations were derived from individual surveys of county airports. Locomotive emission calculations were derived from surveys of the 3 railroad companies that have operations in the county (Burlington Northern Santa Fe, Union Pacific and Amtrak).

County specific temperature and fuel-related inputs are required for the operation of the NONROAD2005 model. Monthly temperature and fuel data were provided by the Arizona State Weights and Measures Department. The following table lists the local county inputs used:

Table 4.1–1. NONROAD2005 model county temperature and fuel-related inputs.

Month	Max (°F)	Min (°F)	Average (°F)	Fuel RVP (psi)	Diesel Sulfur (ppm)	Gasoline Sulfur (ppm)
January	81	41	57.8	9	354	39
February	72	46	59.2	9	318	43
March	88	46	63.9	9	303	29
April	96	53	72.3	8	301	39
May	109	60	82.7	7	299	43
June	114	71	90.4	7	286	84
July	116	79	97.3	6	260	45
August	113	72	92.2	7	287	40
September	108	70	89.6	7	314	37
October	101	58	78.3	8	339	30
November	90	40	66.3	9	364	34
December	78	35	56.8	9	389	30

Note: All other required temperature and fuel-related inputs not listed assumed NONROAD2005 default values

EPA recommends adjusting default NONROAD2005 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. The NONROAD2005 model defaults were adjusted in the following manner:

- Equipment population numbers and activity levels for commercial lawn and garden equipment were adjusted based on 2003 survey results of the commercial lawn and garden industry performed by ENVIRON as part of an inventory developed to study the impact of visibility impairing pollutants (ENVIRON *et al.,* 2003). 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.

The NONROAD2005 model does not calculate emission values for NH_3. Ammonia emission calculations for NONROAD2005 model were derived by using a ratio of NO_x emissions developed by ENVIRON (2003).

Spatial allocation factors were developed (based on EPA guidance documents) to apportion nonroad emissions to the PM_{10} nonattainment area. The approaches used are described in each section of this chapter.

Temporal allocations (used to calculate PM_{10} average-day emissions) for nonroad equipment categories modeled in the NONROAD2005 model come from EPA recommendations on week-day and weekend day activity levels for each nonroad equipment category (US EPA, 1999). Table 4.1–2 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 4.1–2. 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 NONROAD2005 model, as discussed above. 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.

PM_{10}	$PM_{2.5}$	NO_x	SO_x	NH_3
39.21	38.03	386.34	5.95	0.73

PM_{10} 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 (223,627 acres) to agricultural land inside the county (465,833 acres). See Section 1.5.2 for a discussion of land-use data used.

PM_{10} nonattainment area emissions from agricultural equipment	= County PM_{10} emissions	×	Agricultural land-use allocation factor
	= 39.21 tons	×	48.01%
	= 18.83 tons PM_{10} /yr		

Table 4.2–2. Annual emissions (in tons/yr) from agricultural equipment in the PM_{10} NAA.

PM_{10}	$PM_{2.5}$	NO_x	SO_x	NH_3
18.83	18.26	185.46	2.86	0.35

County average-day emissions were calculated by multiplying annual emissions (generated by the NONROAD2005 model) by the most conservative weekday/weekend day activity allocation factor for agricultural equipment listed in Table 4.1–2, and dividing the product by the number of weeks (52) in the year (US EPA, 1999), as follows:

Maricopa County PM_{10} average-day emissions (lbs/day)	= Annual PM_{10} emissions (tons/year)	× 2000 (lb/ton)	×	daily activity allocation factor for agricultural equipment expressed as (week/day)	÷ 52 (weeks per year)
	= 39.21	× 2000	×	0.166667	÷ 52
	= 251.4 lbs/day				

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

PM_{10}	$PM_{2.5}$	NO_x	SO_x	NH_3
251.4	243.8	2,476.5	38.2	4.7

PM_{10} nonattainment area average-day emissions were calculated by multiplying County average-day emissions by the agricultural land-use allocation factor:

PM_{10} nonattainment area average-day emissions	= Maricopa County PM_{10} average-day emissions	×	Agricultural land-use allocation factor
	= 251.4 lbs/day	×	48.01%
	= 120.7 lbs/day		

Table 4.2–4. Typical daily emissions (lbs/day) from agricultural equipment in the PM_{10} nonattainment area.

PM_{10}	$PM_{2.5}$	NO_x	SO_x	NH_3
120.7	117.0	1,188.9	18.3	2.2

4.3 Airport ground support equipment

Annual emissions from airport ground support equipment (GSE) were calculated based on the MAG Airport Emission Model. Activity data on aircraft operations was obtained through the Federal Aviation Administration website for 8 towered airports in Maricopa County. Since all 8 towered airports are in the PM_{10} nonattainment area, the calculated emissions are equal to Maricopa County totals.

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

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
16.50	15.70	467.82	14.71		16.50	15.70	467.82	14.71	

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

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
90.4	86.0	2,563.4	80.6		90.4	86.0	2,563.4	80.6	

4.4 Commercial equipment

Annual emissions from commercial equipment in Maricopa County were calculated using EPA's NONROAD2005 model, as described in Section 4.1. Annual emissions for the PM_{10} 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.

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
119.34	114.47	1,449.72	17.32	23.18	118.48	113.65	1,439.36	17.20	23.01

County average-day emissions were calculated by multiplying Maricopa County annual emissions (generated by the NONROAD2005 model) by the most conservative weekday/weekend day activity allocation factor for commercial equipment (0.1666667) listed in Table 4.1–2, and dividing the product by the number of weeks (52) in the year (US EPA, 1999). PM_{10} 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.

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
765.0	733.8	9,293.1	111.0	148.6	759.5	728.5	9,226.7	110.2	147.5

4.5 Construction and mining equipment

Annual emissions from construction and mining equipment in Maricopa County were calculated using EPA's NONROAD2005 model as described in Section 4.1. Annual emissions for the PM_{10} 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.

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
1,354.26	1,311.26	16,016.62	287.07	31.22	1,356.40	1,313.34	16,042.02	287.52	31.27

County average-day emissions were calculated by multiplying Maricopa County annual emissions (generated by the NONROAD2005 model) by the most conservative weekday/weekend day activity allocation factor for construction/mining equipment (0.1666667) listed in Table 4.1–2, and dividing the product by the number of weeks (52) in the year (US EPA, 1999). PM_{10} 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.

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
8,681.1	8,405.5	102,670.7	1,840.2	200.1	8,694.9	8,418.8	102,833.5	1,843.1	200.4

4.6 Industrial equipment

Annual emissions from industrial equipment in Maricopa County were calculated using EPA's NONROAD2005 model, as described in Section 4.1. Annual emissions for the PM_{10} 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.

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
110.02	107.01	3,316.67	26.63	79.21	109.23	106.25	3,292.98	26.44	78.64

County average-day emissions were calculated by multiplying Maricopa County annual emissions (generated by the NONROAD2005 model) by the most conservative weekday/weekend day activity allocation factor for industrial equipment (0.1666667) listed in Table 4.1–2, and dividing the product by the number of weeks (52) in the year (US EPA, 1999). PM_{10} 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.

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
705.2	686.0	21,260.7	170.7	507.7	700.2	681.1	21,108.8	169.5	504.1

4.7 Lawn and garden equipment

Annual emissions from lawn and garden equipment in Maricopa County were calculated using EPA's NONROAD2005 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 PM_{10} nonattainment area for this category were derived by applying the ratio of population in the nonattainment area to Maricopa County-level totals, since housing units was not available, as recommended by EIIP guidance (US EPA, 2002). See Section 1.5.1 for a discussion of the population data used.

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

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
178.22	165.18	843.10	9.53	21.21	178.50	165.45	844.43	9.54	21.24

County average-day emissions were calculated by multiplying Maricopa County annual emissions (generated by the NONROAD2005 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 4.1–2, and dividing the product by the number of weeks (52) in the year (US EPA, 1999). PM_{10} nonattainment area average-day emissions were calculated based on population as described above.

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

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
1,226.0	1,135.5	5,882.8	64.2	155.6	1,228.0	1,137.3	5,892.2	64.3	155.8

4.8 Pleasure craft

Annual emissions from pleasure craft equipment in Maricopa County were calculated using EPA's NONROAD2005 model, as described in Section 4.1. Annual emissions for the PM_{10} 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 4.8–1. Annual emissions (in tons/yr) from pleasure craft equipment.

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
11.33	10.45	70.58	0.71	1.49	8.60	7.94	53.59	0.54	1.13

County average-day emissions were calculated by multiplying Maricopa County annual emissions (generated by the NONROAD2005 model) by the most conservative weekday/weekend day activity allocation factor for pleasure craft (0.3500000) listed in Table 4.1–2, and dividing the product by the number of weeks (52) in the year (US EPA, 1999). PM_{10} nonattainment area average-day emissions were calculated based on water surface area as described above.

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

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
152.5	140.7	950.0	9.5	20.1	115.8	106.9	721.4	7.2	15.2

4.9 Railway maintenance equipment

Annual emissions from railway maintenance equipment in Maricopa County were calculated using EPA's NONROAD2005 model, as described in Section 4.1. Annual emissions for the PM_{10} 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 4.9–1. Annual emissions (in tons/yr) from railway maintenance equipment.

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
1.20	1.16	9.27	0.14	0.02	1.20	1.17	9.29	0.14	0.02

County average-day emissions were calculated by multiplying Maricopa County annual emissions (generated by the NONROAD2005 model) by the most conservative weekday/weekend day activity allocation factor for railway maintenance equipment (0.1800000) listed in Table 4.1–2, and dividing the product by the number of weeks (52) in the year (US EPA, 1999). PM_{10} nonattainment area average-day emissions were calculated based on the population ratio as described above.

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

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
8.3	8.1	64.2	1.0	0.1	8.3	8.1	64.3	1.0	0.1

4.10 Recreational equipment

Annual emissions from recreational equipment in Maricopa County were calculated using EPA's NONROAD2005 model, as described in Section 4.1. Annual emissions for the PM_{10} 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 EIIP guidance (US EPA, 2002). See Section 1.5.2 for a discussion of the land-use data used.

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

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
42.29	38.95	59.99	0.68	1.97	8.89	8.19	12.61	0.14	0.41

County average-day emissions were calculated by multiplying Maricopa County annual emissions (generated by the NONROAD2005 model) by the most conservative weekday/weekend day activity allocation factor for recreational equipment (0.2222222) listed in Table 4.1–2, and dividing the product by the number of weeks (52) in the year (US EPA, 1999). PM_{10} nonattainment area average-day emissions were calculated based on land use as described above.

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

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
361.4	332.9	512.7	5.8	16.8	76.0	70.0	107.8	1.2	3.5

4.11 Aircraft

A survey of 17 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, four locations (Buckeye Municipal Airport, Gila Bend Municipal Airport, Gila Bend Air Force Auxiliary Field and Wickenburg Municipal Airport) are outside of the nonattainment area.

Emissions were derived from both computer modeling results 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 4.5) 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 taxi-in and taxi-out times.

For those airports that provided only partial data, the EDMS model could not be used to calculate emissions for that specific airport. Instead, emission factors from similar airports that provided complete information was used. Examples of missing data were detailed fleet mix data or unknown idle times. For airports that did not respond to the survey, LTO figures, taxi-in/taxi-out times and aircraft types were derived from online databases that provide detailed aeronautical information on airports at http://www.transtats.bts.gov, http://www.apo.data.faa.gov and http://www.airnav.com.

The EDMS model was used to estimate emissions for all pollutants for the air carrier category and only for NOx and SOx for air taxi, general aviation and military. This is due to the fact that the EDMS model version 4.5 does not estimate emissions for PM_{10} or $PM_{2.5}$ for air taxi, general aviation and military. For these aircraft categories, 2002 NEI default emission factors for PM_{10} and $PM_{2.5}$ were used (ERG, 2001). The PM_{10} and $PM_{2.5}$ emission factors are shown in Table 4.11–1.

Table 4.11–1. NEI default emission factors for PM_{10} and $PM_{2.5}$, by aircraft category.

Aircraft category	Abbreviation	SCC	PM_{10} Emission Factor (lbs/LTO)	$PM_{2.5}$ Emission Factor (lbs/LTO)
Air Taxi	AT	2275060000	0.60333	0.42
General Aviation	GA	2275050000	0.2367	0.163
Military	ML	2275001000	0.60333	0.42

The following provides an example of how aircraft emissions were calculated using the FAA's EDMS modeling software for Skyranch at Carefree, a small, general-aviation only airport that has an ordinance mandate that the airport can only accept aircraft that weigh 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 a composite emission factor for an airport based on the most common type of aircraft using that facility. The composite emission factor was then applied to the actual reported activity for the airport. For Skyranch, a composite profile was created by selecting within the EDMS model, 12 aircraft likely to utilize the airport, based on data provided by the airport survey and follow-up correspondence. These 12 aircraft types are: Cessna 150, Comanche, 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 model run with the 12 aircraft types resulted in total NO_x emissions of 0.277 tons (assuming each of the 12 aircraft types had 1000 LTOs each during the period).

Composite NO_x emission= Σ modeled NO_x emissions (tons/yr) × 1 yr / 12,000 LTOs × 2000 lb/ton factor (lb/LTO)

= 0.046 lb NO_x /LTO

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

NO_x emissions (lb/ yr) = 2,248 LTO/yr × 0.046 lb NO_x /LTO
= 103.6 lb NO_x /yr

The above approach was used to calculate annual NO_x and SO_x directly from the EDMS model. Annual PM_{10} and $PM_{2.5}$ emissions were calculated by multiplying the default emission factor shown in Table 4.11–1 by the activity level (LTO/year) for the airport and its appropriate aircraft category.

Table 4.11–2 summarizes the activity level for each aircraft category for each airport surveyed as well as the emission factor for each pollutant.

Table 4.11–2. 2005 airport activity data and emission factors.

Airport name	Activity category	2005 LTOs	Lbs/LTO			
			PM_{10}	$PM_{2.5}$	NO_x	SO_x
Arizona Army National Guard [2]	ML	1,080	0.603	0.420	2.251	0.136
Buckeye Municipal Airport [1,2]	GA	21,457	0.237	0.163	1.412	0.112
Chandler Municipal Airport [4]	AT	1,370	0.603	0.420	2.036	0.333
	GA	116,158	0.237	0.163	1.412	0.112
	ML	28	0.603	0.420	4.243	0.371
Falcon Field [2]	AC	24	0.175	0.175	26.34	1.425
	AT	4,098	0.603	0.420	2.036	0.333
	GA	128,835	0.237	0.163	1.214	0.076
	ML	2,136	0.603	0.420	4.243	0.371
Gila Bend Air Force Auxiliary Field [1,2]	ML	31,003	0.603	0.420	4.174	0.345
Gila Bend Municipal Airport [1,3]	GA	6,935	0.237	0.163	1.214	0.076
Glendale Municipal Airport [4]	AT	935	0.603	0.420	2.036	0.333
	GA	65,438	0.237	0.163	1.214	0.076
	ML	62	0.603	0.420	4.243	0.371
Luke Air Force Base [2]	ML	59,500	0.603	0.420	14.327	0.809
Phoenix Deer Valley Airport [4]	AT	2,293	0.603	0.420	2.036	0.333
	GA	186,231	0.237	0.163	1.214	0.076
	ML	30	0.603	0.420	4.243	0.371
Phoenix Goodyear Airport [4]	AC	172	0.175	0.180	26.34	1.425
	AT	1,893	0.603	0.420	2.036	0.333
	GA	46,440	0.237	0.163	1.214	0.076
	ML	2,005	0.603	0.420	4.243	0.371
Phoenix Sky Harbor International [4]	AC	204,856	0.168	0.168	16.889	1.373
	AT	48,118	0.603	0.420	5.494	0.636
	GA	20,670	0.237	0.163	1.412	0.112
	ML	1,447	0.603	0.420	35.936	1.814
Pleasant Valley Airport [2]	GA	14,096	0.237	0.163	0.354	0.064
Scottsdale Airport [2]	AT	5,903	0.603	0.420	2.036	0.333
	GA	100,164	0.237	0.163	1.412	0.112
	ML	155	0.603	0.420	4.243	0.371
Skyranch at Carefree [2]	GA	2,248	0.237	0.163	0.046	0.002
Stellar Airpark [2]	GA	19,528	4.421	0.163	1.214	0.076
Wickenburg Municipal Airport[1]	AT	485	0.603	0.420	2.036	0.333
	GA	23,059	0.237	0.163	1.214	0.076
	ML	728	0.603	0.420	4.243	0.371
Williams Gateway Airport [4]	AC	450	0.175	0.180	26.34	1.425
	AT	3,874	0.603	0.420	2.036	0.333
	GA	128,310	0.237	0.163	1.214	0.076
	ML	5,689	0.603	0.420	19.82	1.429

1. Airport is outside the nonattainment area.
2. Activity data reported from source.
3. No data reported from source. Data derived from http://www.airnav.com
4. No data reported from source. Data derived from http://www.apo.data.faa.gov/main/atads.asp

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 4.11–3 lists the total annual emissions and average daily emissions, for each airport and aircraft type.

Table 4.11–3. Annual and typical daily emissions, by airport and aircraft type.

Facility	Category[1]	Tons/yr PM_{10}	Tons/yr $PM_{2.5}$	Tons/yr NO_x	Tons/yr SO_x	Lbs/day PM_{10}	Lbs/day $PM_{2.5}$	Lbs/day NO_x	Lbs/day SO_x
Arizona Army National Guard	ML	0.33	0.22	1.22	0.07	1.8	1.2	6.7	0.4
Chandler Municipal Airport	AT	0.41	0.29	1.39	0.23	2.3	1.6	7.6	1.2
	GA	13.75	9.49	82.01	6.50	75.3	52.0	449.4	35.6
	ML	0.01	0.01	0.06	0.01	0.0	0.0	0.3	0.0
Falcon Field	AC	0.00	0.00	0.32	0.02	0.0	0.0	1.7	0.1
	AT	1.24	0.85	4.17	0.68	6.8	4.7	22.9	3.7
	GA	15.25	10.52	78.20	4.90	83.5	57.6	428.5	26.8
	ML	0.64	0.44	4.53	0.40	3.5	2.4	24.8	2.2
Glendale Municipal Airport	AT	0.28	0.19	0.95	0.16	1.5	1.1	5.2	0.9
	GA	7.74	5.34	39.72	2.49	42.4	29.3	217.6	13.6
	ML	0.02	0.01	0.13	0.01	0.1	0.1	0.7	0.1
Luke Air Force Base	ML	17.94	12.38	426.23	24.07	98.3	67.8	2,335.5	131.9
Phoenix Deer Valley Airport.	AT	0.69	0.48	2.33	0.38	3.8	2.6	12.8	2.1
	GA	22.04	15.21	113.04	7.08	120.8	83.3	619.4	38.8
	ML	0.01	0.01	0.06	0.01	0.0	0.0	0.3	0.0
Phoenix Goodyear Airport	AC	0.02	0.02	2.27	0.12	0.1	0.1	12.4	0.7
	AT	0.57	0.39	1.93	0.32	3.1	2.2	10.6	1.7
	GA	5.50	3.79	28.19	1.76	30.1	20.8	154.5	9.7
	ML	0.60	0.42	4.25	0.37	3.3	2.3	23.3	2.0
Phoenix Sky Harbor International	AC	17.21	17.21	1,729.91	140.63	94.3	94.3	9,478.9	770.6
	AT	14.52	10.02	132.18	15.30	79.5	54.9	724.3	83.8
	GA	2.45	1.69	14.59	1.16	13.4	9.2	80.0	6.3
	ML	0.44	0.30	26.00	1.31	2.4	1.6	142.5	7.2
Pleasant Valley Airport	GA	1.67	1.15	2.49	0.45	9.1	6.3	13.7	2.5
Scottsdale Airport	AT	1.78	1.23	6.01	0.98	9.8	6.7	32.9	5.4
	GA	11.85	8.18	70.72	5.61	65.0	44.8	387.5	30.7
	ML	0.05	0.03	0.33	0.03	0.3	0.2	1.8	0.2
Skyranch at Carefree	GA	0.27	0.18	0.05	0.00	1.5	1.0	0.3	0.0
Stellar Airpark	GA	2.31	1.59	11.85	0.74	12.7	8.7	65.0	4.1
Williams Gateway Airport	AC	0.04	0.04	5.93	0.32	0.2	0.2	32.5	1.8
	AT	1.17	0.81	3.94	0.65	6.4	4.4	21.6	3.5
	GA	15.19	10.48	77.88	4.88	83.2	57.4	426.8	26.7
	ML	1.72	1.18	56.38	4.06	9.4	6.5	308.9	22.3
PM_{10} nonattainment area totals:		**157.68**	**114.15**	**2,929.27**	**225.69**	**864.0**	**625.5**	**16,050.8**	**1,236.7**

Airports outside the nonattainment area:

Facility	Category[1]	Tons/yr PM_{10}	Tons/yr $PM_{2.5}$	Tons/yr NO_x	Tons/yr SO_x	Lbs/day PM_{10}	Lbs/day $PM_{2.5}$	Lbs/day NO_x	Lbs/day SO_x
Buckeye Mun. Airport	GA	2.54	1.75	15.15	1.20	13.9	9.6	83.0	6.6
Gila Bend AF Aux Field	ML	9.35	6.45	64.70	5.35	51.2	35.3	354.5	29.3
Gila Bend Mun. Airport	GA	0.82	0.57	4.21	0.26	4.5	3.1	23.1	1.4
Wickenburg Municipal Airport	AT	0.15	0.10	0.49	0.08	0.8	0.6	2.7	0.4
	GA	2.73	1.88	14.00	0.88	15.0	10.3	76.7	4.8
	ML	0.22	0.15	1.54	0.14	1.2	0.8	8.5	0.7
Maricopa County totals:		**173.48**	**125.05**	**3,029.37**	**233.60**	**950.6**	**685.2**	**16,599.3**	**1,280.0**

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

4.12 Locomotives

Annual emissions from locomotives were calculated based on diesel fuel usage provided by Burlington Northern/Santa Fe Railway (BNSF), Union Pacific Railway (UP) and Amtrak. Railway operations from these companies fall into two categories: Class I haul lines and yard/switching operations. 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 4.12–1.

Table 4.12–1. 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 4.12–2.

PM_{10} emissions from UP Class I haul lines	= Diesel fuel used (gals)	×	EPA emission factor (lbs/gal) for PM_{10}	÷ 2000 lbs/ton
	= 7,598,448 gallons	×	0.015 lbs/gal	÷ 2000 lbs/ton
	= 56.99 tons PM_{10}/yr			

Table 4.12–2. 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	1,089,969	8.17	7.08	324.27	19.62	0.52
UP Class I haul line	7,598,448	56.99	49.39	2,260.54	136.77	3.61
BNSF yard/switch operations	500,000	5.00	4.75	199.50	9.00	0.24
UP yard/switch operations	415,740	4.16	3.95	165.88	7.48	0.20
Amtrak	17,000	0.13	0.11	5.06	0.31	0.01
Totals:	**9,621,157**	**74.45**	**65.28**	**2,955.24**	**173.18**	**4.57**

PM_{10} nonattainment area emissions were calculated by multiplying Maricopa County emissions by the percentage of track miles inside the PM_{10} nonattainment area, determined by GIS mapping:

PM_{10} nonattainment area emissions from UP Class I haul lines	=	County PM_{10} emissions	×	Percentage of track in the nonattainment area
	=	56.99 tons PM_{10}/yr	×	44.27%
	=	30.56 tons PM_{10}/yr		

Table 4.12–3. Annual emissions (in tons/yr) from locomotives in the PM_{10} 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	3.62	3.14	143.55	8.69	0.23
UP Class I haul line	44.27	25.23	21.86	1,000.74	60.55	1.60
BNSF yard/switch operations	100.00	5.00	4.75	199.50	9.00	0.24
UP yard/switch operations	100.00	4.16	3.95	165.88	7.48	0.20
Amtrak	0.00	0.00	0.00	0.00	0.00	0.00
Totals:		**38.01**	**33.70**	**1,509.67**	**85.72**	**2.26**

PM_{10} typical daily emissions for both the county (shown in Table 4.12–4) and the PM_{10} nonattainment area (Table 4.12–5) were calculated by dividing annual totals by 365 days per year, as locomotive activity is assumed to be uniform throughout the year.

PM_{10} typical daily emissions from haul lines	=	Annual PM_{10} emissions (tons)	×	2000 lbs/ton	÷	365 days
	=	56.99 tons PM_{10}/yr	×	2000 lbs/ton	÷	365 days
	=	312.3 lbs PM_{10}/day				

Table 4.12–4. 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	44.8	38.8	1,776.8	107.5	2.8
UP Class I haul line	312.3	270.6	12,386.5	749.4	19.8
BNSF yard/switch operations	27.4	26.0	1,093.2	49.3	1.3
UP yard/switch operations	22.8	21.6	908.9	41.0	1.1
Amtrak	0.7	0.6	27.7	1.7	0.0
Totals:	**407.9**	**357.7**	**16,193.1**	**948.9**	**25.0**

Table 4.12–5. Typical daily emissions (in lbs/day) from locomotives in the PM_{10} nonattainment area.

Locomotive type	PM_{10}	$PM_{2.5}$	NO_x	SO_x	NH_3
BNSF Class I haul line	19.8	17.2	786.6	47.6	1.3
UP Class I haul line	138.2	119.8	5,483.5	331.8	8.8
BNSF yard/switch operations	27.4	26.0	1,093.2	49.3	1.3
UP yard/switch operations	22.8	21.6	908.9	41.0	1.1
Amtrak	0.0	0.0	0.0	0.0	0.0
Totals:	**208.2**	**184.7**	**8,272.2**	**469.7**	**12.4**

4.13 Summary of all nonroad mobile source emissions

Table 4.13–1 summarizes annual and daily emissions of PM_{10}, $PM_{2.5}$, NO_x, SO_x and NH_3 from nonroad mobile sources in Maricopa County respectively. Table 4.13–2 shows annual and typical daily emissions for these pollutants for the PM_{10} nonattainment area.

Table 4.13–1. Annual and typical daily emissions from nonroad mobile sources in Maricopa County.

	Annual emissions (tons/yr)					Typical daily emissions (lbs/day)				
Category	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**NH_3**	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**NH_3**
Agricultural	39.21	38.03	386.34	5.95	0.73	251.4	243.8	2,476.5	38.2	4.7
Airport ground support	16.50	15.70	467.82	14.71		90.4	86.0	2,563.4	80.6	
Commercial	119.34	114.47	1,449.72	17.32	23.18	765.0	733.8	9,293.1	111.0	148.6
Construction & mining	1,354.26	1,311.26	16,016.62	287.07	31.22	8,681.1	8,405.5	102,670.7	1,840.2	200.1
Industrial	110.02	107.01	3,316.67	26.63	79.21	705.2	686.0	21,260.7	170.7	507.7
Lawn & garden	178.22	165.18	843.10	9.53	21.21	1,226.0	1,135.4	5,882.8	64.1	155.5
Pleasure craft	11.33	10.45	70.58	0.71	1.49	152.5	140.7	950.0	9.5	20.1
Railway maintenance	1.20	1.16	9.27	0.14	0.02	8.3	8.1	64.2	1.0	0.1
Recreational	42.29	38.95	59.99	0.68	1.97	361.4	332.9	512.7	5.8	16.8
Aircraft	173.48	125.05	3,029.37	233.60		950.6	685.2	16,599.3	1,280.0	
Locomotives	74.45	65.28	2,955.24	173.18	4.57	407.9	357.7	16,193.1	948.9	25.0
Totals:	**2,120.29**	**1,992.56**	**28,604.72**	**769.51**	**163.58**	**13,599.9**	**12,815.2**	**178,466.6**	**4,550.0**	**1,078.7**

Table 4.13–2. Annual and typical daily emissions from nonroad mobile sources in the PM_{10} NAA.

	Annual emissions (tons/yr)					Typical daily emissions (lbs/day)				
Category	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**NH_3**	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**NH_3**
Agricultural	18.83	18.26	185.46	2.86	0.35	120.7	117.0	1,188.9	18.3	2.2
Airport ground support	16.50	15.70	467.82	14.71		90.4	86.0	2,563.4	80.6	
Commercial	118.48	113.65	1,439.36	17.20	23.01	759.5	728.5	9,226.7	110.2	147.5
Construction & mining	1,356.40	1,313.34	16,042.02	287.52	31.27	8,694.9	8,418.8	102,833.5	1,843.1	200.4
Industrial	109.23	106.25	3,292.98	26.44	78.64	700.2	681.1	21,108.8	169.5	504.1
Lawn & garden	178.50	165.44	844.44	9.54	21.24	1,227.9	1,137.2	5,892.2	64.2	155.8
Pleasure craft	8.60	7.94	53.59	0.54	1.13	115.8	106.9	721.4	7.2	15.2
Railway maintenance	1.20	1.17	9.29	0.14	0.02	8.3	8.1	64.3	1.0	0.1
Recreational	8.89	8.19	12.61	0.14	0.41	76.0	70.0	107.8	1.2	3.5
Aircraft	157.68	114.15	2,929.27	225.69		864.0	625.5	16,050.8	1,236.7	
Locomotives	38.01	33.70	1,509.67	85.72	2.26	208.2	184.7	8,272.2	469.7	12.4
Totals:	**2,012.32**	**1,897.78**	**26,786.52**	**670.50**	**158.33**	**12,866.0**	**12,163.8**	**168,029.9**	**4,001.8**	**1,041.4**

4.14 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.

4.15 References

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5. Onroad Mobile Sources

5.1 Introduction

Onroad mobile source emission estimates have been calculated for particulate matter for the 2005 Periodic Particulate Matter Emissions Inventory. For the purposes of this particulate matter inventory, the following pollutants were included: PM_{10}, $PM_{2.5}$, nitrogen oxides (NO_x), sulfur oxides (SO_x), and ammonia (NH_3). PM_{10} 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.

Onroad mobile source emissions are estimated for the PM_{10} nonattainment area (approximately 3,000 square miles), as well as for Maricopa County (approximately 9,000 square miles). Emission factors were calculated using 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.

The 2005 motor vehicle exhaust, tire wear, and brake wear emissions were estimated using the MOBILE6.2 model. The modeling accounted for the oxygenated fuel and vehicle inspection/ maintenance (I/M) programs in existence in Maricopa County in 2005. Fuel use assumptions for 2005, including oxygen content and Reid Vapor Pressure (RVP), were based on actual July 2005 testing results provided by the Arizona Department of Weight and Measures. MOBILE6.2 calculations reflected a 91.6 percent participation in the I/M program.

The 2005 vehicle miles of travel (VMT) used in developing the onroad mobile source emissions were derived from the latest 2005 traffic assignment produced by the MAG travel demand model (i.e., EMME2). The 2005 VMT was split into 28 vehicle classes. The VMT by vehicle class was derived using the VMT mix produced by MOBILE6.2. The MOBILE6.2 VMT mix is based on July 2003 vehicle registration data for Maricopa County obtained from the Arizona Department of Transportation. The VMT by vehicle class was multiplied by the appropriate MOBILE6.2 emission factors to produce 2005 onroad exhaust, tire wear, and brake wear emissions.

Paved road fugitive dust emissions were estimated using emission factors from AP-42 applied to VMT from the 2005 traffic assignment produced by the MAG EMME2 travel demand model. The 2005 VMT for freeways, high traffic arterials, and low traffic arterials were derived from the traffic assignment. Low traffic arterials are assumed to carry 5,000 or fewer vehicles on an average weekday, while high traffic arterials carry more than 5,000 vehicles per weekday. These VMTs were multiplied by the appropriate paved road particulate emission factors from AP-42. The paved road fugitive dust particulate emission factors were derived from the AP-42 equation for paved roads, assuming silt loadings from the Serious Area PM_{10} Plan and a mean vehicle weight of three tons. GIS was applied to obtain VMT estimates for the PM_{10} nonattainment area and Maricopa County.

Unpaved road VMT was developed using the mileage for low and high traffic unpaved roads derived from the unpaved road inventory in the Serious Area PM_{10} Plan. Low traffic unpaved roads are assumed to carry an average of four vehicles per day, while high traffic unpaved roads carry an average of 120 vehicles per day. The unpaved road mileage used in developing the 2005 particulate emission inventory assumes that all commitments to pave unpaved roads in the Serious Area PM_{10} Plan have been implemented. Low and high traffic unpaved road VMTs were multiplied by the appropriate AP-42 emission factor to produce unpaved road particulate emissions. The unpaved road particulate emission factors were derived from the AP-42 equation for publicly accessible unpaved roads, assuming a silt content of 11.9%, soil moisture content of 0.5%, a mean vehicle weight of three tons, and an average speed of 25 mph.

The main references for preparing the onroad mobile source portion of the 2005 emissions inventory were:

- 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

MAG prepared the 2005 vehicle miles of travel (VMT) estimates for the PM_{10} nonattainment area and Maricopa County. The source of data for these estimates is the 2005 traffic assignment prepared by MAG using the EMME2 travel demand model. Highway Performance Monitoring System (HPMS) data for 2005 prepared by the Arizona Department of Transportation was not available in time to be used for the 2005 periodic particulate matter emissions inventory.

The distribution of VMT by vehicle class for the PM_{10} nonattainment area was derived from the MAG EMME2 traffic assignment and MOBILE6.2 runs for 2005. The output of the traffic assignment was evaluated using GIS to obtain VMT for the PM_{10} nonattainment area and Maricopa County. Since information provided by the 2005 traffic assignment does not cover the far western and far northeastern areas of Maricopa County, 2005 VMT for Maricopa County was obtained by multiplying the 2005 traffic assignment VMT by the ratio of the 2002 HPMS VMT for Maricopa County to the 2002 traffic assignment VMT for Maricopa County. The traffic assignment VMTs shown below represent annual average daily traffic volumes. The ratio applied to obtain Maricopa County VMT was calculated as follows:

Maricopa County 2002 HPMS VMT = 73,579,000 miles per day
Maricopa County 2002 traffic assignment VMT = 71,988,181 miles per day
Maricopa County 2005 traffic assignment VMT = 80,374,602 miles per day
Ratio = 73,579,000 / 71,988,181 = 1.02
2005 VMT for Maricopa County = 1.02 × 80,374,602 = 82,150,747 miles per day

VMTs for the PM_{10} nonattainment area and Maricopa County were split by vehicle class using VMT mix data obtained from the MOBILE6.2 run. The VMT estimates by 28 vehicle class categories for the PM_{10} nonattainment area and Maricopa County are shown in Table 5.2–1.

Table 5.2–1. 2005 daily VMT (vehicle miles of travel) by vehicle class.

Vehicle Type	PM_{10} NAA	Maricopa County
LDGV	32,364,131	33,951,479
LDGT1	5,937,079	6,228,272
LDGT2	19,761,545	20,730,780
LDGT3	6,579,349	6,902,043
LDGT4	3,023,368	3,171,653
HDGV2B	2,294,940	2,407,498
HDGV3	78,326	82,167
HDGV4	31,330	32,867
HDGV5	93,991	98,601
HDGV6	195,814	205,418
HDGV7	78,326	82,167
HDGV8A	0	0
HDGV8B	0	0
MC	375,963	394,402
LDDV	62,660	65,734
LDDT12	23,498	24,650
LDDT34	140,986	147,901
HDDV2B	720,595	755,938
HDDV3	219,312	230,068
HDDV4	234,977	246,502
HDDV5	109,656	115,034
HDDV6	556,112	583,387
HDDV7	806,754	846,322
HDDV8A	971,237	1,018,873
HDDV8B	3,430,661	3,598,922
HDGB	15,665	16,433
HDDBT	70,493	73,950
HDDBS	133,153	139,684
Total	**78,309,918**	**82,150,747**

VMT for estimating fugitive dust emissions from paved roads was also estimated using data from the 2005 EMME2 traffic assignment. Roadway silt loading measurements used in the Serious Area PM_{10} Plan reflect three silt loading classifications: freeways, high traffic arterials (greater than or equal to 5,000 vehicles per average weekday), and low traffic arterials (less than 5,000 vehicles per average weekday). GIS was applied to extract VMT for the PM_{10} modeling area from the MAG 2005 traffic assignment. The PM_{10} modeling area for the Serious Area PM_{10} Plan is a rectangle that encompasses the portion of the PM_{10} nonattainment area in Maricopa County. The VMT for freeways and high and low traffic arterials in the PM_{10} modeling area is shown in Table 5.2–2. These VMTs represent annual average daily traffic volumes. All travel on local streets is included in the low traffic arterial category below.

Table 5.2–2. 2005 VMT by silt loading category on paved roads in the PM_{10} modeling area.

	VMT			
	Freeways	**High Traffic Arterials**	**Low Traffic Arterials**	**Total**
PM_{10} Modeling Area	27,929,802	40,164,352	9,688,202	77,782,356

The miles of unpaved roads used to estimate VMT for unpaved roads was derived from the Serious Area PM_{10} Plan (MAG, 2000). The unpaved road mileages shown in Table 5.2–3 have been reduced to account for control measures to Reduce Particulate Emissions from Unpaved Roads and Alleys in the Plan. The Plan classifies the miles of unpaved roads as low traffic and high traffic. Low traffic unpaved roads have an annual average traffic level of 4 vehicles per day; high traffic unpaved roads have an annual average traffic level of 120 vehicles per day. Applying these traffic volumes to the unpaved road mileages, after implementation of committed measures in the Plan, results in the daily VMTs for the PM_{10} modeling area shown in Table 5.2–3. The PM_{10} modeling area is a rectangle that includes the portion of the PM_{10} nonattainment area located in Maricopa County.

Table 5.2–3. 2005 unpaved road mileages and VMT in the PM_{10} modeling area.

	2005	
Unpaved Road Type	**Miles**	**Daily VMT**
High Traffic	224.3	26,916
Low Traffic	1,129.2	4,517
Total	1,353.5	31,433

To estimate paved and unpaved road emissions for Maricopa County and the entire PM_{10} nonattainment area, including Apache Junction in Pinal County, the emissions for the PM_{10} modeling area were multiplied by the ratio of the total daily VMT in Maricopa County (or the PM_{10} nonattainment area) to the total daily VMT in the PM_{10} modeling area. GIS was applied to extract the total VMTs for Maricopa County and the PM_{10} nonattainment area from the 2005 MAG traffic assignment. These VMTs represent annual average daily traffic volumes. The resultant VMTs and ratios are shown in Table 5.2–4.

Table 5.2–4. VMTs for the PM_{10} modeling area, PM_{10} nonattainment area, and Maricopa County.

Area	Total Daily VMT
PM_{10} Modeling Area (MA)	77,782,356
PM_{10} Nonattainment Area (NA)	78,309,918
Maricopa County (MC)	82,150,747
Ratio (NA/MA)	1.007
Ratio (MC/MA)	1.056

5.3 Vehicle speed

Vehicle speeds have no effect on the emission factors for exhaust particulate matter, re-entrained dust from paved roads, brake wear, tire wear, or exhaust ammonia (NH_3) and have only a very slight effect on the pollutants, SO_4 and SO_2. However, speeds can have a significant effect on NO_x exhaust emissions and re-entrained dust from unpaved roads. The MOBILE6.2 default speeds were assumed for the NO_x emission calculations and 25 miles per hour was assumed on all unpaved roads.

5.4 Emission factor estimation procedures

PM_{10}, $PM_{2.5}$, SO_2, NH_3, and oxides of nitrogen (NO_x) vehicle exhaust emission factors were calculated using MOBILE6.2. The PM_{10} and $PM_{2.5}$ non-exhaust components of tire wear and brake wear were also estimated using MOBILE6.2. The PM_{10} 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. MOBILE6.2 is the latest version in a series of models developed by the U.S. EPA for the purpose of estimating motor vehicle emission factors. The MOBILE6.2 runs were executed by MAG. The contact person for the MOBILE6.2 emission estimates is Taejoo Shin (602-254-6300).

Fugitive dust emission factors were derived from AP-42. The contact person for the fugitive dust emission estimates is Cathy Arthur (602-254-6300).

5.4.1 MOBILE6.2 emission factor model

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). Of the pollutants modeled for this study, the presence or lack of an I/M program only affects the modeled emission factors for NOx. Refer to Appendix 5 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 91.6 percent of the vehicles operating within the nonattainment area participate in the I/M program. The remaining 8.4 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.

5.4.1.1 MOBILE6.2 inputs

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. The specific model run inputs to the MOBILE6.2 model are described in Appendix 5.

5.4.1.2 MOBILE6.2 outputs

MOBILE6.2 was executed to obtain composite emission factors in grams per mile (g/mi) for exhaust PM_{10}, $PM_{2.5}$, NO_x, SO_2, and NH_3. These values were obtained for 28 vehicle classes. The emission factors generated for 2005 are presented in the following section. Representative output runs are contained in Appendix 5. These values were then used in developing emission estimates.

5.4.1.3 Summary of MOBILE6.2 emission factors

MOBILE6.2 was used to generate emission factors by vehicle class in terms of gram per mile. Table 5.4–1 provides the emission factors for each vehicle class for the PM_{10} nonattainment area and Maricopa County.

Table 5.4–1. Emission factors by vehicle class for the PM_{10} nonattainment area and Maricopa County.

Vehicle Type	PM_{10} Ext	PM_{10} Tire	PM_{10} Brake	$PM_{2.5}$ Ext	$PM_{2.5}$ Tire	$PM_{2.5}$ Brake	NO_x	SO_x
LDGV	0.0052	0.0080	0.0125	0.0048	0.0020	0.0053	0.766	0.020
LDGT1	0.0061	0.0080	0.0125	0.0057	0.0020	0.0053	0.788	0.026
LDGT2	0.0061	0.0080	0.0125	0.0057	0.0020	0.0053	1.043	0.026
LDGT3	0.0066	0.0080	0.0125	0.0061	0.0020	0.0053	1.200	0.034
LDGT4	0.0066	0.0080	0.0125	0.0061	0.0020	0.0053	1.590	0.034
HDGV2B	0.0616	0.0080	0.0125	0.0547	0.0020	0.0053	4.024	0.049
HDGV3	0.0671	0.0120	0.0125	0.0583	0.0030	0.0053	4.442	0.053
HDGV4	0.0731	0.0120	0.0125	0.0586	0.0030	0.0053	4.769	0.054
HDGV5	0.0602	0.0120	0.0125	0.0505	0.0030	0.0053	4.844	0.062
HDGV6	0.0593	0.0120	0.0125	0.0500	0.0030	0.0053	4.788	0.061
HDGV7	0.0605	0.0120	0.0125	0.0507	0.0030	0.0053	5.375	0.067
HDGV8A	0.0620	0.0360	0.0125	0.0513	0.0090	0.0053	5.961	0.071
HDGV8B	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.000	0.000
MC	0.0208	0.0040	0.0125	0.0145	0.0010	0.0053	1.240	0.010
LDDV	0.1857	0.0080	0.0125	0.1711	0.0020	0.0053	1.563	0.070
LDDT12	0.3148	0.0080	0.0125	0.2899	0.0020	0.0053	2.736	0.069
LDDT34	0.1079	0.0080	0.0125	0.0998	0.0020	0.0053	1.147	0.115
HDDV2B	0.1405	0.0080	0.0125	0.1301	0.0020	0.0053	3.996	0.152
HDDV3	0.1252	0.0120	0.0125	0.1162	0.0030	0.0053	4.443	0.169
HDDV4	0.1286	0.0120	0.0125	0.1194	0.0030	0.0053	5.286	0.192
HDDV5	0.1210	0.0120	0.0125	0.1124	0.0030	0.0053	5.642	0.199
HDDV6	0.2371	0.0120	0.0125	0.2194	0.0030	0.0053	7.711	0.225
HDDV7	0.2427	0.0120	0.0125	0.2247	0.0030	0.0053	9.578	0.260
HDDV8A	0.2961	0.0360	0.0125	0.2741	0.0090	0.0053	12.217	0.298
HDDV8B	0.3127	0.0360	0.0125	0.2895	0.0090	0.0053	14.339	0.313
HDGB	0.1377	0.0120	0.0125	0.0995	0.0030	0.0053	7.831	0.079
HDDBT	0.5888	0.0120	0.0125	0.5442	0.0030	0.0053	17.002	0.455
HDDBS	0.6102	0.0120	0.0125	0.5631	0.0030	0.0053	11.940	0.315

5.4.1.4 MOBILE6.2 emission estimates

The annual average daily VMT shown in Table 5.2–1 was multiplied by the appropriate emission factor shown in Table 5.2–1 for each vehicle class to calculate exhaust emissions. Calculations for brake wear and tire wear involved the multiplication of the VMT by appropriate emission factors from MOBILE6.2 also shown in the table above.

Tables 5.4–2 through 5.4–3 show the resultant PM_{10}, $PM_{2.5}$, NO_x, SO_2, and NH_3 emissions for each vehicle class in the PM_{10} nonattainment area and Maricopa County, respectively. The emissions are shown in terms of metric tons per day.

Tables 5.4–4 and 5.4–5 show the same emissions on an annual basis in metric tons per year. In Tables 5.4–1 through 5.4–5, the abbreviation "Ext" refers to exhaust particulate emissions, "Tire" refers to tire wear particulate emissions, and "Brake" refers to brake wear particulate emissions. NO_x and SO_x refer to exhaust emissions.

Table 5.4–2. Daily PM_{10} nonattainment area emissions by vehicle class (metric tons/day).

Vehicle type	PM_{10} Ext	PM_{10} Tire	PM_{10} Brake	$PM_{2.5}$ Ext	$PM_{2.5}$ Tire	$PM_{2.5}$ Brake	PM_{10} Total	$PM_{2.5}$ Total	NO_x	SO_x	NH_3
LDGV	0.168	0.259	0.405	0.155	0.065	0.172	0.832	0.392	24.788	0.660	3.285
LDGT1	0.036	0.047	0.074	0.034	0.012	0.031	0.158	0.077	4.679	0.156	0.594
LDGT2	0.121	0.158	0.247	0.113	0.040	0.105	0.526	0.257	20.611	0.518	1.976
LDGT3	0.043	0.053	0.082	0.040	0.013	0.035	0.178	0.088	7.895	0.225	0.651
LDGT4	0.020	0.024	0.038	0.018	0.006	0.016	0.082	0.041	4.807	0.103	0.299
HDGV2B	0.141	0.018	0.029	0.126	0.005	0.012	0.188	0.142	9.234	0.112	0.104
HDGV3	0.005	0.001	0.001	0.005	0.000	0.000	0.007	0.005	0.348	0.004	0.004
HDGV4	0.002	0.000	0.000	0.002	0.000	0.000	0.003	0.002	0.149	0.002	0.001
HDGV5	0.006	0.001	0.001	0.005	0.000	0.000	0.008	0.006	0.455	0.006	0.004
HDGV6	0.012	0.002	0.002	0.010	0.001	0.001	0.016	0.011	0.938	0.012	0.009
HDGV7	0.005	0.001	0.001	0.004	0.000	0.000	0.007	0.005	0.421	0.005	0.004
HDGV8A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
HDGV8B	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MC	0.008	0.002	0.005	0.005	0.000	0.002	0.014	0.008	0.466	0.004	0.004
LDDV	0.012	0.001	0.001	0.011	0.000	0.000	0.013	0.011	0.098	0.004	0.000
LDDT12	0.007	0.000	0.000	0.007	0.000	0.000	0.008	0.007	0.064	0.002	0.000
LDDT34	0.015	0.001	0.002	0.014	0.000	0.001	0.018	0.015	0.162	0.016	0.001
HDDV2B	0.101	0.006	0.009	0.094	0.001	0.004	0.116	0.099	2.879	0.110	0.019
HDDV3	0.027	0.003	0.003	0.025	0.001	0.001	0.033	0.027	0.974	0.037	0.006
HDDV4	0.030	0.003	0.003	0.028	0.001	0.001	0.036	0.030	1.242	0.045	0.006
HDDV5	0.013	0.001	0.001	0.012	0.000	0.001	0.016	0.013	0.619	0.022	0.003
HDDV6	0.132	0.007	0.007	0.122	0.002	0.003	0.145	0.127	4.288	0.125	0.015
HDDV7	0.196	0.010	0.010	0.181	0.002	0.004	0.216	0.188	7.727	0.210	0.022
HDDV8A	0.288	0.035	0.012	0.266	0.009	0.005	0.335	0.280	11.866	0.290	0.026
HDDV8B	1.073	0.124	0.043	0.993	0.031	0.018	1.239	1.042	49.192	1.075	0.093
HDGB	0.002	0.000	0.000	0.002	0.000	0.000	0.003	0.002	0.123	0.001	0.001
HDDBT	0.042	0.001	0.001	0.038	0.000	0.000	0.043	0.039	1.199	0.032	0.002
HDDBS	0.081	0.002	0.002	0.075	0.000	0.001	0.085	0.076	1.590	0.042	0.004
Total	**2.587**	**0.759**	**0.979**	**2.385**	**0.190**	**0.415**	**4.324**	**2.990**	**156.814**	**3.817**	**7.133**

Table 5.4–3. Daily Maricopa County emissions by vehicle class (metric tons/day).

Vehicle type	PM_{10} Ext	PM_{10} Tire	PM_{10} Brake	$PM_{2.5}$ Ext	$PM_{2.5}$ Tire	$PM_{2.5}$ Brake	PM_{10} Total	$PM_{2.5}$ Total	NO_x	SO_x	NH_3
LDGV	0.177	0.272	0.424	0.163	0.068	0.180	0.873	0.411	26.004	0.693	3.446
LDGT1	0.038	0.050	0.078	0.036	0.012	0.033	0.166	0.081	4.909	0.163	0.623
LDGT2	0.126	0.166	0.259	0.118	0.041	0.110	0.551	0.270	21.622	0.543	2.073
LDGT3	0.046	0.055	0.086	0.042	0.014	0.037	0.187	0.092	8.282	0.236	0.683
LDGT4	0.021	0.025	0.040	0.019	0.006	0.017	0.086	0.043	5.043	0.108	0.314
HDGV2B	0.148	0.019	0.030	0.132	0.005	0.013	0.198	0.149	9.687	0.117	0.109
HDGV3	0.006	0.001	0.001	0.005	0.000	0.000	0.008	0.005	0.365	0.004	0.004
HDGV4	0.002	0.000	0.000	0.002	0.000	0.000	0.003	0.002	0.157	0.002	0.001
HDGV5	0.006	0.001	0.001	0.005	0.000	0.001	0.008	0.006	0.478	0.006	0.004
HDGV6	0.012	0.002	0.003	0.010	0.001	0.001	0.017	0.012	0.984	0.013	0.009
HDGV7	0.005	0.001	0.001	0.004	0.000	0.000	0.007	0.005	0.442	0.005	0.004
HDGV8A	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
HDGV8B	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
MC	0.008	0.002	0.005	0.006	0.000	0.002	0.015	0.008	0.489	0.004	0.004
LDDV	0.012	0.001	0.001	0.011	0.000	0.000	0.014	0.012	0.103	0.005	0.000
LDDT12	0.008	0.000	0.000	0.007	0.000	0.000	0.008	0.007	0.067	0.002	0.000
LDDT34	0.016	0.001	0.002	0.015	0.000	0.001	0.019	0.016	0.170	0.017	0.001
HDDV2B	0.106	0.006	0.009	0.098	0.002	0.004	0.122	0.104	3.021	0.115	0.020
HDDV3	0.029	0.003	0.003	0.027	0.001	0.001	0.034	0.029	1.022	0.039	0.006
HDDV4	0.032	0.003	0.003	0.029	0.001	0.001	0.038	0.031	1.303	0.047	0.007
HDDV5	0.014	0.001	0.001	0.013	0.000	0.001	0.017	0.014	0.649	0.023	0.003
HDDV6	0.138	0.007	0.007	0.128	0.002	0.003	0.153	0.133	4.498	0.131	0.016
HDDV7	0.205	0.010	0.011	0.190	0.003	0.004	0.226	0.197	8.106	0.220	0.023
HDDV8A	0.302	0.037	0.013	0.279	0.009	0.005	0.351	0.294	12.448	0.304	0.028
HDDV8B	1.125	0.130	0.045	1.042	0.032	0.019	1.300	1.093	51.605	1.128	0.097
HDGB	0.002	0.000	0.000	0.002	0.000	0.000	0.003	0.002	0.129	0.001	0.001
HDDBT	0.044	0.001	0.001	0.040	0.000	0.000	0.045	0.041	1.257	0.034	0.002
HDDBS	0.085	0.002	0.002	0.079	0.000	0.001	0.089	0.080	1.668	0.044	0.004
Total	**2.713**	**0.796**	**1.027**	**2.502**	**0.199**	**0.435**	**4.536**	**3.136**	**164.506**	**4.004**	**7.483**

Table 5.4–4. Annual PM_{10} nonattainment area emissions by vehicle class (metric tons/year).

Vehicle type	PM_{10} Ext	PM_{10} Tire	PM_{10} Brake	$PM_{2.5}$ Ext	$PM_{2.5}$ Tire	$PM_{2.5}$ Brake	PM_{10} Total	$PM_{2.5}$ Total	NO_x	SO_x	NH_3
LDGV	61.4	94.5	147.7	56.7	23.6	62.6	303.6	142.9	9,047.6	241.0	1,199.0
LDGT1	13.2	17.3	27.1	12.4	4.3	11.5	57.6	28.2	1,708.0	56.8	216.7
LDGT2	44.0	57.7	90.2	41.1	14.4	38.2	191.9	93.8	7,523.0	189.0	721.3
LDGT3	15.8	19.2	30.0	14.6	4.8	12.7	65.1	32.2	2,881.7	82.1	237.7
LDGT4	7.3	8.8	13.8	6.7	2.2	5.8	29.9	14.8	1,754.6	37.7	109.2
HDGV2B	51.6	6.7	10.5	45.8	1.7	4.4	68.8	51.9	3,370.4	40.7	37.8
HDGV3	1.9	0.3	0.4	1.7	0.1	0.2	2.6	1.9	127.0	1.5	1.3
HDGV4	0.8	0.1	0.1	0.7	0.0	0.1	1.1	0.8	54.5	0.6	0.5
HDGV5	2.1	0.4	0.4	1.7	0.1	0.2	2.9	2.0	166.2	2.1	1.5
HDGV6	4.2	0.9	0.9	3.6	0.2	0.4	6.0	4.2	342.2	4.4	3.2
HDGV7	1.7	0.3	0.4	1.4	0.1	0.2	2.4	1.7	153.7	1.9	1.3
HDGV8A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HDGV8B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MC	2.9	0.5	1.7	2.0	0.1	0.7	5.1	2.9	170.2	1.3	1.6
LDDV	4.2	0.2	0.3	3.9	0.0	0.1	4.7	4.1	35.7	1.6	0.2
LDDT12	2.7	0.1	0.1	2.5	0.0	0.0	2.9	2.5	23.5	0.6	0.1
LDDT34	5.6	0.4	0.6	5.1	0.1	0.3	6.6	5.5	59.0	5.9	0.3
HDDV2B	37.0	2.1	3.3	34.2	0.5	1.4	42.3	36.1	1,051.0	40.0	7.1
HDDV3	10.0	1.0	1.0	9.3	0.2	0.4	12.0	10.0	355.7	13.5	2.2
HDDV4	11.0	1.0	1.1	10.2	0.3	0.5	13.1	11.0	453.4	16.5	2.3
HDDV5	4.8	0.5	0.5	4.5	0.1	0.2	5.8	4.8	225.8	7.9	1.1
HDDV6	48.1	2.4	2.5	44.5	0.6	1.1	53.1	46.2	1,565.2	45.7	5.5
HDDV7	71.5	3.5	3.7	66.2	0.9	1.6	78.7	68.6	2,820.4	76.5	8.0
HDDV8A	105.0	12.8	4.4	97.2	3.2	1.9	122.2	102.2	4,330.9	105.7	9.6
HDDV8B	391.6	45.1	15.7	362.5	11.3	6.6	452.3	380.4	17,955.2	392.4	33.8
HDGB	0.8	0.1	0.1	0.6	0.0	0.0	0.9	0.6	44.8	0.5	0.3
HDDBT	15.1	0.3	0.3	14.0	0.1	0.1	15.8	14.2	437.5	11.7	0.7
HDDBS	29.7	0.6	0.6	27.4	0.1	0.3	30.8	27.8	580.3	15.3	1.3
Total	**944**	**277**	**357**	**871**	**69**	**151**	**1,578**	**1,091**	**57,237**	**1,393**	**2,603**

Table 5.4–5. Annual Maricopa County emissions by vehicle class (metric tons/year).

Vehicle type	PM_{10} Ext	PM_{10} Tire	PM_{10} Brake	$PM_{2.5}$ Ext	$PM_{2.5}$ Tire	$PM_{2.5}$ Brake	PM_{10} Total	$PM_{2.5}$ Total	NO_x	SO_x	NH_3
LDGV	64.4	99.1	154.9	59.5	24.8	65.7	318.5	149.9	9,491.3	252.8	1,257.8
LDGT1	13.9	18.2	28.4	13.0	4.5	12.0	60.5	29.6	1,791.7	59.6	227.3
LDGT2	46.2	60.5	94.6	43.1	15.1	40.1	201.3	98.4	7,892.0	198.2	756.7
LDGT3	16.6	20.2	31.5	15.4	5.0	13.4	68.3	33.8	3,023.1	86.2	249.4
LDGT4	7.6	9.3	14.5	7.1	2.3	6.1	31.4	15.5	1,840.7	39.6	114.6
HDGV2B	54.1	7.0	11.0	48.1	1.8	4.7	72.1	54.5	3,535.7	42.7	39.6
HDGV3	2.0	0.4	0.4	1.7	0.1	0.2	2.7	2.0	133.2	1.6	1.4
HDGV4	0.9	0.1	0.1	0.7	0.0	0.1	1.2	0.8	57.2	0.7	0.5
HDGV5	2.2	0.4	0.4	1.8	0.1	0.2	3.0	2.1	174.3	2.2	1.6
HDGV6	4.4	0.9	0.9	3.7	0.2	0.4	6.3	4.4	359.0	4.6	3.4
HDGV7	1.8	0.4	0.4	1.5	0.1	0.2	2.5	1.8	161.2	2.0	1.4
HDGV8A	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HDGV8B	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
MC	3.0	0.6	1.8	2.1	0.1	0.8	5.4	3.0	178.5	1.4	1.6
LDDV	4.5	0.2	0.3	4.1	0.0	0.1	4.9	4.3	37.5	1.7	0.2
LDDT12	2.8	0.1	0.1	2.6	0.0	0.0	3.0	2.7	24.6	0.6	0.1
LDDT34	5.8	0.4	0.7	5.4	0.1	0.3	6.9	5.8	61.9	6.2	0.4
HDDV2B	38.8	2.2	3.4	35.9	0.6	1.5	44.4	37.9	1,102.6	42.0	7.4
HDDV3	10.5	1.0	1.0	9.8	0.3	0.4	12.6	10.5	373.1	14.2	2.3
HDDV4	11.6	1.1	1.1	10.7	0.3	0.5	13.8	11.5	475.6	17.3	2.4
HDDV5	5.1	0.5	0.5	4.7	0.1	0.2	6.1	5.1	236.9	8.3	1.1
HDDV6	50.5	2.6	2.7	46.7	0.6	1.1	55.7	48.5	1,642.0	48.0	5.7
HDDV7	75.0	3.7	3.9	69.4	0.9	1.6	82.5	72.0	2,958.7	80.2	8.3
HDDV8A	110.1	13.4	4.6	101.9	3.3	2.0	128.2	107.3	4,543.4	110.9	10.0
HDDV8B	410.8	47.3	16.4	380.3	11.8	7.0	474.5	399.1	18,835.8	411.7	35.5
HDGB	0.8	0.1	0.1	0.6	0.0	0.0	1.0	0.6	47.0	0.5	0.3
HDDBT	15.9	0.3	0.3	14.7	0.1	0.1	16.6	14.9	458.9	12.3	0.7
HDDBS	31.1	0.6	0.6	28.7	0.2	0.3	32.4	29.1	608.8	16.1	1.4
Total	**990**	**291**	**375**	**913**	**73**	**159**	**1,656**	**1,145**	**60,045**	**1,461**	**2,731**

5.4.2 AP-42 emission factors for paved and unpaved roads

While the exhaust, tire wear, and brake wear emissions 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, November 2006. AP-42 is the common name for the EPA Compilation of Air Pollutant Emission Factors. Specifically, sections 13.2.1 and 13.2.2 of AP-42 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. As described previously, paved roads were split into three silt loading levels; freeways with a silt loading of 0.02 grams per square meter, high traffic arterials, 0.067 grams per square meter, and low traffic arterials, 0.23 grams per square meter. All local roadways were assumed to fall into the low traffic arterial category. These silt loading estimates are consistent with the Serious Area PM_{10} Plan. When input to the AP-42 equation, these silt loadings result in the following PM_{10} emission factors: for freeways 0.15 grams per VMT, for high ADT non-freeways, 0.58 grams per VMT, and for low ADT non-freeways, 1.54 grams per VMT.

Applying the same AP-42 equation produces $PM_{2.5}$ emission rates of 0.00 grams per VMT for freeways and high ADT non-freeways and 0.06 grams per VMT for low ADT non-freeways.

The VMT in each silt loading category may be found in Table 5.2–2. Multiplying the paved road fugitive dust emission factors by the VMT estimates in Table 5.2–2 results in the emission totals for the PM_{10} modeling area shown in Table 5.4–6.

Table 5.4–6. 2005 paved road fugitive dust emissions in the PM_{10} modeling area.

	Emissions (kg/day)	
Silt Loading Category	**PM_{10}**	**$PM_{2.5}$**
Freeway	4,189	0
High Traffic Arterial	23,295	0
Low Traffic Arterial	14,920	581
Total	42,404	581

Applying the VMT ratios in Table 5.2–4 to the modeling area emissions in Table 5.4–6 produces the total 2005 paved road fugitive dust emissions in the PM_{10} nonattainment area and Maricopa County without reductions due to control measures in the Serious Area PM_{10} Plan. These results are shown in Table 5.4–7.

Table 5.4–7. 2005 paved road fugitive dust emissions without Serious Area PM_{10} Plan control measures.

Total emissions (kg/day)	PM_{10}	$PM_{2.5}$
Nonattainment area	42,701	585
Maricopa County	44,779	614

The Serious Area PM_{10} Plan contained a number of measures to reduce paved road fugitive dust emissions (MAG, 2000). The estimated emission reductions attributable to these measures in 2005 are summarized below in Table 5.4–8:

Table 5.4–8. Estimated emission reductions attributed to measures to reduce paved road fugitive dust.

Paved Road Control Measures	2005 PM_{10} Emission Reductions (kg/day)
1. PM_{10} Efficient Street Sweepers	6,441
2. Curbing, Paving or Stabilizing Shoulders on Paved Roads	1,412
3. Paving, Vegetating or Chemically Stabilizing Unpaved Access Points onto Paved Roads	590
Total 2005 PM_{10} Emission Reductions	**8,443**

Applying these control measures to the PM_{10} emissions in Table 5.4–7, results in the PM_{10} emissions shown in Table 5.4–9. The $PM_{2.5}$ emissions in Table 5.4–9 were obtained by applying the percentage reductions in PM_{10} (i.e., 19.8% for the NAA and 18.9% for Maricopa County) to the $PM_{2.5}$ emissions in Table 5.4–7.

Table 5.4–9. 2005 fugitive dust emissions from paved roads.

	PM_{10} Emissions			$PM_{2.5}$ Emissions		
Area	**kg/day**	**lbs/day**	**tons/yr**	**kg/day**	**lbs/day**	**tons/yr**
PM_{10} NAA	34,258	75,525	13,783	469	1,034	189
Maricopa County	36,336	80,106	14,619	498	1,098	200

For unpaved roads, emission factors from AP-42 were applied to the VMT estimates from the Serious Area PM_{10} Plan shown in Table 5.2–3. The unpaved road particulate emission factors were derived from the AP-42 equation for publicly accessible unpaved roads, assuming a silt content of 11.9%, soil moisture content of 0.5%, a mean vehicle weight of three tons, and an average speed of 25 mph. The resultant emission factor for PM_{10} is 666.62 grams per vehicle mile of travel. The comparable $PM_{2.5}$ emission factor based on AP-42 is 10 percent of the PM_{10} factor or 66.66 grams per vehicle mile. The unpaved road mileage estimates in Table 5.2–3 assume that all commitments to pave unpaved roads in the Serious Area PM_{10} Plan have been implemented by 2005. Multiplying the unpaved road emission factors by the VMT estimates in Table 5.2–3 results in the emissions for the PM_{10} modeling area shown in Table 5.4–10.

Table 5.4–10. Unpaved road fugitive dust emissions for the PM_{10} modeling area.

	Emissions (kg/day)	
Unpaved road type	**PM_{10}**	**$PM_{2.5}$**
High traffic	17,943	1,794
Low traffic	3,011	301
Total	20,954	2,095

Applying the VMT ratios in Table 5.2–4 to the PM_{10} modeling area emissions in Table 5.4–10 produces the total 2005 unpaved road fugitive dust emissions in the PM_{10} nonattainment area and Maricopa County. These results are shown in Table 5.4–11.

Table 5.4–11. 2005 fugitive dust emissions from unpaved roads.

	PM_{10} Emissions			$PM_{2.5}$ Emissions		
Area	**kg/day**	**lbs/day**	**tons/yr**	**kg/day**	**lbs/day**	**tons/yr**
PM_{10} NAA	21,101	46,519	8,490	2,110	4,652	849
Maricopa County	22,127	48,781	8,903	2,213	4,879	890

5.5 Summary of particulate emissions from onroad mobile sources

Table 5.5–1 summarizes the annual emissions (in English tons per year) and the average daily emissions (in pounds per day) for the pollutants PM_{10}, $PM_{2.5}$, NO_x, SO_2, and NH_3 from all onroad mobile sources in the PM_{10} nonattainment area in 2005. Similar data for all of Maricopa County is presented in Table 5.5–2.

Table 5.5–1. Annual and average daily 2005 emissions from all onroad mobile sources for the PM_{10} 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	1,041	960	63,093	1,536	2,870	5,702	5,258	345,713	8,415	15,725
Paved road fugitive dust	13,783	189				75,523	1,034			
Unpaved road fugitive dust	8,490	849				46,519	4,652			
Tire wear	305	76				1,673	418			
Brake wear	394	167				2,158	915			
Total:	**24,013**	**2,241**	**63,093**	**1,536**	**2,870**	**131,575**	**12,277**	**345,713**	**8,415**	**15,725**

Table 5.5–2. Annual and average daily 2005 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	1,092	1,007	66,187	1,611	3011	5,982	5,516	362,669	8,827	16,496
Paved road fugitive dust	14,619	200				80,104	1,098			
Unpaved road fugitive dust	8,903	890				48,781	4,879			
Tire wear	320	80				1,755	439			
Brake wear	413	175				2,264	960			
Total:	**25,347**	**2,352**	**66,187**	**1,611**	**3,011**	**138,886**	**12,892**	**362,669**	**8,827**	**16,496**

5.6 Quality assurance process

5.6.1 VMT estimates

Normal quality assurance procedures, including automated and manual consistency checks, were conducted by MAG in developing the 2005 EMME2 traffic assignment used to generate the VMT data. The MAG travel demand model VMT estimates have been validated against more than 3,000 traffic counts collected in 2002–2003, as well as Highway Performance Monitoring System data submitted annually by ADOT to the Federal Highway Administration.

5.6.2 Emission factor estimates

The quality assurance process performed on the MOBILE6.2 analyses included accuracy, completeness, and reasonableness checks. For accuracy and completeness, a system was used that included an independent reviewer. All calculations were checked independently for accuracy and completeness by the reviewer. Any errors found were corrected and the changes were then rechecked by the reviewer.

5.6.3 Draft particulate matter emissions inventory

The draft onroad mobile source portion of the 2005 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.

5.7 References

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US EPA, 2003b. User's Guide to MOBILE6.1 and MOBILE6.2 (Mobile Source Emission Factor Model), EPA420-R-03-010, August 2003.

US EPA, 2004. Technical Guidance on the Use of MOBILE6 for Emission Inventory Preparaton, EPA420-R-04-013.

6. Biogenic Sources

6.1 Introduction and scope

Biogenic source emission estimates have been calculated for particulate matter precursors for use in the 2005 Periodic PM_{10} Inventory. These biogenic source emission estimates are for Maricopa County and the approximately 3,000 square-mile portion of the PM_{10} nonattainment area within Maricopa County and a small portion of Pinal County. The biogenic emissions were estimated using the Model of Emissions of Gases and Aerosols from Nature (MEGAN). MEGAN is a state-of-the-art model, developed by Dr. Alex Guenther and ENVIRON International Corporation (Guenther, 2006a and b). MAG contracted with ENVIRON and Dr. Guenther in 2005 to develop a more reliable and accurate biogenic emissions model. Dr. Guenther performed field studies in June 2006 to measure vegetation emission rates within Maricopa County. During 2006, Dr. Guenther also collected data on desert plant emission rates in Clark County, Nevada. Due to the incorporation of emission rates that are more characteristic of plants located in the desert southwest, the MEGAN estimates represent a substantial improvement over previous biogenic emission estimates for Maricopa County. Among the chemical species included in MEGAN, only nitric oxide (NO) is attributable to PM formation. Therefore, only NO_x emissions are included in the inventory.

6.2 MEGAN input files

To calculate biogenic emissions using MEGAN, seven gridded input files were prepared:

- User domain file: this file describes the user's domain such as the number of grid cells, grid cell size, and latitude and longitude coordinates of grid cells
- Solar radiation and temperature file
- Monthly Leaf Area Index (LAI) file
- Plant Functional Type (PFT) file
- Emission Factor (EF) file
- Wind speed and humidity
- Soil moisture

Since MEGAN requires that all input data files be provided for grid cells defined in the user domain file, gridded meteorological data (e.g., temperature, solar radiation, wind speed and humidity, and soil moisture) generated by the Penn State/NCAR Mesoscale Meteorological Model 5 (MM5) for MAG 8-hour ozone modeling were provided to MAG by ENVIRON. The MM5 meteorological data files were reformatted for MEGAN input. LAI, PFT and EF files for Maricopa County developed by Dr. Guenther were extracted from the MEGAN database using the MEGAN driving variables processor.

6.3 Emission estimation

Since MM5-generated meteorological data for all days in 2005 were not available, NO emission estimates from MEGAN for May 31 to June 7, 2002 for the MAG 8-hour ozone modeling area were employed to derive 2005 daily average NO emissions for the PM_{10} nonattainment area and Maricopa County. The PM_{10} nonattainment area, Maricopa County, and 8-hour ozone modeling area are delineated in Figure 6.3–1.

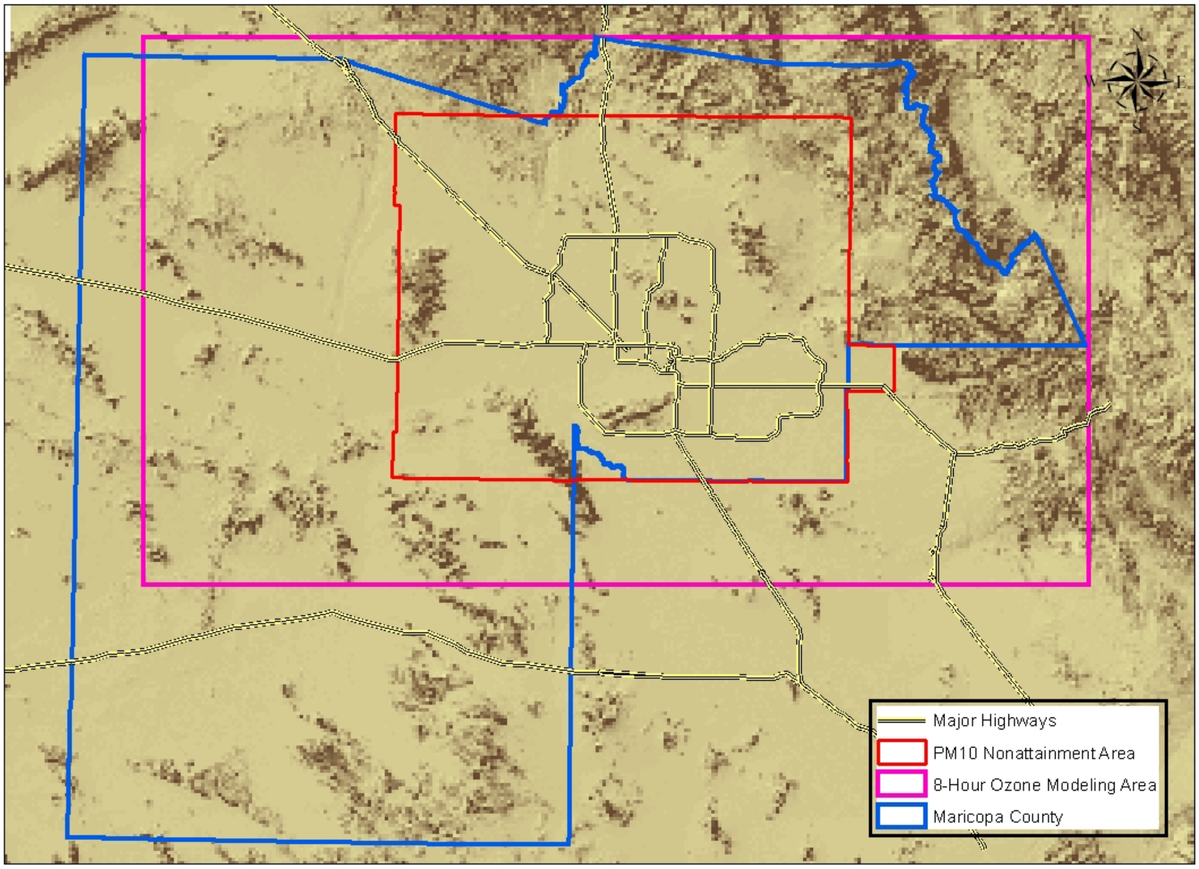

Figure 6.3–1. Boundaries of PM_{10} Nonattainment Area, 8-Hour Ozone Modeling Area and Maricopa County

The daily average NO emissions for the 8-hour ozone modeling area within Maricopa County and PM_{10} nonattainment area were extracted from NO emissions for the 8-hour ozone modeling area using GIS. The extracted daily NO emissions for May 31 to June 7, 2002 for the Maricopa County portion of the 8-hour ozone modeling area and PM_{10} nonattainment area are provided in Tables 6.3-1 and Table 6.3-2, respectively.

However, the emissions developed for the 8-hour ozone modeling area do not cover 7,295 square kilometers of the western and southern areas of Maricopa County. To obtain NO emissions for all of Maricopa County, emissions per square kilometer were calculated using MEGAN NO emission estimates for a 1,600 square kilometer area in the southwest corner of the 8-hour ozone modeling area. This relatively remote and largely unpopulated area was assumed to be representative of vegetation in the portion of Maricopa County that was not modeled for 8-hour ozone. The average NO emissions per square kilometer for the 1,600 square kilometer area, 0.3505 kg/km^2-day, was multiplied by 7,295 square kilometers. The result, 2,557 kg/day, was added to NO emissions estimated for the 8-hour ozone modeling area within Maricopa County to obtain total biogenic NO emissions for all of Maricopa County.

Table 6.3–1. Daily NO emissions in the 8-hour ozone modeling area (Maricopa County).

Date	NO (kg/day)
5/31/2002	6,414
6/1/2002	5,921
6/2/2002	5,197
6/3/2002	4,742
6/4/2002	4,926
6/5/2002	5,655
6/6/2002	6,536
6/7/2002	6,182
Average	**5,697**

Table 6.3–2. Daily NO emissions in the PM_{10} nonattainment area.

Date	NO (kg/day)
5/31/2002	2,920
6/1/2002	2,707
6/2/2002	2,371
6/3/2002	2,169
6/4/2002	2,262
6/5/2002	2,598
6/6/2002	2,993
6/7/2002	2,829
Average	**2,606**

6.4 Summary of biogenic source emissions

Annual and typical daily NO_x biogenic emissions for Maricopa County and the PM_{10} nonattainment area are summarized in Tables 6.4–1.

Table 6.4–1. Annual and typical daily NO_x biogenic emissions.

Geographic area	Annual emissions (metric tons/yr)	Annual emissions (tons/yr)	Season-day emissions (kg/day)	Average daily emissions (lbs/day)
Maricopa County	3,013	3,321	8,254	18,197
PM_{10} NAA	951	1,048	2,606	5,745

6.5 References

Guenther, A., 2006a. User's Guide to Processing Driving Variables for Model of Emissions of Gases and Aerosols from Nature (MEGAN), August 14, 2006.

Guenther, A., 2006b. User's Guide to the Model of Emissions of Gases and Aerosols from Nature (MEGAN) Version MEGAN-VBA-2.0, August 28, 2006.

ENVIRON International Corp., Final Report, Maricopa Association of Governments 2006 Biogenics Study, September 11, 2006.

Appendix 1

Responsiveness Summary to Comments Received on Public Review Draft 2005 Periodic Emissions Inventory for PM_{10} for the Maricopa County, Arizona, Nonattainment Area

Responsiveness Summary to Comments Received on

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The purpose of this document is to present public comments and responses to comments received on the public review draft of the 2005 Periodic Emissions Inventory. The Maricopa County Air Quality Department (MCAQD) released the 2005 PM_{10} emissions inventory for public review and comment on January 23, 2007. The public review period ended on March 1, 2007. MCAQD and the Maricopa Association of Governments (MAG) have evaluated the comments received on the PM_{10} emissions inventory and prepared written responses to these comments. Table 1 contains a list of all individuals who submitted comments. Comments are taken verbatim from written comments received with a few minor exceptions (some ancillary tables and general introductory/closing statements not directly germane to the emission inventory calculations are not reproduced here). Comments about ambient air monitoring, control measures, dispersion modeling, zoning, source clustering, compliance, and complaint response are outside the scope of the emissions inventory report.

Table 1. Written Comments Received.

Comment Number	Commenter	Affiliation	Date Received
1	Charlie Carrier	n/a	Jan. 25, 2007
2	John Enkoji	n/a	Feb. 1, 2007
3	Oddvar Tveit	City of Tempe	Feb. 12, 2007
4 A–H	Stephen M. Brittle	Don't Waste Arizona, Inc.	Feb. 12, 2007
5 A–F	Tom Merrifield	n/a	Feb. 22, 2007
6 A–G	Shirley McDonald	Joint Environmental Task Force	Feb. 22, 2007
7	Shirley McDonald	Joint Environmental Task Force	Feb. 22, 2007
8 A–L	Amanda McGennis and Albert H. Acken, Lewis and Roca, LLP On behalf of Spencer Kamps	–Arizona Chapter of Associated General Contractors –Home Builders Association of Central Arizona	Feb. 22, 2007
9 A–L	Attachment to Comment #8 - Memorandum from Jim Wilson, et al., E.H. Pechan & Associations	–Arizona Chapter of Associated General Contractors –Home Builders Association of Central Arizona	Feb. 22, 2007
10	Larry Biland	U.S. Environmental Protection Agency	Feb. 22, 2007

Comment #1:

Living near the intersection of Lindsay and Riggs Roads, I have had plenty of opportunity to observe poor air quality. While there has been an abundance of new home building in this area the past 5 years, most of the builders have been pretty good in trying to comply with the “no dust” rules imposed by the county. The major problem that we have down here stems from 3 sources: 1. The existing farms that continue to pulverize the soil prior to planting cotton, etc. 2. The dairy farms where the powdered manure gets carried aloft with each passing breeze. 3. The Gila River reservation which plows and discs the soil for weed control, but is yet to plant anything to retain the soil. Since all three of these sources are “Grandfathered” in, they really have no incentive to lessen their dust-causing activities. Until the state or federal government gets serious about dust abatement it won't matter how much bluster is raised on this issue. Our legislature probably needs to give some sort of incentive such as a tax credit or something along that line to bring the farmers on board. What we can do about the problems arising on the reservation is probably beyond our reach. I wish you good luck in your quest.

Response #1:

Dust compliance issues from agriculture, dairies, and tribal lands are outside the scope of the emissions inventory report. However, for your information within the Maricopa County PM_{10} nonattainment area, agriculture is required to implement best management practices to reduce PM_{10} emissions under Arizona Department of Environmental Quality's (ADEQ's) Agricultural PM_{10} General Permit (Arizona Administrative Code R18-2-611). Agricultural dust complaints can be filed on ADEQ's online complaint form at: http://www.azdeq.gov/function/ compliance/complaint.html or by calling (602) 771-2324.

Fugitive dust from dairies is regulated under Maricopa County Rule 310.01. The Maricopa County Air Quality Department's Dust Compliance Division investigates dust complaints concerning commercial livestock areas. Rule 310.01 imposes a 20% dust opacity limit and requires the prevention of excessive emissions of fugitive dust and implementation of one of the following control measures: dust suppressants (water or dust palliative), surface gravel, or shrubs and/or trees within 50 feet of animal pens. Dust complaints can be filed on line with Maricopa County Air Quality Department at: http://www.maricopa.gov/aq/contact_us/forms/dust_form.asp or by calling (602) 372-2703.

According to staff at the Gila River Indian Community's Department of Environmental Quality, the agricultural fields mentioned by the commenter have been out of production due to lack of water; however, these fields are expected to go back into production in early summer 2007, once water is received under a water rights settlement. Air quality concerns on the Gila River Indian Community can be referred to the Gila River Indian Community's Department of Environmental Quality by calling (520) 562-2234.

Comment #2:

> One way to reduce emissions would be to ban drive up windows throughout Maricopa County. This would include fast food restaurants, banks, dry cleaners, pharmacies, etc. While convenient, they serve no essential or critical purpose and are only luxuries that should be banned in the interests of helping to clean our air. If the ban were universal and county wide, no specific business or establishment would suffer a disadvantage or gain an advantage. The numbers of cars that are idling at drive up windows on a daily basis in the county must number in the hundreds of thousands.

Response #2:

Development of potential control measures to reduce emissions is outside the scope of the emissions inventory. However, the Maricopa Association of Governments (MAG) is in the process of developing a preliminary draft comprehensive list of control measures to reduce PM_{10} for a new PM_{10} SIP. Your suggestion has been forwarded to MAG for consideration.

Comment #3:

> The non-road mobile sources inventory for airport ground support equipment calculates emissions for 8 towered airports using the MAG Airport Emission Model that is limited to ground support equipment (Auxiliary Power Units). Below I have compared the numbers with calculations the URS Corporation did for the FAA for proposed projects at the PHX Sky Harbor International Airport in the 2006 EIS using a different model, FAA's Emission and Dispersion Modeling System. The numbers below are taken from table 3.5.9.1 in the FEIS that also include airport non-road on-site vehicle traffic. It appears that the draft 2005 inventory only accounts for Sky Harbor emissions, or is the use of different models/input the reason for this discrepancy in tpy inventories?

Inventory	Sources	PM_{10}	$PM_{2.5}$	NOx	SOx	NH3
PHX Final EIS (2001)	On-site Vehicles	7	5	233	n/a	n/a
	GSE	11	10	424	n/a	n/a
MAG 2005 Draft Emission Inventory	GSE	16.5	15.7	467.82	14.71	n/a

Response #3:

The MAG Airport Emissions Model was used to generate 2005 ground support equipment emissions for all the towered airports in Maricopa County. The airport emissions model was developed under Phase II of the MAG Aviation Air Quality Study, November 1996.

The table below lists the contribution from each of the towered airports in Maricopa County. It is clear from the table that Sky Harbor alone contributes more than 85% of the total emissions from GSE. MAG staff had not had an opportunity to review the methodology used by FAA in developing the FEIS for Sky Harbor. However, the differences between the Phoenix FEIS and the MAG 2005 GSE estimates are most likely explained by the used of different models and input assumptions.

Pollutant Contribution from GSEs at Towered Airports in Maricopa County

Airport	CO	NO_X	SO_2	PM_{10}	$PM_{2.5}$
Chandler	1%	1%	1%	0%	0%
Glendale	1%	0%	1%	0%	0%
Mesa Falcon	3%	1%	1%	0%	0%
Dear Valley	0%	0%	0%	0%	0%
Goodyear	4%	2%	2%	1%	1%
Sky Harbor	86%	89%	89%	92%	92%
Scottsdale	1%	1%	1%	1%	1%
Williams Gateway	3%	6%	5%	5%	5%

Comment #4 A & B:

> The draft emissions report draft (2005 Periodic Emissions Inventory for PM_{10} for the Maricopa County PM_{10} Nonattainment Area) is fatally flawed. For one thing, the emissions from sand and gravel operations and asphalt batch plants are exponentially under-stated.
>
> The MCAQD has systemically and programmatically failed to accurately account for the PM_{10} and $PM_{2.5}$ emissions from sand and gravel outfits operating in Maricopa County. Don't Waste Arizona, Inc. (DWAZ) has reviewed the annual emissions reports of several sand and gravel operations in Maricopa County, covering several years, and the reported PM emissions have no basis in reality. Some sand and gravel operations have reported no (zero) emissions of PM, year after year, while others have filed amounts that are vastly understated. This could indicate several things: 1) the agency itself has no quality control over the emissions reports being filed; and/or 2) there is someone at the agency who has deliberately allowed this to occur, i.e. corruption. In any event, the problem is systemic, and indicates that the entire county air program is fatally flawed.

Response #4 A & B:

All annual emission reports undergo a number of quality control checks; these are described in detail in Section 2.7 of the report. While the County does not currently regulate emissions of $PM_{2.5}$, EPA's Consolidated Emissions Reporting Rule (CERR) requires that $PM_{2.5}$ be estimated and reported in periodic emissions inventories. Thus $PM_{2.5}$ emissions are estimated based on calculated PM_{10} emission rates, using standard procedures outlined by EPA or other regulatory agencies (e.g., the California Air Resources Board).

Comment #4 C & D:

> Further investigation into the agency's oversight of these sand and gravel outfits shows that their required dust control plans are frankly a joke. Several of these sand and gravel outfits claim that the enormous piles of dirt they create have a "natural moisture content" that prevents blowing dust. DWAZ has seen no evidence that MCAQD has ever tested the soil moisture content of any of these. Other ridiculous assertions include statements that driving trucks over miles of unpaved roads are controlled and produce little dust.
>
> Some facilities state that their water trucks are responsible for keeping piles of dirt and dirt roads watered, yet when the agency actually showed up due to complaints, the inspector found that the water truck was not working.

Response #4 C & D:
The issue of enforcement in the sand and gravel industry is beyond the scope of the emissions report. The Department is currently in the process of conducting full inspections at all Maricopa County permitted sand and gravel facilities. All submitted dust control plans will be reviewed over the next several months for revision, where necessary, and approval.

Stockpiled materials will retain moisture from process controls with the surface subject to drying. Stabilization of the stockpile surface, in compliance with Maricopa County Rule 316, by crusting with water, application of dust suppressants, covers, or other methods are intended to control wind generated fugitive emissions. The soil moisture does not need to be tested unless there is a question of compliance with Rule 316 subsection 306.1 or 306.5.

Rule 316 is not a zero emissions regulation, however through the use of water, palliatives, or other dust suppressants unpaved roads fugitive dust generation and stabilization standards may be in compliance with the regulation. Comments made on an inspection report are intended to convey issues as observed at time of inspection. A non-operational water truck does not always indicate that a facility is in violation of a permit condition or rule standard. Violations are only issued based on inspector observations which unfortunately do not always occur contemporaneously with complainant observations.

Comment #4 E & F:

> There is a faulty response to citizens' complaints, or not even a response. Citizens complain, then no one ever investigates or responds. In some cases, the inspector has called days or weeks after the complaint was filed, and if the inspector does not reach the complainant, there is no on-site investigation. When the head of the agency is notified that there has been no follow up to the complaint, nothing changes.
>
> There are no night-time or weekend inspectors, and sand and gravel operations stop using spray bars and emit enormous amounts of dust without ever reporting these emissions on emissions reports. Even when these are reported to the director of the agency, no enforcement action or investigation ensues. (See a short video of what goes on at night at http://www.dontwastearizona.org/gravel.html) This URL was supplied to the agency director, and there was no action taken. The problem persists.
>
> There is a lack of inspections while these sand and gravel outfits are actually operating. Time after time, the agency inspector shows up to conduct an annual inspection, and the facility is not in operation at that time, and the inspector does not return that year.

Response #4 E & F:
Response to citizen complaints and other enforcement issues are beyond the scope of the emissions report. Starting December 2006, inspection of the sand and gravel facilities became a shared responsibility between Dust Compliance and Stationary Source Compliance. This effectively increased the number of responding inspectors by 30. The Department is committed to responding to all complaints within 24 hours and is working on plans to institute a second and weekend shift pending

approval of staffing. By Department policy all fugitive dust complaints result in an inspection and contact with the complainant where possible.

Comment #4G:

> There are portable facilities operating in Maricopa County using ADEQ-issued permits. There are no records of their emissions or of any inspections of these outfits while they are operating by ADEQ. None of these emissions are accounted for in the draft report.

Response #4G:

On the contrary, portable sources with permits issued by ADEQ are addressed in section 3.3.11 of the report, "State-permitted portable sources". Emissions attributable to activity within Maricopa County were estimated based on information provided by the Arizona Dept. of Environmental Quality.

Comment #4H:

> The worst air quality is in the areas where sand and gravel outfits are operating, along the Salt River Bed and along the Agua Fria riverbed. There are several of these sand and gravel outfits along the Salt River Bed, which has the highest PM levels, and where the exceedances of the federal standard have occurred. Rusty Bowers, while a state senator, demanded that the MCAQD's air monitors at the 22nd Avenue and Lower Buckeye Road location be moved. He is now officially the lobbyist for the sand and gravel outfits. The City of Phoenix was complicit in the moving of the 22nd Avenue and Lower Buckeye Road monitor to 43rd Avenue and Broadway because of its vast earthmoving project, the Rio Salado Project, and the certainty that this would trigger even more exceedances at that monitor.
>
> The second worst place for PM concentrations in the ambient air in Maricopa County is in the Sun City area, where there are 26 sand and gravel outfits and asphalt plants in a five-mile radius operating along the Agua Fria riverbed. The MCAQD's own money was spent to conduct this monitoring. There is no industry in Sun City other than the 26 sand and gravel outfits and asphalt plants. Folks there don't commute to work. Clearly, the 26 sand and gravel outfits and asphalt plants are the source of the particulate matter.

Response #4H:

Annual emissions from mining and quarrying sand and gravel operations are included in the 2005 PM_{10} emissions inventory in Chapter 2 (Point Sources) and Chapter 3 (Area Sources). Ambient monitor siting and ambient concentrations are outside the scope of this report; however, MCAQD would like to clarify the facts pertaining to comments made regarding relocation of the Salt River monitor and PM_{10} concentrations in Sun City.

The Salt River monitor was established at a City of Phoenix vehicle maintenance yard (near 19th Avenue and Lower Buckeye Road) in 1994. In January 2002, the monitor site was relocated from its original location in the southeast corner of the property to the roof of the City office building on the property. Removal of the monitor site was requested by the City of Phoenix because of scheduled construction on and near the vehicle maintenance yard property (unrelated to the Rio Salado project construction which actually began in 2000).

Efforts to find a suitable replacement site with comparable PM_{10} concentrations and industrial emissions were conducted by Maricopa County and Arizona Department of Environmental Quality in 2002. The West 43rd Avenue site was determined to be a suitable replacement site. This site is located at a Maricopa County Department of Transportation storage lot and is surrounded by a combination of heavy industry and residential homes. The main purpose of the monitor is to measure maximum concentration PM_{10} and to determine the impact on ambient pollution levels of significant sources or source categories. The sources around the site include sand and gravel operations, auto and metal recycling, landfills, paved and unpaved haul roads, and cement casting.

In 2002, ADEQ analyzed the PM_{10} concentrations and source attributions for the West 43rd Avenue site and the Salt River site. The results of ADEQ's analysis are documented in the Salt River PM_{10} State Implementation Plan Revision.[1] ADEQ concluded that despite the contrast between the two sites in their nearby emission sources, the PM_{10} concentrations were nearly equivalent. Their analysis showed that diurnal patterns are similar and late evening and early morning concentrations were nearly identical. ADEQ concluded that since PM_{10} concentrations at the West 43rd Avenue site are higher than the Salt River site, the former is an adequate replacement for the latter. This equivalence was also born out by a cursory look at the regulatory important extreme values. In 2002, the Salt River PM_{10} maximum concentrations were 249, 184, and 174 $\mu g/m^3$, with the first two under high wind conditions. At West 43rd Avenue, the highest PM_{10} concentrations were about the same: 243, 174, and 181 $\mu g/m^3$, with the first two under high wind conditions. Under low-wind and high-wind conditions, the two sites recorded equivalent maximum 24-hour average PM_{10} concentrations.

In response to concerns from Sun City residents in the vicinity of several sand and gravel operations, in 2004 MCAQD contracted with Weston Solutions, Inc. to conduct a 4-month ambient air quality study along the Agua Fria River basin in the Sun City area. The study focused on particulate matter and polynuclear aromatic hydrocarbons (PAHs). Only a single day at one monitoring location had a 24-hour PM_{10} concentration above NAAQS of 150 $\mu g/m^3$. This concentration was caused by a natural occurrence which was recorded on a county-wide basis and was not the result of a particular source or industry. The event resulted in elevated PM_{10} concentrations at all the study monitors. Furthermore, since this was a single occurrence in a short-term monitoring program (less than 1 year), this elevated concentration does not constitute a violation of the NAAQS.

Lastly, in response to Sun City residents concerns, in spring 2007, MCAQD installed a special purpose PM_{10} monitor in the Coyote Lakes subdivision of Sun City near 111th Avenue and Beardsley on April 1, 2007. The real-time data is available on the county website at http://www.maricopa.gov/aq/divisions/monitoring/Default.aspx.

Comment #5A:

> The fundamental question I have when reviewing this document is "where the beef;" by that I mean "where is the data." Because the "data" for this study is primarily a calculation for each facility or activity, I feel that appendices should be available to review that shows calculations for each permitted facility mentioned or activity. I think there is too much latitude for error and misrepresentation of the calculations. Furthermore, for each permitted facility or activity, there needs to be more detail on any adjustments made, for instance, how were contributions made when NOVs were issued, when operating in a manner inconsistent with the permit. In the report oral conversations with a facility were noted as part of the data base; notes from those conversations should be included in the appendix.

Response #5A:

The emissions inventory report follows EPA guidelines for required documentation. Individual facility reports are available at the Department offices and are available for inspection and review upon request; reproducing this level of detail in the inventory report itself would be inefficient (and cost-prohibitive). In developing emission inventories for SIP planning purposes, the US EPA requires the application of rule effectiveness which is designed to reflect the fact that regulatory programs typically achieve less than full compliance. Section 2.3.2 of the report describes the application of rule

[1] Final Salt River PM_{10} State Implementation Plan Revision, Technical Support Document Chapter 3, Arizona Dept. of Environmental Quality, Air Quality Division, January 2004.

effectiveness, and all facilities that that have had rule effectiveness applied to their emission calculations according to current EPA guidance, are clearly indicated in the report.

Comment #5B:

> I feel that any monitoring data gathered needs to be included. This data needs to be utilized to calibrate and adjust the calculations. Perhaps this was done in this report; if so, this needs to be made very clear, perhaps in a separate chapter.

Response #5B:

MCAQD assumes that the commenter is referring to monitoring data from stationary source continuous emissions monitors (CEMs) rather than ambient air monitoring data. Data from CEMs are preferred for estimating a source's emissions; however, CEMs data from individual sources are not always available. The EPA only requires certain large stationary source categories to install and operate CEMs. Electric utilities are the only source category operating within Maricopa County, required to operate CEMs. Thus, source performance tests and emission factors are frequently the best or only method available for estimating emissions.

Maricopa County has an established annual reporting program for sources with air quality permits. Businesses submitting annual emission reports must use the most accurate method for calculating actual emissions. Whenever available, emissions are calculated based on CEMs data. When CEMs data are not available, emissions are calculated based on source performance tests, material balance, emissions factors from EPA's AP-42, or by equivalent methods supported by back-up documentation that will substantiate the chosen method.

Comment #5C:

> I feel there needs to be a chapter entitled "Analysis or Interpretation" of the data and a chapter entitled "Summary or Conclusion/Recommendations." I understand this is an inventory, but the EPA is asking this inventory to be done for a reason. It is unclear to me what this inventory is going to do for the public in order to address the overall problem of non-attainment of PM_{10}.

Response #5C:

The Clean Air Act requires states with areas failing to meet National Ambient Air Quality Standards (NAAQS) to produce a state implementation plan (SIP). A SIP is an enforceable plan developed at the state and local level that explains how the area will comply with air quality standards according to the Federal Clean Air Act and its amendments.

The PM_{10} emissions inventory is one component of the SIP currently being developed to address the PM_{10} problem in Maricopa County (referred to as the "Five Percent Plan"). The Five Percent Plan will include historical background information, a description of the nonattainment area, an assessment of air quality conditions and ambient air quality data for the area, an emissions inventory of sources of pollutants, control strategies, an attainment demonstration, and contingency provisions. Before the Five Percent Plan is submitted to EPA in December 2007, it will be available for public review. The public review phase is slated for fall 2007.

Comment #5D:

> In order to address the EPA compliance issue of non-attainment for Maricopa County, this inventory of data needs to be mapped and an analysis of the density of tonnage of pollutants can be better estimated. This really needs to be completed in order to address Item #2 above *(see comment #5B in this document)*. The results of this density analysis should be used to address where more monitoring stations need to be set up to calibrate the inventory data throughout Maricopa County.

Response #5D:
Ambient air monitoring stations are set up to measure ambient air not to calibrate the emissions inventories. MCAQD's Air Monitoring Division maintains ambient air monitoring networks within the borders of Maricopa County. The purpose of the ambient air monitoring network is to sample air pollution in a variety of settings, assess the health and welfare effects, and assist in determining sources of air pollution.

Conversely, emissions inventories are developed to meet Federal Clean Air Act requirements and they provide a baseline understanding of local and regional sources of emissions. The Maricopa Association of Governments is developing a PM_{10} state implementation plan (referred to as the Five Percent Plan). The Five Percent Plan must show reductions in PM_{10} emissions of five percent per year until attainment is achieved at all monitors. The 2005 PM_{10} emissions inventory will be the starting point for the five percent per year reductions.

The Five Percent Plan will also include an assessment of air quality conditions and ambient air quality data for the area and must demonstrate through modeling that the PM_{10} standard will be met at all monitors. Before the Five Percent Plan is submitted to EPA in December 2007, it will be available for public review. The public review phase is slated for fall 2007.

Comment #5E:

> Where the density of pollutant emissions are high, care needs to be taken to ensure that ARS 49-401-B is not violated. This statute states that a new facility shall not begin operation if existing air quality is already degraded beyond the EPA standards.
>
> In my mind the EPA standards are what protect my health and my property through the vehicle of ARS 49-401A, and as a person living 180 feet down gradient from a future emitting facility, I question the applicability of the calculations presented herein in order to ensure compliance with the statute. The calculations in this report tell me nothing about how this inventory affects me personally. In my mind this report so far has been a waste of my tax dollars.

Response #5E:
The comment is outside the scope of this emissions inventory report. An emissions inventory is not meant to provide a measurement of impacts on a particular individual. An emissions inventory is a comprehensive listing by source category of air pollutant emissions. Emissions inventories are developed to meet Federal Clean Air Act mandates and to identify sources and general emission levels, patterns, and trends to develop control strategies and new regulations.

Conversely, ARS 49-401-B requires industries to operate within the emission standards set by the director of the Arizona Department of Environmental Quality. The Maricopa County Air Quality Department has the legal authority to enforce all Air Quality Rules and Ordinances within County borders. The rules are adopted under the authority granted by Arizona Revised Statures §49-479 to fulfill the State's responsibilities under the Federal Clean Air Act and its amendments to provide a legally enforceable State Implementation Plan for the attainment and maintenance of the National Ambient Air Quality Standards.

The Maricopa County Air Pollution Control Regulations were put in place with the goal of assisting Maricopa County in complying with the Federal health-based National Ambient Air Quality Standards. Air permit conditions are based on an engineering review, which included the calculation of potential emissions, and an analysis of applicable County, State, and Federal regulations. Each facility is required to comply with all applicable Maricopa County Air Quality Department regulations and standards related to their operations. Failure to meet the requirements of all applicable rules can result in an enforcement action to be brought against the facility.

Comment #5F:

> Personally I am involved in negotiating with a future emitting facility 180 feet from my house because in my opinion the Maricopa County zoning laws for county islands are so relaxed and do not support ARS 49-401-A. I feel the negotiations with the future emitting facility next to my house are going very well, but I still question the legality of the county zoning laws given the statements made in ARS 49-401-A, which should apply to the entire state. I am not a lawyer, but in my opinion the County is using an archaic federal mining law to be used as a basis for granting an exemption to normal zoning regulations that would protect me, my family and my property under ARS 49-401-A. It appears to me to be a local vs. federal rights legal issue. The irony is that the local government is using federal law to govern locally, which to me is absurd, and I question its legality, especially in view of the state statute.

Response #5F:

Zoning issues are outside the scope of this emissions inventory report.

Comment #6A:

> The para. 2.3.4 example calculation on page 20 uses a rule effectiveness factor of 93.88% for a “point source” process. Since this plant (River Ranch Plant #40) was listed in Table 2.4-1 as a “point source”, it appears that this would be the correct RE factor. However, when applying the “non-point” source RE factor (54.36%) from paragraph 2.3.4, to the annual emission report PM_{10} annual totals for each of four Rinker plants, it appears that the numbers in Table 2.4-1 were derived using this factor rather that the point source factor. Why?

Response #6A:

In the example equation on page 20, of section 2.3.4, which describes how annual emissions are calculated to incorporate rule effectiveness, MCAQD incorrectly applied the point source RE percentage (93.88%) to a process that should have used the Rule 316 effectiveness study percentage (54.36%). As stated in Appendix 2.2, all processes that are subject to Rule 316 and use a manual control such as watering are subject to the Rule 316 effectiveness percentage (54.36%), regardless if the process is categorized as a point or non-point process. Table 2.4-1 correctly summarizes the emissions from each facility and includes processes that are subject to the Rule 316 effectiveness percentage (54.36%). MCAQD will correct the example equation in section 2.3.4.

Comment #6B:

> Are all of the sand and gravel mining plant data derived from the nonpoint source factor? Are you going to collect fees for the extra emissions?

Response #6B:

Data used to calculate emissions from sand and gravel facilities are based on annual surveys completed by individual sand and gravel facilities from within Maricopa County. MCAQD reviews the annual surveys for completeness and accuracy of data submitted. For this report, MCAQD also applies rule effectiveness percentages to each reported process where appropriate. For sand and gravel facilities, all processes that are manually controlled by water and are subject to Rule 316, a rule effectiveness percentage of 54.36% is applied to those processes (see Appendix 2.2). Processes that are not controlled manually with water (such as a baghouse) apply the point source rule effectiveness percentage of 93.88% (see Appendix 2.3). For processes where no controls are used, neither the point source nor the Rule 316 rule effectiveness percentages apply.

Emission fees are outside the scope of the emissions inventory report. See Response #6C for an explanation of increased individual facility emissions due to the application of rule effectiveness percentages.

Comment #6C:

> When the PM_{10} permit limits for seven plants are compared with the annual emissions shown in Table 2.4-1, six of the seven are out of limits. Are you going to compare all of the plant permit limits with the annual emissions shown in Table 2.4-1? Are you going to issue violations? Why not?

Response #6C:

The application of rule effectiveness percentage can substantially increase an individual facility's base reported emissions. Rule effectiveness percentages are a useful tool in the development of regional inventory to help predict the effects of assumed operator error and faulty control equipment. It is possible that the process of applying rule effectiveness to individual facilities will increase their annual emissions beyond their permit limits. However, annual emission estimates that include adjustments for rule effectiveness cannot be used for compliance purposes, as compliance with permit limits is based on actual reported emissions.

Comment #6D & E:

> Of the 30 permits that we have, 23 would be considered point sources according to the 5 tpy criterion. Six of these are 2006 permits. In the July 7, 2005 response to comments for the 3/15/05 Vulcan permit #970105 Hearing, it is stated that there are 87 sand and gravel operations in the valley. Add the six 2006 permits, and it becomes 93 plants. If 23/30 permits are point sources, then the number of point sources listed in Table 2.4-1 should be about 70 rather than the 20+ shown there. The criterion is the 5tpy not whether a plant is portable or not.
>
> With numbers like these that are questionable, how are you going to convince the public and the EPA that you have caused a 5% reduction this year and for the next 3 years?

Response #6D & E:

MCAQD determined which facilities are categorized as point sources through a review of all 2005 annual emissions reports that were submitted to MCAQD. In order to be categorized as a point source, a facility needed to have actual reported emissions that meet or exceed 25 tons of carbon monoxide (CO); or 10 tons of either volatile organic compounds (VOC), oxides of nitrogen (NO_x), or sulfur oxides (SO_x); or 5 tons of either particulate matter less than 10 microns (PM_{10}) or ammonia compounds (NH_x). In addition to meeting or exceeding one of the pollutant thresholds noted above, MCAQD chose to list only the permanent stationary sources (non-portable) as part of Chapter 2 (Point

Sources). MCAQD-permitted portable concrete batch and sand and gravel facility emissions are included in Chapter 3 (Area Sources) Sections 3.3.4 and 3.3.5, respectively. All MCAQD-permitted portable were assumed to operate in the nonattainment area in order to conservatively estimate emissions. ADEQ-permitted portable facility emissions are included in Section 3.3.11. MCAQD listed 36 MCAQD-permitted facilities in the point source chapter that engage in sand and gravel activity. 71 MCAQD-permitted facilities comprise the area source section for sand and gravel activities (mining and quarrying, 3.3.5); and of those 71, 23 are listed as portable sand and gravel permits. ADEQ reported 69 ADEQ-permitted portable sources that comprise the emissions in Section 3.3.11.

Comment #6F:

> The nonroad internal combustion engines that are exempt still contribute to the nonattainment here. Add their pollution to the totals. Some are 1000hp.

Response #6F:
All emissions from nonroad engines are included in Chapter 4. Nonroad engines associated with sand and gravel or concrete batch facilities are included in Section 4.5 (Construction and mining equipment) and 4.6 (Industrial equipment).

Comment #6G:

> There are plenty of witnesses in the Northwest Valley who see dust at night from mining operations because water sprays are not used. When water is not used, pollution is not 30%, its 100%!

Response #6G:
Part of the Rule 316 rule effectiveness study takes into account the compliance rate of facilities that are controlling process emissions through the use of water. Failure to use water to control emissions is included in the quantification of the effectiveness percentage of the Rule 316 study (contained in Appendix 2.2 of this report). Using this rule effectiveness percentage, MCAQD has on average increased emissions from these types of processes to account for possible non-compliance with dust control or watering requirements.

Comment #6H:

> The out of compliance condition here is evidence that guessing what the total pollution is … is not working. You need more monitors. You also need to take into account what the excess pollution is doing to the public health, even your own families. It is especially hazardous to those who live near clusters of plants.

Response #6H:
Ambient air monitoring is outside the scope of the emissions inventory report. MCAQD develops an annual network review which is posted on MCAQD's website at: http://www.maricopa.gov/aq/divisions/monitoring/network.aspx. A fundamental purpose of this review is to provide the citizens of Maricopa County with relevant information, so that they may make better decisions about their lives. This information is used in a variety of ways. Most importantly it is used to determine the attainment status for parts of Maricopa County. Mathematical models are using the data to determine the effectiveness of control programs on pollution levels.

It is physically and fiscally impossible to monitor air quality in every location, representative samples must be obtained. The optimal locations for obtaining these samples are determined by using the monitoring objectives and the spatial measurement scales established by EPA. For example, there might be numerous locations where the highest concentration of particulate matter may occur. Using

EPA monitoring objectives and spatial measurement scales, only one or two sites will be established to represent all of the high-concentration areas.

Comment #7:

> The Joint Environmental Task Force also supports the comments from Tom Merrifield. The idea of a three dimensional plot of the data would be very enlightening. Looking at averages for the valley as a whole versus finding out where the "clustered" pollution is occurring and causing the noncompliance is a reasonable as well as a scientific approach.

Response #7:

Ambient air monitoring stations are set up to measure ambient air not to calibrate the emissions inventories. MCAQD's Air Monitoring Division maintains ambient air monitoring networks within the borders of Maricopa County. The purpose of the ambient air monitoring network is to sample air pollution in a variety of settings, assess the health and welfare effects, and assist in determining sources of air pollution.

Conversely, emissions inventories are developed to meet Federal Clean Air Act requirements and they provide a baseline understanding of local and regional sources of emissions. The Maricopa Association of Governments is developing a PM_{10} state implementation plan (referred to as the Five Percent Plan). The Five Percent Plan must show reductions in PM_{10} emissions of five percent per year until attainment is achieved at all monitors. The 2005 PM_{10} emissions inventory will be the starting point for the five percent per year reductions.

The Five Percent Plan will also include an assessment of air quality conditions and ambient air quality data for the area and must demonstrate through modeling that the PM_{10} standard will be met at all monitors. Before the Five Percent Plan is submitted to EPA in December 2007, it will be available for public review. The public review phase is slated for fall 2007.

Comment #8A:

> Home Builders and AGC were extremely disappointed that the Draft Emissions Inventory and supporting studies were developed without stakeholder input and involvement. Home Builders and AGC have a great deal of technical expertise and unique understandings about their industries. This knowledge is an invaluable resource that MCAQD should use when developing the best emissions inventory possible.
>
> For example, Home Builders and AGC expressed a willingness and desire to work with MCAQD to develop a technically sound and rigorous Rule Effectiveness Study methodology in the summer of 2006. Unfortunately, MCAQD developed its initial study behind closed doors. Additionally, MCAQD did not provide an opportunity to review the Draft Emissions Inventory when it was first developed.
>
> Notwithstanding these earlier disappointments, Home Builders and AGC welcome the opportunities provided by MCAQD to provide input to the Draft Emissions Inventory during the public comment period and appreciate MCAQD's willingness to consider additional information provided.
>
> We recognize that some of the comments and ideas suggested by Home Builders and AGC will require some effort to address. We hope that MCAQD does not simply take the position that there is now too little time left to resolve outstanding issues and incorporate Home Builders' and AGC's suggestions. To ensure that timing and resource issues are not a concern when developing the final emissions inventory, Home Builders and AGC hereby volunteer their expertise and assistance and stand willing to assist MCAQD in its efforts.

Response #8A:

MCAQD concurs that an open process is important to developing an emission inventory that will become part of a state implementation plan such as the Five Percent Plan. This is the reason MCAQD released on January 23, 2007, a draft of the PM_{10} emissions inventory with supporting documentation via the department's website. MCAQD made the document available to the public for a 30-day review and comment period. In addition, MCAQD held a public workshop on January 30, 2007, to provide an overview of the emissions inventory and to answer questions. MCAQD is evaluating and responding to all comments received during the public review period.

EPA emissions inventory guidance requires EPA approval and thus a public review process for emission inventories that are deemed to be of "regulatory significance". In general, this means that the approval process for an emissions inventory of "regulatory significance" will be as a component of a SIP submittal. Clearly, the draft 2005 PM_{10} emissions inventory is of "regulatory significance" and thus requires public review and EPA approval as a component of the Five Percent Plan submittal. Because the public review process for the Five Percent Plan is not scheduled until September 2007, after all the technical work and attainment demonstrations are completed, MCAQD made the draft PM_{10} emissions inventory available for public review well in advance of when the document was technically required to be made available. Further, MCAQD provided the public an opportunity to review the document less than one week after it went through internal peer review at Maricopa Association of Governments and Arizona Department of Environmental Quality.

Comment #8B:

> It is critical that all PM_{10} sources be identified and explained. This includes secondary and condensable particulate formation.
>
> For all emission sources, please also identify, and explain the reasons for using, the data sources, assumptions, emission factors, methodologies and categories used to develop emission estimates. For example, we recommend that summary tables 1.6-10, 1.6-1 1, 3.1-1, 3.6-1, and 3.6-2 be revised to identify construction sources by subcategories, as has been done for other sources such as agriculture, which is subdivided into various agricultural activities.
>
> Additionally, with respect to construction emission estimates, it would be helpful to have definitions of the various subcategories of construction sources that are identified in tables 3.3-17 through 3.3-21. We are concerned that MCAQD's methodology for identifying construction subcategories, which was based on dust control permit forms, does not necessarily correlate to emission factors developed by WRAP, EPA, and others. Roughly two-thirds of the road construction projects in Maricopa County over the past two years involved reconstruction above sub-grade and sub-base or milling and overlaying. These activities generate relatively few emissions.

Response #8B:

MCAQD is willing to address specific instances where data sources, emission factors, and methodology may be unclear; however, it is difficult to respond to sweeping generalizations. MCAQD has used the most current published emission factors and data available and thoroughly documented all data sources, assumptions, and emission factors. The 2005 PM_{10} emissions inventory report, including appendices, encompasses more than 200 pages of documentation.

Summary tables 1.6-10, 1.6-11, 3.1-1, 3.6-1, and 3.6-2 have been revised to identify separately the following construction subcategories: residential, commercial, road, and "other" construction activities ("other" includes trenching, demolition, weed control, site prep/land development, and temporary storage yard projects).

MCAQD categorizes the project type from information provided by the permit applicant on the Application for Dust Control Permit. Prior to July 2005, the applicant indicated the project type by selecting "Type of Project" from a discrete series of check boxes. The dust control permit application form was revised effective July 2005 in response to EPA concerns requiring more documentation regarding the control measure to be used at each project. Since that time, information on the project has been provided by the applicant in a number of ways: data provided on the application forms include "Name of Project" (Item 7), "Description of Project" (Item No. 8), and "Project Site Drawing" (Item 12). From this information, MCAQD permit intake staff assign a "project type" code (consulting with the permit applicant in-person or by phone if additional details are needed).

While a single permit may encompass more than one project category (e.g., a dust control permit for a new "residential" development often entails substantial road construction activity), the assignment of a category for emission calculation purposes is directed at the **primary** activity at the site. MCAQD acknowledges that the emission factor used for all "road construction" projects in its January 2007 emissions inventory report reflects "worst-case" conditions[2], and thus has adjusted its assumptions (described in detail in Response 9B, below) for the May 2007 report.

Lastly, a dust control permit is only required for reconstruction above sub-grade and sub-base or milling and overlaying should the contractor remove sufficient surface road layers to reach the dirt or rock surfaces. However sources that do not reach the dirt or rock surface, may still require a dust control permit for a storage yard. For example, one company that does repaving that does not involve sub-grade and sub-base does not obtain their dust control permit for the repaving work, they obtain the permit for the other disturbed areas, such as storage piles. Should this type of reconstruction activity be included in the "road construction" projects it will be relatively small acreage in comparison to the total "road construction" acreage.

Comment #8C:

> Home Builders and AGC believe that the best way to ensure the emissions inventory represents actual conditions is to use the best information available. We believe local, current, and measured observations are superior to emission factors extrapolated from national or regional sources. For example, we understand that unpaved road emissions are based on data from the 1990s. See page 108, estimates for miles of improved roads and traffic levels. This information is simply too stale to be used for this important project, which must be comprehensive, accurate, and current.

Response #8C:

MAG used the best available data on unpaved roads to prepare the PM_{10} emissions estimates in the Draft 2005 Periodic Emissions Inventory for PM_{10}. The unpaved road mileage by traffic volume category (i.e., low – average of 4 average daily trips (ADT) and high – average of 120 ADT) was derived from a database developed for the MAG Serious Area PM_{10} Plan. The Serious Area PM_{10} Plan, that was approved by EPA on July 25, 2002, reduced the miles of unpaved roads to reflect legally-binding commitments made by local jurisdictions to pave and stabilize unpaved roads by 2006. To ensure that these unpaved road assumptions continue to be representative of the PM_{10} nonattainment area, MAG will work diligently to update the traffic counts on a sample of unpaved roads. MAG will also apply geographic information systems (GIS) and recent aerial photography to estimate the current unpaved road mileage. Since it will take several months to collect this data, it will not be available to recalculate unpaved road emissions for the final 2005 periodic emissions inventory; however, it will be available for use in estimating the 2007 unpaved road emissions for the Five Percent Plan for PM_{10}.

Comment #8D:

[2] MRI, 1996. Improvement of Specific Emission Factors (BACM Report No. 1), Final Report, March 29, 1996, Table 7.

E.H. Pechan & Associates, Inc. (Pechan) has reviewed the assumptions, emission factors, methodologies, and calculations for some of the major source categories identified in the Draft Emissions Inventory. Pechan's analysis is attached and incorporated by reference. As detailed in the attached analysis, Pechan discovered specific concerns with the following categories: (1) construction; (2) windblown dust; (3) paved roads; and (4) unpaved roads.

Pechan's technical concerns include, but are not limited to, the following: (1) computational errors; (2) the use of different assumptions, emission factors, and data in the Draft Emissions Inventory when compared to other inventories; (3) the lack of supporting documentation for some assumptions; and (4) the use of a rule effectiveness methodology that does not adequately represent actual conditions at complex sources such as construction sites.

The following table, solely based on Pechan's analysis of construction emissions, shows the relative contributions of major sources and total emissions in the PM10 nonattainment area:

Source Category	Total PM_{10} Emissions	% of Total Emissions
Residential: Single-Family	895	1.46%
Residential: Multi-Unit	2051	3.33%
Commercial	2908	4.73%
Road Construction	1754	2.85%
Site Prep/Land Development	216	0.35%
Other Construction	58	0.09%
Total Agriculture	2719	4.42%
Offroad Rec. Vehicles	2159	3.51%
Unpaved Parking Lots	3009	4.89%
Windblown dust	1087	1.77%
Wildfires	4860	7.90%
Aircraft	6364	10.35%
Paved road Fugitive Dust	13783	22.41%
Unpaved Roads	8490	13.80%
Other Emission Sources	11154	18.13%
Total Emissions	61507	100.00%

Pechan has proposed alternative rule compliance methodologies that they believe are appropriately rigorous and detailed for the important purpose of estimating Rule 310 compliance. We requested that MCAQD revise the Draft Emissions Inventory to be consistent with Pechan's suggestions.

Response #8D:

MCAQD and MAG responded to each of Pechan's comments separately in responses 9A–9L.

Comment #8E:

It is a common practice in the construction industry for one entity to obtain a permit for a large site, and then shortly thereafter subdivide the site to builders, who then obtain another permit for a position of the same site originally covered under the first permit. Accordingly, using the permit database to determine the amount of acreage actually under construction can be only a starting point for any assessment of acreage under construction.

We are glad to learn that MCAQD recognizes this, and has attempted some creative solutions to address this problem in past. We appreciate MCAQD's expressed interest in obtaining additional information that will further help it identify instances of double counting.

A good first place to look is at all permits where the site activity listed is site preparation/land development. The entities that obtain these permits are typically large developers who then pass along portions of the large site to individual builders. In fact, MCAQD should review all permits obtained by these entities as well as the permits pulled by others in the same area to identify instances of double-counting.

Additionally, this is a common practice in growing areas near the boundaries of the metropolitan area. We recommend reviewing permits in those areas to determine whether double-counting has occurred. We offer our assistance in that effort. Implementing the recommendations will allow MCAQD to revise table 3.3-17 to best reflect actual conditions.

Response #8E:

MCAQD looked at a sample of the largest acreage permits where the project type was identified as site preparation/land development and saw no indication that the initial site preparation/land development company ownership had been transferred to another entity. MCAQD believes if this does occur it is relatively small in comparison to the overall acreage being disturbed.

Comment #8F:

In addition to the limitations of the County's methodology highlighted in Pechan's comments, there are a number of other problems with the Rule Effectiveness Study.

We are greatly concerned that MCAQD's proposal is overly simplistic and insufficiently rigorous for its purpose.

Dust control operations are complex, with several activities ongoing at any one time. Rule 310 is also extremely complex, with dozens of subsections and requirements. However, under the County's approach, limited noncompliance with one requirement, or limited noncompliance at one small area of a dust generating operation, deems the entire site uncontrolled. For example, under MCAQD's methodology, a 1000 acre site with 10 exits that has 51 feet of trackout from those ten exits, is assumed to be completely uncontrolled.

The County's methodology is obviously flawed. As the illustration above suggests, it does not reasonably represent actual conditions. It also conflicts with EPA guidance. In addition, even the underlying inspection data does not support MCAQD's approach. For example, for one site deemed to be noncompliant, the inspector acknowledges that trackout is less than 50 feet, and that the site has “overall good stabilization.” See inspection # 609003.

MCAQD has attempted to justify its approach by expressing the concern that even limited noncompliance at a construction site can have an impact on monitored readings of particulate matter. This anecdotal belief, however, in no way justifies creating an emissions inventory that does not represent actual conditions. After all, an inventory that represents actual conditions is what the Clean Air Act requires. The only way to develop a plan that will achieve attainment is to start with an emissions inventory that represents real world conditions. MCAQD's Rule Effectiveness Study does not do that.

MCAQD has also attempted to justify this approach by stating that EPA has remarked in the past that rule compliance was relatively low. We are unaware of any EPA study conducted of' Rule 310 compliance. If one has been conducted, it should be made available for public review. To the extent that EPA's belief was based on anecdotal observations made while driving around the Phoenix metropolitan area several years ago, we submit that these observations are stale and pale in comparison to the scientifically rigorous methodology proposed by Pechan. Accordingly, these anecdotes do not justify an abnormally low compliance rate that does not represent actual conditions.

Response #8F:

Rule effectiveness is a term that describes a method to account for the reality that not all facilities covered by a rule are in compliance with the rule 100% of the time. A rule effectiveness study is an examination of a rule and its implementation. Rule effectiveness studies are field evaluation studies designed to determine the percentage of non-compliance among sources for the selected rule. A representative number of sources within the study group are chosen at random and inspected. The effectiveness of a rule is reflected in the non-compliance rates determined by dividing the number of non-complying facilities by the number inspected.

An inspection is a snapshot in time and reflects conditions which may be present most of the time. In the rule effectiveness study, a site with an observed violation during the inspection was deemed noncompliant (not completely uncontrolled). Similarly, other sites in the rule effectiveness study with no observed violations were deemed to be 100% compliant, although violations may have occurred before or after the inspection.

The rule effectiveness study was conducted in accordance with EPA rule effectiveness guidance. Inspection report # 609003 noted an observed violation for a trackout control device that was not suitable. This is a violation of Rule 310. This inspection report supports MCAQD's approach; the site had an observed violation and was deemed to be noncompliant.

MCAQD made no mention in the rule effectiveness study that "limited noncompliance at a construction site can have an impact on monitored readings" nor were past EPA remarks regarding low rule compliance mentioned in the study. Neither of these issues was factored into the study results. The study results were based on compliance status established during inspections and determined by dividing the number of noncomplying facilities by the number inspected.

Comment #8G:

> MCAQD relied on a sample of 63 inspections for its Rule Effectiveness Study. Yet, thousands and thousands of inspections are conducted every year. MCAQD has acknowledged that it has the ability to identify the number of inspections that occurred during a given time period, and determine the number of inspections that resulted in an allegation of noncompliance. This data must be reviewed to determine whether the Rule Effectiveness Study sample is truly representative.[3]
>
> MCAQD previously made available similar inspection data from the June 2006 - August 2006 time frame during an October 10, 2006 meeting.[4] This data from 2,811 inspections showed that the simplistic compliance rate for both administrative and emissions-related requirements was 68%, far higher than the 33% compliance rate determined by MCAQD in the 63 set sample. These more representative numbers should be considered when determining rule compliance.
>
> Additionally, we believe it is also possible to determine which of those violations were administrative and which were emissions-related. We understand that the process of identifying administrative vs. emissions-related allegations of noncompliance is more labor intensive than the process of identifying the total number of inspections, and the total number of sites with violations. Accordingly, Home Builders and AGC would be willing to provide their assistance in any manner that would be helpful to MCAQD to accomplish this goal.

Response #8G:

MCAQD followed EPA guidance to determine a statistically adequate sample size for the Rule 310 rule effectiveness study.[5] The number of inspection sites in the sample size was determined by calculating the standard deviation of the initial ten random inspections. Then using EPA's recommended confidence interval (90 percent) and sample error (5 percent), MCAQD determined that sixty-three Rule 310 inspections were needed.

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[3] Even this data must be reviewed, of course, with the caveat that drive-by compliant inspections may not show up in MCAQD's database, and therefore the compliance rate shown in the data is less than the true compliance rate.

[4] This 60% figure must also be viewed in context. The 32% of sites with documented violations were not completely uncontrolled.

[5] Guidelines for Estimating and Applying Rule Effectiveness for Ozone/CO State Implementation Plan Base Year Inventories, Appendix D, U.S. EPA, EPA-452/R-92-010, November 1992.

Using the compliance data from MCAQD's Environmental Management System (EMS) would not be the same as inspections done under a rule effectiveness study. All inspections done for the rule effectiveness study were full scale level 2 inspections where every applicable rule subsection was inspected for compliance. Inspections entered into EMS include level 1 (onsite or offsite) and level 2 (onsite). The level 1 inspections are commonly done as spot inspections for violation follow-up, complaint inspections, or the next multiple inspection of a site. The follow-up inspections in particular tend to have a higher compliance rate because it is possible that only those issues found in violation previously will be checked during a follow-up inspection.

It is unclear what 33 percent compliance rate the commenter is referring to as the Rule 310 rule effectiveness study results showed a 49 percent compliance rate (revised to 51% in the April 2007 rule effectiveness study). The discrepancy between the 68 percent compliance rate cited by the commenter and the 49 percent compliance rate found in the rule effectiveness study is due to the reasons discussed above. Specifically, follow-up inspections have a higher compliance rate and including these in the data set will result in a higher overall compliance rate. The example below illustrates this point:

63 level 1 inspections with 49% non-compliance rate = 31 sites out of compliance
31 sites are re-inspected and found to be in compliance
94 total inspections (63 Level 1 + 31 follow-up inspections) with 31 site out of compliance = 32.98% non-compliance rate or 67.02% compliance rate.

The higher compliance rate found in follow-up inspections will increase the overall compliance rate.

Comment #8H:

> The inspection reports on which the Rule Effectiveness Study is based contain numerous errors and unsupported allegations. For example, none of the allegations concerning Rule 310, Sections 301 and 302, provides supporting documentation that demonstrate test methods were used to determine compliance. As a result, these unsupported statements cannot be used to allege noncompliance.
>
> Similarly, some of the allegations are not violations of Rule 310 at all. For example, one inspector noted that the stockpile on a particular site was wet, but wrote an NTC because the material "needs visible crust." See inspection # 609030. This allegation is unfounded. Under Rule 310, Section 308.6, a permittee has the option to keep an inactive stockpile moist or maintain a visible crust. For active stockpiles, maintaining a visible crust is not even a listed alternative, because it is not feasible.
>
> Some of the inspection reports allege violations for activities that are not regulated under Rule 310. One inspection report documents an NTC for opacity greater than 20% during sandblasting. See inspection # 609023. Sandblasting is not subject to Rule 310. Another alleges a violation resulting from tile cutting. See inspection # 609024. Tile cutting is not regulated under Rule 310; it is regulated by OSHA.
>
> Finally, Horne Builders and AGC concur with Maricopa County's decision to exclude administrative allegations in its emissions compliance methodology. However, the fact that these allegations are mentioned at all in the Rule Effectiveness Study implies rampant noncompliance**.**
>
> Again the facts do not bear this out. At least half of the administrative allegations concern dust control complaint phone numbers. During calendar 2006, MCAQD created a new phone number for dust complaints. The previous number continued to work, and continues to work to this day. The applicable rule requirement does not state that there can be only one current/accurate phone number. Therefore, these are not violations under any reasonable interpretation of the rule.

Response #8H:

Nineteen inspection reports showed Rule 310 Section 301 or 302 violations; fourteen of these inspection reports showed other emission violations. If a NOV was issued for a Rule 310 Section 301 opacity violation, a visible emissions evaluation was conducted and documented. The evaluation is documented on separate forms which are forwarded in the referral report to MCAQD's Enforcement Division; these were not included with the inspection reports provided to the commenter. Inspectors evaluate the surface under inspection for compliance with Rule 310 Section 302. The inspectors are able to determine through visual examination and depth analysis the severity of the unstabilized soil. When larger elements are not present in the first 3/8 inch, the surface will not pass the threshold friction velocity test. Furthermore, Rule 310 Section 302.3 requires that the owner/operator conduct the stabilization tests.

In regards to inspection report # 609030, MCAQD reviewed this inspection report and determined that a NTC was issued for an administrative violation for not posting the dust control plan. Because no emission violation was observed, this inspection was excluded from the violations used in calculating rule effectiveness. In reviewing the inspection report, MCAQD determined that an error was made in Table 3.4.1 in the Rule Effectiveness Study pertaining to inspection report #609030 (Permit Id E054400). MCAQD incorrectly noted in Table 3.4.1 the violation as Rule 310 Section as 308; the violation was actually a Section 401 violation. This error has been corrected in the April 2007 Rule Effectiveness Study.

In regards to inspection report # 609023, MCAQD reviewed this report and determined that the violation for exceeding opacity while sandblasting should have been a violation of Rule 312 not Rule 310. MCAQD has corrected the rule effectiveness study results accordingly. The correction results in an increase to rule effectiveness (or compliance rate) from 49% to 51%. This change will be been reflected in the April 2007 Rule Effectiveness Study report and in the calculated emissions for construction in the May 2007 emissions inventory report.

In regards to inspection report # 609024, the NTC was for block cutting not tile cutting and this was one of several NTCs and an NOV observed at this site. Block cutting is regulated under Rule 310 as a dust generating operation. The Rule 310 definition of dust generating operations is:

> Any activity capable of generating fugitive dust, including but not limited to, land clearing, earthmoving, weed abatement by discing or blading, excavating, construction, demolition, bulk material handling, storage and/or transporting operations, vehicle use and movement, the operation of any outdoor equipment, or unpaved parking lots. For the purpose of this rule, landscape maintenance and playing on or maintaining a field used for non-motorized sports shall not be considered a dust generating operation. However, landscape maintenance shall not include grading, trenching, or any other mechanized surface disturbing activities performed to establish initial landscapes or to redesign existing landscapes.

Finally, administrative violations with no observed emissions violation were excluded from the rule effectiveness calculation; thus, a discussion of administrative violations that were excluded, such as the dust control complaint phone number is outside of the scope of this report.

Comment #8I:

> Under Section 172(c) (3) of the Clean Air Act, the emissions inventory must be a "comprehensive, accurate, current inventory of actual emissions from all sources of the relevant pollutant or pollutants in such area..." Given the serious scientific flaws in MCAQD's Rule Effectiveness Study, the Draft Emissions Inventory cannot be a comprehensive, accurate, or current inventory of actual emissions from all sources.

Response #8I:

The rule effectiveness study was conducted in accordance with EPA guidance. MCAQD followed EPA guidance to determine a statistically adequate sample size for the Rule 310 rule effectiveness study and used a quality assurance supervisor and an observer for the study to assure consistency during the inspections. MCAQD reviewed all comments made pertaining to the rule effectiveness study and made adjustments where appropriate.

Comment #8J:

> Unpaved road emissions are a significant portion of the inventory. Unpaved road emissions, based on stale data and unsupported assumptions, are greatly underestimated. By MCAQD's own estimate, they constitute 9% of the PM_{10} inventory. Revising the Draft Emissions Inventory to accurately reflect construction emissions increases the unpaved road contribution to nearly 14%. Accordingly, it is critical that unpaved road emission estimates be based on comprehensive, accurate, and current information. Pechan's analysis identified a number of areas where the data sources for unpaved road estimates do not meet these criteria.
>
> For example, MCAQD does not explain the average speed estimate of 25 miles per hour. On rural unpaved roads, speeds are certainly higher. Pechan's analysis showed that changing the speed to 40 mph would increase unpaved road emissions to 10,697 tons per year. Because vehicle speeds greatly influence emission estimates, it is critical that MCAQD base its estimate for vehicle speeds on the best information available.
>
> Second, MCAQD uses average daily traffic volumes that were carried forward from a 1994 study (we understand this is the basis for the assumption on page 108 that the average annual traffic level is 4 vehicles per day). Data from 1994 are not current under any definition of the term, and cannot be used in a 2005 emissions inventory.
>
> In addition, the Draft Emissions Inventory assumes that the mileage of unpaved roads actually decreased slightly over the last several years. See page 108. As noted by Pechan, the Draft Emissions Inventory does not account for new unpaved roads added over the past several years.
>
> Finally, Pechan noted the rigorous methodology undertaken in Clark County to determine unpaved road emissions. Similar methodologies must be used here to create a comprehensive, accurate, and current estimate of unpaved road emissions. Revising the ADT numbers to be consistent with Clark County's would increase the unpaved road fugitive dust PM_{10} emissions reported in Table 5.4-10 from 20,954 kg/day to 36,762kg/day.

Response #8J:

As indicated in Response #8C, MAG used the best available data on unpaved roads to prepare the PM_{10} emissions estimates in the Draft 2005 Periodic Emissions Inventory for PM_{10}. The unpaved road mileage by traffic volume category (i.e., low – average of 4 average daily trips (ADT) and high – average of 120 ADT) was derived from a database developed for the MAG Serious Area PM_{10} Plan. The Serious Area PM_{10} Plan, that was approved by EPA on July 25, 2002, reduced the miles of unpaved roads to reflect legally-binding commitments made by local jurisdictions to pave and stabilize unpaved roads by 2006. To ensure that these unpaved road assumptions continue to be representative of the PM_{10} nonattainment area, MAG will work diligently to update the traffic counts on a sample of unpaved roads. MAG will also apply geographic information systems (GIS) and recent aerial photography to estimate the current unpaved road mileage. Since it will take several months to collect this data, it will not be available to recalculate unpaved road emissions for the final 2005 periodic emissions inventory; however, it will be available for use in estimating the 2007 unpaved road emissions for the Five Percent Plan for PM_{10}.

With respect to the speed used in estimating unpaved road emissions, 25 mph was assumed, because it is the speed limit that the Arizona Department of Transportation Motor Vehicle Division has officially established for roads that are not posted with a speed limit sign. While collecting traffic counts on a sample of unpaved roads, MAG will try to obtain typical vehicle operating speeds on the same roads. Although these speeds will not be scientifically-derived (i.e., through a formal travel time survey or speed study), the observations should provide a basis to determine whether the current assumption of 25 mph is reasonable.

Comment #8K:

> Every stakeholder involved in this process understands that it is critical that the emissions inventory represents actual and current conditions in the nonattainment area. We urge MCAQD to look at the available data objectively and without preconceptions. Only one reasonable conclusion can be drawn if that is done. Rule 310 effectiveness is much higher and construction emissions are much lower than reported in the Draft Emissions Inventory. Pechan has provided its best estimate, which was based on the available information, and took many of MCAQD's assumptions at face value. We ask that MCAQD use Pechan's methodology and results, incorporate modifications as necessary to reflect our additional comments, and revise the emissions inventory to be a "comprehensive, accurate, current inventory of actual emissions from all sources...."

Response #8K:

MCAQD carefully reviewed all comments received and modified the emissions inventory report where warranted. Each of Pechan's comments was addressed separately and responses are provided below in responses 9A-9L.

Comment #9A:

> The basic approach used by MCAQD to estimate 2005 construction activity PM10 emissions is to develop estimates of affected acreage by type of activity, and then to apply standard emission factors and average project durations by project type along with estimates of the effectiveness of existing fugitive dust control rules to estimate controlled 2005 emissions. This approach is a standard one for this source category, with some similarities to the methods used by EPA for its National Emissions Inventory. MCAQD uses estimates of acres permitted for construction during 2005, which is an improvement over some approaches which are based on the dollars spent on construction projects. Overall, Pechan has three concerns [*Note: included as comments 9A–C*] about the construction activity PM10 emission estimates in the 2005 MCAQD Inventory:
>
> 1. There is a computational error in the site preparation/land development emission estimate that results in the emissions for the Maricopa County portion of the PM_{10} nonattainment area for this project type being overestimated by 2,110 tons per year. The total acre-months in Table 3.3-20 for site prep/land development should be 4,905.6, not 39,244.6. The controlled PM_{10} estimate should be 301.6. Table 1 [*Note: not reproduced in this responsiveness summary*] provides a revised version of Table 3.3-20 with corrected values for site prep/land development.

Response #9A:

The one-month average duration for "site prep/land development" shown in Table 3.3-18 is a typographical error. The average duration used to estimate emissions from "site prep/land development" projects was eight (8) months and not the one (1) month shown in Table 3.3-18. A correction has been made in Table 3.3-18 to show the correct average duration for "site prep/land development" of eight (8) months. The typographical error did not affect the emission calculations as the emissions were estimated using the correct average duration.

Comment #9B:

> 2. The 2005 MCAQD Inventory applies an emission factor of 0.42 tons/acre-month to estimate road construction emissions. This value was selected based on information from the WRAP Fugitive Dust Handbook, which advises that a 0.42 tons/acre-month emission factor be used for worst case conditions. It is not clear from the information presented by MCAQD in its report why a worst case conditions

emission factor was deemed appropriate for road construction in this geographic area. For its 2002 PM_{10} emission inventory, a 0.11 tons/acre-month emission factor was applied to estimate uncontrolled road construction emissions. This emission factor change alone produces a 281 percent higher PM_{10} emission estimate for road construction than was estimated for the 2002 calendar year. This emission factor selection seems unjustified without evidence being presented by MCAQD for its selection.

Pechan reviewed recent PM_{10} emission calculations performed by the South Coast Air Quality Management District, where it is estimated that 25 percent of road construction is at the 0.42 tons/acre-month emission rate and 75 percent is at the 0.11 tons/acre-month rate, which is a net emission factor of 0.1875 tons/acre-month. It is suggested that MCAQD consider using the SCAQMD assumptions in its road construction emission estimates to estimate uncontrolled PM_{10} emissions. Making this revision would change the road construction controlled PM_{10} emission estimate in Table 3.3-20 to 5,281 from 11,831 tons per year, a reduction of 6,550 tons. This would change the Table 1 corrected PM_{10} controlled emission estimate to 28,631 tons per year (from 35,181 tons per year).

Response #9B:
MCAQD requested a citation or documentation from the commenter on the PM_{10} emission calculations performed by the South Coast Air Quality Management District (SCAQMD). The commenter was not able to provide specific documentation on the methodology but rather sent information from the California Air Resources Board which only describes the method in general terms and does not include the specific percentages used to apply the 0.42 tons versus the 0.11 tons emissions factor for road construction. It is also important to note that the SCAQMD work cited assumed the construction emission factors included the effects of typical control measures such as routine watering.[6] Whereas, MCAQD assumed the emission factor values were uncontrolled and applied a 90% control efficiency. If MCAQD had adopted the entire SCAQMD methodology as the commenter requested, overall emissions from this source category would have increased significantly.

MCAQD rational for selecting the 0.42 tons/acre-month emission factor for road construction was based on the following excerpts in the WRAP Fugitive Dust Handbook:

1. The WRAP Fugitive Dust Handbook (Section 3.2.4 Road Construction) states on page 3-6: Almost all roadway construction involves extensive earthmoving and heavy construction vehicle travel, causing emissions to be higher than found for other construction projects. The PM_{10} emissions produced by road construction are calculated using the BACM recommended emission factor for heavy construction[7] and the miles of new roadway constructed.

2. On page 3-7, the WRAP Fugitive Dust Handbook further states: The BACM worst case scenario emission factor of 0.42 tons/acre-month is used to account for the large amount of dirt moved during the construction of roadways. Since most road construction consists of grading and leveling the land, the higher emission factor more accurately reflects the high level of cut and fill activity that occurs at road construction sites.

In its 2002 PM_{10} emission inventory, MCAQD used an emission factor of 0.11 tons/acre-month to estimate uncontrolled road construction. MCAQD strives to use improved estimation methods where available and practical in order to update and improve emission estimates. Because the WRAP

[6] California Air Resources Board, Emissions Estimation Methodology, Section 7.7 (Building Construction Dust) and Section 7.8 (Road Construction Dust), Sept. 2002 and August 1997, respectively.
[7] Midwest Research Institute, 1999. Estimating Particulate Matter Emissions From Construction Operations, Kansas City, Missouri, September.

Fugitive Dust Handbook was published in September 2006, after the 2002 PM_{10} emissions inventory but prior to finalizing the 2005 PM_{10} emissions inventory, MCAQD chose to use the road construction emission factor (0.42 tons/acre-month) recommended by WRAP in the Fugitive Dust Handbook to estimate road construction emissions.

MCAQD researched PM_{10} emission calculations performed by the SCAQMD and was unable to locate emissions estimation methodology specifically from SCAQMD for road construction emissions. The only reference to this methodology is in the WRAP Fugitive Dust handbook and in the California Air Resources Board (CARB) building and road construction dust estimation methodology. Both indicate that the SCAQMD applied 0.42 tons/acre-month emission rate and 0.11 tons/acre-month rate to both road and building construction. Neither WRAP nor CARB showed the specific percentages used to apply the 0.42 tons versus the 0.11 tons emissions factor for road construction. Further, the SCAQMD and CARB work both assumed the construction emission factors included the effects of typical control measures such as routine watering.[8] Adopting the entire SCAQMD methodology would have significantly increased the overall emissions from this source category.

EPA used the 0.42 tons/acre-month emission factor to estimate emissions from road construction for the 1999 and 2002 National Emissions Inventory (NEI).

EPA's Procedures Document for National Emissions Inventory, Criteria Air Pollutants 1985-1999 states:

> An emission factor of 0.42 tons/acre/month is used to account for the large amount of dirt moved during the construction of roadways. Since most road construction consists of grading and leveling the land, the higher emission factors more accurately reflects the high level of cut and fill activity that occurs at road construction sites.[9]

In 2004, E.H. Pechan & Associates used the 0.42 tons/acre-month PM_{10} emission factor (adjusted to account for conditions in Yuma including correction parameters for silt moisture level and silt content) to calculated road construction emissions in the 1999 and 2016 Emission Estimates for the Yuma, Arizona PM_{10} Nonattainment Area Maintenance Plan, prepared for Arizona Department of Environmental Quality[10]

Because MCAQD was unable to locate detailed documentation of the SCAQMD approach and because the 1999 and 2002 NEIs, the WRAP Fugitive Dust Handbook, and E.H. Pechan & Associates all used the 0.42 tons/acre-month for road construction, MCAQD believes that the 0.42 tons/acre-month is an appropriate emission factor. However, since Clark County Department of Air Quality and Environmental Management used an average emission factor of 0.265 tons/acre/month ([0.11 + 0.42] / 2) for construction projects that sometimes include cut and fill areas, large-scale earthmoving activities, and/or heavy traffic volumes and other times do not, MCAQD will use the Clark Co. approach for road construction activities and revise road construction emissions accordingly. [11]

[8] California Air Resources Board, Emissions Estimation Methodology, Section 7.7 (Building Construction Dust) and Section 7.8 (Road Construction Dust), Sept. 2002 and August 1997, respectively.
[9] U.S. EPA, Procedures Document for National Emission Inventory, Criteria Air Pollutants 1985-1999, EPA-454/R-01-006, March 2001, p. 4-291.
[10] Appendix: Technical Support Document: Yuma Natural Events Action Plan, January 2004. 1999 and 2016 Emission Estimates for the Yuma, Arizona, PM10 Nonattainment Area Maintenance Plan, Final Report, Prepared for: Arizona Department of Environmental Quality, Prepared by E.H. Pechan & Associates, Inc., June 2003, Contract No. 98-0159, Pechan Rpt. No. 03.06.004/9412.001 (Rev.), p. 22.
[11] PM_{10} SIP Plan for Clark Co., Appendix B: Methodology, Emission Factors, and Emission Estimates, June 2001, p. B-59.

Comment #9C:

3. One of the key variables in the controlled PM_{10} emission estimate for road construction is the estimated rule effectiveness. Rule effectiveness in this case is a measure of the Rule 310-Fugitive Dust compliance rate in the area. The rule effectiveness guidance available from EPA during the 1990s suggested that a default rule effectiveness assumption of 80 percent be used in most cases to estimate compliance rates in cases where data were not available to estimate this value quantitatively. More recent guidance from EPA removes the previous recommendation for use of an across the board 80 percent default value. EPA's revised rule effectiveness guidance provides inventory preparers with lists of factors that are most likely to affect RE and ranks these factors in a priority order. For nonpoint sources like construction activity, EPA provides three ranges: 86 to 100 percent, 70 to 85 percent and below 70 percent with associated importance factors to use in determining the appropriate RE to apply.

As part of its 2005 inventory development, MCAQD performed its own RE study to quantify compliance with the fugitive dust rules in the Maricopa County air quality regulatory program. One portion of this RE study examined earthmoving sources. For the earthmoving site RE study, site inspections were performed for 63 sites. MCAQD used the information from these special site visits to assign each site as either being fully compliant (100% RE) or non-compliant (0% RE or uncontrolled). The MCAQD RE study for earthmoving sites found that 31 of 63 inspected sites with no emission violation, and 32 of 63 with observed violations. This information was used to compute an overall RE value of 49 percent, which was used in the PM_{10} emission calculations for this source category.

Pechan staff reviewed the inspection results for all of sites that either received a Notice to Correct (NTC) or a Notice of Violation (NOV) and matched that information with the applicable project types, which were described in the inspection reports as not being fully compliant with Rule 310. We then made judgments about which emission sources within the site were uncontrolled and adjusted only those sources. This resulted in a scoring system that assigned values in between zero and 1 when warranted by the information provided by the site inspectors. Table 2 shows how the site inspection reports were evaluated. The columns in this table are the site inspection report numbers. For each site inspection, the letters V and C are used in Table 2 to indicate the source type (project type) associated with any violation (V) or notice to correct (C). There were three sites with notices of violation that indicated widespread violations to the extent that the site was deemed fully uncontrolled (site numbers 609071, 609005, and 609007). For all other sites, the PM_{10} emission rates were estimated to be uncontrolled at the sites where either a V or a C is indicated in that row. As an example, if 10 sites had a V or C for site prep/land development, then the RE was estimated to be 10/63 times zero plus 53/63 times 100 percent, or 84 percent. The denominator of 63 is the total number of earthmoving sites inspected during the MCAQD RE study. In this way, a rule effectiveness value is computed for each project type. Then, that project type-specific RE value is used to estimate 2005 emissions consistent with the methods employed by MCAQD in section 3.3.9 Construction of the 2005 Periodic PM_{10} Emission Inventory.

Pechan's revised .PM_{10} emission estimates for the construction category using the above methods are provided in Table 3 *(not included in this responsiveness summary)*. Pechan's revised PM_{10} emission estimate for construction activity in Table 3 is 10,059 tons per year, significantly lower than the MCAQD reported value. (This table uses the higher 0.42 tons/acre-month emission factor for road construction.) If the lower SCAQMD composite emission factor of 0.1875 were used, this would change the resulting construction activity PM_{10} estimate to 7,882 tons per year.

Response #9C:

The project type relates to the type of construction (residential, commercial, road construction, etc.) and should not be confused with the dust generating activities (bulk material hauling, trackout, unpaved haul roads, open storage piles, disturbed surfaces etc.) that occur on a construction site or the types of violations (trackout > 50 feet, opacity > 20%, ineffective trackout control device, etc.) observed at a given construction site or identified in an inspection report. MCAQD determines the project type from “Description of Project” information submitted on the Application for Dust Control Permit.

Pechan interpreted violations identified on inspection reports as emission sources and then incorrectly allocated these violations to project types. For example, inspection report #609073 identified the following two NOVs:

- Trackout on Central from site west exit point extends southerly for > 250 feet.
- Ineffective trackout control device at time of inspection earthmoving activities disturbed more (than) 2 acres.

Pechan incorrectly interpreted these NOVs as "site prep/land development" and "temporary storage yard" (see Table 2 on page 6 of Pechan comment letter). This was actually a commercial construction project and not "site prep/land development" or "temporary storage yard".

Further, Pechan also created two project types that are not identified separately in the emissions inventory: trackout and opacity. These are actually types of violations observed during inspections. Pechan identified in Table 2, 17 Notices of Violation/Notices to Correct for "trackout" and 6 Notices of Violation/Notices to Correct for "opacity", yet Pechan failed to include these in their revised NOV/NTC count or revised emission estimates in Table 3.

Comment #9D:

> Because the information in the rule effectiveness study inspection reports is organized by Rule 310 section rather than by emissions generating subcategory, an alternate analysis was performed where the NOVs and NTCs were organized by the Rule 310 sections. This analysis is shown in Table 4 (*not included in this responsiveness summary*). This table was constructed by taking the information in the rule effectiveness study inspection reports and noting wherever the report said that a specific rule NOV or NTC occurred. The level-of-detail provided in Table 4 for the Rule 310 requirements is designed to match the level-of-detail provided in the inspection reports.
>
> Table *5* (*not included in this responsiveness summary*) summarizes the results of this alternate analysis. Table 5 summarizes the total NOV plus NTCs by rule number as well as the occurrences of NOVs and NTCs separately. Then, in the right-most columns of this table, the number of occurrences is used to compute a non-compliance rate for each rule number that had an NOV or an NTC. For example, Table 5 shows that about 8 percent of inspected sites had either an NOV or an NTC for the opacity limits for dust generating operations (Section 301 of Rule 310). Therefore, for this specific section of Rule 310, the rule effectiveness survey showed a 92 percent compliance rate, and an 8 percent non-compliance rate.
>
> For the eight rule sections in Table *5* where there were one or more NOVs/NTCs, the noncompliance rates were averaged to estimate an overall non-compliance rate of 13 percent. The non-compliance rates by rule section range from a low of 1.5 percent for unpaved haul/access piles to a high of 27 percent for stabilization. This average rule effectiveness value of 87 percent (13 percent non-compliance) computed using this alternate methodology is very close to the 84 percent estimate provided above, and serves as confirmation of the revised PM_{10} emission estimates provided in the right-most column in Table 3.

Response #9D:

Pechan reviewed the 63 inspection reports from the Rule Effectiveness Study and totaled the multiple violations observed at each construction site according to the specific <u>sections</u> of Rule 310. Pechan listed ten different sections of Rule 310 in Table 5 (see page 9 of Pechan's comment letter). Pechan then calculated a noncompliance rate for <u>each section</u> of the rule and suggests that averaging the noncompliance rate for each section estimates an overall noncompliance rate. However, this approach represents the average noncompliance rate for <u>each section</u> of the rule rather than an overall noncompliance rate. In other words, the rate that any one section of the rule had been violated.

Based on Pechan's count of the different rule sections in Table 4, 32 of 63 inspections (51%) resulted in a notice of violation or notice to correct. The 32 inspections which resulted in notices of violations or notices to correct had 66 separate Rule 310 section violations.

Rule effectiveness is reflected in the non-compliance rates determined by dividing the number of non-complying facilities by the number inspected.

MCAQD estimated rule effectiveness by conducting a statistically significant number of randomly selected inspections (63) and determining the number of inspected sites with no observed violation (32 inspections (of 63 total) had no observed violation = 51%). Conversely, Pechan's approach estimates the number of times each section of the rule was violated. Their approach measures the non-compliance rate of individual sections of Rule 310 rather than the non-compliance rate of Rule 310. Their approach simple does not represent an overall rate of compliance; it represents an average rate of non-compliance with individual section of Rule 310.

Further, Pechan miscounted the number of violations identified on the inspection reports. The total of all NOV and NTC is short by 13 violations; thus, 79 violations were identified in the 32 inspections with observed violations. The violations miscounted by Pechan are identified in the table below:

Inspection Number	Number of Violations Identified in Inspection Report	Number of Violations Listed in Pechan's Table 4	Number of Violations Not Counted by Pechan
609071	4	2	2
609005	6	1	5
609007	5	4	1
607450	6	4	2
607448	5	3	2
605737	2	1	1
Total	28	15	13

Comment #9E:

> Any calculation of 5 percent per year emission reductions for the PM_{10} nonattainment area should use an average, or typical year emission estimate for windblown dust emissions, so more information is needed in the ENVIRON analysis, or the body of the report, about the representativeness of the PM_{10} emission estimate computed using 2005 meteorological data. One of the weaknesses of the windblown dust inventory model application is the lack of accounting for rainfall (page 2-8 of Appendix 3-3). In addition, it is suggested that daily PM_{10} emissions be presented in the appendix for the specific days when wind speeds exceeded 20 miles per hour and there were positive emissions for this source type. The 2005 windblown dust emissions estimate for the PM_{10} nonattainment area is 1,086 tons per year.

Response #9E:

Since the January 2007 draft report was published, the model has been revised to incorporate the effects of rainfall. Five years (2001–2005) of hourly precipitation data from approximately 200 monitoring stations (throughout Maricopa and Pinal Counties) was provided by Maricopa County Flood Control district, and has been incorporated into the model input data sets.

The comment re: a 20-mph threshold is unclear. As discussed in the January 2007 draft report, the windblown dust inventory has been developed using a grid-based modeling system. Dust emissions from wind erosion are determined from the gridded wind speeds and surface characteristics. Windblown emission are only possible when wind speeds exceed a threshold wind speed determined by the aerodynamic surface roughness lengths of the underlying surface. These vary by landcover type, and so the threshold also vary. However, the draft report does summarize a previous version of the modeling system developed for WRAP during Phase I of the WRAP project. That version of the model did use a constant threshold corresponding to a 20-mph wind speed (at a height of 10 m).

Comment #9F:

> Another concern with the approach used by ENVIRON is its suitability for estimating windblown dust PM_{10} emissions for an analysis of this geographic scale. The RMC windblown dust model "is designed to estimate fugitive windblown dust emissions for regional air quality modeling." Is the model valid for smaller scale applications like this one where the relative accuracy of the estimate is more important? Has the model been validated for PM_{10}? It seems likely that this model has been designed primarily to estimate fine particulate windblown dust emissions over large geographic regions and may not be a good predictor of PM_{10} emissions for a State Implementation Plan/regulatory analysis.

Response #9F:

The ENVIRON windblown dust model was indeed developed for application to regional air quality modeling studies. However, this limitation is actually due to the various databases used as inputs. For the modeling work conducted for the Western Regional Air Partnership (WRAP), the inventory was required to cover the entire conterminous United States. Because of this, the underlying GIS databases (i.e. soil characteristics and land use/land cover [LULC]) were somewhat lacking in detail and resolution, primarily due to limited time and resources available for their development. The emission estimation methodology is valid regardless of the scale of the final inventory as has been validated through field studies using wind tunnels. It should be noted that the model has been successfully applied to other nonattainment-area scale studies.[12] In fact, the current inventory developed for Maricopa County is considered by the model developers to be better and <u>more</u> applicable than that of the WRAP due to the use of local high resolution and detailed LULC data. Additionally, the methodology is designed to estimate PM_{10} directly; $PM_{2.5}$ is apportioned from the estimated PM_{10} dust emissions.

Comment #9G:

> The ENVIRON report also lacks clarity in describing how the emission calculations were performed for each land use type, which makes it difficult to determine whether the emission estimates are correct. For example, page 2-9 of the ENVIRON report discusses surface disturbance assumptions used in the windblown dust model that conflict with what is said later in the report on page 4-3. Some of the key assumptions mentioned on page 4-3, like those about the fraction of barren lands that are disturbed (30 percent) and the fraction of shrublands that are disturbed (8 percent) are provided with no back-up information. These assumptions and the assumptions about threshold friction velocities have a substantial effect on resulting emission estimates by land use type and should be justified and referenced.

Response #9G:

A concise summary of the computational steps required has been included in the revised version of the report summarizing the modeling results, along with further details concerning the original and/or derivation of threshold friction velocities for individual land use types. To summarize:

> 1) The model calculates the threshold surface friction velocity as a function of the surface roughness lengths for each landuse type in each grid cell using the relationship displayed in Figure 2-1, and the assumed roughness lengths by landuse type (listed in Table 3-2).
> 2) The surface friction velocity is calculated from the relationship displayed in page 2-2, the assumed roughness lengths by landuse type (Table 3-2) and the gridded 10-meter wind speeds. When the surface friction velocity exceeds the estimated threshold from step 1) the model

[12] See (e.g.) "Development of a Wind Blown Fugitive Dust Model and Inventory For Imperial County, California", ENVIRON International Corp., May 2004.

calculates PM_{10} dust emissions using the relationships shown in Figure 2-2 as a function of the wind speed and soil texture.
3) Any adjustments for agricultural lands are then computed.
4) The final step involves summing all the PM_{10} dust emissions in each grid cell for each hour. (Note that in any given grid cell, the percentages of the various landuse and soils are available for use in estimating the dust emissions).

Comment #9H:

> In the end analysis, ENVIRON estimates PM_{10} emissions for just four land use types: (1) agricultural lands, (2) grassland, (3) shrubland, and (4) barren lands. Urban lands are estimated to have no windblown dust emissions. When the relationship between land area, land use type and PM_{10} emissions is compared (Table 3.3 and Table 5-3), the relative PM_{10} emission strengths (in tons per square kilometer) are: barren land (1.14 tons per square km), shrubland (0.25 tons per square km), and agricultural land (0.0078 tons per square km).

Response #9H:

The windblown dust emission estimation methodology relies on the relationship between threshold surface friction velocity and aerodynamic surface roughness lengths. Further, the surface roughness lengths are a function of the landuse. Clearly, these roughness lengths exhibit a range of values even for the same nominal landuse type. Unfortunately, a database of specific surface roughness lengths for the study are was not available, so assumed values were used for each of the general landuse types in the GIS data used. The assumed roughness lengths were chosen from a range of values reported in the literature. Based on these values, only those landuse types that are considered in the model would result in threshold surface friction velocities that would typically be observed in nature. Note however, that although urban lands are not considered, the LULC data used for the current project included such detail within the Phoenix metro area as residential and commercial buildings under construction. Therefore, although urban land, per se, is not considered, dust emission are generated with in the metro, or urban, area of Phoenix.

Comment #9I:

> The 2002 windblown dust PM_{10} emission estimate for the nonattainment area was 10,505 tons per year. However, the 2002 PM_{10} emission estimate used a threshold wind speed of 15 miles per hour and the 2005 analysis assumed a threshold wind speed of 20 miles per hour. The 2005 emission inventory report should explain why a higher threshold wind speed was used in 2005 than previously. Is this based on research within the Phoenix area on the wind speed versus emissions relationship?

Response #9I:

The 2002 windblown dust emission estimates cited by Pechan (10,505 tons per year) were developed prior to the development of the model used in the current application. The previous emission estimates were based on a very simplistic modeling approach which indeed used a constant threshold surface friction velocity. Contrary to Pechan's implication, the current model does not use a fixed threshold (see response above). In addition, the previous estimate of 10,505 tpy of windblown PM_{10} dust included numerous assumptions and flawed wind tunnel study data and should be disregarded.

Comment #9J:

Paved road emissions were estimated using EPA's AP-42 equations. Area-specific inputs to this equation are the paved road silt loadings and average weight of the vehicle fleet traveling on the roads. The values used for silt loadings varied by freeways, high-traffic roads, and local and low traffic roads. The values for these silt loading values are documented in the MCAQD 1999 Serious Area Particulate Plan and appear to be reasonable values, and are also relatively close to the AP-42 default. The average vehicle weight assumption of 3 tons per vehicle is a default value that essentially eliminates vehicle weight from factoring into the emission factor calculation. This is generally acceptable practice. However, a more locally-specific value could be derived based on the VMT mix used in calculating the onroad exhaust emissions, by assigning an average vehicle weight to each vehicle type and weighting these values according to the VMT mix. The one significant area of concern in the paved road emissions calculations, though, is the improper calculation of $PM_{2.5}$ emissions from the PM_{10} emissions. In the MCAQD 2005 inventory, the $PM_{2.5}$ paved road emissions are calculated by multiplying the PM_{10} emissions by 0.15. Instead, the $PM_{2.5}$ emissions should be calculated by using the same AP-42 equation used to calculate the PM_{10} emissions, but using the $PM_{2.5}$-based particle size multiplier and the $PM_{2.5}$-based correction factor that accounts for exhaust, brake wear, and tire wear. Using the appropriate equation and factors results in $PM_{2.5}$ emissions for the PM_{10} modeling area of approximately 1,000 kg/day, yields a reduction of about 5,000 kg/day from the 6,360 kg/day value reported in Table 5.4-6.

The AP-42 equation for paved roads also includes an adjustment to account for the effects of precipitation on paved road emissions. MCAQD does not include this adjustment. Based on 18 days in 2002 with greater than 0.0 1 inches of precipitation, the PM emissions from paved roads would be reduced by approximately 1.4 percent. This would change the Table 5.5-1 PM_{10} annual emissions from paved road fugitive dust for the PM_{10} nonattainment area from 13,783 tons per year to 13,590 tons per year. Unless the Phoenix area experienced significantly more precipitation than this in 2005, it is not expected that applying the precipitation correction would significantly change the calculated paved road emissions.

Response #9J:

MAG has recalculated $PM_{2.5}$ emissions using the same equation (i.e., AP-42, Section 12.2.1, Equation (2)) used to estimate PM_{10} paved road dust emission factors, but substituting the new $PM_{2.5}$ particle size multiplier shown in AP-42, Table 13.2-1.1. This reduces $PM_{2.5}$ emissions to 581 kilograms per day for the PM_{10} modeling area, compared with the 6,360 kg/day reported in Table 5.4-6 of the draft inventory. All $PM_{2.5}$ paved road dust emissions in the 2005 inventory will be revised to be consistent with this reduced estimate for the PM_{10} modeling area. It is important to note that $PM_{2.5}$ emissions are included in the inventory to meet EPA periodic reporting requirements. This change has no impact on the PM_{10} emissions for paved roads that will be used in the Five Percent Plan for PM_{10}.

As previously stated, MAG used AP-42, Section 12.2.1, Equation (2), to estimate PM_{10} emission factors for paved road dust. In that equation, MAG applied 36 days as the precipitation correction term, P, for the 365 days in 2005. P, which represents the number of days with at least 0.01 inches of precipitation, was derived from an analysis of 2005 measurements at meteorological stations located throughout Maricopa County. A precipitation correction term based on this actual 2005 data is considered to be more accurate in estimating 2005 paved road dust emissions than the 2002 P value of 18 days, proposed by the commenter.

Comment #9K:

Unpaved road emissions were also calculated using the AP-42 emission factor equation. This equation for unpaved road emissions includes terms for surface material silt content, average vehicle speed, and surface material moisture content. The values used by MCAQD are all reasonable, however, no explanation for the use of these values is provided. The average speed value modeled of 25 miles per hour should be based on actual data, as this can have a significant impact on the emissions. For example, changing the speed to 40 mph would cause the unpaved road PM_{10} emissions to increase by about 26 percent. This would change the Table 5.5-1 PM_{10} annual emissions from unpaved road fugitive dust for the PM_{10} nonattainment area from 8,490 tons per year to 10,697 tons per year. In contrast, modeling these emissions at a speed of 15 mph would result in a decrease in PM_{10} annual emissions to 6,537 tons per year. Another general concern is that the emission totals for the PM_{10} modeling area reported in Table 5.4-10 cannot be duplicated using the AP-42 equation and the stated inputs. Applying the information provided by MCAQD to the AP-42 unpaved road equation results in PM_{10} emissions that are about 11 percent greater than those reported in Table 5.4-10, or 23,226 kg/day.

Activity for unpaved roads is calculated by multiplying an average daily traffic (ADT) volume by unpaved road mileage. MCAQD uses an ADT of 4 vehicles per day on low traffic roads and 120 vehicles per day on high traffic roads. This is an assumption that appears to be carried forward from the 1994 PM inventory for Maricopa County. This value is an assumption that does not appear to have been based on any actual data. The unpaved road emissions are directly proportional to the ADT values. Thus, if the low traffic ADT is actually 40 rather than 4, then the emissions from the low traffic roads would be increased by a factor of 10. This would result in a change to the Table 5.4- 10 total unpaved road PM_{10} fugitive dust emissions in the modeling area from 20,954 kg/day to 48,053 kg/day. Thus, it is important that this ADT value have some basis in actuality.

The unpaved road mileage used in these calculations is also of concern. The 2005 unpaved road mileage for low traffic roads of 1,129.2 miles is essentially the same as the values used for 2001 through 2006 in the 1999 Serious Area PM_{10} Plan. The mileage modeled for the 2005 inventory on high traffic unpaved roads of 224.3 represents a decrease of 54 miles from the 2006 projections in the 1999 Plan. The 2005 inventory indicates that this represents the reduction in unpaved road mileage due to the control measures in the 1999 Plan to Reduce-Particulate Emissions from Unpaved Roads and Alleys. However, the documentation does not state how many miles of roads have assumed to have been paved. One of the appendices to the Revised MCAQD 1999 Serious Area Particulate Plan for PM_{10} for the Maricopa County Nonattainment Area lists commitments by several jurisdictions in the MCAQD area to pave, gravel, or stabilize emissions from unpaved roads. This list does not provide sufficient information to calculate the mileage reduced from unpaved roads. Additionally, there is no indication that growth in unpaved roads since the time of the 1999 plan has been factored into this analysis. With the growth in population and VMT in the MCAQD area, it is unrealistic to expect that the mileage of unpaved roads in the area has not increased since 1999.

As with the paved roads, the AP-42 documentation includes a precipitation adjustment. No adjustment for precipitation was applied to the unpaved roads, but, again, this is not expected to have a significant impact.

Response #9K:

As indicated in Responses #8C and #8J, MAG used the best available data on unpaved roads to prepare the PM_{10} emissions estimates in the Draft 2005 Periodic Emissions Inventory for PM_{10}. The unpaved road mileage by traffic volume category (i.e., low – average of 4 average daily trips (ADT) and high – average of 120 ADT) was derived from a database developed for the MAG Serious Area PM_{10} Plan. The Serious Area PM_{10} Plan, that was approved by EPA on July 25, 2002, reduced the miles of unpaved roads to reflect legally-binding commitments made by local jurisdictions to pave and stabilize unpaved roads by 2006. To ensure that these unpaved road assumptions continue to be representative of the PM_{10} nonattainment area, MAG will work diligently to update the traffic counts on a sample of unpaved roads. MAG will also apply geographic information systems (GIS) and recent aerial photography to estimate the current unpaved road mileage. Since it will take several months to collect this data, it will not be available to recalculate unpaved road emissions for the final 2005 periodic emissions inventory; however, it will be available for use in estimating the 2007 unpaved road emissions for the Five Percent Plan for PM_{10}.

As indicated in Response #8J, the 25 mph speed on unpaved roads was assumed, because it is the speed limit that the Arizona Department of Transportation Motor Vehicle Division has officially established for roads that are not posted with a speed limit sign. While collecting traffic counts on a sample of unpaved roads, MAG will try to obtain typical vehicle operating speeds on the same roads.

Although these speeds will not be scientifically-derived (i.e., through a formal travel time survey or speed study), the observations should provide a basis to determine whether the current assumption of 25 mph is reasonable.

MAG used AP-42, Section 12.2.2, Equation (1b), to estimate PM_{10} emission factors for unpaved road dust. As documented on Page 116 of the inventory, the inputs to this equation were mean vehicle weight (3 tons), surface material silt content (11.9%), average vehicle speed (25 mph), and surface material moisture content (0.5%). The mean vehicle weight and surface moisture content represent EPA default values. The source for the speed assumption is discussed above. The average silt content was derived from analysis of soils in Maricopa County for the 1994 Regional PM_{10} Emission Inventory. In calculating unpaved road dust emissions, MAG also applied Equation (2) which corrects the particulate emission factor for precipitation. MAG applied 36 days as the precipitation correction term, P, for 2005. P, which represents the number of days with at least 0.01 inches of precipitation, was derived from an analysis of 2005 measurements at meteorological stations located throughout Maricopa County. The commenter should be able to replicate the unpaved road emissions if the correct 2005 precipitation correction factor is applied.

Comment #9L:

> Due to the sensitivity of the unpaved road fugitive dust emissions to the average daily traffic volume used, information on how this value was derived in other comparable areas in the Southwest was investigated. The Clark County, Nevada, PM_{10} SIP was prepared in June 2001 and estimates the ADT for unpaved roads based on traffic count data. The Clark County SIP indicates that traffic counts were taken on a representative sample of the unpaved roads in the area and these samples were then used to predict daily traffic volumes on the remaining unpaved roads. The roads were divided into four volume categories. For the first three categories, the average of the daily traffic volume range was modeled as the ADT for the roads in each category, resulting in ADTs of 25, 75, and 125 for these three categories. The fourth category included unpaved roads with ADTs estimated to be greater than 150. Because the upper end of this range was unknown, the ADT for this category was set to 15 1. This method of estimating ADT based on actual traffic counts is more robust than the Maricopa County method which relies on model assumptions of 4, 120, and 120 vehicles per day on low, medium, and high ADT roads, respectively. Although the MCAQD documentation does not indicate the ADT volume range for the low, medium, and high ADT unpaved road categories, a conservative assumption could be made that these roads fall in a less than 50 ADT volume category. Making the argument that the lowest ADT category of unpaved roads in Maricopa County should be comparable to those in Clark County, based on proximity and comparable geographic conditions, then it would be reasonable to assume that the ADT for the low ADT category should be increased to 25 vehicles per day. Such an assumption would increase the unpaved road fugitive dust PM_{10} emissions reported in Table 5.4-10 from 20,954 kg/day to 36,762 kg/day in the PM_{10} modeling area.

Response #9L:

As indicated in Responses #8C, #8J and #9K, MAG used the best available data on unpaved roads to prepare the PM_{10} emissions estimates in the Draft 2005 Periodic Emissions Inventory for PM_{10}. The unpaved road mileage by traffic volume category (i.e., low – average of 4 average daily trips (ADT) and high – average of 120 ADT) was derived from a database developed for the MAG Serious Area PM_{10} Plan. To ensure that the traffic volumes on unpaved roads continue to be representative of the PM_{10} nonattainment area, MAG will work diligently to update the traffic counts on a sample of unpaved roads. Since it will take several months to collect this data, it will not be available to recalculate unpaved road emissions for the final 2005 periodic emissions inventory; however, it will be available for use in estimating the 2007 unpaved road emissions for the Five Percent Plan for PM_{10}.

Comment #10:

We have given a preliminary review of the 2005 Periodic Emissions Inventory for PM_{10} for the Maricopa County, Arizona, Nonattainment Area; and have the following questions concerning the assumption of construction activities occurring only 5 days per week.

EPA has found in Las Vegas, Nevada that activities for residential construction occur 6 days per week on non union sites (70%) and 5 days for union sites (30%). Commercial construction occurs 6 to 7 days per week. Road construction activities occur 7 days per week with most of the road construction activities occurring at night in the summer months. EPA finds that the activities in Las Vegas are similar to the activities in Maricopa County. Although the emissions calculated for these activities will probably not change, since the emission factors are based upon acres disturbed, number of homes built, number of miles of roads constructed, etc; EPA concern is that Construction and Mining Equipment may have been underestimated with the assumption of only 5 days of construction activities. If there are laws, ordinances, or rules that prohibit construction to just 5 days, then the assumptions in the inventory are correct. EPA asks that the number of days of construction activities be reviewed and if found to occur above 5 days, to adjust the emissions in the Construction and Mining Equipment category.

EPA has found that there are some emissions that were not included in the draft inventory but are stated to be included in the final inventory. They were: ammonia emissions for fertilizer applications, cattle feedlots and dairies, and $PM_{2.5}$ emissions from windblown dust.

Response #10:

MCAQD Dust Compliance Division staff acknowledge that residential and commercial construction may occur 6 or 7 days/week and roadway construction may occur 7 days/week. However MCAQD does not track this information and the activity can vary depending on the project. MCAQD chose to modify it's assumption regarding the number of days per week that construction activities occurs from 5 days per week to 6 days per week. The effect of this modification has no effect on annual emission calculations, but results in lower daily PM_{10} emissions from construction. This change is reflected in the May 2007 emissions inventory report.

Appendix 2.1

Instructions for Reporting 2002 Annual Air Pollution Emissions

MARICOPA COUNTY
AIR QUALITY DEPARTMENT

INSTRUCTIONS

FOR REPORTING 2005

ANNUAL AIR POLLUTION EMISSIONS

February 2006

Emissions Inventory Unit
1001 North Central Avenue, Suite 400
Phoenix, Arizona 85004
(602) 506-6790
(602) 506-6985 (Fax)

Copies of this document, related forms
and other reference materials are available online at our web site:
www.maricopa.gov/aq/ei.aspx

TABLE OF CONTENTS

WHAT'S NEW FOR 2005?

Emissions reporting requirements:

- The US EPA has recently designated the chemical **t-butyl acetate** (CAS number 540-88-5) as a VOC for record-keeping and emissions reporting requirements, but not for emission limitations or content requirements. If you use this chemical at your facility, see the box on page 3 for specific reporting instructions.

- It is **critical** to the accuracy of your report to use the emission calculation method that best represents **actual** emissions from your facility. Page 4 of these instructions now includes details on the preferred emission calculation methods. Please double check your emissions calculations to make sure the best method is employed.

Reporting forms:

- Some **pre-printed information** on your report may be different from last year's version. Please review the enclosed forms carefully, and verify all pre-printed information.

- Many of our reporting forms **have changed** recently. If you use your own forms, or a computerized reproduction of our forms, the forms used ***MUST*** conform to the current information requirements and **FORMAT** as supplied on our preprinted forms. "Homemade" reporting forms that vary significantly from the preprinted forms sent to you will ***not*** be accepted.

Miscellaneous:

- **EPA emission factors** for certain activities at sand and gravel facilities have been revised. The new emission factors appear on applicable pre-printed general process forms and are also listed on our revised Sand & Gravel Helpsheet available at: **www.maricopa.gov/aq/ei.aspx**

- In accordance with Maricopa County Air Pollution Control Rule 280 (Fees), the 2005 annual emission fee (for Title V sources only) is $13.65/ton.

I. INTRODUCTION

An annual emissions inventory is a document submitted by a business that: (1) lists all processes emitting reportable air pollutants and (2) provides details about each of those processes. Submitting the emissions inventory report is ***required*** as a condition of your Maricopa County Air Quality Permit. A separate emissions report is required for each business location with its own air quality permit.

Follow these steps to complete your 2005 Maricopa County emissions inventory:

STEP 1: Determine which forms are needed for your business. There are eight different forms available, but not all are required for every type of business. For most permitted sources, the packet you received from us contains the necessary pre-printed forms based on your site's most recent emissions inventory.

1. **Business Form**: Contains general contact information about the permitted site. This form is required for all businesses.
2. **Stack Form**: Only required if your business location annually emits over 10 tons of a single pollutant (CO, VOC, NO_x, PM_{10}, or SO_x). A "stack" is defined as a stack, pipe, vent or opening through which a significant percentage of emissions (from one or more processes) are released into the atmosphere. See the "Stack Form Instructions" on page 9 for specific requirements.
3. **Control Device Form**: Required only if there is one or more emission control devices used at the business location.
4. **General Process Form** and
5. **Evaporative Process Form**: } Either or both will be required for all businesses.
6. **Off-Site Recycling/Disposal Form**: Required if you want to claim off-site recycling or disposal.
7. **Emission Factor Calculations**: Required as attachment for each process for which you calculated your own emission factors.
8. **Data Certification Form or Data Certification/Fee Calculation Form**: Only sources with a **Title V** permit are required to pay a fee for their emissions and need to use the Data Certification/Fee Calculation Form. All other sources use the Data Certification Form.

STEP 2: Complete the applicable forms. Verify all preprinted information, and make corrections where necessary. When making corrections, strike out the preprinted data and write in corrections beside it. Please make all changes readily noticeable. Detailed information on how to complete the most common forms is included in this document. The packet you received also contains information about other resources (workshops, one-on-one assistance, etc.) available to help you in completing the necessary forms.

STEP 3: Make a copy of your completed emissions inventory report. Make sure to KEEP COPIES of all forms submitted and copies of all records and calculations used in completing the forms. Air pollution control regulations require that you keep all documentation for at least FIVE YEARS at the location where pollution is being emitted.

STEP 4: Make sure the Data Certification Form (or Data Certification/Fee Calculation Form for Title V sources) is ***signed*** by a company representative. ***Include your air quality permit number on all correspondence and applicable checks submitted with your report.*** Return the ***original***, signed copy of your annual emission report, with payment for any applicable emission fees to:

Maricopa County Air Quality Department
Emissions Inventory Unit
1001 North Central Avenue, Suite 100
Phoenix, AZ 85004

II. REPORTING REQUIREMENTS

POLLUTANTS TO BE REPORTED:
Your emissions inventory must include your business's emissions of the following air pollutants:

CO	=	Carbon monoxide
NO_x	=	Nitrogen oxides
PM_{10}	=	Particulate matter less than 10 microns
SO_x	=	Sulfur oxides
VOC	=	Volatile organic compounds *
HAP&NON	=	Hazardous Air Pollutant (HAP) that is also NOT a volatile organic compound (VOC)**
NH_x	=	Ammonia and ammonium compounds
Pb	=	Lead

* A ***volatile organic compound (VOC)*** is defined as any compound of carbon that participates in atmospheric photochemical reactions. This definition ***excludes***: carbon monoxide, carbon dioxide, acetone, carbonic acid, metallic carbides or carbonates, and ammonium carbonate, as well as certain other organic compounds. (See Maricopa County Air Pollution Control Rule 100, Sections 200.69 and 200.110 for a full definition.)

NEW FOR 2005: EPA has redesignated the chemical **t-butyl acetate (CAS Number 540-88-5)** as a VOC for record-keeping requirements and emissions reporting, but not for emission limitations or content requirements. An anticipated revision to County Rule 100, Section 200.69 (tentatively scheduled for adoption in March 2006) will incorporate this change as follows:

"The following compound(s) are VOC for purposes of all recordkeeping, emissions reporting, photochemical dispersion modeling and inventory requirements which apply to VOC and shall be uniquely identified in emission reports, but are not VOC for purposes of VOC emissions limitations or VOC content requirements: t-butyl acetate (540-88-5)."

Therefore, if your facility uses t-butyl acetate, it is necessary to report t-butyl acetate as a separate material on the evaporative process form, <u>not</u> as part of a grouped material (e.g., solvents, thinners, activators, etc.). T-butyl acetate will continue to be identified as a VOC on your emission report and count towards any applicable emission fees.

** ***HAP&NON:*** Usage of certain materials that are: (1) a Hazardous Air Pollutant (HAP) **and** (2) **not** also a VOC (that is, not also an ozone precursor) should also be reported if:
(a) your site is subject to a Federal MACT (Maximum Achievable Control Technology) standard ***<u>or</u>***
(b) your air quality permit contains specific quantitative limits for HAP emissions.

The most common materials categorized as "HAP&NON" include:

- methylene chloride (dichloromethane)
- perchloroethylene
- 111-trichloroethane (111-TCA or methyl chloroform)
- hydrochloric acid
- hydrofluoric acid

NOTE: HAPs that are also considered volatile organic compounds are reported as <u>VOC</u>.

EMISSION CALCULATION METHOD HIERARCHY:

When preparing emission information for your report, the most accurate method for calculating **actual** emissions must be used. The hierarchy listed below outlines the preferred methods for calculating emission estimates. (The hierarchy listed below will be incorporated into an anticipated July 2006 revision of Rule 280 of Maricopa County's Air Pollution Control Rules and Regulations).

(1) Whenever available, emissions estimates should be calculated from continuous emissions monitors certified under 40 CFR Part 75, Subpart C, or data quality assured pursuant to Appendix F of 40 CFR, Part 60.

(2) When sufficient data obtained using the methods described in paragraph 1 is not available, emissions estimates should be calculated from source performance tests conducted pursuant to Rule 270 in Maricopa County's Air Pollution Control Rules and Regulations.

(3) When sufficient data obtained using the methods described in paragraphs 1 or 2 is not available, emissions estimates should be calculated from material balance using engineering knowledge of the process.

(4) When sufficient data obtained using the methods described in paragraphs 1 through 3 is not available, emissions estimates shall be calculated using emissions factors from EPA Publication No. AP-42 "Compilation of Air Pollutant Emission Factors," Volume I: Stationary Point and Area Sources.

(5) When sufficient data obtained using the methods described in paragraphs 1 through 4 is not available, emissions estimates should be calculated by equivalent methods supported by back-up documentation that will substantiate the chosen method.

III. CONFIDENTIALITY OF DATA SUBMITTED

Information submitted in your annual emissions reports must be made available to the public unless it meets certain criteria of Arizona State Statutes and Maricopa County Rules. Applicable excerpts concerning confidentiality of data are reproduced below.

ARS § 49-487 D. ...the following information shall be available to the public:…

2. The chemical constituents, concentrations and amounts of any emission of any air contaminant. ...

MARICOPA COUNTY AIR POLLUTION CONTROL RULES AND REGULATIONS, Rule 100:

§ **200.107 TRADE SECRETS -** Information to which all of the following apply:

a. A person has taken reasonable measures to protect from disclosure and the person intends to continue to take such measures.
b. The information is not, and has not been, reasonably obtainable without the person's consent by other persons, other than governmental bodies, by use of legitimate means, other than discovery based on a showing of special need in a judicial or quasi-judicial proceeding.
c. No statute, including ARS §49-487, specifically requires disclosure of the information to the public.
d. The person has satisfactorily shown that disclosure of the information is likely to cause substantial harm to the business's competitive position.

§ **402 CONFIDENTIALITY OF INFORMATION:**

402.2 Any records, reports or information obtained from any person under these rules shall be available to the public ... unless a person:

a. Precisely identifies the information in the permit(s), records, or reports which is considered confidential.
b. Provides sufficient supporting information to allow the Control Officer to evaluate whether such information satisfies the requirements related to trade secrets as defined in Section 200.107 of this rule.

For emissions inventory information to be deemed confidential, the following steps must be followed:

- Specific data which you request be held confidential must be identified by marking an "X" in the corresponding gray confidentiality box(es) on the relevant report forms.
- Provide a written explanation which gives factual information satisfactorily describing why releasing this information could cause substantial harm to the business's competitive position.
- Use the gray-shaded boxes on the reporting forms to indicate which data are to be held confidential. Do NOT stamp "Confidential", highlight data, or otherwise mark the page.
  No data can be held confidential without proper justification.

IV. HELPFUL HINTS AND INFORMATION

Be sure to verify all preprinted information on forms. If any information is incorrect or blank, please provide correct information. Making a change on the Business Form will **NOT** transfer the permit ownership or location. You must contact the Department's Permit Engineering Division at (602) 506-6464 to accomplish this.

WHAT IS A PROCESS? A ***process*** is a business activity at your location that emits one or more of the pollutants listed on page 3, and has only ***one*** material type as input and ***one*** operating schedule. For each applicable process at your business, you must assign a unique Process ID number to differentiate each process.

PROCESSES AND MATERIALS THAT DO ***NOT*** HAVE TO BE REPORTED:

- Welding.
- Acetone usage.
- Fuel use for forklifts or other vehicles. (NOTE: Fuel use in ***non-vehicle*** engines ***is*** reportable.)
- Soil remediation activities. (Note: Other periodic reporting requirements may exist; consult your permit.)
- Storage emissions from fuels or organic chemicals in any tank with a capacity of 250 gallons or less.
- Storage emissions of diesel and Jet A fuel in underground tanks of any size.
- Storage emissions of diesel and Jet A fuel in aboveground tanks, with throughput < 4,000,000 gal/yr.
- Routine pesticide usage, housekeeping cleaners, and routine maintenance painting at your facility.

Please group all similar equipment and materials together before applying the following limitations:

- Internal combustion engines (e.g., emergency generators) or external combustion equipment (e.g., boilers and heaters) that operated less than 100 hrs. and burned less than 200 gals. diesel or gas, or less than 100,000 cubic feet of natural gas.
- Materials with usage of less than 15 gallons or 100 pounds per year.

GROUPING MATERIALS AND/OR EQUIPMENT UNDER ONE PROCESS ID:
You can group together under one process ID:

- All internal combustion engines ***less than 600 hp*** if they burn the same fuel and have similar operating schedules.
- All external combustion equipment (boilers, heaters) with a capacity of ***less than 10,000,000 Btu*** per hour if they burn the same fuel and have similar operating schedules.
- All similar evaporative materials with similar emission factors that have similar operating schedules and process descriptions. For example, group low-VOC red paint, green paint and white paint together as one material: “Paint: Low-VOC.” Do ***not*** group dissimilar materials together, such as thinners and paints. Attach documentation (see example, p. 20) showing how the grouped emission factor was determined.
- All underground tanks with the same fuel and same type of vapor recovery system.

ASSIGNING IDENTIFICATION NUMBERS (IDs):
Unique IDs are required for the following report elements: Stacks, Control Devices and Processes. For processes, that means a process ID number may be used only once on each General Process form and for each material reported on the Evaporative Process Forms.

These numbers are usually assigned by the person who prepares the original report. If you are adding a new item to a preprinted report, assign a number not already in use. Once an ID number is assigned, continue using the same number for that item each year. If that item is no longer reportable, return the preprinted form with a brief explanation. Do not use that ID number again.

INDUSTRY-SPECIFIC INSTRUCTIONS: Additional help sheets, detailed examples, and special instructions are available for a number of specific processes or industries listed below. To get copies of any of these documents, please visit our web site at *www.maricopa.gov/aq/ei.aspx* or call (602) 506-6790.

- Bakeries
- Concrete Batch Plants
- Fuel Storage and Handling
- Incinerators and Crematories
- Lg. Aboveground Storage Tanks
- Natural Gas Boilers/Heaters
- Polyester Resin
- Printing Plants
- Roofing Asphalt
- Sand and Gravel Plants
- Using EPA's TANKS 4.09d Program
- Vehicle Refinishing
- Vehicle Travel on Unpaved Roads
- Woodworking

COMMONLY USED CONVERSION FACTORS:

1 gram/liter	=	0.00834 lbs/gal	1 foot	=	0.0001894 mile
1 liter	=	0.2642 gallon (US)	1 square foot	=	0.000022957 acre
1 therm	=	0.0000952 MMCF	1 pound	=	0.0005 ton

NOTE: MM = 1,000,000 Example: MMCF = 1,000,000 cubic feet
M = 1,000 Example: MGAL = 1,000 gallons

ADDITIONAL RESOURCES AND ASSISTANCE:
The Maricopa County Emissions Inventory web site at *www.maricopa.gov/aq/ei.aspx* contains additional reference materials, such as:

- blank copies of most emissions reporting forms.
- an updated list of emission factors for a large number of industrial processes, including SCC codes.
- a list of Tier Codes for industrial processes.
- detailed help sheets for a number of specific industries or processes.

To receive any of the above materials by fax or mail, or for additional information or assistance in how to calculate and report your emissions, please call us at (602) 506-6790.

V. INSTRUCTIONS AND EXAMPLES FOR COMPLETING EMISSIONS REPORTING FORMS

Business Form Instructions

Verify all preprinted information, and make corrections where necessary. When making corrections, strike out the preprinted data and write in corrections beside it. Please make all changes readily noticeable.

NOTE: Indicating a change in ownership or business location on the Business Form will ***not*** serve to transfer the permit ownership or location. You must contact the Department's Permit Engineering Division at (602) 506-6464 to accomplish this.

Data fields:

6 Number of employees: This should be the annual average number of full-time equivalent (FTE) employee positions ***at this business location***.

9 NAICS Code: This 5- or 6-digit North American Industrial Classification System (NAICS) code has been introduced to replace the 4-digit Standard Industrial Classification (SIC) codes. Please list the primary and secondary NAICS codes for your business, if known. (Consult our website, at *www.maricopa.gov/aq/ei.aspx*, for a link to a full list of NAICS codes.)

10 Preparer of the Inventory (primary contact for technical questions concerning this report): This should be the person who knows the most about the data in the report. If this person has an e-mail address used for business purposes, please provide it.

Stack Form Instructions

A “stack” is defined as a **stationary** stack, pipe, vent or opening through which a significant percentage of emissions (from one or more processes) are released into the atmosphere (with or without a control device).

NOTE: Stack information is required only if your business location annually emits over 10 tons of any one individual pollutant. If so, you must complete a Stack Form for:

- each stack connected to a control device.
- any stack that discharges annually more than 5 tons of combined pollutant emissions (such as a paint booth exhaust).

EXAMPLE Stack Form Information:

1	**2**	**3**	**4**	**5a OR 5b**		**6a OR 6b & 6c**			**7**
Stack ID	Stack Type Code*	Stack Height**	Exit Gas Temperature	Velocity feet/sec	Flow Rate acfm	Diameter inside inch	Length / Width inside inch		Stack Name/Description. Include lat/long coordinates of stack (in decimal degrees)
1	*W*	*30* ft	*90* ^{o}F		*20,000*	*36*			*paint booth Lat: N33.531873 Long: W112.261331*
2	*V*	*14* ft	*200* ^{o}F		*19,186*	*40*			*thermal oxidizer, Bldg. 2 Lat: N33.5325 Long: W112.26136*

* Stack Type Codes:
V = Vertical unobstructed
H = Horizontal unobstructed
D = Downward unobstructed
G = Gooseneck
W = Obstructed vertical (e.g. weather cap)

** Stack height is calculated relative to the surrounding terrain. For instance, the stack height of a 10-foot stack on top of a 20-foot tall building is 30 feet.

Data fields:

1 Stack ID: (See “Assigning Identification Numbers” on page 6.) A number (up to three digits, numeric only) which identifies a specific stack. It is suggested you start with 1, then 2, etc.

4 Exit Gas Temperature: Should represent average operating conditions, in degrees Fahrenheit. ***DO NOT*** report “ambient”.

5a Exit Gas Velocity: ***OR*** 5b Gas Flow Rate:
Provide ***EITHER*** the exit velocity (in feet per second) ***OR*** the flow rate of gas (in actual cubic feet per minute) exiting the stack during normal operations. Preprinted information provides both.

6a Inside Stack Diameter: For round stacks, provide Inside Stack ***Diameter*** in inches.
OR
6b & 6c Inside Stack Length and Width: For square or rectangular stacks, provide inside ***Length and inside Width*** in inches.

7 Stack Name/Description and Lat/Long Coordinates: Provide a brief text description of the stack along with the latitude and longitude coordinates of the stack (in decimal degrees).

Control Device Form Instructions

EXAMPLE Control Device Form Information

1	2	3	4	5	6
Control ID	Installation/ Reconstruction* Date	Size or Rated Capacity**	Control Type Code	Control Device Name/Description	Stack ID
1	***05/09/98***	***25,000.0*** cfm	***021***	***Thermal oxidizer***	***2***
4	***03/10/97***	cfm	***153***	***Watering with water trucks***	

Data fields:

1 Control ID: (See "Assigning Identification Numbers" on page 6.) A unique number (up to three digits) that you assign to identify a specific control device.

2 Installation/Reconstruction Date: The completion date (given in *mm/dd/yy* format) of installation or the most recent reconstruction of the identified control device. This is not a date on which routine repair or maintenance was done. Reconstruction means any component of the control device was replaced and the cost (fixed capital) of the new component(s) was more than half of what it would have cost to purchase or construct a new control device.

3 Size or Rated Capacity: Report the air or water flow rate in ***cubic feet per minute***. Some devices (e.g., water trucks for dust control) will not include a value in this field.

4 Control Type Code: A 3-digit code designating the type of control device. A complete list of all EPA control device codes can be found on the Web at *www.maricopa.gov/aq/ei.aspx* or call (602) 506-6790 for assistance.

6 Stack ID: Not all businesses require a Stack ID. This is required if the Stack Form is used for your site (see page 9) ***and*** the control device is vented through that identified stack. This is the ID number shown in column 1 of the Stack Form. The Stack ID can be entered on this form after the Stack Form has been filled out.

General Process Form Instructions

The General Process Form is used to record data on all emissions-producing processes except evaporative processes. A "***general process***" is normally characterized by the burning or handling of a material. One form reports all the pollutants for one process. For example, several pollutants are produced by burning fuel, and PM_{10} is emitted by processing rock products, processing materials such as wood or cotton, and driving on unpaved areas.

Data fields: (See sample forms on pages 13 and 14.)

1 Process ID: A number (up to three digits) that is preprinted or you assign. (See "Assigning Identification Numbers" on page 6.) This Process ID number can not be used for any other process at this location.

2 Process Type/Description: Brief details on the type of activity that is occurring.

3 Stack ID(s): The stack ID number(s) shown in column 1 of the Stack Form that identify the stack(s) which vent pollution created by this process. Not all businesses are required to report stacks. This is only required if the Stack Form is required for your site (see page 9) ***and*** the process has a stack.

4 Process Tier Code and
5 SCC Code: If these codes are not preprinted on your form, please consult the section "Other Resources" on our web site, or call (602) 506-6790.

6 Seasonal Throughput Percent: Enter the percent of total annual operating time that occurred per season, rounded to the nearest percent. For example, "Dec-Feb 30% " means 30% of total annual activity occurred in January, February and December 2005. The total for all four seasons must equal 100%.

7 Normal Operating Schedule and
8 Typical Hours of Operation: These reflect the normal daily, weekly, and annual operating parameters of ***this process*** during 2005.

9 Emissions Based on: Provide the ***name*** of the material used, fuel used, product produced, or whatever was measured for the purpose of calculating emissions, such as "natural gas", "hours of operation," "vehicle miles traveled," or "acres."

10 Used, Produced or Existing: Indicate whether calculated emissions are based on a material type or fuel *used* (an input, such as "paint" or "natural gas"), or an *output* (such as "sawdust produced" or "finished product"). Use "Existing" if the parameter reported on line 9 is not directly used or produced in the process (such as "vehicle miles traveled" or "acres").

11 Annual Amount: The annual amount (a number) of material that was used, fuel combusted, product produced, hours of operation, vehicle miles traveled, or acres.

12 Fuel Sulfur Content (in percent): For processes that involve the combustion of oil or diesel fuels, report the sulfur content of the fuel as a decimal value. Example: 0.05 % (= 500 ppm)

13 Unit of Measure: Units of the material used, fuel used or product produced shown on line 9. For example: gallons, pounds, tons, therms, acres, vehicle miles traveled, units produced.

14 Unit Conversion Factor: You must provide this if you use an emission factor with an emission factor unit (see item 17 below) that is ***not*** the same as the unit of measure (from line 13). This is the standard number you would multiply your amount (line 11) by to convert it to the units of the emission factor. See page 7 for a list of commonly used conversion factors.

General Process Form Instructions (continued)

15 Pollutant: See page 3 for a list of pollutants that need to be reported.

16 Emission Factor (EF): The number to be multiplied by the annual amount (line 11) to determine how much of the pollutant was emitted. If you calculate your own emission factor or change the preprinted emission factor, you must provide details of your calculations in an attachment.

17 Emission Factor (EF) Units: Enter the appropriate Emission Factor Units in pounds (lb) per unit; e.g., lb/ton, lb/MMCF, lb/gal.

18 Controlled Emission Factor (EF)? YES or NO: Indicate "YES" if: 1) you have your own emission factor from testing **and** included the control device efficiency within the factor, or 2) the emission factor used is clearly identified as a controlled emission factor. A "YES" response requires the use of Formula A (see #25 below). Indicate "NO" if: 1) there is no emission control device, or 2) the emission factor represents emission rates **before** controls. A "NO" response requires the use of Formula B (see #25 below).

19 Calculation Method: Enter the number code (listed at the bottom of the General Process Form) which best describes the method you used to obtain this emission factor. Code 5, "AP-42/FIRE Method or Emission Factor" means that the factor comes from EPA documents or software. ***NOTE:*** If you have continuous emissions monitors (CEM) data or conducted a source test that was required and approved by the County for a specific process or piece of equipment, you ***must*** use the emission data from the CEM or the test results. Report "1" in this column for CEM data or "4" for performance test data.

20 through 24: Leave blank if there is no control device.

20 Capture % Efficiency: The percent of the pollutant that is captured and sent to the primary control device in this process. Be sure to list capture efficiency separately for ***each*** pollutant affected.

21 Primary Control Device ID: If this pollutant is being controlled in this process, enter the Control Device ID number which represents the first control device affecting the pollutant.

22 Secondary Control Device ID: If this pollutant is being controlled sequentially by 2 devices, enter the Control Device ID number which represents the second control device; otherwise leave this field blank.

23 Control Device(s) % Efficiency: Enter the total control efficiency of the control device(s). Be sure to list control device efficiency separately for ***each*** pollutant affected. If you report control device efficiency, you must ***also*** show capture efficiency in column 20.

24 Efficiency Reference Code: Enter the code (1 through 6) that best describes how you determined the ***control device efficiency***. A list of possible codes is included at the bottom of the form.

25 Estimated Actual Emissions (in pounds/year): You may round the calculated emissions values to the nearest pound. Calculate as follows:

A. *Emissions with no controls* or *controls are reflected in the emission factor:*
Column 25 = line 11 × line 14 × column 16

B. *Emissions after control:*
Column 25 = line 11 × line 14 × column 16 × (1 – [column 20 × column 23])

Use the decimal equivalent for columns 20 and 23. Example: 96.123% = 0.96123

General Process Form **2005** **EXAMPLE: Internal Combustion** Permit number(s) **V99999**

Place an X in any gray cell to mark data requested to be held confidential. See page 5 for requirements for information to be deemed confidential.

1- Process ID **80**

2- Process Type/Description: ***3 ENGINES FOR CRUSHING (EACH LESS THAN 600 HP)***

3- Stack ID(s) *(only if required on Stack Form)*

4- Process TIER Code: ***020599*** ***FUEL COMB. INDUSTRIAL: INTERNAL COMBUSTION***

5- SCC Code ***20200102*** *(8 digit number)* ***IND:DIESEL-RECIPROCATING***

6- Seasonal Throughput Percent: Dec-Feb ***25*** % Mar-May ***25*** % Jun-Aug ***25*** % Sep-Nov ***25*** %

7- Normal Operating Schedule: Hours/Day ***8*** Days/Week ***5*** Hours/Year ***2080*** Weeks/Year ***52***

8- Typical Hours of Operation: *(military time)* Start ***0700*** End ***1530***

9- Emissions based on *(name of material or other parameter, e.g. "rock", "diesel", "vehicle miles traveled")* ***DIESEL***

10- ☒ Used (input) or ☐ Produced (output) or ☐ Existing (e.g. VMT, acres)

11- Annual Amount: *(a number)* ***16,250*** 12- Fuel Sulfur Content (in percent) ***0.05*** %

13- Unit of Measure: *(for example: tons, gallons, million cu ft, acres, units produced, etc.)* ***GALLONS***

14- Unit Conversion Factor *(if needed to convert Unit of Measure to correlate with emission factor units)* ***0.001***

	Emission Factor (EF) Information				Control Device Information					
15	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
Pollutant	Emission Factor (EF) (number)	Emission Factor Unit (lb per)	Controlled EF? Yes or No	Calculation Method Code*	Capture % Efficiency	Primary Control Device ID	Secondary Control Device ID	Control Device(s) % Efficiency	Efficiency Reference Code**	Estimated Actual Emissions
CO	130	M GALS	N	5						2,113 lbs
NOx	604	M GALS	N	5						9,815 lbs
PM-10	42.5	M GALS	N	5						691 lbs
SOx	39.7	M GALS	N	5						645 lbs
VOC	49.3	M GALS	N	5						801 lbs

*** Calculation Method Codes:**
- **1** = Continuous Emissions Monitoring Measurements
- **2** = Best Guess / Engineering Judgment
- **3** = Material Balance
- **4** = Source Test Measurements (Stack Test)
- **5** = AP-42 / FIRE Method or Emission Factor
- **6** = State or Local Agency Emission Factor
- **7** = Manufacturer Specifications
- **8** = Site-Specific Emission Factor
- **9** = Vendor Emission Factor
- **10** = Trade Group Emission Factor

**** Control Efficiency Reference Codes:**
- **1** = Tested efficiency / EPA reference method
- **2** = Tested efficiency / other source test method
- **3** = Design value from manufacturer
- **4** = Best guess / engineering estimate
- **5** = Calculated based on material balance
- **6** = Estimated, based on a published value

General Process Form 2005

EXAMPLE: Unpaved Road Travel

Permit number(s) V99999

Place an X in any gray cell to mark data requested to be held confidential. See page 5 for requirements for information to be deemed confidential.

1- Process ID 28

2- Process Type/Description: UNPAVED ROAD TRAVEL: HEAVY-DUTY TRUCKS @ 15 MPH

3- Stack ID(s) *(only if required on Stack Form)*

4- Process TIER Code: 140799 MISCELLANEOUS: FUGITIVE DUST

5- SCC Code 30502504 *(8 digit number)* SAND/GRAVEL: HAULING

6- Seasonal Throughput Percent: Dec-Feb 25 % Mar-May 25 % Jun-Aug 25 % Sep-Nov 25 %

7- Normal Operating Schedule: Hours/Day 8 Days/Week 5 Hours/Year 2080 Weeks/Year 52

8- Typical Hours of Operation: *(military time)* Start 0700 End 1530

9- Emissions based on *(name of material or other parameter, e.g. "rock", "diesel", "vehicle miles traveled")* VEHICLE MILES TRAVELED (VMT)

10- ☐ Used (input) or ☐ Produced (output) or ☒ Existing (e.g. VMT, acres)

11- Annual Amount: *(a number)* 7,500 12- Fuel Sulfur Content (in percent) %

13- Unit of Measure: *(for example: tons, gallons, million cu ft, acres, units produced, etc.)* VMT

14- Unit Conversion Factor *(if needed to convert Unit of Measure to correlate with emission factor units)*

	Emission Factor (EF) Information				Control Device Information					
15	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
Pollutant	Emission Factor (EF) (number)	Emission Factor Unit (lb per)	Controlled EF? Yes or No	Calculation Method Code*	Capture % Efficiency	Primary Control Device ID	Secondary Control Device ID	Control Device(s) % Efficiency	Efficiency Reference Code**	Estimated Actual Emissions
PM-10	3.2	VMT	N	6	100	4		70	6	7200 lbs
										lbs
										lbs
										lbs
										lbs
										lbs

NOTE: Emissions in col. 25 are calculated as follows: **(line 11 × col. 16) × (1 – [col. 20 × col. 23])**

*** Calculation Method Codes:**
- **1** = Continuous Emissions Monitoring Measurements
- **2** = Best Guess / Engineering Judgment
- **3** = Material Balance
- **4** = Source Test Measurements (Stack Test)
- **5** = AP-42 / FIRE Method or Emission Factor
- **6** = State or Local Agency Emission Factor
- **7** = Manufacturer Specifications
- **8** = Site-Specific Emission Factor
- **9** = Vendor Emission Factor
- **10** = Trade Group Emission Factor

**** Control Efficiency Reference Codes**
- **1** = Tested efficiency / EPA reference method
- **2** = Tested efficiency / other source test method
- **3** = Design value from manufacturer
- **4** = Best guess / engineering estimate
- **5** = Calculated based on material balance
- **6** = Estimated, based on a published value

Evaporative Process Form Instructions

The Evaporative Process Form is used to report all emissions produced by evaporation. Examples include: cleaning with solvents, painting and other coatings, printing, using resin, evaporation of fuels from storage tanks, ammonia use, etc. All other processes should be shown on the General Process Form.

One Evaporative Process Form may be used to report numerous materials, with each material given a separate process ID number, as long as the information on lines 1–5 apply to all items on that form. Use a separate form for each group of materials that has a different Process Type/Description (shown on line 1), different Tier Code (line 2) or different operating schedule (lines 3, 4, or 5).

Data fields: (See sample forms on pages 17 and 18.)

1 Process Type/Description: Brief details of the activity in which the listed materials were used.

2 Process Tier Code: If this 6-digit code is not preprinted on your form, please refer to the Tier Code list at *www.maricopa.gov/aq/ei.aspx* or call (602) 506-6790.

3 Seasonal Throughput Percent: Enter the percent of total annual operating time that occurred per season (rounded to the nearest percent). For example, "Dec-Feb 30% " means 30% of the total annual activity occurred during January, February and December 2005. The total for all four seasons must equal 100%.

4 Normal Operating Schedule and
5 Typical Hours of Operation: These represent the usual number of hours, time of day and weeks per year when ***this process*** occurred during the calendar year.

6 Process ID: A number (up to three digits) that represents this specific material (process). Each process on one form must have the same tier code and operating schedule as that shown in the top portion of the form. This Process ID number can ***not*** be used for any other process at this business location. See page 6 of these instructions for more explanation of ID numbers and for exclusions and guidance on grouping materials.

7 Stack ID(s): The stack ID number(s) shown in column 1 of the Stack Form that identify the stack(s) which vent pollution created by this process. Not all businesses are required to report stacks. This is only required if the Stack Form is required for your site (see page 9) ***and*** the process has a stack.

8 Material Type: Provide the name of the material used in this process. Give the chemical name for pure chemicals or a name that reflects its use (paint, ink, etc.), rather than just a brand name or code number. Examples of materials include: paint, thinner, degreasing solvent (plus its common name), ink, fountain solution, ammonia, alcohol, ETO (ethylene oxide), gasoline (in a storage tank).

9 Annual Material Usage/Input: Amount of this material used during the year. In most cases, the amount purchased is suitable. Write in "lbs" or "gal" (pounds or gallons).

10 Pollutant: The only pollutants reported on this form are VOC, HAP&NON and NH_X (see definitions on page 3). When one process (or material) has more than one of these pollutants, list each pollutant on a separate line, using the same process ID number.

11 Emission Factor (EF): An emission factor is a number used to calculate the pounds of pollutant emitted based on the quantity of material used in a process. Emission factors can be obtained from your supplier (usually provided on a Material Safety Data Sheet or environmental data sheet), and must correspond with the material units reported in column 9. If the material unit is "gal," then the emission factor must be in pounds of pollutant per gallon. If the material unit is "lb," then the emission factor must be in pounds of pollutant per pound of material.

Verify (and correct, where necessary) all pre-printed emission factors, as the composition of materials used may have changed since your last report. A "lb/gal" emission factor is almost always less than 8 and never greater than 14. A "lb/lb" emission factor is never larger than 1.0.

12 Pounds of pollutant sent off-site: Required only if you wish to take credit for reduced emissions because waste of this material is sent off-site for recycling or disposal. Only waste generated during the report year may be claimed. The Off-Site Recycling/Disposal Form ***must*** be completed if you wish to claim a credit. The number of pounds reported in column 12 ***must*** equal the number of pounds reported on the Off-Site Recycling/Disposal Form(s) for the same Process ID number.

13 and 14: Leave these fields blank if there is no control device present.

13 Capture % Efficiency: The percent of the pollutant from this process that is captured and sent to the control device.

14 Control ID: If this pollutant is being controlled in this process, enter the Control Device ID number from column 1 of the Control Device Form.

Control % Efficiency: Enter the percent of this pollutant that is controlled by this control device.

Code: Select the Control Efficiency Reference Code from the list at the bottom of the form.

15 Estimated Emissions (lbs/yr): Estimated pounds of the pollutant emitted during the year, after off-site recycling/disposal and controls if applicable. **Credit will not be given for off-site recycling/disposal unless it is shown on the Off-Site Recycling/Disposal Form.** Round to the nearest pound. If the answer is 0, give a decimal answer to the first significant digit. Column 15 is calculated as follows:

Emissions without off-site recycling/disposal or controls:
Column 15 = column 9 × column 11

Emissions with off-site recycling/disposal:
Column 15 = (column 9 × column 11) – column 12

*Emissions with off-site recycling/disposal **and** controls:*
Column 15 = ([column 9 × column 11] – column 12) × (1 – [column 13 × column 14])

Use the decimal equivalent for columns 13 and 14. Example: 96.123% = 0.96123

EXAMPLE: Coating and Painting

***Evaporative Process Form* 2005**

Permit number(s) **V99999**

Place an X in any gray cell to mark data requested to be held confidential. See page 5 for requirements for information to be deemed confidential.

1- Process Type/Description: ***Coating metal widgets***

2- Process TIER Code: ***080415*** **SOLVENT USE: SURFACE COATING - MISC METAL PARTS**

3- Seasonal Throughput Percent: Dec-Feb ***25*** % Mar-May ***25*** % Jun-Aug ***25*** % Sep-Nov ***25*** %

4- Normal Operating Schedule: Hours/Day ***8*** Days/Week ***5*** Hours/Year ***2080*** Weeks/Year ***52***

5- Typical Hours of Operation *(military time)* Start ***0800*** End ***1700***

6	7	8		9			10	11			12	13	14			15
Process ID	Stack ID(s)	Material Type		Annual Usage Input		lb or gal	VOC, HAP&NON or NHx	Emission Factor		EF Units (lbs per)	Pounds of pollutant* sent off site	Capture Efficiency %	Control ID	Control Efficiency %	Control Efficiency Code**	Estimated Emissions (lbs/yr)
800	***1***	***Lacquer 6455-06***		***95***		***gl***	***VOC***	***4.7***		***gal***		%		%		***447***
801	***1***	***lacq thinner***		***120***		***gl***	***VOC***	***7.1***		***gal***		%		%		***852***
802	***1***	***Paint red 4039-03***		***940***		***gl***	***VOC***	***4.2***		***gal***		%		%		***3,948***
803	***1***	***paint thinner***		***707***		***gl***	***VOC***	***7.0***		***gal***		%		%		***4,949***
804	***1***	***powder paint 8730-11***		***20,200***		***lb***	***VOC***	***0.001***		***lb***		%		%		***20***
												%		%		

Note: Do NOT change pre-printed Process ID numbers. See page 6 of these instructions for information on how to delete materials that are no longer used, or to assign Process ID numbers for new materials.

* If you have off-site recycling/disposal of any of the materials listed above, you must complete an Off-site Recycling/Disposal Form to receive credit for reduced emissions.

NOTE: Emissions in col. 15 are calculated as follows: **([col. 9 × col. 11] – col. 12) × (1 – [col. 13 × col. 14])**

**** Control Efficiency Reference Codes**

1 = Tested efficiency / EPA reference method
2 = Tested efficiency / other source test method
3 = Design value from manufacturer
4 = Best guess / engineering estimate
5 = Calculated based on material balance
6 = Estimated, based on a published value.

EXAMPLE: Cleaning solvent (with recycling)

Evaporative Process Form **2005** Permit number(s) ***V99999***

Place an X in any gray cell to mark data requested to be held confidential. See page 5 for requirements for information to be deemed confidential.

1- Process Type/Description: ***Cleaning metal parts***

2- Process TIER Code: ***080103*** **SOLVENT USE: DEGREASING - COLD CLEANING**

3- Seasonal Throughput Percent: Dec-Feb ***25*** % Mar-May ***25*** % Jun-Aug ***25*** % Sep-Nov ***25*** %

4- Normal Operating Schedule: Hours/Day ***8*** Days/Week ***5*** Hours/Year ***2080*** Weeks/Year ***52***

5- Typical Hours of Operation *(military time)* Start ***1300*** End ***1700***

6	7	8	9		10	11		12	13	14			15
Process ID	Stack ID(s)	Material Type	Annual Usage Input	lb or gal	VOC, HAP&NON or NHx	Emission Factor	EF Units (lbs per)	Pounds of pollutant* sent off site	Capture Efficiency %	Control ID	Control Efficiency %	Control Efficiency Code**	Estimated Emissions (lbs/yr)
3	***2***	***sanitizer***	***716***	***lb***	***VOC***	***1.0***	***lb***		***95*** %	***1***	***80*** %	***3***	***172***
6		***gun cleaner***	***180***	***gl***	***VOC***	***7.2***	***gl***	***569***	%		%		***727***
7		***xyz stripper***	***1300***	***gl***	***VOC***	***3.3***	***gl***	***1,884***	%		%		***2,406***
8		***cleaning solvents***	***358***	***gl***	***VOC***	***6.4***	***gl***	***1,006***	%		%		***1,285***
9		***generoclean***	***2258***	***gl***	***VOC***	***6.8***	***gl***	***6,741***	%		%		***8,613***
									%		%		

Note: Do NOT change pre-printed Process ID numbers. See page 6 of these instructions for information on how to delete materials that are no longer used, or to assign Process ID numbers for new materials.

* If you have off-site recycling/disposal of any of the materials listed above, you must complete an Off-site Recycling/Disposal Form to receive credit for reduced emissions.

NOTE: This example shows the case where 2,400 of the original 4,096 gallons of materials #6 through 9 were captured for off-site recycling, and the pollutant content of the waste material was estimated to be 75% of the original. The pounds of pollutant sent off-site shown in column 12 is calculated on the example Off-Site Recycling/Disposal Form on the next page.

EXAMPLE

Off-Site Recycling/Disposal Form 2005

Permit number(s) ***V99999***

NOTE: If you need blank copies of this form, call the Emissions Inventory Unit at (602) 506-6790 or consult our web page at www.maricopa.gov/aq/ei.aspx.

Provide one off-site recycling/disposal form for each waste stream at your business location. A waste stream is the waste from one or more processes mixed together to make one waste product before it is taken off site for recycling, disposal or combustion.

1) Assign a unique two-digit ID number to identify the waste stream that will be described below. ***01***
   (Start with ID# 01 for first waste stream. Make copies of a blank Off-Site Recycling/Disposal form and use 02 for second, etc.)

Check one:

- ☐ pounds
- ☒ gallons

2) What was the quantity of this waste stream in 2005? 2,400
   Indicate whether this quantity is reported in pounds or gallons. Keep waste disposal company manifests as proof that this amount of waste was taken off-site.

3) What was the **average** pollutant content of the waste stream? NOTE: Report in the same units (pounds or gallons) as used in line 2.

   VOC ***4.25*** lbs/unit HAP&NON ________ lbs/ unit NHx ________ lbs/ unit

NOTE: Waste normally has less pollutant content than the new product. Some of the pollutant evaporates during the use of the product, and there is usually dirt, water or other contaminants in the waste stream. The estimated pollutant content of the waste is usually between 50% and 95% of the new product. This example estimates an average VOC content (on line 3) to be 75% of the original VOC content of 5.67 lbs/gal., to account for evaporation and contaminants. See page 20 to calculate a weighted average.

4) Calculate the **total** annual pollutant content of the waste in this waste stream.
   (volume of waste, from Line 2) × (pollutant content, from Line 3) = Total pollutants in waste stream, in lbs/yr.

   VOC ***10,200*** lbs/yr HAP&NON ________ lbs/yr NHx ________ lbs/yr

5) List the process ID numbers of the processes contributing to this waste stream. Also estimate the pounds of pollutant that each process contributed to this waste stream.

NOTE: In this example, the amount each process material contributed to total pollutants in the waste stream (Line 4) is based on the percentage, by weight, of each material that contributed to the waste stream. (e.g. Process ID #6 contributed 5.6%, therefore 5.6% × 10,200 lbs/yr = 569 lbs. See example on page 20.)

NOTE: Column totals in the table below must equal the total for each pollutant type reported on line 4. The quantities you report below for each pollutant and process must also be reported in column 12 on the Evaporative Process Form.

Process ID	**Annual VOC (lbs)**	**Annual HAP&NON (lbs)**	**Annual NHx (lbs)**
6 Contributed about	***569*** lbs	lbs	lbs
7 Contributed about	***1,884*** lbs	lbs	lbs
8 Contributed about	***1,006*** lbs	lbs	lbs
9 Contributed about	***6,741*** lbs	lbs	lbs

EXAMPLE: Documentation of Emission Factor Calculations

Identify the process ID number(s) and pollutant(s). Show calculations made to obtain the emission factors used for the process(es). Include references to data sources used, including the document name, date published, page numbers, etc.

Emission Factor Calculation

Process ID ***201*** Permit number ***V99999***

Emission factors derived from source test performed 12/2/00 by XYZ Engineering Company (copy of summary tables also attached).

Outlet (after controls):

CO = 0.43 lb/hr × 1 hr/60 min × 1 min/77.9 cu. ft × 1,000,000 cu. ft/MMCF
= 92.0 lb/MMCF

NOx = 0.09 lb/hr × 1 hr/60 min × 1 min/77.9 cu. ft × 1,000,000 cu. ft/MMCF
= 19.3 lb/MMCF

Weighted average sample calculation

NOTE: The example below shows how the weighted average of the materials going into the waste stream is calculated. A weighted-average emission factor has been calculated by listing usage amounts and emission factors for each material, summing each column, and then dividing the total emissions by the total gallons used.

In this example: 23,231 lbs ÷ 4,096 gal = 5.67 lb/gal average VOC content. This emission factor is then used to calculate the average pollutant content in the Off-site Recycling / Disposal Form example.

This process can also be used to find the weighted average emission factor for similar materials if you are reporting them together as a single line item on the Evaporative Process form. Refer to the explanation of "grouping" on page 6.

Process ID #	Material Type	2005 Usage	Units	VOC (lbs/unit)	VOC Emissions (= Usage × VOC content)	Percent contributed to waste stream
6	*gun cleaner*	*180*	*gal*	*7.2*	*1,296 lbs.*	*5.6 %*
7	*xyz stripper*	*1,300*	*gal*	*3.3*	*4,290 lbs.*	*18.5 %*
8	*cleaning solvent*	*358*	*gal*	*6.4*	*2,291 lbs.*	*9.9 %*
9	*generoclean solvent*	*2,258*	*gal*	*6.8*	*15,354 lbs.*	*66.1 %*
	Totals:	***4,096***	***gal***		***23,231 lbs.***	*100.0 %*

Average VOC content:	***23,231 lbs. / 4,096 gals***	***=***	***5.67 lb/gal***

EXAMPLE (for all sources except Title V sources)

Data Certification Form* 2005** Permit number ***999999

For EACH pollutant listed, total up all emissions recorded on your General Process and Evaporative Process Forms. Enter these numbers in column 1, "Totals from Process Forms." Report any emissions from accidental releases in column 2.
Add the figures in each row across, and enter the result in column 3, "Total Emissions".

NOTE: "Accidental Releases" reported in column 2 should include all excess emissions reported to the Department under Rule 140, Section 500.

Summary of 2005 Annual Emissions:	**(1) Totals from Process Forms**	**(2) + Accidental Releases**	**(3) = TOTAL 2005 Emissions**
CO	*2,113*	*0*	*2,113*
NH_x	*0*	*0*	*0*
Lead	*0*	*0*	*0*
HAP&NON	*0*	*0*	*0*
VOC	*24,220*	*0*	*24,220*
NO_x	*9,815*	*0*	*9,815*
SO_x	*645*	*0*	*645*
PM_{10}	*7,891*	*0*	*7,891*

NOTE: Review specific requirements for data confidentiality on page 5. We cannot hold any data confidential without the required documentation.

TO COMPLETE YOUR EMISSIONS INVENTORY REPORT:

- Complete the Confidentiality Statement below.
- Sign and date this form below where indicated.
- Send the **original** copy of your completed forms: Maricopa County Air Quality Department, Emissions Inventory Unit, 1001 N. Central Ave., Suite 100, Phoenix, AZ 85004. Keep a copy of all forms for your records.

CONFIDENTIALITY STATEMENT:
This annual emissions report contains requests to keep some data confidential. ☐ YES ☒ NO
If you check "YES", you must submit documentation and meet certain requirements before your data can be deemed confidential.
See enclosed instructions for further details.

NOTE: The Data Certification form must be signed by a responsible company official.

CERTIFICATION STATEMENT:
I declare under penalty of perjury that the data (e.g. inputs, emission factors, controls, and annual emissions) presented herein represents the best available information and is true, accurate and complete to the best of my knowledge.

Signature of owner/business officer | Date of signature | Telephone number

Type or print full name of owner/business officer | Type or print full title

How to calculate an emission fee (for Title V sources only):

1. For each pollutant listed on the “Data Certification/Fee Calculation” form, total up all emissions recorded on your General Process and Evaporative Process Forms. Enter these numbers in column 1, “Totals from Process Forms.”

NOTE: While most processes that generate PM_{10} should be reported on line 5 of the Data Certification/Fee Calculation form, “[f]ugitive emissions of PM_{10} from activities other than crushing, belt transfers, screening, or stacking” (County Rule 280, § 305.2d) are NOT subject to annual emission fees. The most common occurrences of these PM_{10}-producing activities that are NON-billable are listed below:

SCC codes and description of PM_{10}-producing processes that are NOT subject to emission fees

SCC	Major Category	Subcategory	Facility / Process Type	Process Description
30200814	Industrial Processes	Food and Agriculture	Feed Manufacture	Storage
30400737	Industrial Processes	Secondary Metal Production	Steel Foundries	Raw Material Silo
30500120	Industrial Processes	Mineral Products	Asphalt Roofing Manufacture	Storage Bins: Ferric Chloride
30500121	Industrial Processes	Mineral Products	Asphalt Roofing Manufacture	Storage Bins: Mineral Stabilizer
30500134	Industrial Processes	Mineral Products	Asphalt Roofing Manufacture	Blown Saturant Storage
30500135	Industrial Processes	Mineral Products	Asphalt Roofing Manufacture	Blown Coating Storage
30500141	Industrial Processes	Mineral Products	Asphalt Roofing Manufacture	Granules Storage
30500143	Industrial Processes	Mineral Products	Asphalt Roofing Manufacture	Mineral Dust Storage
30500203	Industrial Processes	Mineral Products	Asphalt Concrete	Storage Piles
30500212	Industrial Processes	Mineral Products	Asphalt Concrete	Heated Asphalt Storage Tanks
30500213	Industrial Processes	Mineral Products	Asphalt Concrete	Storage Silo
30500290	Industrial Processes	Mineral Products	Asphalt Concrete	Haul Roads: General
30500303	Industrial Processes	Mineral Products	Brick Manufacture	Storage of Raw Materials
30500608	Industrial Processes	Mineral Products	Cement Manufacturing (Dry Process)	Raw Material Piles
30500708	Industrial Processes	Mineral Products	Cement Manufacturing (Wet Process)	Raw Material Piles
30501710	Industrial Processes	Mineral Products	Mineral Wool	Storage of Oils and Binders
30502007	Industrial Processes	Mineral Products	Stone Quarrying - Processing	Open Storage
30502011	Industrial Processes	Mineral Products	Stone Quarrying - Processing	Hauling
30502504	Industrial Processes	Mineral Products	Construction Sand and Gravel	Hauling
30502507	Industrial Processes	Mineral Products	Construction Sand and Gravel	Storage Piles
30502760	Industrial Processes	Mineral Products	Industrial Sand and Gravel	Sand Handling, Transfer, & Storage
30531090	Industrial Processes	Mineral Products	Coal Mining, Cleaning, Material Handling	Haul Roads: General
30532007	Industrial Processes	Mineral Products	Stone Quarrying - Processing	Open Storage
30704002	Industrial Processes	Pulp and Paper & Wood Pdts.	Bulk Handling and Storage - Wood/Bark	Stockpiles
31100199	Industrial Processes	Building Construction	Construction: Building Contractors	Other Not Classified
31100299	Industrial Processes	Building Construction	Demolitions/Special Trade Contracts	Other Construction/Demolition
50100401	Waste Disposal	Solid Waste Disposal	Landfill Dump	Unpaved Road Traffic
50100402	Waste Disposal	Solid Waste Disposal	Landfill Dump	Fugitive Emissions
50100403	Waste Disposal	Solid Waste Disposal	Landfill Dump	Area Method
50100404	Waste Disposal	Solid Waste Disposal	Landfill Dump	Trench Method
50100405	Waste Disposal	Solid Waste Disposal	Landfill Dump	Ramp Method

2. Report any accidental releases in column 2. Add columns 1 and 2 together for each pollutant, and enter the sum in column 3. Sum lines 1 through 5 together, and enter the total on line 6.

3. Divide your facility's total billable emissions (on line 6) by 2000 to convert pounds into tons. **Round to the nearest ton.** Enter this value on line 7. Multiply this number by **$13.65**, and enter the result on line 8. This is your 2005 emission fee.

EXAMPLE (for Title V sources only)

Data Certification/Fee Calculation Form **2005** Permit number ***V99999***

For EACH pollutant listed, total up all emissions recorded on your General Process and Evaporative Process Forms. Enter these numbers in column 1, "Totals from Process Forms." Report any emissions from accidental releases in column 2.
Add the figures in each row across, and enter the result in column 3, "Total Emissions".
Carefully follow the instructions on lines 6 through 8 to calculate any emission fee owed.

NOTE: "Accidental Releases" reported in column 2 should include all excess emissions reported to the Department under Rule 140, Section 500.

	Summary of 2005 Annual Emissions:	**(1) Totals from Process Forms**	**(2) + Accidental Releases**	**(3) = TOTAL 2005 Emissions**
	CO	*2,113*	*0*	*2,113*
	NH_x	*0*	*0*	*0*
	Lead	*0*	*0*	*0*
	PM_{10} (non-billable; see page 22)	*7,200*	*0*	*7,200*
	Emissions fees are based on your emissions of the following pollutants ONLY:			
1	HAP&NON	*0*	*0*	*0*
2	VOC	*24,220*	*0*	*24,220*
3	NO_x	*9,815*	*0*	*9,815*
4	SO_x	*645*	*0*	*645*
5	PM_{10} (billable; see page 22)	*691*	*0*	*691*
6	**Add "TOTAL" column from lines 1 through 5 ONLY:**			*35,371* lbs.
7	Divide the total on line 6 by 2000 (pounds per ton) to get tons, and round the number to the nearest ton. (Drop any decimal of .499 or less. Increase to the next whole number any decimal of .500 or more.) Enter the resulting WHOLE NUMBER here.			*18* TONS
8	Multiply line 7 (a WHOLE number) by **$ 13.65**. This is your **2005 ANNUAL EMISSION FEE**.			$ *245.70*

NOTE: Review specific requirements for data confidentiality on page 5. We cannot hold any data confidential without the required documentation.

TO COMPLETE YOUR EMISSIONS INVENTORY REPORT:

- Include a check (made payable to Maricopa County Air Quality Department) for the amount calculated on line 8 above.
- Complete the Confidentiality Statement below.
- Sign and date this form below where indicated.
- Send the **original** copy of your completed forms, along with any emission fee due to: Maricopa County Air Quality Department, Emissions Inventory Unit, 1001 N. Central Ave., Suite 100, Phoenix, AZ 85004. Keep a copy of all forms for your records.

CONFIDENTIALITY STATEMENT:
This annual emissions report contains requests to keep some data confidential. ☐ YES ☒ NO
If you check "YES", you must submit documentation and meet certain requirements before your data can be deemed confidential.
See enclosed instructions for further details.

NOTE: The Data Certification form must be signed by a responsible company official.

CERTIFICATION STATEMENT:
I declare under penalty of perjury that the data (e.g. inputs, emission factors, controls, and annual emissions) presented herein represents the best available information and is true, accurate and complete to the best of my knowledge.

Signature of owner/business officer Date of signature Telephone number

Type or print full name of owner/business officer Type or print full title

Appendix 2.2

Rule Effectiveness Study For Maricopa County Rules 310, 310.01, and 316

RULE EFFECTIVENESS STUDY FOR MARICOPA COUNTY RULES 310, 310.01, AND 316

Table of Contents

1. Overview

This rule effectiveness study objective is to quantify compliance with the fugitive dust rules in the Maricopa County air quality regulatory program and determine how well the rules are achieving the intended results. Rule Effectiveness is applied to emissions inventory estimates used in State Implementation Plans (SIP). This evolved from the observation that regulatory programs may be less than 100 percent effective due to lack of rule compliance or control equipment inefficiency. EPA's initial rule effectiveness policy[1] was limited to the ozone related pollutants and recommended an 80 percent default rule effectiveness factor. EPA has revised their initial rule effectiveness policy and replaced it; specifically, the 80 percent default no longer applies and particulate matter related pollutants are now included.[2]

EPA has encouraged local agencies and regional planning organizations to include in rule effectiveness evaluations consideration of inspection frequency, experience with equipment processes as well as previous rule effectiveness studies that have been conducted to determine current rule effectiveness factors. In this study the application of these various factors and data from actual compliance inspections are used to measure how well a rule is achieving its intended results.

This study of the effectiveness of the Maricopa County fugitive dust rules consists of two parts: field and office inspections. The study team consists of representatives from Maricopa County's Air Quality Department (MCAQD) and the Arizona Department of Environmental Quality's Air Quality Division.

2. Background

In May 1997, ADEQ submitted the Plan for Attainment of the 24-hour PM-10 Standard – Maricopa County PM-10 Nonattainment Area, as a SIP revision. This plan demonstrated attainment and reasonable further progress (RFP) for the 24-hour PM-10 standard at the Salt River air quality monitoring site by May 1998.

On July 9, 1999, the Maricopa Association of Governments (MAG) submitted to EPA the MAG 1999 Serious Area Particulate Plan for PM-10, demonstrating attainment for both the 24-hour and annual PM-10 standards for the Metropolitan Phoenix area (Maricopa County), Arizona. A revised plan was submitted in February 2000. The Revised Plan included an extension request for PM-10 attainment, no later than Dec. 31, 2006.

The Salt River air quality monitoring site continued to violate the standard and on July 2, 2002 (67 FR 44369), EPA found the SIP for the Metropolitan, Phoenix serious PM-10 area to be inadequate to attain the 24-hour PM-10 standard at the Salt River monitoring site. Under authority from the Clean Air Act, EPA required a SIP revision be submitted to correct the inadequacy. A component of this SIP revision demonstrates attainment at the Salt River monitoring site as a result of the additional controls adopted by the Maricopa County Air Quality Department to strengthen its dust rule inspection program.

As of 2006, the Metropolitan Phoenix serious nonattainment area continues to violate the PM-10 24 hour standard. There were 19 exceedances in 2005 and 27 exceedances in 2006.[3] Three years without

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[1] U.S. EPA, Guidelines for Estimating and Applying Rule Effectiveness for Ozone/CO State Implementation Plan Base Year Inventories, EPA-452/R-92-010, November 1992.

[2] Emissions Inventory Guidance for Implementation of Ozone and Particulate Matter NAAQS and Regional Haze Regulations. EPA-454/R-05-001, August 2005.

[3] a. The 2006 data has been validated by the Maricopa County Air Quality Department
b. Monitoring data for 2006 is Calendar year January through December, 2006.

violations (3-year average) is required at all PM-10 monitors to attain the standard. Because this area did not attain the PM-10 standards by December 31, 2006, the Clean Air Act requires a demonstration plan be submitted providing for attainment of the PM-10 air quality standard and five percent annual reductions of PM10 or PM10 precursor emissions until attainment. The five percent plan is due to EPA by December 31, 2007.

To prepare the Five Percent Plan, Maricopa Association of Governments (MAG) will use the 2005 PM-10 2007, 2008, and 2009 period emissions inventory prepared, by MCAQD to project the emissions inventories. The results of the Rule Effectiveness Study will be incorporated into this 2005 PM-10 periodic emissions inventory.

Maricopa County has implemented dust control regulations to help achieve timely attainment of the ambient standard for PM-10. The following are Maricopa County Regulations that apply to PM-10 control:

Maricopa County	Rule 310	Fugitive Dust Sources
Maricopa County	Rule 310.01	Fugitive Dust From Open Areas, Vacant Lots, Unpaved Parking Lots and Unpaved Roadways
Maricopa County	Rule 316	Nonmetallic Mineral Mining and Processing

For state permitted portable sources, that operate within Maricopa County, the Maricopa County Air Pollution Control Regulations are applied in lieu of the state of Arizona's Administrative Code Article 6 rules (R18-2-604, 605, 606, and 607). The state of Arizona Air Quality Control General Permit for Crushing and Screening plants incorporates the requirements of Maricopa County Air Pollution Control Rule 310 for the dust control plan requirements and Rule 316 for the visible emission limitations for facilities that operate in Maricopa County.

2.1 Study Purpose and Goals

The purpose of this rule effectiveness study is to quantify the control strategy efficiency as described in the rules of MCAQD and determine if these rules are adequate. This study was conducted according to EPA guidance provided for states and local agencies on how to review and measure the efficiency of a control strategy intended to progress towards reaching air quality goals. To accomplish this goal, a two part study was conducted comprised of field and office inspections and focusing on the compliance and enforcement of Maricopa County Rules 310, 310.01, 316.

2.1.1 Office Inspection Phase

The office investigation phase focused on rule content and the internal policies and procedures that affect how rules are implemented and enforced, such as regulatory enforceability, inspection procedures, training, and agency resource management.

2.1.2 Field Inspection Phase

In the field inspections conducted as part of this rule effectiveness study, the study team visited sites subject to Maricopa County Rules 310, 310.01, and 316. The study group identified which rules apply, which specific parts of the rule apply to the site, the type of site (earthmoving, vacant lots, nonmetallic mineral processing), the compliance status of the site and if any compliance notifications would be issued. Inspections occurred consistent with current department

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c. Exceedances are defined as number of days in 2006 where at least one monitor exceeded the 24hr PM-10 Standard

schedules. If a level 1 inspection was planned, then that was carried out. If a level 2 inspection was planned, then that type of inspection occurred. The goals of this phase were to determine whether MCAQD and ADEQ programs are adequate to:
1) Determine compliance and
2) Deter, detect and correct any instances of noncompliance.

2.2 Sample Size and Rule Effectiveness Calculation

The number of inspections determines sample size of the study. There is a very large number of Rule 310, 310.01, 316 inspections sites in Maricopa County so it is not practical to visit each site for this study. Since we can not visit all the inspection sites in the county, we can randomly select according to statistically sound procedures, a small number of sites that provides inference from the sample drawn, to the entire population of inspections. This process used in this study is detailed in EPA's 'Guidelines for Estimating and Applying Rule Effectiveness for Ozone/CO State Implementation Plan Base Year Inventories', Appendix D [4].

There are three distinct categories of inspection sites:

- Maricopa County Rule 310 — Fugitive Dust Sources
- Maricopa County Rule 310.01 — Fugitive Dust From Open Areas, Vacant Lots, Unpaved Parking Lots and Unpaved Roadways
- Maricopa County Rule 316 — Nonmetallic Mineral Processing.

EPA guidance recommends for each category, a 90 percent confidence interval and a sample error of 5 percent, that should not exceed 10 percent. These parameters are listed in Table D-1 of EPA's guidelines (Appendix C of this report). Referring to this table, assuming the above parameters, we can determine what sample size is needed for each population category after we calculate the standard deviation of each sample group.

In summary:

The variance or variation of a sample is reflected in the standard deviation.
Since we do not have an estimate of the standard deviation from past surveys of Rule 310, Rule 310.01 inspection sites, we are required to calculate one. According to the EPA rule effectiveness guidance, the standard deviation is calculated from ten randomly chosen inspection sites from each category. From these initial inspections, the calculated standard deviation for each category is used to determine adequate study sample size. The standard deviation reflects the amount of variation of the inspection site compliance with existing rules. In this study, the variation ranged from total compliance to non-compliance. After adequate study sample size was determined, additional inspections were scheduled to comprise a statistically sound study sample size.

The rule effectiveness for Rule 316 sources was estimated following the recently updated EPA guidance[5], with factors that are most likely to affect rule effectiveness. These factors are listed in Appendix A. EPA grouped likely responses to these factors into rule effectiveness ranges, such that

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[4] U.S. EPA, Guidelines for Estimating and Applying Rule Effectiveness for Ozone/CO State Implementation Plan Base Year Inventories, EPA-452/R-92-010, November 1992.

[5] US EPA, Emissions Inventory guidance for Implementation of Ozone and Particulate Matter National Ambient Air Quality Standards (NAAQS) and Regional Haze Regulations, EPA, August 2005.

more positive responses to a number of the factors will lead towards selection of a higher RE value, whereas more negative responses will direct one to select an RE value from a lower range.

Rule Effectiveness factors are only applied to those emissions estimates where a control device or control technique is used   The Maricopa County fugitive dust rules define a pollution control technique; therefore emission estimates of sources regulated by these rules would need to be adjusted for rule effectiveness.

3. Study Team

The study team is composed of personnel from the MCAQD and the Arizona Department of Environmental Quality (ADEQ). Both the Compliance and Planning-Analysis sections from the Maricopa County Air Quality will participate.

The study team inspected three types of facilities: Nonmetallic mineral processing, earthmoving sources, and vacant lots. The Quality Assurance/ Supervisor insured consistency of the data collection.

The Study Team consists of three members:

- Maricopa County Quality Assurance/ Supervisor
- Maricopa County earthmoving, dust or small source inspector or ADEQ Compliance Inspector
- Maricopa County Planning & Analysis Observer

3.1 Rule Summaries

The following includes a summary of the Maricopa County fugitive dust rules included in this study.

3.1.1 Rule 310

Rule 310 applies to all dust generating operations including open areas, vacant lots, unpaved parking lots, and unpaved roadways which are located at sources that require a permit under Maricopa County Rules. Normal farm cultural practices as defined under Arizona Revised Statutes (ARS) §49-457 and ARS §49-504.4 and are exempt from this rule. These sources are subject to the ADEQ's PM-10 General Permit (AAC R18-2-611) established under Arizona Revised Statutes Section 49-457 and were not be subject to this study. Fugitive dust sources are required to keep dust stabilized and control measures implemented at all times and visible fugitive dust emissions shall not exceed a 20% opacity. Measures include stabilization requirements, installing signs restricting trespassing, applying gravel or paving unpaved parking lots, applying water, gravel, or dust suppressant to haul roads, pre-watering work sites, constructing wind barriers and establishing vegetative cover. Earthmoving operations must submit a dust control plan if the project is equal to or greater than 0.1 acres. Specific work practices for different types of activities are described in the rule. Compliance shall be determined by conducting opacity observations, stabilization determinations, observing implementation of controls and recordkeeping.

3.1.2 Rule 310.01

Rule 310.01 applies to open areas, vacant lots, unpaved parking lots and unpaved roadways which are not regulated by Rule 310. Any open area or vacant lot that is not defined as agricultural land and is not used for agricultural purposes according to ARS § 42-1251 and ARS § 42-1252, and normal farm cultural practices as defined under Arizona Revised Statutes (ARS) §49-457 and ARS §49-504.4, is subject to this rule. The rule outlines control measures and stabilization limitations required for different dust source activities such as preventing vehicular access to open areas and vacant lots, establishing vegetative cover, uniformly applying and maintaining surface gravel, and application of dust suppressant. Stabilization and recordkeeping are required to be maintained.

3.1.3 Rule 316

Rule 316 regulates particulate matter emissions from nonmetallic mineral processing and rock product processing plants. Opacity and emission limits, stabilization, equipment design, and control measures are outlined for the different type of operations and stack and fugitive dust emissions. For those sources with air pollution control equipment and/or monitoring equipment, an Operation and Maintenance Plan is required. This rule requires recordkeeping of daily operations and control device data. Additionally a facility with a permitted capacity of 25 tons or more of material per hour shall have in place a Fugitive Dust Control Technician or designee. The owner and/or operator of a nonmetallic mineral processing plant and/or a rock product processing plant shall implement the fugitive dust control measures described in rule 316, section 306.

4. Field Inspection Phase

There are three types of field inspections in this study. The first two require the study team members to conduct inspections at earthmoving sites and vacant lots. The third requires the study team to inspect stationary permitted sources.

4.1 Inspection Scoring Protocol

Study scoring for the rules 316 and Rule 310, 310.01 are prioritized according to significance of creating emissions. For example, an opacity limit has a direct correlation to pollution being emitted, where recordkeeping requirements are administrative in nature and may have less direct affect on emissions. This is similar to the approach taken in EPA's Rule Effectiveness Guidance: Integration of Inventory, Compliance and Assessment Applications.[6]

The scoring system observes: No violations observed on site;
Notice to Correct; and
Notice of Violations.

Points are assigned as follows:
No violations observed on site - Maximum 1.0 point;
All violations: Notice of Violation or
Notice to Correct - zero (0) points;

Administrative compliance is only scored if there are no emissions violations. A complete administrative failure, such as failure to obtain a dust permit is considered a violation and is a zero score. A partial administrative failure is not included in the scoring if there were no emissions violations observed at the site. Both MCAQD Quality Assurance/ Supervisor and inspector reports were summarized but final study results were compiled from the Supervisor reports only.

[6] U.S. EPA, Office of Air quality Planning and Standards, Rule Effectiveness Guidance: Integration of Inventory, Compliance and Assessment Applications, EPA-452/4-94-001, January 1994.

Table 4.1.1: Rule 310 Rule Effectiveness Violations

Emission Violations
Condition of Areas not being worked
Stabilize storage piles
Water:
▪ Available
▪ Use
Track out / Track out device
Haul Roads
Not follow dust plan
Work Practices:
▪ dumping
▪ tarping
▪ >50 ft.track out/ clean up end day
▪ bulk materials
Administrative Violations
Lack of records
Permit not current / on Site
Records not on site
No dust plan posted
Lack of Dust Plan

Table 4.1.2: Rule 310 Rule Effectiveness Score System

Compliance Status	Points
Notice of Violation (NOV)	0
Notice to Correct (NTC)	0
Administrative Violation - NOV or NTC	1.0 - If no observed emissions violations
No violations Observed	1.0

A similar point system is used for Rule 310.01 scoring. When non-compliance is observed at a lot or open area, a letter is sent to the parcel owner requesting correction. After receipt of this letter, the parcel owner has 60 days to institute control measures, establish stabilization, or contact MCAQD. The owner has 14 more days to comply and/or contact the MCAQD offices before a Notice of Violation (NOV) is issued.

The study scoring for Rule 310.01 is the same as described above where either No Violations are observed (1.0) or Violations exist (0). Stabilization test methods are completed to determine violations in accordance with rule requirements. If the inspection site passes one of the five stabilization test, then the site is scored as "no violations are observed".

Table 4.1.3 Rule 310.01 Rule Effectiveness Score System

Results of Stabilization Tests	Points
Passed	1.0
Failed	0

TABLE 4.1.4 Rule 316 Violation

Emissions Violations
Standards
Stack Emissions
Operations or Process
Trucks Dumping
O&M Requirements
Submit Permit
Permit maintained and Onsite
Comply with Permit actions & Schedules
Schedules
Recordkeeping Requirements
General Data/Hours of Operations

4.2 Inspection Priority for Rule 310.01 sources

The MCAQD inspects vacant lots, open areas and unpaved parking lots based on following criteria:

1. Citizen complaints.
2. Located within Salt River Study Area.
3. Open areas with soil textures that may consist of high silt content and increased wind erosion potential.
4. Areas that are in excess of ten acres.
5. Areas outside the Salt River Study area but within the border of the Maricopa County PM10 nonattainment area.
6. Areas located in close proximity to schools, health care facilities, assisted care facilities, residential neighborhoods, parks, etc.
7.

The goal of the inspection program is to proactively inspect vacant lots/ open areas and unpaved parking lots based on these inspection priorities. Before May 2006, the inspection program was exclusively based on citizen complaints. Over 100,000 vacant lots/open areas and an unknown number of unpaved parking lots exist within Maricopa County and will require at least one compliance inspection. Utilizing data loaded into Permits Plus from the County Assessor records, the vacant lots/open areas are identified and then inspection schedules and routes are determined. Further, utilizing GPS readings provides map locations of these areas for planning and monitoring. MCAQD vacant lot/open area program goal is to complete 5,200 vacant lot inspections per year (approximately 3,100 inspections of vacant parcels > 10 acres; and 2,100 inspections of vacant parcels < 10 acres). Initial focus is on vacant parcels > 10 acres. The program also provides for complaint processing from telephone as well as internet based submittals.

4.3 Rule Effectiveness Calculation

As referenced earlier in the report, the number of inspection sites in the sample size was determined by calculating the standard deviation of the initial ten random inspections, based on EPA guidance.7 Table D-1 referenced in EPA guidance correlates confidence level, sample error, standard deviation, and sample size and is listed in Appendix C of this report.

The standard deviation for both Rule 310 and 310.01 from the first 10 sites inspected was 24%.

The standard deviation calculated from 10 initial Rule 310 and Rule 310.01 inspection sites with a 90 percent confidence level and a sample error of 5%, determined that a sample size of at least 63 sites was required. Sixty-three Rule 310 sites and 124 Rule 310.01 sites (many sites have multiple parcels) were inspected. The first 47 Rule 310.01 inspections were conducted over a three week period. The remaining seventy-seven inspections were conducted during the last six months of 2006. Inspections conducted over a six month time period were required so as to obtain a sample of inspections that represents the average Maricopa County ambient weather conditions.

4.4 Inspection Results

4.4.1 Earthmoving Sites

Ten earthmoving sites were randomly chosen for inspection during the months of July - August, 2006. Fifty-three additional earthmoving sites were inspected during September through November 2006. The following table summarizes what was observed at each site and if any corrective action was taken. Two types of corrective actions were taken: Notice to Correct (NTC) and Notice of Violation (NOV). The NOV is the most serious corrective action.

Table 4.4.1 List of Inspected Earthmoving Sites

Date	Permit ID	Site	Address	Violation Observed	Rule310 Section NTC/ NOV Issued
7/19/2006	E062984	Ardavin Builders	16705 E. Ave. of Fountains	No	*
9/27/06	EO54480	Aston Woods	Westar/184 Ave Goodyear	No	
7/17/2006	E061115	Gierczyk	17275 N. Litchfield Rd.	No	*
7/17/2006	E053622	Quailwood Const.	13370 West Van Buren	Yes	308
7/17/2006	E060901	Canterra Contract	SWC Maricopa Rd & Miller Rd	Yes	306, 308
7/17/2006	E054144	Concord Companies	708 W. Baseline Rd	Yes	306, 308
7/17/2006	E054289	Catalina Custom Hms	5009 E. Road Runner Rd	No	*
7/17/2006	E062849	Markham Contract.	2565 E. Southern Ave	Yes	308
7/17/2006	E062311	Zacher Homes	119 W. Maryland	No	*
7/18/2006	E054191	Veneto Inc.	19th Ave & Vineyard	Yes	306, 308
7/18/2006	E060726	Layton	Happy Valley & Lake Pleasant	Yes	306, 308
9/21/2006	E062535	Lehi Meadow	2354 E. Meadow Mesa	Yes	301,302,308
9/21/2006	E063893	Larry Boblitz	4728 E. Virginia Mesa	Yes	302
9/21/2006	E063372	TRC Bellatrix	Val Vista & Thomas Mesa	No	*
9/26/2006	E063550	Pulte Homes	200 N. 95th Ave Buckeye	Yes	308
9/26/2006	E054400	SouthwestGas	Jackrabbit Buckeye	Yes	401

[7] Guidelines for Estimating and Applying Rule Effectiveness for Ozone/CO State Implementation Plan Base Year Inventories, U.S. EPA, EPA-452/R-92-010, November 1992.

Date	Permit ID	Site	Address	Violation	Rule310 Section NTC/ NOV
7/26/2006	E063293	Ames Const.	Perryville/Northern Waddell	Yes	301, 306,308
9/28/2006	E061166	Trend Homes	Citrus/Bell Surprise	No	*
9/28/2006	E060852	HBT Const.	Bell/Citrus Surprise	Yes	307
9/28/2006	E054565	KB Homes	Bell/Citrus Surprise	No	*
9/20/2006	E061304	Colorado Stru	1825 W. Bell Rd. Phoenix	Yes	302
9/20/2006	E061294	Colorado Stru	1525 W. Bell Rd. Phoenix	No	*
9/19/2006	E060380	Buzz Oats	4707 W. Camelback Phoenix	Yes	307
9/19/2006	E060641	Hallcraft Homes	75th Ave/ Glendale Glendale	Yes	302, 306
9/20/2006	E060974	Summit Bldrs	8220 N. 23rd Ave Phoenix	Yes	401
9/19/2006	E054279	MT Buildiers	11120 W. Van Buren Avondale	Yes	307
9/19/2006	E060071	Morrison Hms	107th Ave/Becker Avondale	Yes	307, 503
9/19/2006	E060073	Morrison H	103 S. 110th Ave Avondale	Yes	307, 503
9/19/2006	E060026	Sundt.	115 Ave/Van Buren Avondale	No	*
9/19/2006	E061280	Randall Martin	Roosevelt Park Avondale	Yes	302, 308
9/21/2006	E062154	Bill Dennis	3435 N. 91st Pl. Mesa	No	*
9/21/2006	E055258	Willow Park	1928 E. Riverdale St. Mesa	No	*
9/19/2006	E063901	Design Bldg	326 S. 353 Rd Tonopah	Yes	302
9/19/2006	E063039	Beazer Hms	SR 85/ I -10 Buckeye	Yes	306, 308
9/19/2006	E063922	Meritage Homes	Rainbow/Yuma Rd Buckeye	Yes	306, 401, 503
9/19/2006	EO54234	Meritage Homes	228 Ave/ Moonlight Path Buck	Yes	308
9/19/2006	E061531	Morison Homes	Yuma/ Watson Buckeye	No	*
9/20/2006	E062768	Maracay Homes	Dobson/ German Chandler	Yes	307
9/20/2006	E061984	Nickle Contr	Ryan/ Hartford Chandler	No	*
9/20/2006	E063069	Double AA	German/ Gilbert Changler	Yes	302, 306
9/20/2006	E060500	Laguna Homes	24410 S. 120 Way Chandler	Yes	401
9/20/2006	E060025	Meritage Homes	Hunt HWY/AZ Ave Chandler	Yes	306
9/21/2006	E063747	Austin Bridge	I - 10 / Ray Rd Phx-Chandler	No	*
9/21/2006	E063029	Starpointe	16160 S. 50 st. Phoenix	Yes	302, 306, 308
9/21/2006	E061488	Sunstate Building	685 W. Elliott Tempe	Yes	306, 308
9/21/2006	E061056	Scott Homes	Rural / Elliot Tempe	No	*
9/21/2006	E054436	Carlson Mas	1901 E. 5th St Tempe	No	*
9/26/2006	E060334	Eagle Homes	395 E. Baseline Phoenix	Yes	302, 308
9/26/2006	E061805	Engle Homes	2901 E. Baseline Rd Phoenix	Yes	302
9/26/2006	E063979	Stnd Pacific Homes	67th/Baseline Laveen	Yes	302
9/26/2006	E063559	Stnd Pacific Homes	Meadow Loop W/ Beverly Laveen	Yes	401
9/26/2006	E060896	B & D Ericks	S. Mountain Rd/ 7th Ave Phoenix	No	*
9/28/2006	E063571	Northld Res	4000 W. Mohave St. Phoenix	No	*
9/28/2006	E062060	Heartland Exp	4555 W. Mohave St Phoenix	Yes	306, 308
9/28/2006	E063832	Renaissance	4747 W. Buckeye Rd Phoenix	Yes	301, 308
11/1/2006	E062927	Sundt.	1636 W Alameda Tempe	No	*
11/1/2006	E055477	Russell Granors	1845 E University Tempe	No	*
11/1/2006	E061981	LGE Corporation	4040 W EarHart Chandler	Yes	302. 308
11/1/2006	E061791	Forte Homes	4452 W Kitty Hawk Chandler	No	*
11/6/2006	E063905	Gemcor Homes	1121 E. Birdwood Chandler	Yes	302,306,308
11/6/2006	EO63799	SGL Custom Homes	3660 S Nash Way, Chandler	Yes	302, 306
11/6/2006	EO64332	CGS109 - Magee	SWC Pecos& Hamilton Gilbert	Yes	302, 306, 308
11/6/2006	EO63826	Monza Const.	2920 E. Germann Rd Gilbert	Yes	306
Total					63 Inspected Sites

* Indicates there is no violation observed during this inspection.

The scoring system described in section 3.1 was applied to each inspection site. Each site has 1.0 possible point. If a corrective action is required, then the score is zero. The status of the site is either 'yes' a violation was observed or 'no violations were observed' for the site.

Table 3.4.1 above summarizes 63 Rule 310 inspection sites. There were violations observed at forty-one (41) of these sites. Ten (10) of these violating sites were administrative violations only and emissions violations were not observed. The ten (10) administrative only violations were excluded in the final count of violating sites because of the absence of an emission violation resulting in the final count of violating sites totaling thirty-one (31).

The resulting rule effectiveness for all Rule 310 sites inspected is 51% (32/63 = 51%), where conversely 49% of the sites had an observed a violation (31/63=49%).

4.4.2 Vacant Lots/Open Areas

Ten vacant lots were randomly chosen for inspection subject to Rule 310.01 during the months of August - September 2006. Applying the standard deviation calculated from these 10 initial Rule 310.01 inspection sites, to the matrix of 90 percent confidence level and sample error of 5%, the sample size should be at least 63 sources. The following table lists the compliance status of each Rule 310.01 site as determined by the test methods required in Rule 310.01.

Table 4.4.2 List of Inspected Vacant Lot Sites

Site	*Date*	*Parcel #*	*Address*	*Violation Observed*
AO10318	9/22/2006	105-03-078A	1527 W. Buckeye	No
"		105-03-078H	"	No
	9/22/2006	105-02-123	1235 S. 15 Ave. Phoenix	No
"		105-02-124	"	No
"		105-02-122	"	No
A010318	9/22/2006	105-02-121	1233 S. 15th Ave. Phoenix	Non-Reg
"	9/22/2006	105-02-125	1241 S. 15th Ave Phoenix	Non-Reg
"	9/22/2006	105-03-078F	1227 S. 15th Drive Phoenix	Non-Reg
	9/22/2006	105-03-078B	1231 S. 15th Drive Phoenix	Non-Reg
A010318	9/22/2006	105-03-078G	15th Dr/Buckeye Phoenix	Non-Reg
"	9/22/2006	105-03-0780	1225 S. 15th Dr. Buckeye	Non-Reg
	9/22/2006	105-03-078C	1229 S. 16Ave Phoenix	Non-Reg
AO10203	9/29/2006	106-10-066	623 N. 37th Dr. Phoenix	No
A010203	9/29/2006	106-10-068	611 N. 37th Dr. Phoenix	No
A0102	9/29/2006	111-34-102	City of Ph - 3rd Ave Portland	Yes
A010203	9/29/2006	106-10-067	617 N. 37th Dr. Phoenix	No
BO20115	9/18/2006	502-62-011F	Litchfield/Camelback Litchfield	No
BO20115	9/18/2006	501-62-008C	Litchfield/Camelback Litchfield	No
BO20114	9/18/2006	501-63-013D	Dysart/Camelback Maricopa	No
BO20122	9/18/2006	501-68-414B	Litchfield/Wigwam Litchfield Park	No
B020122	9/18/2006	501-68-012S	Litchfield/Wigwam Litchfield Park	No
A0102	10/3/2006	106-10-065	629 N. 37 Dr, Phoenix	No
A0102	10/3/2006	106-10-047	3734 W Fillmore Phoenix	No
A0102	10/3/2006	106-10-048	3740 W Fillmore Phoenix	Non-Reg
A0102	10/3/2006	106-10-046	3728 W Fillmore Phoenix	No
A0102	10/3/2006	106-10-045	3722 W Fillmore Phoenix	No
DO20730	9/27/2006	304-90-375J	Power/Riggs Queen Creek	No
"	9/27/2006	304-90-375F	"	No
DO20732	9/27/2006	304-90-017G	25518 S 192 Pl Maricopa Co	Yes
DO20731	9/27/2006	304-89-013-U	Power/San Tan Maricopa Co	Yes
A06033100	9/22/2006	21151003D	36822 N 17th Ave Phoenix	No
21151003L	9/22/2006	A06033100	36824 N.17th Ave Phoenix	No
21151033L	9/22/2006	A06033100	11th & Maddock Phoenix	No
21153049	9/22/2006	A05030500	7th Ave &Cloud Rd. Phoenix	No
21181001	9/22/2006	A05030200	32nd St & Cloud Phoenix	No
D01061200	9/29/2006	30416004G	SW Power/Guadalupe Gilbert	No
D01061200	9/29/2006	30405985	NE Power/Guadalupe Gilbert	No
AOBO409	10/2/2006	21561004A	62 st / Thunderbird Phoenix	No
3N403Sec 7	10/2/2006	21570356	NWC Tatum/Nesbet Phoenix	No
3N403Sec 7	10/2/2006	21570355	NWC Tatum/Nesbet Phoenix	No
T03R04506	10/2/2006	21531007-8	NEC Steuer T/Jerry Florence	No
T03R04506	10/2/2006	21531007-7	NEC Steuer T/Jerry Florence	No
A031406	10/2/2006	21524001	SEC Paradise.40th St Phoenix	No
A205040900	10/2/2006	21564005J	5880 E Thunderbird Phoenix	No
A03040700	10/2/2006	21570354	15002 N. Tatum Phoenix	No
A2030407	10/2/2006	21570357	15030 N. Tatum Phoenix	No
A010535	9/27/2006	13913244A	1511 S. Mesa Dr Mesa	No
A010522	9/27/2006	13861080	NE Pasadena Mesa	No
A010523	9/27/2006	13822098	139 S. Mesa Dr. Mesa	No
A010523	9/27/2006	13827096	2nd Ave/ Mesa Dr Mesa	No
A010523	9/27/2006	13827095-A	2nd Ave/ Mesa Dr Mesa	No

Site	*Date*	*Parcel #*	*Address*	*Violation Observed*
A010523	9/27/2006	13827097	2nd Ave/ Mesa Dr Mesa	No
A010523	9/27/2006	13827064A	2nd Ave/ Mesa Dr Mesa	No
A010523	9/27/2006	13827065A	2nd Ave/ Mesa Dr Mesa	No
A010523	9/27/2006	13827066A	2nd Ave/ Mesa Drive Mesa	No
A01073500	9/18/2006	22081002D	SWC Signal Butte/Southeast Mesa	No
A01073500	9/18/2006	220-81-002D	SW Signal Butte/Southeast Mesa	No
A01073500	9/18/2006	22081004B	SW Signal Butte/Southeast Mesa	No
A01072600	9/18/2006	22071001Q	NW Signal Butte/Southeast Mesa	No
A01073400	9/18/2006	22080007Q	SW Crimson/SO Mesa	Yes
A01073400	9/18/2006	22080001M	SW Ellsworth/Southeast Mesa	No
A01073400	9/18/2006	22080001P	SW Ellsworth/Southeast Mesa	No
A01073400	9/18/2006	2208007-Q	1330 S. Crismon Mesa	Yes
A01073400	9/18/2006	22080007P	S Signal Butte/South Mesa	No
A01073500	9/18/2006	77081004B	SW Signal Butte/SE Mesa	No
1073500	9/18/2006	22081002D	SW Signal Butte/Southeast Mesa	No
A010786	9/18/2006	22071001Q	NW Signal Butte/Southeast Mesa	No
A01073400	9/18/2006	22680001P	SE Ellsworth/Southern Mesa	Yes
A1073400	9/18/2006	22080001M	SE Ellsworth/Southern Mesa	Yes
A01073400	9/18/2006	22080007N	SW Crimson/Southern Mesa	No
D010304	10/3/2006	33019023D	SW 7th St/Baseline Phoenix	No
D010304	10/3/2006	30019023E	SE 7th St/Baseline Phoenix	No
D010304	10/3/2006	30043019M	SW 7th St/Baseline Phoenix	No
D010304	10/3/2006	30043007A	SW 7th St/Baseline Phoenix	Yes
D010304	10/3/2006	30062066A	Central/Dobbins Phoenix	No
A01070600	9/29/2006	30405977B	NE Power/ Guadalupe Mesa	Yes
A010706	9/29/2006	30405977A	2650 S. Power Mesa	Yes
D01061200	9/29/2006	30416004G	SW Power/Guadalupe Mesa	No
D01030400	10/3/2006	30019023D	SW 7th St/Baseline Phoenix	No
A06033100	9/22/2006	21151003D	36822 N 17th Avenue Phoenix	No
A06033100	9/22/2006	21151003C	36824 N. 17th Avenue Phoenix	No
A06033100	9/22/2006	21151933C	SE 11th Ave/ Maddock Phoenix	No
A050305	9/22/2006	21153049	SE 7th Ave/Cloud Phoenix	No
A05030200	9/22/2006	21181001	SW 2411 E Cloud Phoenix	No
A010523	9/27/2006	13827096	NE Mesa dr/2nd Avenue Mesa	No
A01053500	9/27/2006	13913244A	SE Mesa Dr/Holmes Mesa	No
A01052300	9/27/2006	13827098	NE Mesa dr/2nd Avenue Mesa	No
A010522	9/27/2006	13861080	NE Pasadena/2nd Street Mesa	No
A01052300	9/27/2006	13827095A	NE Mesa Dr/2nd Avenue Mesa	No
		13827064A	Adjoining parcels	No
		13827065A	"	No
A01052300	9/27/2006	13827066A	"	No
B0204Sec28	10/3/2006	11932002A	3109 N 16th Street Phoenix	No
B0204Sec28	10/3/2006	11930076	3435 N 16th Street Phoenix	No
B02032800	10/3/2006	16328048A	4249 N. 16th Street Phoenix	Yes
A29040200	9/27/2006	20027005P	20000 N 57th Drive Glendale	No
"	"	20027010	"	No
"	"	200005W	"	No
"	"	20027005P	"	No
"	"	20027005Q	"	No
"	"	20027005T	"	No
"	"	20027005G	"'	No
"	"	20027005K	"	No
"	"	20027005L	"	No

Site	*Date*	*Parcel #*	*Address*	*Violation Observed*
"	"	20027005U	"	No
"	"	20027005V	"	No
"	"	20027005N	"	No
A29040200	9/27/2006	20027005M	"	No
A030406	9/22/2006	21526031	4102 E. Greenway Phoenix	No
A030406	9/22/2006	21531001M	"	No
"	"	21531007	"	No
"	9/22/2006	21531008	"	No
US 60 & El Recreo	9/18/2006	50526005A	US 60 & El Recreo Phoenix	No
US 60 & El Recreo	9/18/2006	50526011	"	No
US 60 & El Recreo	9/18/2006	50526003C	"	No
Mariposa & US 60	9/18/2006	50534049	NW US60/Mariposa Dr. Phoenix	No
	10/2/2006	21231966	Hayden/101 Freeway Phoenix	No
	10/2/2006	21705017	NE 92st/Pinacle Peak Scottsdale	No
	10/2/2006	21705018	NE 92st/Pinacle Peak Scottsdale	No
	10/02/2006	21705013B	9456 E. Pinnacle Peak Scottsdale	No
A010624	9/29/2006	14159017	6762 E. Albany St. Mesa	Yes
"	9/29/2006	14159018	206 N Power Rd Mesa	Yes
A010624	9/29/2006	14159019	214 N. Power Rd Mesa	No
A010601	9/29/2006	14171158J	Power/Heather Dr Mesa	No
		14171158K		
3/2S/6E	5/23/2006	304-52-041	16202 E. Claxton Gilbert	No
4/1S/GE	6/7/2006	30409- 956	Val Vista-Baseline Gilbert	No
17/15/GE	6/30/2006	304-22-170	1240 E Sagebrush Gilbert	No
DO10509	7/17/2006	302-04-006-Q	SE Vineyard/Baseline Mesa	No
TINR2E Sec 22	8/15/2006	104-61-002-D	43rd/ Lower Buckeye Phoenix	No
TIN2E14	8/17/2006	10512015	1817 S 35th Avenue Phoenix	No
67th Ave &Chester	8/22/2006	201-12-816-A	64th Ave Peay Dr Phoenix	No
A03032400	8/24/2006	166-36-004-Q	10801 N. 32 St. Phoenix	No
A010211	8/29/2006	10958108	3402 W. Buckeye Phoenix	Yes
A010212	8/29/2006	109-49-071A	19th Ave/Madison Phoenix	Non-reg
A010309	8/31/2006	116-48-001A	1451 E. Washington Phoenix	No
A010214	8/31/2006	10510011A	2916 W. Yuma Phoenix	No
A040427	9/21/2006	215-04-037	Scottsdale/Mayo Phoenix	No
A040428	9/21/2006	212-32-953	56th St/ Mayo Phoenix	No
A10040300	9/28/2006	212-15-438	N 23 St/E Avenida Del Sol Phoenix	Yes
A04040200	10/4/2006	205-07-076	4500 Block W. Saddlehorn Phoenix	No
1 IN 1E	10/12/2006	102-41-297-A	7309 W. Lynwood Phoenix	No
9 1N 1E	10/12/2006	101-08-012-L	91Ave/Adams Tollison	Non-reg
13-2S-Se	10/12/2006	303-43-4-529	Cooper/Queen Creek Chandler	No
D010526	10/16/2006	302-84-001M	215 N. McQueen Chandler	No
18 1N 1E	10/16/2006	101-17-169	111Ave/4 St. Avondale	Non-reg
A02010700	10/17/2006	102-59-001-T	Glen Harbor Blvd Glendale	Yes
A03031500	10/19/2006	166-40-298-J	1802 E Larkspur Phoenix	Yes
D0206500	10/20/2006	304-78-014 V	24620 S. 182 Pl Gilbert AZ	Yes
A050406	10/23/2006	211-48-083	Lt 1 La Ventanas Cave Creek	No
A03033300	10/23/2006	160-11-012	1247 E. Griswold Phoenix AZ	No
A050406	10/23/2006	211-48-066	48 St. Carefree HWY Phoenix AZ	No
14 IN 1E	10/23/2006	104-32-013-C	83Ave Buckeye Maricopa AZ	Yes
30-2S-5E	10/31/2006	303-50-001-4	Sun Lakes Blvd/Riggs Sun Lakes	No
A030319	11/1/2006	159-15-047-F	1326 W. Becker Lane Phoenix AZ	No
A02023400	11/2/2006	108-11-058	3630 W Roanoke Ave Phoenix AZ	No

Site	*Date*	*Parcel #*	*Address*	*Violation Observed*
D01060900	11/2/2006	304-09-014	159 E. Elliot Rd Gilbert AZ	No
A010309	11/3/2006	116-47-084	1302 E. Jefferson Phoenix AZ	Yes
A0290403	11/6/2006	200-24-013A	19812 N. 53 Ave Glendale AZ	Yes
A02022700	11/9/2006	107-33-054	35 Ave/Indian School Phoenix AZ	Yes
D010509	11/9/2006	302-88-989	Arizona Ave/Chilton Chandler	No
A02022600	11/13/2006	108-04-202	3010 Grand Ave Phoenix AZ	Yes
D010509	11/14/2006	302-88-989	3300 Arizona Ave Chandler AZ	No
D02073100	11/15/2006	304-89-066-U	Chandler Heights Citrus Unit 3127	Yes
D010529	11/15/2006	302-48-830-B	Alma School/Ivanhoe Chandler	No
D02073200	11/15/2006	304-90-417	NEC Sossaman/Happy Rd City	Yes
01 01 19	11/15/2006	101-23-004-A	Avondale Blvd/ Broadway Avondale	Yes
A040424	11/16/2006	212-31-976	Pima/ Deer Valley Rd Scottsdale	No
A02020300	11/16/2006	151-04-080	7750 N 35 Ave Phoenix	No
D020533	11/16/2006	303-59-972-C	25558 S Arizona Ave Chandler	No
D010521	11/16/2006	302-23-095	Arizona/Orchid Chandler	Yes
A040424	11/16/2006	212-31-977	Pima/Deer Valley Scottsdale	No
D020503	11/21/2006	303-28-022A	800 E. Germann Rd Chandler	No
A010206	11/21/2006	103-23-003-P	67Ave/Roosevelt Phoenix	Yes
D020522	11/21/2006	303-46-011-C	McQueen/Chandler Heights Chandler	No
D01071100	11/21/2006	304-01-006-E	NW Signal Butte/Elliot Mesa	Yes
A0303225	11/22/2006	165-15-003-A	3937 E. Ocotillo Phoenix	Yes
A040109	11/27/2006	210-16-288	23416 N Cunino Rancho Peoria	Yes
A040123	12/27/2006	200-20-006-G	21000 N 75 Ave Glendale	Yes
A0404109	11/27/2006	201-16-299	MCR 58440 Peoria	Yes
A03020300	11/27/2006	207-14-045	4101 W Waltann Lane Phoenix	No
A03020700	11/27/2006	200-70-004-T	76 Ave/ Thunderbird Glendale	No
A02023100	11/28/2006	103-13-695-	59 Ave McDowell Phoenix	No
D01070400	11/28/2006	304-03-009N	Joslyn/Guadalupe Mesa	No
D020522	11/28/2006	303-46-002-A	450 E Chandler Heights Chandler,	Yes
A02023500	11/29/2006	108-26-115	32 Ave/McDowell Phoenix	No
A02023300	11/29/2006	103-51-143	4733 W. Thomas Phoenix	No
B030113	12/1/2006	200-85-972-A	115 Ave/El Mirage	Yes
A030206	12/1/2006	20051007E	59 Ave/Paradise Lane Phoenix	Yes
D010622	12/1/2006	304-27-016-K	Higley/Ray Gilbert	No
A01 02 22	12/4/2006	102-19-007-V	4115 N. 91 Ave Phoenix	Yes
A040207	12/5/2006	20112004Q	67 Ave Pinnacle Peak Phoenix	Yes
A060215	12/6/2006	203-03-003	Anthem Common Park Lot 2 Phoenix	No
D020525	12/6/2006	303-55-161	2331 E Cedar Pl Chandler	Yes
A060215	12/6/2006	203-03-034	4124 W Fortune Dr Phoenix	No
A03021000	12/11/2006	207-13-003-B	15024 N 37 Phoenix	Yes
D020525	12/11/2006	303-55-165	2452 E Elmwood Chandler	Yes
D02070400	12/12/2006	304-62-011-C	88 st/ Woodland Ave Mesa	Yes
A02022700	12/12/2006	107-33-026-F	3515 W. Clarendon Phoenix	Yes
A010219	12/15/2006	104-57-001-K	63 Ave/Broadway Phoenix	Yes
A060328	12/13/2006	2111-49-027	1- St/ Joy Ranch Rd Phoenix	Yes
A02031800	12/15/2006	156-38-029	1604 W. Pasadena Phoenix	Yes
A010211	12/21/2006	109-40-001M	3101 W. Washington St Phoenix	Yes
D010626	12/4/2006	304-39-016W	Higley/Ray Rd Gilbert	No

Yes = Violations were observed
No = No Violations were observed during this inspection
Non-Regulated = Parcel greater than .5 acre and no vehicle use.

Table 3.4.2 above summarizes 124 Inspected Rule 310.01 sites. Often one inspection site will have multiple owners, creating more than one parcel at a specific site. These multiple parcels were counted as one site. There were violations observed at forty (40) of the 124 sites; thus 32% of sites had an observed violation. From this we observe a 68% Rule Effectiveness. 68% of the sites inspected had no observable violations. Rule 310.01 Supervisor/ Inspector inspection reports were identical. There were no differences between supervisor and inspector observations of Rule 310.01 violations.

Forty-seven of the inspections were conducted during a three week period: September 18, 2006 through October 3, 2006. Two weeks before, September 2 – September 14, Maricopa County experienced a high precipitation rate. Many of these days were categorized by the U.S. National Weather service as Thunderstorm activity days. Stabilization observed at these sites was due to this unusual but naturally occurring wet weather and not to actions initiated by property owners. Within two weeks, activity or trespass on these vacant lots destabilized some of the later test sites. To better reflect the range of weather conditions more representative of Maricopa County, the Department randomly selected 77 more inspection sites from the last six-months of 2006 to include with the original 47 sites. This larger set of inspection sites more closely approximates the average Maricopa County weather conditions.

4.4.3 Nonmetallic Mineral Processing Plants

Ten Rule 316 sources were randomly chosen for inspection during the months of August - November 2006. The following table lists the compliance status of each site as determined by QA/Supervisor – Inspector.

Table 4.4.3: List of Inspected Non-Metallic Mineral Processing

Site Address	Permit Issued By	Compliance Status
Paradise Valley Desert Rock Inc. 17238 N. Cave Creek Rd Phoenix Arizona	MCAQD	CSN
Kilauea Crushers, Inc 7516 W. Deer Valley Phoenix Arizona	MCAQD	No Observed Violation
Master Block 12620 W. Butler Drive Phoenix Arizona	MCAQD	NOVs
Maricopa Ready Mix 1800 N. Alma School Rd Mesa Arizona	MCAQD	NOVs
Southwest Asphalt Paving Fisher Sand & Gravel dba Tempe Arizona	ADEQ & MCAQD	NOVs
Vulcan Materials/ Calmat Div. 5301 S. Dysart Rd. Avondale, Arizona	ADEQ	No Observed Violation
Vulcan Materials Co. Plant #138 2205 W. Adobe Dr. Phoenix, Arizona	MCAQD	CLOSED PLANT
Rinker 11920 W. Glendale Glendale Arizona	MCAQD	NOV
Superstition Crushing 3914 East Presidio Street Mesa Arizona 85215 (double inspection State/ County)	ADEQ & MCAQD	NOVs
Kilauea Crushers	MCAQD	NOV

Site Address	Permit Issued By	Compliance Status
16402 S. Tuthill Buckeye Arizona		
Imix Group LLC 7505 S. 143 Ave Goodyear Arizona	MCAQD	NOVs
Sunshine Redi-Mix, Inc. 5725 N. 55th Ave Glendale Arizona 85301	MCAQD	NOV

Of the eleven randomly chosen inspection sites, two of the sites had no observable violations. Consequently, 18% of these sites had not observable violations.

Using EPA guidance (EPA, 1992), MCAQD determined that eleven inspections were not adequate to meet the required 90 percent confidence level and 5 percent sample error. Therefore, MCAQD applied recently revised EPA Rule Effectiveness Guidance (August 2005) to the Nonmetallic Mineral Processing source category and derived a rule effectiveness of 54% for Rule 316 (Appendix B). Appendix B describes the revised rule effectiveness methodology used. In this methodology, the value assigned to the "compliance history" was derived from the inspection results of the eleven randomly selected Rule 316 inspections.

4.5 Summary of Rule Effectiveness Study

		Rule Effectiveness Study Results	Revised EPA Rule Effectiveness Guidance
Rule 310	Earth Moving Sources	51%	-
Rule 310.01	Vacant Lots/Open Areas	68%	-
Rule 316	Nonmetallic Mineral	-	54%

4.6 Quality Assurance

As mentioned above, a quality assurance (QA) supervisor assigned to follow inspectors on the Rule 310 and Rule 310.01 inspections. The Earthmoving inspector data reported a lower rule effectiveness or 46% Rule Effectiveness while the QA/ Supervisor data resulted in a 49% rule effectiveness. As the difference between scoring was relatively small, the Department chose to rely upon the more experienced, QA/ Supervisor observations to score the Rule 310 rule effectiveness. The Rule 310.01 QA/Supervisor and the inspector reports were identical. The consistent observations result from the application of the Fugitive Dust Test Methods required by Rule 310.01

5. Recommendations

Maricopa County's significant growth rate over the last 5 years significantly affected the Department's workload. The Department was unable to add staff as rapidly as the growth took place. As a result, for a period of time the Department responded to complaints but was unable to complete many proactive inspections. To train the significant number of new staff necessary, the Department updated its new employee training program and developed an ongoing training program. These updates were put in place since the last rule effectiveness study.8 The small (3%) difference in Supervisor/inspector observations reflects the success of this training and ongoing inspector quality control program.

[8] MCESD, 2003 Rule Effectiveness Study for Salt River PM_{10} Study. Maricopa County Environmental Services Department. Revised December 2003.

6. Policy/Procedure Improvements

The Department programs for non-permitted sources are at the point where it is now conducting proactive and well as reactive inspections. Based on the experience gained from inspections, the Department will be recommending clarifications as to rule text to make the rule clearer to both the regulated community and the regulators.

APPENDIX A

EPA Revised Rule Effective Guidance Factors for Non-point Sources

NON-POINT SOURCE RULE EFFECTIVENESS FACTORS:	
Most important factor:	• Compliance History
Other important factors:	
	• Compliance Certification
	• Type of Inspection
	• Unannounced inspections
	• Inspection Frequency
	• Enforcement
	• Compliance assistance
	• Monitoring requirements
	• Follow-up inspections
	• Media publicity

APPENDIX B

Rule 316- EPA Revised Rule Effectiveness Guidance-Nonmetallic Mineral Processing

A. Most important factor (1 criteria, assigned weighting of 40% total)

	Range		Midpt. Value	Description	Weight	Value Assigned by MCAQD	Score (=weight x value)
Compliance History	86%	100%	93%	Over 90% of facilities Inspected in the source Category are in compliance			
	70%	85%	78%	Over 75% of facilities inspected in the source category are in compliance			
		<70%	35%	Over 60% of facilities inspected in the source category are in compliance	40%	18%	7.2%
B. Other Important factors (6 criteria, each assigned weighting of 8% of total)							
Compliance Certifications	86%	100%	93%	Source is subject to some type of compliance certification			
	70%	85%	78%	Source is subject to some type of compliance certification			
		<70%	35%	Source is not subject to any type of compliance certification;	8%	50%	4.00%
Type of Inspection	86%	100%	93%	Inspections are thorough and detailed, and include close examination of control equipment, and a detailed records review			
	70%	85%	78%	Inspections consist of a records review, and sometimes inspections of control equipment	8%	80%	6.4%
		<70%	35%	Inspections generally consist of a records review only;			
Inspection Frequency/ Percentage	86%	100%	93%	Percent of facilities inspected in the sector in a given year is 25% or greater.			
	70%	85%	78%	Percent of facilities inspected in the sector in a given year is 15% or greater	8%	80%	6.40%
		<70%	35%	Percent of facilities inspected in the sector in a given year is less than 15%			
Unannounced Inspections	86%	100%	93%	Unannounced inspections are sometimes done	8%	93%	7.44%
	70%	85%	78%	Unannounced inspections are sometimes done, but infrequently			
		<70%	35%	Unannounced inspections are never done			
Enforcement Penalties	86%	100%	93%	Agency takes prompt enforcement action, including monetary fines, against violators			
	70%	85%	78%	Agency usually takes enforcement action, including monetary fines against violators;	8%	80%	6.40%
		<70%	35%	Agency usually does not take enforcement action against violators;			
Compliance Assistance	86%	100%	93%	A compliance assistance program exists and is adequately staffed, and includes such things as workshops,			
	70%	85%	78%	Mailings, web-based tutorials, etc.	8%	80%	6.40%
		<70%	35%	Workshops, mailings, web-based tutorials, etc available			

C. Other factors (3 criteria, each assigned weighting of 4% total):							
Monitoring Requirements	86%	100%	93%	Monitoring requirements exist and must be reported to regulatory agency at least once a year;			
	70%	85%	78%	Monitoring requirements exist but records don't have to be filed with regulatory agency	4%	80%	3.2%
		<70	35%	Monitoring requirements do not exist;			
Follow Up Instructions	86%	100%	93%	Follow-up inspections are done when violations are noted most (>75%) of the time			
	70%	85%	78%	Follow-up inspections are done when violations are noted most (>75%) of the time	4%	80%	3.2%
		<70%	35%	Follow-up inspections are routinely done;			
Media Publicity	86%	100%	93%	Media publicity of enforcement actions is routinely conducted	4%	93%	3.72%
	70%	85%	78%	Media publicity of enforcement actions is sometimes done			
		<70%	35%	Media publicity of enforcement actions is rarely if ever done			
							54.35%

APPENDIX C

SAMPLE SIZE with a 90% CONFIDENCE LEVEL
As a function of Standard deviation & Sample error [9]

	TABLE D-1		ANALYSIS OF SAMPLE SIZE; CONFIDENCE LEVEL = 90%								
					STANDARD DEVIATION						
SAMPLE											
ERROR	2%	4%	6%	8%	10%	12%	14%	16%	18%	20%	22%	24%
2.5%	2	7	16	28	44	63	85	112	141	174	211	251
3.0%	1	5	11	19	30	44	59	77	98	121	146	174
3.5%	1	4	8	14	22	32	44	57	72	89	108	128
4.0%	1	3	6	11	17	25	33	44	55	68	82	98
4.5%	1	2	5	9	13	19	26	34	44	54	65	77
5.0%	0	2	4	7	11	16	21	28	35	44	53	63
5.5%	0	1	3	6	9	13	18	23	29	36	44	52
6.0%	0	1	3	5	8	11	15	19	25	30	37	44
6.5%	0	1	2	4	6	9	13	16	21	26	31	37
7.0%	0	1	2	4	6	8	11	14	18	22	27	32
7.5%	0	1	2	3	5	7	9	12	16	19	23	28
8.0%	0	1	2	3	4	6	8	11	14	17	21	25
8.5%	0	1	1	2	4	5	7	10	12	15	18	22
9.0%	0	1	1	2	3	5	7	9	11	13	16	19

[9] Guidelines for Estimating and Applying Rule Effectiveness for Ozone/CO State Implementation Plan Base Year Inventories, U.S. EPA, EPA-452/R-92-010, November 1992.

Appendix 2.3

Calculating Rule Effectiveness for Controlled (Title V and non-Title V) Point Source Processes

A. Most important factors (2 criteria, each assigned weighting of 20% of total):

	Range		Midpt. value	Description	Weight	Value assigned to MCAQD	Score (= weight × value)
Monitoring	94%	100%	97%	Source specific monitoring used for compliance purposes, and monitoring records filed with regulatory agency at least every 4 months.			
	87%	93%	90%	Source specific monitoring used as an indicator of compliance, and monitoring records filed with regulatory agency every 6 to 9 months.	20%	90%	18.0%
	81%	86%	84%	Source specific monitoring used as an indicator of compliance, and monitoring records filed with regulatory agency each year.			
	70%	80%	75%	General guidance exists for source specific enhanced monitoring, and monitoring records required but aren't submitted to regulatory agency.			
		< 70%	35%	No requirements for any type of monitoring.			

Compliance History	94%	100%	97%	The facility has been in compliance for the past eight quarters.		18 of 39 facilities	9.0%
	87%	93%	90%	The facility is believed to have been in compliance for the past eight quarters, although inspection frequency is such that this can't be positively confirmed.		5 of 39 facilities	2.3%
	81%	86%	84%	On schedule; the facility is meeting its compliance schedule.			
	70%	80%	75%	In Violation; facility is in violation of emissions and/or procedural requirements.		7 of 39 facilities	2.7%
		< 70%	35%	High Priority Violator (HPV): the facility is in significant violation of one or more applicable requirement of the CAA.		9 of 39 facilities	1.6%
					20%	Sum:	**15.6%**

B. Other important factors (4 criteria, each assigned weighting of 6% of total):

Type of Inspection	94%	100%	97%	Inspections involve compliance test methods with a high degree of accuracy, such as stack testing or other types of precise emissions measurement.	6%	97%	5.8%
	87%	93%	90%	Inspections involve detailed review of process parameters & inspection of control equipment.			
	81%	86%	84%	Inspections involve review of process and inspection of control equipment.			
	70%	80%	75%	Inspections generally consist of only a records review.			
		< 70%	35%	Inspections most likely consist of visual inspection (e.g., opacity), or drive by.			

Operation & Maintenance	94%	100%	97%	Control equipment operators follow and sign daily O&M instructions.			
	87%	93%	90%	Control equipment operators follow daily O&M instructions.	6%	90%	5.4%
	81%	86%	84%	Control equipment operators follow daily or weekly O&M instructions.			
	70%	80%	75%	O&M requirements exist, but on no specific schedule.			
		< 70%	35%	No specific O&M requirements.			

	Range		Midpt. value	Description	Weight	Value assigned to MCAQD	Score (= weight × value)
Unannounced Inspections	94%	100%	97%	Routinely conducted.	6%	97%	5.8%
	87%	93%	90%	Sometimes done.			
	81%	86%	84%	Done, but infrequently.			
	70%	80%	75%	Rarely done.			
		< 70%	35%	Never done.			

Enforcement Penalties	94%	100%	97%	Agency has the authority to impose punitive measures, including monetary fines, towards violators such as in delegated Title V Operating Permit programs.	6%	97%	5.82%
	87%	93%	90%	Agency has the authority to impose punitive measures, including monetary fines, towards violators such as in delegated Title V Operating Permit programs.			
	81%	86%	84%	Agency has the authority to impose punitive measures, including monetary fines, towards violators such as in delegated Title V Operating Permit programs.			
	70%	80%	75%	Agency has the authority to impose punitive measures, including monetary fines, towards violators such as in delegated Title V Operating Permit programs.			
		< 70%	35%	Agency does not have sufficient authority to impose punitive measures towards violators.			

C. Other factors (9 criteria, each assigned weighting of 4% of total):

Compliance Certifications	94%	100%	97%	Source subject to Title V or other type of compliance certification.	4%	97%	3.88%
	87%	93%	90%	Source subject to Title V or other type of compliance certification.			
	81%	86%	84%	Source not subject to any type of compliance certification.			
	70%	80%	75%	Source not subject to any type of compliance certification.			
		< 70%	35%	Source not subject to any type of compliance certification.			

Inspection Frequency	94%	100%	97%	Source(s) are inspected once every 2 years or more frequently.	4%	97%	3.88%
	87%	93%	90%	Source(s) inspected every 3 years or more frequently.			
	81%	86%	84%	Source(s) inspected every 5 years or more frequently.			
	70%	80%	75%	Inspection of source(s) infrequent. > every 5 years.			
		< 70%	35%	Inspections rarely, if ever, performed.			

EPA HPV Enforcement	94%	100%	97%	Agency has sufficient resources to implement EPA's 12/22/98 HPV policy.	4%	97%	3.88%
	87%	93%	90%	Agency's resources allow it to implement EPA's 12/22/98 HPV policy in most instances.			
	81%	86%	84%	Agency's resources allow it to implement EPA's 12/22/98 HPV policy in most instances.			
	70%	80%	75%	Agency's resources allow it to implement EPA's 12/22/98 HPV policy more often than not.			
		< 70%	35%	Resource constraints prohibit agency from implementing EPA's 12/22/98 HPV policy in most instances.			

	Range		Midpt. value	Description	Weight	Value assigned to MCAQD	Score (= weight × value)
Operator Training	94%	100%	97%	Control equipment operators complete a formal training program on use of the equipment, and such program is kept up to date and has been reviewed by the regulatory agency.			
	87%	93%	90%	Control equipment operators complete formal training program, and such program is kept up to date and available for review by the regulatory agency upon request.			
	81%	86%	84%	Control equipment operators complete some amount of formal training.	4%	84%	3.36%
	70%	0.8	75%	Control equipment operators receive only on the job training .			
		< 70%	35%	Control equipment operators receive no specific training.			

Media Publicity	94%	100%	97%	Media publicity of enforcement actions.	4%	97%	3.88%
	87%	93%	90%	Media publicity of enforcement actions.			
	81%	86%	84%	Media publicity of enforcement actions.			
	70%	80%	75%	Media publicity of enforcement actions.			
		< 70%	35%	No media publicity of enforcement actions.			

Regulatory Workshops	94%	100%	97%	Regulatory workshops are available annually, and/or the implementing agency mails regulatory information packages each year.	4%	97%	3.88%
	87%	93%	90%	Regulatory workshop are available every 1-2 years, and/or the implementing agency mails regulatory information packages every 1-2 years.			
	81%	86%	84%	Regulatory workshop are available every 2-3 years, and/or the implementing agency mails regulatory information packages once every 2-3 years.			
	70%	80%	75%	Regulatory workshop not routinely available, but implementing agency mails regulatory information packages out about once every 2-3 years.			
		< 70%	35%	Regulatory workshops not routinely available. implementing agency mails regulatory information packages infrequently, if ever.			

Inspector Training	94%	100%	97%	Inspectors must undergo 2 weeks of comprehensive basic training, and 1 to 2 weeks of source specific training, and such training is updated each year.			
	87%	93%	90%	Inspectors must undergo 1 to 2 weeks of basic training and 1 week of source specific training, and such training is updated every 1-2 years.	4%	90%	3.60%
	81%	86%	84%	Inspectors must undergo 1 to 2 weeks of basic training and 3 to 5 days of source specific training, and such training is updated every 1-2 years.			
	70%	80%	75%	Inspectors must undergo 1 to 2 weeks of basic training and 1 to 3 days of source specific training, and such training is updated every 1-2 years.			
		< 70%	35%	Inspectors must undergo less than 5 days of basic training less than 3 days of source specific training, and such training is updated only every 2 years or less frequently.			

	Range		Midpt. value	Description	Weight	Value assigned to MCAQD	Score (= weight × value)
Testing Guidelines	94%	100%	97%	Specific guidelines and schedule for testing and test methods exist.	4%	97%	3.88%
	87%	93%	90%	Specific guidelines on testing and test methods exist, but no schedule for testing.			
	81%	86%	84%	Specific guidelines on testing and test methods exist, but no schedule for testing.			
	70%	80%	75%	Specific guidelines on testing and test methods, but no schedule for testing.			
		< 70%	35%	Only general guidance on testing, or no mention of testing requirements.			

Follow-up Inspections	94%	100%	97%	Follow-up inspections always or almost always done (90 % of the time or more).	4%	97%	3.88%
	87%	93%	90%	Follow-up inspections usually done (approximately 75% of the time).			
	81%	86%	84%	Follow-up inspections sometimes done (approximately 50% of the time).			
	70%	80%	75%	Follow-up inspections infrequently done (approximately 25% of the time).			
		< 70%	35%	Follow-up inspections rarely or never done (10% of the time or less)			
							90.55%

A. Most important factors (2 criteria, each assigned weighting of 20% of total):

	Range		Midpt. value	Description	Weight	Value assigned to MCAQD	Score (= weight × value)
Monitoring	94%	100%	97%	Source specific monitoring used for compliance purposes, and monitoring records filed with regulatory agency at least every 4 months.			
	87%	93%	90%	Source specific monitoring used as an indicator of compliance, and monitoring records filed with regulatory agency every 6 to 9 months.			
	81%	86%	84%	Source specific monitoring used as an indicator of compliance, and monitoring records filed with regulatory agency each year.			
	70%	80%	75%	General guidance exists for source specific enhanced monitoring, and monitoring records required but aren't submitted to regulatory agency.	20%	75%	15.0%
		< 70%	35%	No requirements for any type of monitoring.			

Compliance History	94%	100%	97%	The facility has been in compliance for the past eight quarters.		182 of 748 facilities	4.7%
	87%	93%	90%	The facility is believed to have been in compliance for the past eight quarters, although inspection frequency is such that this can't be positively confirmed.		404 of 748 facilities	9.7%
	81%	86%	84%	On schedule; the facility is meeting its compliance schedule.			
	70%	80%	75%	In Violation; facility is in violation of emissions and/or procedural requirements.		156 of 748 facilities	3.1%
		< 70%	35%	High Priority Violator (HPV): the facility is in significant violation of one or more applicable requirement of the CAA.		6 of 748 facilities	0.1%
						Sum:	**17.6%**

B Other important factors (4 criteria, each assigned weighting of 6% of total):

Type of Inspection	94%	100%	97%	Inspections involve compliance test methods with a high degree of accuracy, such as stack testing or other types of precise emissions measurement.			
	87%	93%	90%	Inspections involve detailed review of process parameters & inspection of control equipment.	6%	90%	5.4%
	81%	86%	84%	Inspections involve review of process and inspection of control equipment.			
	70%	80%	75%	Inspections generally consist of only a records review.			
		< 70%	35%	Inspections most likely consist of visual inspection (e.g., opacity), or drive by.			

Operation & Maintenance	94%	100%	97%	Control equipment operators follow and sign daily O&M instructions.			
	87%	93%	90%	Control equipment operators follow daily O&M instructions.	6%	90%	5.4%
	81%	86%	84%	Control equipment operators follow daily or weekly O&M instructions.			
	70%	80%	75%	O&M requirements exist, but on no specific schedule.			
		< 70%	35%	No specific O&M requirements.			

	Range		Midpt. value	Description	Weight	Value assigned to MCAQD	Score (= weight × value)
Unannounced Inspections	94%	100%	97%	Routinely conducted.	6%	97%	5.8%
	87%	93%	90%	Sometimes done.			
	81%	86%	84%	Done, but infrequently.			
	70%	80%	75%	Rarely done.			
		< 70%	35%	Never done.			

Enforcement Penalties	94%	100%	97%	Agency has the authority to impose punitive measures, including monetary fines, towards violators such as in delegated Title V Operating Permit programs.	6%	97%	5.82%
	87%	93%	90%	Agency has the authority to impose punitive measures, including monetary fines, towards violators such as in delegated Title V Operating Permit programs.			
	81%	86%	84%	Agency has the authority to impose punitive measures, including monetary fines, towards violators such as in delegated Title V Operating Permit programs.			
	70%	80%	75%	Agency has the authority to impose punitive measures, including monetary fines, towards violators such as in delegated Title V Operating Permit programs.			
		< 70%	35%	Agency does not have sufficient authority to impose punitive measures towards violators.			

C. Other factors (9 criteria, each assigned weighting of 4% of total):

Compliance Certifications	94%	100%	97%	Source subject to Title V or other type of compliance certification.			
	87%	93%	90%	Source subject to Title V or other type of compliance certification.			
	81%	86%	84%	Source not subject to any type of compliance certification.			
	70%	80%	75%	Source not subject to any type of compliance certification.	4%	75%	3.00%
		< 70%	35%	Source not subject to any type of compliance certification.			

Inspection Frequency	94%	100%	97%	Source(s) are inspected once every 2 years or more frequently.	4%	97%	3.88%
	87%	93%	90%	Source(s) inspected every 3 years or more frequently.			
	81%	86%	84%	Source(s) inspected every 5 years or more frequently.			
	70%	80%	75%	Inspection of source(s) infrequent. > every 5 years.			
		< 70%	35%	Inspections rarely, if ever, performed.			

EPA HPV Enforcement	94%	100%	97%	Agency has sufficient resources to implement EPA's 12/22/98 HPV policy.	4%	97%	3.88%
	87%	93%	90%	Agency's resources allow it to implement EPA's 12/22/98 HPV policy in most instances.			
	81%	86%	84%	Agency's resources allow it to implement EPA's 12/22/98 HPV policy in most instances.			
	70%	80%	75%	Agency's resources allow it to implement EPA's 12/22/98 HPV policy more often than not.			
		< 70%	35%	Resource constraints prohibit agency from implementing EPA's 12/22/98 HPV policy in most instances.			

	Range		Midpt. value	Description	Weight	Value assigned to MCAQD	Score (= weight × value)
Operator Training	94%	100%	97%	Control equipment operators complete a formal training program on use of the equipment, and such program is kept up to date and has been reviewed by the regulatory agency.			
	87%	93%	90%	Control equipment operators complete formal training program, and such program is kept up to date and available for review by the regulatory agency upon request.			
	81%	86%	84%	Control equipment operators complete some amount of formal training.			
	70%	80%	75%	Control equipment operators receive only on the job training .	4%	75%	3.00%
		< 70%	35%	Control equipment operators receive no specific training.			
Media Publicity	94%	100%	97%	Media publicity of enforcement actions.	4%	97%	3.88%
	87%	93%	90%	Media publicity of enforcement actions.			
	81%	86%	84%	Media publicity of enforcement actions.			
	70%	80%	75%	Media publicity of enforcement actions.			
		< 70%	35%	No media publicity of enforcement actions.			
Regulatory Workshops	94%	100%	97%	Regulatory workshops are available annually, and/or the implementing agency mails regulatory information packages each year.	4%	97%	3.88%
	87%	93%	90%	Regulatory workshop are available every 1-2 years, and/or the implementing agency mails regulatory information packages every 1-2 years.			
	81%	86%	84%	Regulatory workshop are available every 2-3 years, and/or the implementing agency mails regulatory information packages once every 2-3 years.			
	70%	80%	75%	Regulatory workshop not routinely available, but implementing agency mails regulatory information packages out about once every 2-3 years.			
		< 70%	35%	Regulatory workshops not routinely available. implementing agency mails regulatory information packages infrequently, if ever.			
Inspector Training	94%	100%	97%	Inspectors must undergo 2 weeks of comprehensive basic training, and 1 to 2 weeks of source specific training, and such training is updated each year.			
	87%	93%	90%	Inspectors must undergo 1 to 2 weeks of basic training and 1 week of source specific training, and such training is updated every 1-2 years.	4%	90%	3.60%
	81%	86%	84%	Inspectors must undergo 1 to 2 weeks of basic training and 3 to 5 days of source specific training, and such training is updated every 1-2 years.			
	70%	80%	75%	Inspectors must undergo 1 to 2 weeks of basic training and 1 to 3 days of source specific training, and such training is updated every 1-2 years.			
		< 70%	35%	Inspectors must undergo less than 5 days of basic training less than 3 days of source specific training, and such training is updated only every 2 years or less frequently.			

	Range		Midpt. value	Description	Weight	Value assigned to MCAQD	Score (= weight × value)
Testing Guidelines	94%	100%	97%	Specific guidelines and schedule for testing and test methods exist.	4%	97%	3.88%
	87%	93%	90%	Specific guidelines on testing and test methods exist, but no schedule for testing.			
	81%	86%	84%	Specific guidelines on testing and test methods exist, but no schedule for testing.			
	70%	80%	75%	Specific guidelines on testing and test methods, but no schedule for testing.			
		< 70%	35%	Only general guidance on testing, or no mention of testing requirements.			

Follow-up Inspections	94%	100%	97%	Follow-up inspections always or almost always done (90 % of the time or more).	4%	97%	3.88%
	87%	93%	90%	Follow-up inspections usually done (approximately 75% of the time).			
	81%	86%	84%	Follow-up inspections sometimes done (approximately 50% of the time).			
	70%	80%	75%	Follow-up inspections infrequently done (approximately 25% of the time).			
		< 70%	35%	Follow-up inspections rarely or never done (10% of the time or less)			
							87.95%

Appendix 3.1

Calculating Rule Effectiveness for Agricultural Activities

A. Most important factors (1 criteria with an assigned weight of 25% of total):

	Range		Midpt. value	Description	Value assigned to MCAQD	Weight	Score (= weight × value)
Compliance History	86%	100%	93%	Over 90% of facilities inspected in the source category are in compliance.	93%	25%	23%
	70%	85%	80%	Over 75% of facilities inspected in the source category are in compliance.			
		< 70%	35%	Over 60% of facilities inspected in the source category are in compliance.			

B. Other important factors (6 criteria, each assigned weighting of 10% of total):

Compliance Certification	86%	100%	93%	Source is subject to some type of compliance certification.			
	70%	85%	80%	Source is subject to some type of compliance certification.			
		< 70%	35%	Source is not subject to any type of compliance certification.	35%	10%	4%

Level of Inspection	86%	100%	93%	Inspections are thorough and detailed, and include close examination of control equipment, and a detailed records review.			
	70%	85%	80%	Inspections consist of a records review, and sometimes inspection of control equipment.			
		< 70%	35%	Inspections generally consist of a records review only.	35%	10%	4%

Unannounced Inspections	86%	100%	93%	Unannounced inspections are sometimes done.			
	70%	85%	80%	Unannounced inspections are done, but infrequently.	0.7	10%	7%
		< 70%	35%	Unannounced inspections are never done.			

Inspections Frequency	86%	100%	93%	Percent of facilities inspected in the sector in a given year is 25% or greater.			
	70%	85%	80%	Percent of facilities inspected in the sector in a given year is 15% or greater.			
		< 70%	35%	Percent of facilities inspected in the sector in a given year is less than 15%.	35%	10%	4%

	Range		Midpt. value	Description	Value assigned to MCAQD	Weight	Score (= weight × value)
Enforcement	86%	100%	93%	Agency takes prompt enforcement action, including monetary fines, against violators.			
	70%	85%	80%	Agency usually takes enforcement action, including monetary fines, against violators.			
		< 70%	35%	Agency usually does not take enforcement action against violators.	35%	10%	4%

Compliance Assistance Programs	86%	100%	93%	A compliance assistance program exists and is adequately staffed, and includes such things as workshops, mailings, web-based tutorials, etc.	0.93	10%	9%
	70%	85%	80%	A compliance assistance program exists, but is minimally staffed. The program occasionally makes workshops, mailings, web-based tutorials, etc.;available.			
		< 70%	35%	A compliance assistance program does not exist.			

C. Other factors (3 criteria, each assigned weighting of 5% of total):

Monitoring Requirements	86%	100%	93%	Monitoring requirements exist and must be reported to regulatory agency at least once a year.			
	70%	85%	80%	Monitoring requirements exist but records don't have to be filed with regulatory agency.			
		< 70%	35%	Monitoring requirements do not exist.	35%	5%	2%

Follow-up Inspections	86%	100%	93%	Follow-up inspections are done when violations are noted most (>75%) of the time.			
	70%	85%	80%	Follow-up inspections are done when violations are noted most (>75%) of the time.			
		< 70%	35%	Follow-up inspections are not routinely done.	35%	5%	2%

Media Publicity	86%	100%	93%	Media publicity of enforcement actions is routinely conducted.			
	70%	85%	80%	Media publicity of enforcement actions is sometimes done.			
		< 70%	35%	Media publicity of enforcement actions is rarely if ever done.	35%	5%	2%
							59%

Appendix 3.2

Development of a Fugitive Windblown PM_{10} Dust Emission Inventory for the Phoenix PM_{10} Nonattainment Area

Final Report

Development of a Fugitive Windblown PM10 Dust Emission Inventory for the Phoenix PM10 Nonattainment Area

Prepared for

Maricopa County Air Quality Department
1001 N. Central Ave., Suite 400
Phoenix, AZ 85004

Prepared by

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Revised
16 May 2007

TABLE OF CONTENTS

Page

TABLES

FIGURES

1. INTRODUCTION

The Maricopa County Air Quality Department (MCAQD) has contracted with ENVIRON to develop a windblown dust PM10 emissions inventory for the metro Phoenix PM10 non-attainment area (NAA). The draft inventory was developed for calendar year 2005 and the first quarter of calendar year 2006 for inclusion in a complete 2005 PM10 emissions inventory. As part of this development effort, the Windblown Dust emissions model, developed by the Western Regional Air Partnership Regional Modeling Center (WRAP RMC), was used in combination with local and regional data sets describing the land characteristics within the study area. The development of the windblown PM10 dust emission inventory is described in this report.

ENVIRON applied the WRAP RMC Windblown Dust Model to develop the necessary PM_{10} and $PM_{2.5}$ emissions inventory. The dust model was developed to generate hourly gridded estimates of PM dust emissions based on landuse, soils characteristics, hourly meteorological data and additional information related to agricultural practices. The accuracy and quality of the dust estimates is limited by the detail and resolution of available input data, particularly the characterization of land use and landcover. The existing databases used previously for the WRAP Regional Haze modeling efforts were augmented with additional local data for Maricopa County and surrounding areas. In addition to surface characteristics data, the model requires gridded, hourly wind speeds to estimate PM10 dust emissions from wind erosion. The Maricopa Association of Governments (MAG) has provided ENVIRON with observed wind data from meteorological monitoring sites within the Phoenix PM10 non-attainment area (NAA).

The emission inventory pollutants include both PM_{10} and $PM_{2.5}$ in order to facilitate the assessment of potential control measures. Emission estimates were apportioned to specific land use categories based upon GIS analysis and existing land use data bases. Emissions estimates were developed at a spatial resolution of 12-km on a modeling domain encompassing Maricopa County, the Phoenix PM_{10} Non-Attainment Area, and Pinal County. Figure 1-1 displays the 12-km windblown dust modeling domain used in the present study. The emission estimates were aggregated and provided separately for each of the regions from the gridded modeling results.

The draft dust emission inventory and project report (Mansell and Hoats, 2007) presented and discussed results for both calendar year 2005 and the first quarter of 2006. This report and the final windblown dust emissions inventory focuses only on the calendar year 2005 estimates.

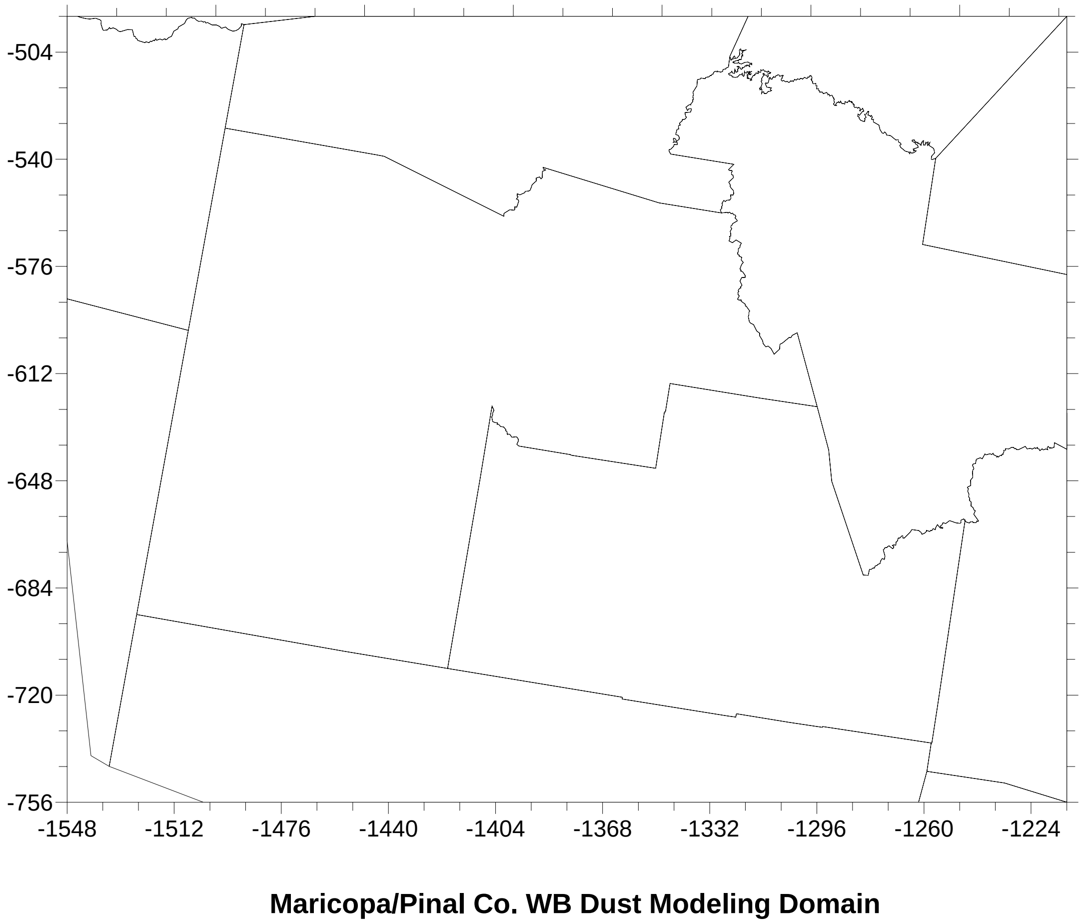


Figure 1-1. MCAQD 12-km windblown dust emissions modeling domain.

This report is organized as follows:

- Section 2 provides a summary of the WRAP RMC windblown dust emission estimation methodology used for the project.
- Section 3 presents and discusses the various data sources used for the emissions inventory development.
- The implementation of the dust model for Maricopa and Pinal Counties is described in Section 4.
- Section 5 documents the results of the windblown dust emissions modeling for calendar year 2005. Various sensitivity simulations performed during the course of the project are also discussed in this section.
- Section 6 provides an overall summary of the work performed as part of the project. Limitations of the model and results, as well as recommendations for future modeling efforts are also provided.
- Section 7 includes references for this report.

2. WINDBLOWN PM10 DUST EMISSION ESTIMATION METHODOLOGY

The WRAP Windblown Dust model was developed by the WRAP Regional Modeling Center (RMC) in two phases. The current application for Maricopa and Pinal Counties uses the most recent version developed during Phase II of the RMC's model development efforts. A brief description of the Phase I methodology is provided below, including a discussion of the various assumptions and associated limitations. A discussion of the Phase II estimation methodology used for this project is then presented.

Summary of Phase I Methodology

The development of the Phase I Wind Blown Dust model and implementation, including various assumptions incorporated in the estimation methodology, has been documented previously (ENVIRON, 2004; 2003a; 2003b; Mansell, 2003a; 2003b). In summary, the method relies on the characterization of vacant land types and soil conditions, and numerous assumptions regarding dust reservoir characteristics. Wind erosion is initiated in the model based on an arbitrary wind speed assignment, independent of surface conditions. Emission factors, or dust fluxes, were derived from very limited wind tunnel study results as a function of wind speed and soil texture. Adjustments were applied to the resulting emission rates based on vegetation density of vacant land parcels. Surface disturbance levels were based on land use types. In addition, adjustments were applied for agricultural lands based on non-climatic factors. Land use characterization was based on the Biogenic Emission Landuse Database (BELD3); soil texture was derived from the State Soil Geographic Database (STATSGO).

The relative lack of detail in the data sets used for characterizing the physical conditions of land parcels and soils required a number of assumptions to be employed in the methodology. These assumptions were presented and discussed in detail by Mansell, 2003b and Mansell et al., 2004. The primary assumptions affecting the model results can be summarized as follows:

- Threshold wind velocities: The threshold wind velocity is assumed to be 20 mph, independent of land use and soil texture.
- Vacant land stability: The methodology developed relies on the specification of stability of vacant land parcels. The stability characteristics of land parcels are based solely on the land use type.
- Dust Reservoirs: Reservoir properties are based on the stability characteristics of vacant land parcels and determine the duration of dust events. Limited reservoirs emit dust for a shorter duration of time than unlimited reservoirs. Assumptions are made concerning the amount of time a reservoir will emit wind blown dust. Also assumed are the reservoir recharge intervals.
- Rain, Snow and Freeze Events: Assumptions are included which determine time intervals after which land parcels will emit dust following precipitation, snow and freeze events. These assumptions greatly impact the number of wind events treated in the methodology as well as the total dust emissions generated.

- Vegetation Density: The percentage of vegetative, or canopy, cover is determined by the general land use category of vacant land parcels. These percentages are constant for a given land type. Estimated emission factors, or emission rates, are attenuated based on the assumed canopy cover percentage.

These various assumptions have a number of implications with respect to the estimation of fugitive dust from wind erosion. However, in many cases, the data necessary to address these issues on a regional scale domain are lacking. These issues and their implications were discussed in Mansell et al., 2004. The Phase II Windblown Dust methodology, described in the following section, seeks to address these assumptions and limitations and provide improvements to the overall estimation methodology and dust model implementation. It should be noted that previous windblown PM10 dust emission inventories for the State of Arizona have been developed using the Phase I estimation methodology (Pollack, et al., 2004)

WRAP RMC Phase II Methodology

The WRAP RMC developed the Phase II estimation methodology based a review of recent literature and windblown dust studies. A summary of the literature review can be found in Mansell, et al., 2004. Based on a review of wind tunnel studies it was noted that the two important components to characterize the dust emission process from an erodible surface are the threshold friction velocity that defines the inception of the emission process as a function of the wind speed and as influenced by the surface characteristics, and the strength of the emissions that follow the commencement of particle movement. The two critical factors affecting emission strength are the wind speed (wind friction velocity) that drives the saltation system, and the soil characteristics.

Friction Velocities

Surface friction velocities are determined from the aerodynamic surface roughness lengths and the 10-meter wind speeds. Friction velocity u_*, is related to the slope of the velocity versus the natural logarithm of height through the relationship:

$$\frac{u_z}{u_*} = \frac{1}{\kappa} \ln \frac{z}{z_o}$$

where u_z = wind velocity at height z (m s^{-1})
u_* = friction velocity (m s^{-1})
κ = von Karman's constant (0.4)
z_o = aerodynamic roughness height (m)

Threshold Friction Velocities

The methodology relies on the determination of threshold surface friction velocities, u_{*t}, as a function of aerodynamic surface roughness length, z_0. In addition to aerodynamic roughness, the degree of disturbance of the surface also plays a key role in the estimation of threshold friction velocities. Based on the work of Marticorena et al. (1997), relationships between u_{*t} and z_0

where identified and compared with wind tunnel data from Gillette et al. (1980, 1982), Gillette (1988) and Nickling and Gillies (1989). This comparison is presented in Figure 2-1.

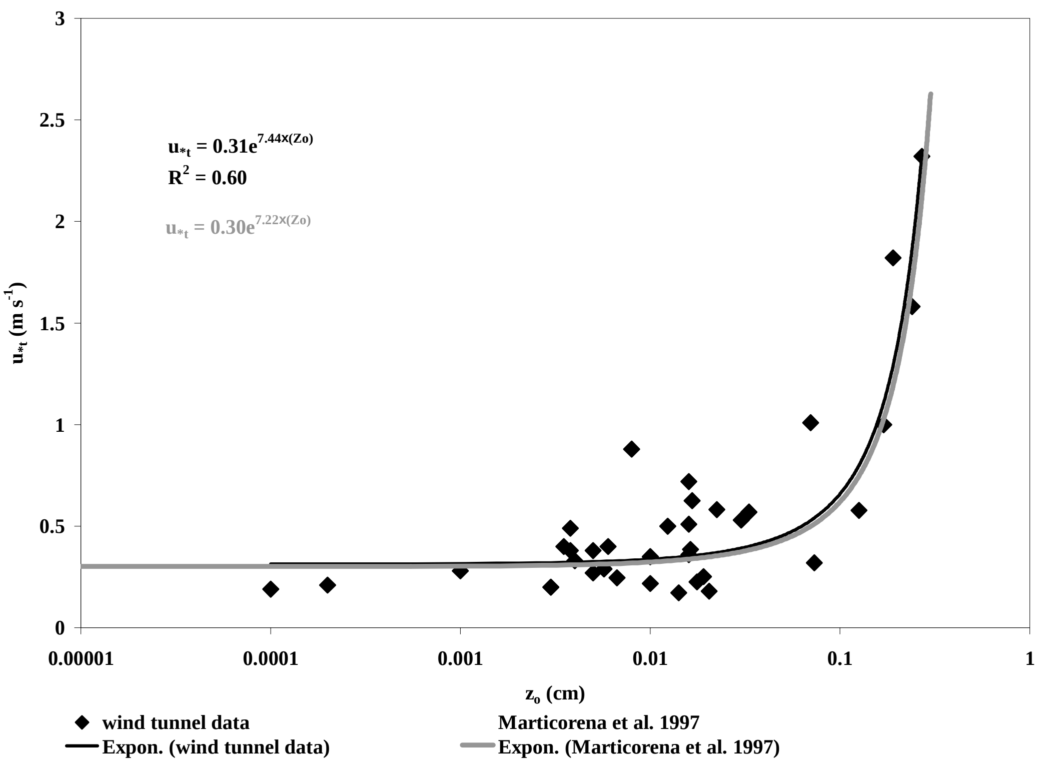


Figure 2-1. Comparison between the Marticorena *et al*. (1997) modeled relationship of threshold friction velocity and aerodynamic roughness length and wind tunnel data from Gillette *et al*. (1980, 1982), Gillette (1988) and Nickling and Gillies (1989).

Several general relationships can be described for threshold friction velocity data. Two major factors have the greatest influence on the threshold of wind erodible soils: the degree of disturbance and the aerodynamic roughness. For loose or disturbed soils the most important factor that controls the threshold friction velocity is aerodynamic roughness. The effect of surface disturbance on threshold friction velocity can be seen in Table 2-1 for data from Gillette et al. (1980, 1982), Gillette (1988), and Nickling and Gillies (1989) where surfaces are grouped by land type. For a given surface type, the effect of disturbance is to lower the threshold between ~90% to ~20% of the undisturbed value.

Table 2-1. Threshold friction velocities for typical surface types calculated from available data and as reported in the literature[1].

Site Type	Average u_{*t}(m s^{-1}) Undisturbed	Std. D. u_{*t} (m s^{-1}) Undisturbed	No. of Data Points	Average u_{*t} (m s^{-1}) Disturbed	Std. D. u_{*t} (m s^{-1}) Disturbed	No. of Data Points	% change [1-(dist./undist.)]
agricultural fields	1.29	0.74	41	0.55	0.25	37	0.57
alluvial fan	0.72	0.09	2	0.60	0.18	2	0.17
desert flat	0.75	0.06	4	0.51	0.19	4	0.32
desert pavement	2.17	0.67	4	0.59	0.10	5	0.73
fan surface	1.43	0.59	5	0.47	0.25	5	0.67
play, crusted	2.13	0.67	4	0.63	0.50	15	0.70
playa	1.46	0.98	12	0.58	0.56	25	0.60
prairie	2.90	n/a	1	0.24	0.03	3	0.92
sand dune	0.44	0.10	4	0.32	0.05	4	0.27

[1]Sources include: Gillette *et al*. (1980, 1982), Gillette (1988), and Nickling and Gillies (1989).

Surface Roughness Lengths

Surface friction velocities, including the threshold friction velocity, are a function of the aerodynamic surface roughness lengths. The surface roughness lengths are in turn dependent on surface characteristics, particularly land use/land cover. While these values can vary considerable for a given land type, published data are available which provide a range of surface roughness lengths for various land use types and vegetation cover. These data were presented in Table 2-1.

Application of the relationship shown in Figure 2-1 to assign a threshold friction velocity to a surface requires information on a surface’s aerodynamic roughness length. This type of information is not generally available in land use databases, because they were not specifically developed to quantify aerodynamic properties of surfaces. Based on the designation of land use type, the aerodynamic roughness can be assigned based on previously reported values for similar surfaces. A list of surface types and reported aerodynamic roughness lengths is presented in Table 2-2. In the RMC Phase II model, as implemented in the current project, surface roughness lengths were assigned based on the land cover type, and are documented in Section 3.

A degree of uncertainty exists upon assigning an aerodynamic roughness length to a surface, as it will be complicated by the individual condition of the surface, which can change through time on several scales. For agricultural fields, aerodynamic roughness will change as a function of plant height and cover through a growing season and the tillage practices. These affects are considered for agricultural lands within the model, as described below. For natural surfaces, the aerodynamics can change through the season as well as annually through several years affecting dust production cycles. This is linked to plant growth in response to annual and long term climate variability, which will affect plant cover.

Table 2-2. Typical surface aerodynamic roughness lengths calculated from available data and as reported in the literature.

Site Type	Average z_o (cm)	Std. D. z_o (cm)	Number of Data Points	Estimated u_{*t} (m s^{-1})	Source
agricultural fields (bare)	0.031	0.039	9	0.38	Gillette et al. (1980, 1982), Gillette (1988) Nickling and Gillies (1989)
desert flat/pavement	0.133	0.180	8	0.79	Gillette et al. (1980, 1982), Gillette (1988) Nickling and Gillies (1989)
fan surface	0.088	0.148	5	0.57	Gillette et al. (1980, 1982), Gillette (1988) Nickling and Gillies (1989)
play, crusted	0.059	0.099	15	0.46	Gillette et al. (1980, 1982), Gillette (1988) Nickling and Gillies (1989)
playa	0.057	0.083	33	0.46	Gillette et al. (1980, 1982), Gillette (1988) Nickling and Gillies (1989)
prairie	0.049	0.088	4	0.43	Gillette et al. (1980, 1982), Gillette (1988) Nickling and Gillies (1989)
sand dune	0.007	0.006	4	0.32	Gillette et al. (1980, 1982), Gillette (1988) Nickling and Gillies (1989)
scrub desert	0.045	0.040	2	0.42	Nickling and Gillies (1989)
sparse veg. (0.04% cover)	0.370				Wolfe (1993)
sparse veg. (10.3% cover)	6.800				Wolfe (1993)
sparse veg. (13.5% cover)	7.200				Wolfe (1993)
sparse veg. (26% cover)	8.300				Wolfe (1993)
sparse veg. (8% cover)	5.400				Wolfe (1993)
thick grass	2.3				Sutton (1953)
thin grass	5				Sutton (1953)
sparse grass	0.12				Oke (1978)
agricultural crops	2-4				Oke (1978)
orchards	50-100				Oke (1978)
Decid. Forests	100-600				Oke (1978)
Conf. Forests	100-601				Oke (1978)
agricultural crops	15				Deursen et al. (1993)
urban	100				Deursen et al. (1993)
Decid. Forests (closed canopy)	121				Deursen et al. (1993)
Conif. Forests (closed canopy)	134				Deursen et al. (1993)

Emission Fluxes

Field and wind tunnel experiments suggest that dust emissions are proportional to wind friction speed and approximate theoretical model predictions, but the considerable scatter in the available data make it impossible to clearly define this dependence (Nickling and Gillies, 1993). Different surfaces appear to have different constants of proportionality for the flux versus wind friction velocity relationship, implying that the flux is predictable, but surface and soil properties affect the magnitude of the flux. A detailed discussion of wind tunnel studies, including various limitations and measured data, was provided in ENVIRON, 2003a; 2003b. The findings of the various wind tunnel studies are briefly summarized here.

Recently Alfaro, et al. (2003) re-analyzed the Nickling and Gillies (1989) data and found that the tendency of a surface to emit dust depends not primarily on its textural qualities, but on the size distribution of the loose soil aggregates available for saltation, and the aerodynamic roughness length that conditions the emission threshold. The re-analysis was based in part on the work of Chatenet, et al. (1996) in which they found that desert soils could be broadly divided into four populations based upon their soil aggregate populations. The differences between the four groups are based upon the estimated geometric mean diameter of the soil particles. The four size classes are 125 mm, 210 mm, 520 mm, and 690 mm, which are labeled FFS, FS, MS, and CS by Chatenet, et al. (1996).

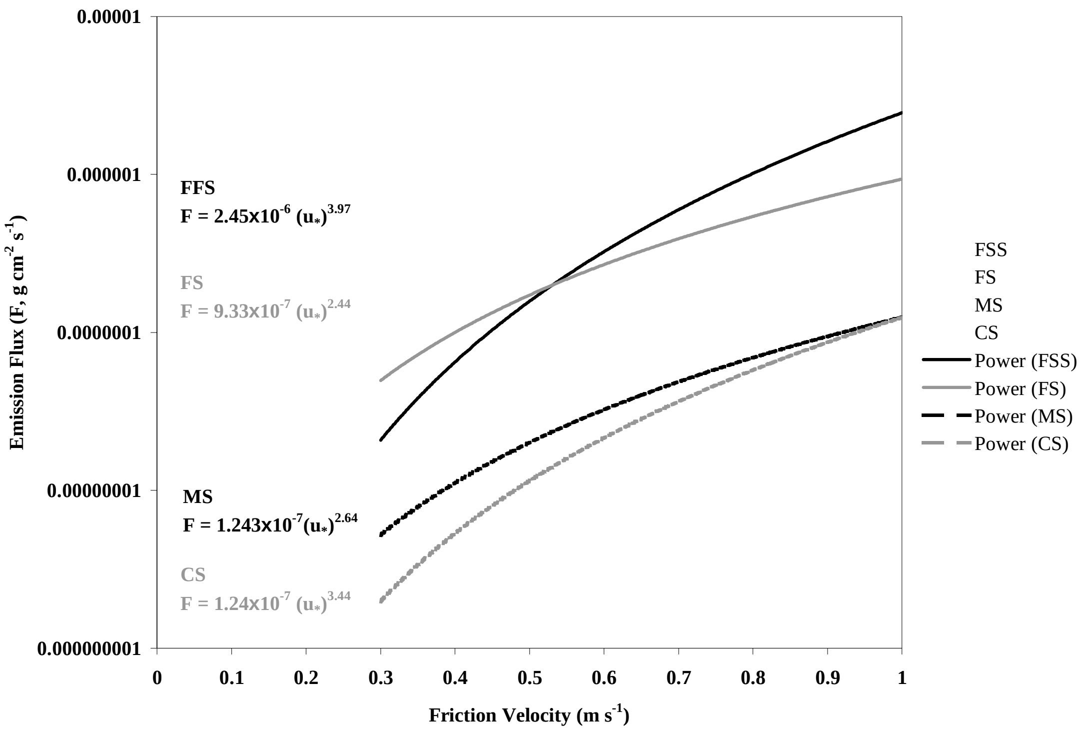


FIgure 2-2. The emission flux as a function of friction velocity predicted by the Alfaro and Gomes (2001) model constrained by the four soil geometric mean diameter classes of Alfaro et al. (2003).

Alfaro et al., (2003) grouped the Nickling and Gillies (1989) emission data based on these classes then tested how well the grouped data matched predicted output of a dust production model developed by Alfaro and Gomes (2001) that was constrained to use the four different geometric mean diameters. The modeled dust emission relationships for the four size classes are shown in Figure 2-2. As presented in Alfaro, et al. (2003) the emission data from Nickling and Gillies (1989), which fall into the FS class (10 out of 13) are well explained by the model (Figure 2-3).

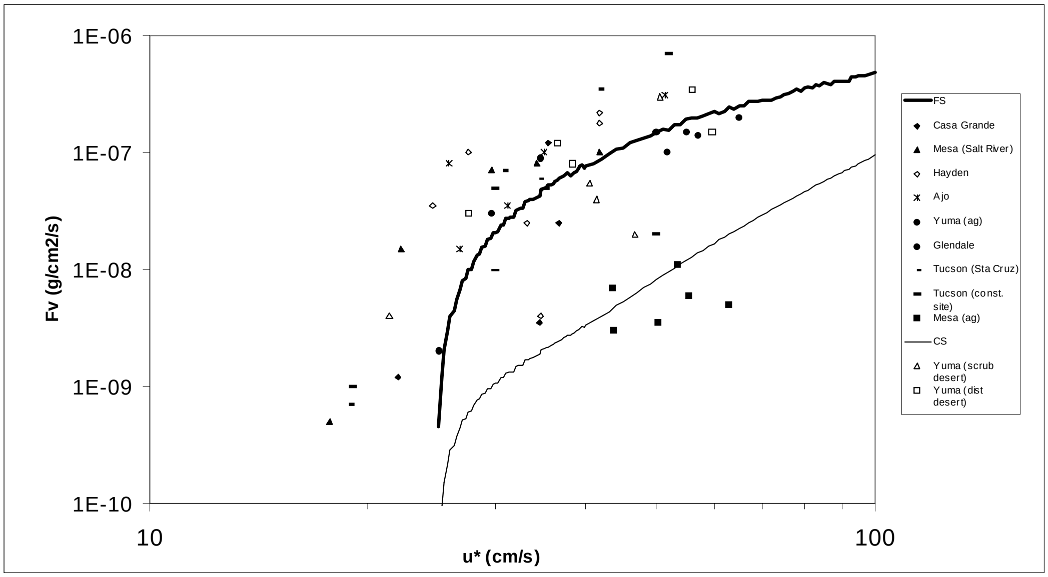


Figure 2-3. Comparison between the Alfaro et al. (2003) model relationship for FS and CS sizes and the wind tunnel flux data of Nickling and Gillies (1989). Ten (out of 13) sites have a dust production potential similar to the FS model and one site (Mesa agricultural) is closely aligned with the CS model (after Alfaro et al., 2003).

Using the Alfaro, et al. (2003) approach, emissions of dust for soils can be confined to four different emission factors, depending on the geometric mean grain size, as determined by the methods of Chatenet, et al. (1996). The model predictions were tested against the wind tunnel data set of Nickling and Gillies (1989) and found to fit the measured data satisfactorily. Of key importance is that Chatenet, et al. (1996) established relationships between the 12 soil types that are defined in the classical soil texture triangle and their four dry soil types (silt [FSS], sandy silt [FS], silty sand [MS], and sand [CS]). The soil texture categorization and the relationships among texture assignments and soil groupings are discussed below.

Reservoir Characteristics

Dust emissions from vacant lands are limited by the amount of erodible soil available for suspension into the atmosphere. In addition to the amount of soil present, the condition of the soils, including textural and stability, as well as climatological factors influence the total wind blown dust emission potential of a given parcel of vacant land. The amount of soil available for a given land parcel is referred to as the reservoir and can be classified as limited or unlimited. Classification of reservoirs as limited or unlimited has implications with respect to the duration of time over which the dust emissions are generated. In general, the reservoirs should be classified in terms of the type of soils, the depth of the soil layer, soil moisture content and meteorological parameters. Finally, the time required for a reservoir to recharge following a wind event is influenced by a number of factors including precipitation and snow events and freezing conditions of the soils.

Given that the soils database for use in the project does not provide information concerning the moisture content or the depth of the soil layer, certain assumption are made regarding the determination and classification of soil reservoirs. These assumptions are based primarily on the land use type and stability of the vacant land parcel. Reservoirs are classified as limited for stable land parcels and unlimited for unstable land parcels.

The duration and amount of precipitation and snow and freeze events will also affect the dust emissions from wind erosion. Barnard (2003) has compiled a set of conditions for treating these events based on seasons, soil characteristics and the amounts of rainfall and snow cover. These conditions were based on limited information found in the literature and additional assumptions. The results of the analysis of Barnard are summarized in Tables 2-3 and 2-4. .

Table 2-3. Number of days after precipitation event to re-initiate wind erosion for rainfall amounts (constant) exceeding 2 inches.

Soil type	Spring/Fall	Summer	Winter
Sand	3	2.1	4.2
Sandy Loam	3	2.1	4.2
Fine Sand Loam	3	2.1	4.2
Loam	4	2.9	3.8
Silt Loam	4	2.9	3.8
Sandy Clay Loam	4	2.9	3.8
Clay Loam	5	3.6	7.2
Silty Clay Loam	6	4.3	8.6
Clay	7	5	10

Table 2-4. Number of days after precipitation event to re-initiate wind erosion for rainfall amounts (constant) less than or equal to 2 inches.

Soil type	Spring/Fall	Summer	Winter
Sand	1	0.7	1.4
Sandy Loam	1	0.7	1.4
Fine Sand Loam	1	0.7	1.4
Loam	2	1.4	2.8
Silt Loam	2	1.4	2.8
Sandy Clay Loam	2	1.4	2.8
Clay Loam	3	2	4
Silty Clay Loam	4	2.8	5.6
Clay	5	3.6	7.2

Soil Disturbance

It has been noted that the level of disturbance of an erodible surface is an important parameter in the estimation of wind blown dust emissions. Disturbed surfaces tend to generate more dust than un-disturbed surfaces. In the application of the Phase I model, different emissions rates were applied for disturbed versus un-disturbed surfaces. The assumed disturbance level of the surface was to be determined by the land type and invariant in time and across the modeling domain. Thus, assumptions were required to assign surface disturbance based on land cover type. As noted previously, the disturbance level of a surface more appropriately has the effect of altering the threshold surface friction velocity; disturbed surfaces have lower thresholds while undisturbed surfaces exhibit higher threshold friction velocities.

The disturbance level of various surfaces across a regional scale modeling is difficult to determine given the lack of detail in both the LULC and soils data available for use in the model. Except for agricultural lands, which are treated separately in the model as described below, vacant land parcels are typically un-disturbed unless some activity is present such as to cause a disturbance, for example, off-road vehicle activity in desert lands, or animal grazing on rangelands.

For the RMC Phase II model implementation, all non-agricultural land types are considered un-disturbed, since there is no a priori information to indicate otherwise for the regional scale modeling domain to be considered. Additional information concerning disturbance levels for certain land types should be was investigated to determine whether an assumed percentage of specific land types can be considered disturbed versus un-disturbed. The windblown dust emission model application for the draft Phoenix NAA emission inventory considered various assumptions regarding the disturbance levels of barren lands and shrublands only, as documented in Mansell and Hoats, 2007. Revised assumptions regarding disturbance levels of various land types for the final inventory are presented and discussed in Section 4 of this report.

<u>Agricultural Land Adjustments</u>

Unlike other types of vacant land, windblown dust emissions from agricultural land are subject to a number of non-climatic influences, including irrigation and seasonal crop growth. As a result, several non-climatic correction or adjustment factors were developed for applicability to the agricultural wind erosion emissions. These factors included:

- Long-term effects of irrigation (i.e., soil “clodiness”);
- Crop canopy cover;
- Post-harvest vegetative cover (i.e., residue);
- Bare soil (i.e., barren areas within an agriculture field that do not develop crop canopy for various reasons, etc.); and
- Field borders (i.e., bare areas surrounding and adjacent to agricultural fields).

The methodology used to develop individual non-climatic correction factors for the Phase I study was described in detail in ENVIRON, 2004. Most of these methods were based upon previous similar work performed by the California Air Resources Board (CARB) in their development of California-specific adjustment factors for USDA’s Wind Erosion Equation (WEQ) (CARB, 1997). These correction factors were developed for specific soil textures, crop types, and geographic locations and then applied to the wind erosion estimates developed from the wind tunnel studies. Correction factors are developed only for the 17 field crops specifically identified in the BELD3.1 data set (i.e., alfalfa, barley, corn, cotton, grass, hay, oats, pasture, peanuts, potatoes, rice, rye, sorghum, soybeans, tobacco, wheat, and miscellaneous crops). Due to the insufficient characterization of the wind erosion emission processes for orchards and vineyards, correction factors for this type of agricultural land were not developed.

For the current windblown dust emission model application, these same non-climatic adjustments are applied. However, because the BELD3 database will not be used, these factors are related to the agricultural land types available in the LULC data used for the project. The existing county-level crop percentages from the BELD3 database are linked to the aggregated agricultural land parcels from the LULC data used. Specific updates to the agricultural information for Maricopa County are considered, as discussed in Section 5 of this report.

The agricultural correction factors are applied to the wind erosion emission rates for agricultural lands developed from wind tunnel studies. The data and methodology used for developing the correction factors is documented in ENVIRON, 2003b, and summarized below.

Long-Term Irrigation Effect Correction Factor

The correction factor for the long-term effects of irrigation is as follows:

$C_{il} = I_i/I_n$

Where: C_{il} = correction factor for long-term effects of irrigation;
I_I = irrigated soil erodibility (tons/acre/year); and
I_n = non-irrigated soil erodibility (tons/acre/year).

This correction factor is the ratio of irrigated and non-irrigated soil erodibilities ("I"). Non-irrigated soil erodibility values (I_n) can be assigned to each soil texture (U.S. EPA, 1974; U.S. EPA, 1977). Irrigated soil erodibilities (I_i) were assigned by staff of the USDA Agricultural Research Service (ARS) to corresponding non-irrigated soil erodibilities (I_n) as shown in Table 3 on Page 7.11-23 of the ARB windblown dust document (ARB, 1997). The long-term irrigation effect correction factors are developed for each soil texture and applied to all irrigated croplands, regardless of crop type. This correction factor has a value of 1.0 for all non-irrigated croplands. The correction factor is applied throughout the year with no seasonal variation.

Crop Canopy Correction Factor

The correction factor for crop canopy cover is as follows:

$C_{cc} = \exp(-0.201CC^{0.7366})$

Where: C_{cc} = correction factor for canopy cover;
exp = exponential function; and
CC = canopy cover (percent).

This correction factor is shown as Equation 7 on Page 7.11-26 of the ARB windblown dust document (ARB, 1997). Because the crop canopy cover correction factor equation contains an exponential function, the correction factor can change significantly with relatively small changes in percent crop cover. In the absence of canopy cover (i.e., CC = 0 percent), the correction factor is 1.000. With total canopy cover (i.e., CC = 100 percent), the correction factor is 0.0025 (i.e., effectively zero). More realistic canopy cover values of 10 and 20 percent give correction factors of 0.334 and 0.161, respectively. As a result, windblown emissions can vary significantly for a given crop depending upon the stage of canopy growth. For this reason, crop-specific canopy profiles should be developed; however, the ability to develop these profiles (i.e., growth curves) is dependent on the availability of data, and the resources and time to collect these data.

Post-Harvest Soil Cover Correction Factor

The correction factor for post-harvest soil cover is as follows:

C_{sc} = exp (-0.0438SC)

Where: C_{sc} = correction factor for post-harvest soil cover;
exp = exponential function; and
SC = post-harvest soil cover (percent).

This correction factor is shown as Equation 8 on Page 7.11-28 of the ARB windblown dust document (ARB, 1997). The post-harvest soil cover correction factor applies to the period of time between harvest and the next year's planting. Because the post-harvest soil cover correction factor equation contains an exponential function, the correction factor can change significantly with relatively small changes in percent post-harvest soil cover. Without any post-harvest soil cover (i.e., SC = 0 percent), the correction factor is 1.000. With total post-harvest soil cover (i.e., SC = 100 percent), the correction factor is 0.013 (i.e., effectively zero). More realistic post-harvest soil cover values of 10 and 20 percent give correction factors of 0.645 and 0.416, respectively.

Unlike canopy cover that varies throughout the growing season, the level of post-harvest soil cover is assumed constant during the post-harvest to pre-planting period. If disk-under operations are conducted for particular crops, then two levels of post-harvest soil cover will be used.

As with the crop canopy during the growing season, crop-specific post-harvest soil cover profiles will need to be developed for the non-growing season. All of the issues discussed regarding crop canopy (e.g., weekly average versus aggregated monthly, non-field crops, sub-state variability, etc.) are also applicable to developing correction factors for post-harvest soil cover.

As described above for the crop canopy correction factor, the planting and harvesting data for RUSLE2 is used to develop the post-harvest soil cover correction factor (ARS, 2003; Lightle, 2003). RUSLE2 provides crop-specific residue profiles for individual CMZs. However, residue levels are extremely dependent upon the equipment treatments conducted between harvest and planting.

Also, the Conservation Technology Information Center (CTIC) maintained by Purdue University provides information regarding the amount of residue left on a field after harvest (e.g., 0-15 percent, 15-30 percent, >30 percent), by crop and by county for the U.S. These data are collected from surveys and stored in CTIC's Crop Residue Management Program (CRM) database (Towery, 2003). State- and county-level data are available on-line for years 1989–1998, 2000, and 2002. Years 1989–1998 are for a suite of 8 crops; years 2000 and 2002 are for 8-crop and 22-crop suites.

Bare Soil Adjustment Correction Factor

The correction factor for bare soil accounts for the fraction of cultivated area that remains barren during the growing cycle. There are many possible reasons for this including uneven ground, uneven irrigation, soil salinity, pest damage, etc.

The bare soil adjustment correction factor is simply a small fraction applied to the total cultivated acreage. The ARB windblown dust document uses bare soil fractions of 0.5 percent for crop acreage and 0.05 percent for pasture (ARB, 1997). These fractions were estimated from limited visual observations by ARB staff. Although statistics quantifying bare soil fractions have not been identified, the USDA has indicated that 2-3 percent of planted cropland experiences “crop failure” (USDA, 1997b). The term “crop failure” appears to indicate that planting occurred, but that harvest did not. However, it may not be appropriate to assume that crop failure acreage is equivalent to bare soil acreage (i.e., some vegetation growth may have occurred, but for some reason the harvest did not). Therefore, ARB’s assumed bare soil fractions seem to be reasonable.

Although the bare soil adjustment correction factor is relatively small compared to overall agricultural acreage, the contribution from the bare soil area may be significant because many of the other non-climatic correction factors are not applicable (i.e., crop canopy cover, post-harvest vegetative cover, post-harvest planting, etc.).

The assumed ARB bare soil adjustment correction factors is applied throughout the year and does not vary by month or season.

Border Adjustment Correction Factor

The correction factor for border adjustment accounts for the fact the surrounding borders of most agricultural fields (excluding pastures) that are not covered in vegetation.

The border adjustment correction factor is simply a small fraction applied to the total cultivated acreage. The ARB windblown dust document uses fractions of 0.5 percent for crop acreage; pastures are assumed to have no borders (ARB, 1997). These fractions were estimated from limited visual observations by ARB staff.

Like the bare soil adjustment correction factor, the border adjustment correction factor is relatively small compared to overall agricultural acreage. However, the contribution from agricultural field borders may be significant. In fact, it may be more significant than the bare soil areas because the field borders are typically non-irrigated (i.e., long- and short-term irrigation adjustments are not applicable.

The assumed ARB border adjustment correction factor is applied throughout the year and does not vary by month or season.

3. INPUT DATA

The various data sets required for implementation of the windblown dust emission model are summarized in this section. These include:

- Landuse/landcover data;
- Soil characteristics data;
- Meteorological data, and;
- Agricultural data

Landuse/Landcover

Landuse and landcover data are required by the model to determine the susceptibility of the surfaces to wind erosion. As discussed previously, wind erosion is initiated when wind speeds exceed the threshold wind speed as determined by surface friction velocities. Surface friction velocities are dependent on the surface roughness lengths, which are assigned based on the landuse/landcover characteristics.

The current application of the model utilizes landuse data for Maricopa County obtained from the Maricopa Association of Governments (MAG). These data provide varying degrees of detail with respect to urban lands and natural landscapes within the modeling domain. Because these data cover only Maricopa County and the Phoenix NAA region of Pinal county, other landuse data were required. The Southwest GAP database was used for this purpose.

The purpose of the Gap Analysis Program (GAP) is to provide regional assessments of the conservation status of native vertebrate species and natural land cover types and to facilitate the application of this information to land management activities. The National GAP URL is http://www.gap.uidaho.edu/. The GAP is conducted as state-level projects and is coordinated by the USGS Biological Resources Division. Currently the program is developing land cover mappings for all U.S. States. The entire GAP process for a state requires four to six years. Although each state is being developed separately, detailed vegetation species covers are being developed based on predetermined classifications.

The National GAP data is available in an Albers Conical Equal Area projection coordinate system at a nominal spatial resolution of approximately 50 meters. Depending on the state, a minimum mapping unit of 2, 5, 40 or even 100 hectares (1 km^2) is used, although 0.09 hectares (30 m^2) is most common. The land cover classifications are based on the National Vegetation Classification System and are derived primarily from Landsat Thematic Mapper (TM) imagery. The base year for the TM scenes used by each state is supposed to be less than three years old at the start of the project. Ancillary input data from aerial photography and other maps is also used. The classification system provides for several hundred species designations, but includes broad categories stratified according to primary, secondary and tertiary coverages based on percent of land cover in each of several broad regions.

For model application of Maricopa and Pinal Counties, the MAG and SW GAP landuse data bases were merged to obtain a single coverage for the entire modeling domain. Table 3-1 presents the landuse classifications available within the final merged dataset. Also included in

Table 3-1 are the assignments of each LULC class to the corresponding dust code used in the model. Note that the assignments for each LULC category presented in Table 3-1 differ from those used in the development of the draft inventory. These revised assignments were based a review and assessment of the landuse categories specific to the Phoenix area conducted by staff at the MCAQD and MAG. The dust code is used to determine the surface roughness lengths as a function of landuse/landcover. These roughness lengths, in turn determine the threshold surface friction velocities, as discussed previously in Section 2. Table 3-2 presents the assigned surface roughness lengths as a function of landuse/landcover and dust codes. Note that for dust codes 1 (urban lands), 2 (forest) and 5 (orchards and vineyards), the assumed surface roughness lengths result in threshold surface friction velocities with magnitudes too high to be considered susceptible to wind erosion, and are therefore not included in the model. Figure 3-1 displays the complete, merged LULC data used for the project.

Table 3-1. Merged land Use/Land Cover classifications (codes < 1000 correspond to MAG LU database).

LU_MRG _Code	LU_Code	Description	Dust_Code
0	0	N/A	0
100	100	General Residential - Residential where no detail available	1
110	110	Rural Residential - <= 1/5 du per acre	1
120	120	Estate Residential - 1/5 du per acre to 1 du per acre	1
130	130	Large Lot Residential (SF) - 1 du per acre to 2 du per acre	1
140	140	Medium Lot Residential (SF) - 2-4 du per acre	1
150	150	Small Lot Residential (SF) - 4-6 du per acre	1
160	160	Very Small Lot Residential (SF) - >6 du per acre (includes mobile home parks)	1
161	161	Very Small Lot Res (SF-Mobile Homes) - Mobile home parks/RV Parks (>6 du per acre)	1
170	170	Medium Density Residential (MF) - 5-10 du per acre	1
180	180	High Density Residential (MF) - 10-15 du per acre	1
190	190	Very High Density Residential (MF) - > 15 du per acre	1
198	198	Parking structures serving Residential - Parking structures serving Residential	1
199	199	Parking lots serving Residential - Parking lots serving Residential	1
200	200	General Commercial - Commercial where no detail available	1
201	201	Very Low Density Commercial - Amusement facilities	1
202	202	Low Density Commercial - Movie Theatres, Skating Rinks	1
203	203	Greenhouse Commercial - Nurseries, Greenhouses	1
210	210	Specialty Commercial - <=50,000 square feet	1
220	220	Neighborhood Commercial - 50,000 to 100,000 square feet	1
230	230	Community Commercial - 100,000 to 500,000 square feet	1
240	240	Regional Commercial - 500,000 to 1,000,000 square feet	1
250	250	Super-Regional Commercial - >= 1,000,000 square feet	1
298	298	Parking structures serving Commercial - Parking structures serving Commercial	1
299	299	Parking lots serving Commercial - Parking lots serving Commercial	1
300	300	General Industrial - Industrial where no detail available	1
310	310	Warehouse/Distribution Centers -	1
320	320	Industrial -	1

LU_MRG _Code	LU_Code	Description	Dust_Code
398	398	Parking structures serving Industrial - Parking structures serving Industrial	1
399	399	Parking lots serving Industrial - Parking lots serving Industrial	1
400	400	Office General - Office where no detail available	1
410	410	Office Low Rise - 1-4 stories	1
420	420	Office Mid Rise - 5-12 stories	1
430	430	Office High Rise - 13 stories or more	1
498	498	Parking structures serving Office - Parking structures serving Office	1
499	499	Parking lots serving Office - Parking lots serving Office	1
500	500	General Employment - Employment where no detail available	1
510	510	Tourist and Visitor Accommodations - Hotels, motels and resorts	1
511	511	Motels - Motels	1
512	512	Hotels - Hotels	1
513	513	Resorts - Resorts	1
520	520	Educational - Public schools, private schools, universities	1
521	521	Schools (K-12 grade) - Schools	1
522	522	Post High School Institutions - Including public and private colleges and technical training institutions	1
523	523	Arizona State University - ASU Main and Extended Campuses	1
524	524	Dormitories - Dormitories associated with educational institutions	1
525	525	Preschool/Daycare facilities - Preschool/Daycare facilities	1
530	530	Institutional - Includes hospitals, churches	1
531	531	Medical Institutions - Hospitals/Medical Centers	1
532	532	Religious Institutions - Churches/Religious Institutions	1
533	533	Nursing Homes - Nursing Homes (Group Quarter)	1
534	534	Assisted Care Facilities - Assisted Care Facilities	1
540	540	Cemeteries -	1
550	550	Public Facilities - Includes community centers, power sub-stations, libraries, city halls, police and fire stations and other government facilities	1
551	551	Public Offices - Includes city halls	1
552	552	Public Services - Includes community centers, libraries, police and fire stations, courts, prisons and other government services	1
553	553	Large Public Facilities - Includes power sub-stations, Work yards, Sewer and Water treatment plants	1
554	554	Military - Military Use	1
555	555	Limited Use Public Facilities - Very small difficult to access parcels	1
560	560	Special Events - Includes stadiums, sports complexes, and fairgrounds	1
570	570	Other Employment (low) - Proving grounds, land fills	1
571	571	Landfill - Landfill	7
572	572	Sand and Gravel - Sand and Gravel	7
573	573	Proving Grounds - Proving Grounds	7
574	574	Mining - Mining	7
580	580	Other Employment (medium) -	1

LU_MRG _Code	LU_Code	Description	Dust_Code
590	590	Other Employment (high) -	1
598	598	Parking structures serving Facilities/Emp - Parking structures serving Facilities/Employment	1
599	599	Parking lots serving Facilities/Employment - Parking lots serving Facilities/Employment	1
600	600	General Transportation - Transportation where no detail available	1
610	610	Transportation - Includes railroads, railyards, transit centers and freeways	1
611	611	Parking Lots - Parking Lots	1
612	612	Parking Structures - Parking Structures	1
613	613	Park and Ride lots - Park and Ride lots	1
614	614	Transit Center - Transit Center	1
620	620	Airports - Includes public use airports	1
621	621	Sky Harbor Airport - Sky Harbor Airport	1
699	699	Unassigned	1
700	700	General Open Space - Open Space where no detail available	7
710	710	Active Open Space - Includes parks	7
720	720	Golf courses -	4
730	730	Passive Open Space - Includes mountain preserves and washes	7
731	731	Restricted Open Space - Restricted Open Space (Including Firing Range)	7
740	740	Water -	7
750	750	Agriculture -	3
800	800	Multiple Use General - Multiple Use where no detail available	1
798	798	Parking structures serving Open Space - Parking structures serving Open Space	1
799	799	Parking lots serving Open Space - Parking lots serving Open Space	7
810	810	Business Park - Includes enclosed industrial, office or retail in a planned environment	1
820	820	Mixed Use - Jurisdiction defined	1
821	821	Mixed Use/Indian Community - Mixed Use/Indian Community	1
830	830	Planned Developments -	1
898	898	Parking structures serving Multiple Use - Parking structures serving Multiple Use	1
899	899	Parking lots serving Multiple Use - Parking lots serving Multiple Use	1
900	900	Vacant (existing land use database only) - Vacant	7
910	910	Developing Residential - Residential Under Construction	7
920	920	Developing Commercial - Commercial Under Construction	7
930	930	Developing Industrial - Industrial Under Construction	7
940	940	Developing Office - Office Under Construction	7
950	950	Developing Public/Other Employment - Employment Under Construction	7
960	960	Developing Transportation - Transportation Under Construction	7
970	970	Developing Open Space - Developing Open Space	7
980	980	Developing Multiple Use - Multiple Use Under Construction	7
999	999	Salvage/Unknown - Evaluate on an individual basis	1

LU_MRG _Code	LU_Code	Description	Dust_Code
1000	0	N/A	1
1001	1	North American Alpine Ice Field	1
1002	2	Rocky Mountain Alpine Bedrock and Scree	1
1003	3	Mediterranean California Alpine Bedrock and Scree	1
1004	4	Rocky Mountain Alpine Fell-Field	1
1005	5	Rocky Mountain Cliff and Canyon	1
1006	6	Sierra Nevada Cliff and Canyon	1
1007	7	Western Great Plains Cliff and Outcrop	1
1008	8	Inter-Mountain Basins Cliff and Canyon	1
1009	9	Colorado Plateau Mixed Bedrock Canyon and Tableland	1
1010	10	Inter-Mountain Basins Shale Badland	1
1011	11	Inter-Mountain Basins Active and Stabilized Dune	7
1012	12	Inter-Mountain Basins Volcanic Rock and Cinder Land	1
1013	13	Inter-Mountain Basins Wash	7
1014	14	Inter-Mountain Basins Playa	7
1015	15	North American Warm Desert Bedrock Cliff and Outcrop	1
1016	16	North American Warm Desert Badland	1
1017	17	North American Warm Desert Active and Stabilized Dune	7
1018	18	North American Warm Desert Volcanic Rockland	1
1019	19	North American Warm Desert Wash	7
1020	20	North American Warm Desert Pavement	1
1021	21	North American Warm Desert Playa	7
1022	22	Rocky Mountain Aspen Forest and Woodland	2
1023	23	Rocky Mountain Bigtooth Maple Ravine Woodland	2
1024	24	Rocky Mountain Subalpine-Montane Limber-Bristlecone Pine Woodland	2
1025	25	Inter-Mountain Basins Subalpine Limber-Bristlecone Pine Woodland	2
1026	26	Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland	2
1027	27	Northern Pacific Mesic Subalpine Woodland	2
1028	28	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	2
1029	29	Rocky Mountain Lodgepole Pine Forest	2
1030	30	Rocky Mountain Montane Dry-Mesic Mixed Conifer Forest and Woodland	2
1031	31	Mediterranean California Dry-Mesic Mixed Conifer Forest and Woodland	2
1032	32	Rocky Mountain Montane Mesic Mixed Conifer Forest and Woodland	2
1033	33	Madrean Pine-Oak Forest and Woodland	2
1034	34	Rocky Mountain Ponderosa Pine Woodland	2
1035	35	Southern Rocky Mountain Pinyon-Juniper Woodland	2
1036	36	Colorado Plateau Pinyon-Juniper Woodland	2
1037	37	Great Basin Pinyon-Juniper Woodland	2
1038	38	Inter-Mountain West Aspen-Mixed Conifer Forest and Woodland Complex	2
1039	39	Rocky Mountain Alpine Dwarf-Shrubland	6
1040	40	Inter-Mountain Basins Mat Saltbush Shrubland	6
1041	41	Rocky Mountain Gambel Oak-Mixed Montane Shrubland	6

LU_MRG _Code	LU_Code	Description	Dust_Code
1042	42	Rocky Mountain Lower Montane-Foothill Shrubland	6
1043	43	Western Great Plains Sandhill Shrubland	6
1044	44	Inter-Mountain Basins Mountain Mahogany Woodland and Shrubland	6
1045	45	Madrean Encinal	6
1046	46	Colorado Plateau Pinyon-Juniper Shrubland	6
1047	47	Great Basin Semi-Desert Chaparral	6
1048	48	Inter-Mountain Basins Big Sagebrush Shrubland	6
1049	49	Great Basin Xeric Mixed Sagebrush Shrubland	6
1050	50	Colorado Plateau Mixed Low Sagebrush Shrubland	6
1051	51	Mogollon Chaparral	6
1052	52	Apacherian-Chihuahuan Mesquite Upland Scrub	6
1053	53	Colorado Plateau Blackbrush-Mormon-tea Shrubland	6
1054	54	Mojave Mid-Elevation Mixed Desert Scrub	6
1055	55	Chihuahuan Succulent Desert Scrub	6
1056	56	Chihuahuan Creosotebush Mixed Desert and Thorn Scrub	6
1057	57	Sonoran Paloverde-Mixed Cacti Desert Scrub	6
1058	58	Inter-Mountain Basins Mixed Salt Desert Scrub	6
1059	59	Chihuahuan Stabilized Coppice Dune and Sand Flat Scrub	6
1060	60	Sonora-Mojave Creosotebush-White Bursage Desert Scrub	6
1061	61	Sonora-Mojave Mixed Salt Desert Scrub	6
1062	62	Inter-Mountain Basins Montane Sagebrush Steppe	4
1063	63	Southern Rocky Mountain Juniper Woodland and Savanna	4
1064	64	Inter-Mountain Basins Juniper Savanna	4
1065	65	Apacherian-Chihuahuan Piedmont Semi-Desert Grassland and Steppe	4
1066	66	Inter-Mountain Basins Big Sagebrush Steppe	6
1067	67	Inter-Mountain Basins Semi-Desert Shrub Steppe	6
1068	68	Chihuahuan Gypsophilous Grassland and Steppe	4
1069	69	Rocky Mountain Dry Tundra	1
1070	70	Rocky Mountain Subalpine Mesic Meadow	4
1071	71	Southern Rocky Mountain Montane-Subalpine Grassland	4
1072	72	Western Great Plains Foothill and Piedmont Grassland	4
1073	73	Central Mixedgrass Prairie	4
1074	74	Western Great Plains Shortgrass Prairie	4
1075	75	Western Great Plains Sandhill Prairie	4
1076	76	Inter-Mountain Basins Semi-Desert Grassland	4
1077	77	Rocky Mountain Subalpine-Montane Riparian Shrubland	6
1078	78	Rocky Mountain Subalpine-Montane Riparian Woodland	2
1079	79	Rocky Mountain Lower Montane Riparian Woodland and Shrubland	6
1080	80	North American Warm Desert Lower Montane Riparian Woodland and Shrubland	6
1081	81	Western Great Plains Riparian Woodland and Shrubland	6
1082	82	Inter-Mountain Basins Greasewood Flat	2
1083	83	North American Warm Desert Riparian Woodland and Shrubland	6
1084	84	North American Warm Desert Riparian Mesquite Bosque	2
1085	85	North American Arid West Emergent Marsh	1
1086	86	Rocky Mountain Alpine-Montane Wet Meadow	1

LU_MRG _Code	LU_Code	Description	Dust_Code
1087	87	Temperate Pacific Montane Wet Meadow	1
1088	88	Mediterranean California Subalpine-Montane Fen	1
1089	89	Western Great Plains Saline Depression Wetland	1
1090	90	Chihuahuan-Sonoran Desert Bottomland and Swale Grassland	4
1091	91	Madrean Upper Montane Conifer-Oak Forest and Woodland	2
1092	92	Madrean Pinyon-Juniper Woodland	2
1093	93	Chihuahuan Sandy Plains Semi-Desert Grassland	4
1094	94	Sonora-Mojave-Baja Semi-Desert Chaparral	6
1095	95	Madrean Juniper Savanna	4
1096	96	Chihuahuan Mixed Salt Desert Scrub	6
1097	97	Coahuilan Chaparral	6
1098	98	Great Basin Foothill and Lower Montane Riparian Woodland and Shrubland	6
1099	99	Western Great Plains Floodplain Herbaceous Wetland	1
1100	100	Mediterranean California Red Fir Forest and Woodland	2
1101	101	Sierra Nevada Subalpine Lodgepole Pine Forest and Woodland	2
1102	102	Mediterranean California Ponderosa-Jeffrey Pine Forest and Woodland	2
1103	103	Rocky Mountain Foothill Limber Pine-Juniper Woodland	2
1104	104	Wyoming Basins Low Sagebrush Shrubland	6
1105	105	Sonoran Mid-Elevation Desert Scrub	6
1106	106	Western Great Plains Tallgrass Prairie	4
1107	107	North Pacific Montane Grassland	4
1108	108	Southern Colorado Plateau Sand Shrubland	6
1109	109	Western Great Plains Mesquite Woodland and Shrubland	7
1110	110	Open Water	1
1111	111	Developed Mixed Desert and Thorn Scrub	6
1112	112	Developed Medium - High Intensity	1
1113	113	Barren Lands Non-specific	7
1114	114	Agriculture	3
1115	115	Disturbed Non-specific	6
1116	116	Recently Burned	7
1117	117	Recently Mined or Quarried	7
1118	118	Invasive Southwest Riparian Woodland and Shrubland	6
1119	119	Invasive Perennial Grassland	4
1120	120	Invasive Perennial Forbland	4
1121	121	Invasive Annual Grassland	4
1122	122	Invasive Annual and Biennial Forbland	4
1123	123	Recently Logged Areas	7
1124	124	Recently Chained Pinyon-Juniper Areas	2
1125	125	Disturbed Oil Well	7
2200	22	Alfalfa	3
2300	23	Barley	3
2400	24	Corn	3
2500	25	Cotteon	3
2600	26	Grass	3
2700	27	Hay	3
2800	28	Misc. crops	3
2900	29	Oats	3

LU_MRG _Code	LU_Code	Description	Dust_Code
3000	30	Pasture	3
3100	31	Peanuts	3
3200	32	Potatoes	3
3300	33	Rice	3
3400	34	Rye	3
3500	35	Sorghum	3
3600	36	Soybeans	3
3700	37	Tobacco	3
3800	38	Wheat	3
3900	39	Forest (from FIA data)	2

Table 3-2. Surface roughness lengths by LULC and dust code.

Landuse Category	Dust Code	Surface Roughness Length (cm)
Agricultural (bare field)	3	0.015
Grasslands	4	0.1
Shrublands	6	0.05
Barren Lands	7	0.002

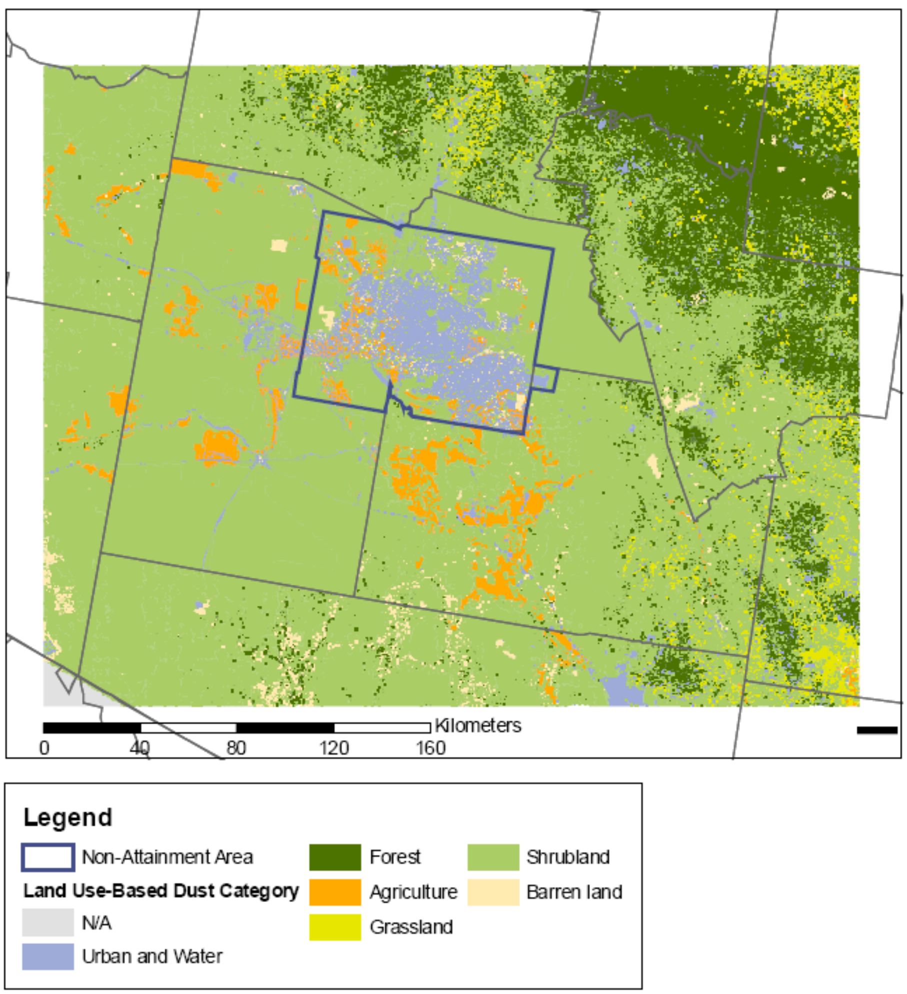


Figure 3-1. Merged LULC data for windblown dust model application.

Soil Characteristics

Soils characteristics data (soil texture) are used in the model to determine dust emissions rates as a function of wind speeds. Application of the emission factor relations described above requires the characterization of soil texture in terms of the 4 soil groups considered by the model. The characteristics, or type, of soil is one of the parameters of primary importance for the application of the emission estimation relations derived from wind tunnel study results.

The SSURGO1 soils geographic database developed by USDA Natural Resource Conservation Service was used as the primary soils database for this study. Because some of the survey areas within the modeling domain were missing from the SSURGO1 database, the State Soil Geographic Database (STATSGO) was used to fill in these regions. The SSURGO1 database was obtained from http://soildatamart.nrcs.usda.gov while the STATSGO databases were obtained from the Earth System Science Center (ESSC) at Penn State University (http://www.essc.psu.edu/soil_info/).

The classification of soil textures and soil group codes is based on the standard soil triangle that classifies soil texture in terms of percent sand, silt and clay. Combining the soil groups defined by the work of Alfaro, et al. (2003) and Chatenet, et al. (1996) and the standard soil triangle provides the mapping of the 12 soil textures to the 4 soil groups considered in their study. Combining the data from these two soil texture/soil group mappings results in the unique mapping of soil textures to the soil groups for which emission factor data can be applied. The results of combining these soil texture definitions allows the assignment of the loam soil group in terms of standard soil texture. The soil texture mappings are summarized in Table 3-3. Figures 3-2 and 3-3 display the merged soils data used for the project.

Table 3-3. Soil texture and soil group codes.

Soil Texture	Soil Texture Code	Soil Group	Soil Group Code
No Data	0	N/A	0
Sand	1	CS	4
Loamy Sand	2	CS	4
Sandy Loam	3	MS	3
Silt Loam	4	FS	1
Silt	5	FSS	2
Loam	6	MS	3
Sandy Clay Loam	7	MS	3
Silty Clay Loam	8	FSS	1
Clay Loam	9	MS	3
Sandy Clay	10	MS	3
Silty Clay	11	FSS	1
Clay	12	FS	2

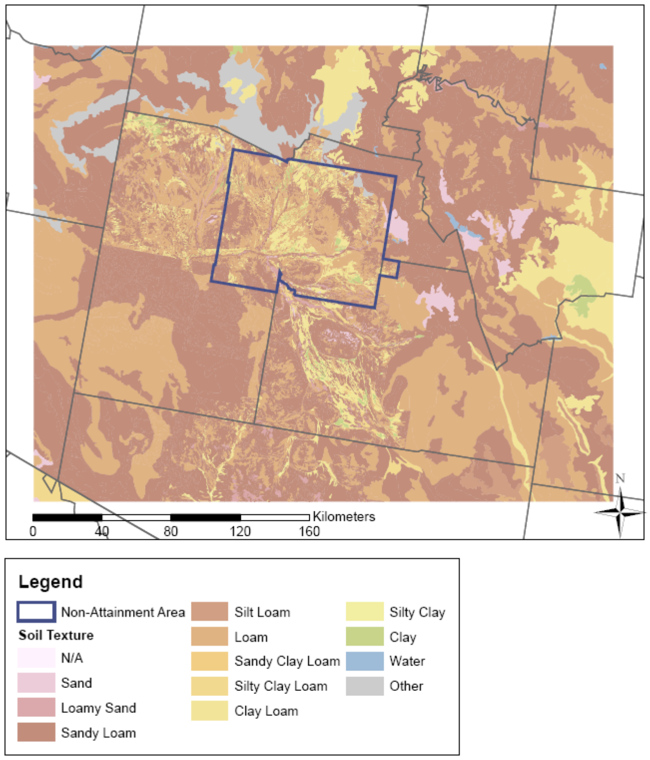


Figure 3-2. Merged soil texture data for windblown dust model application.

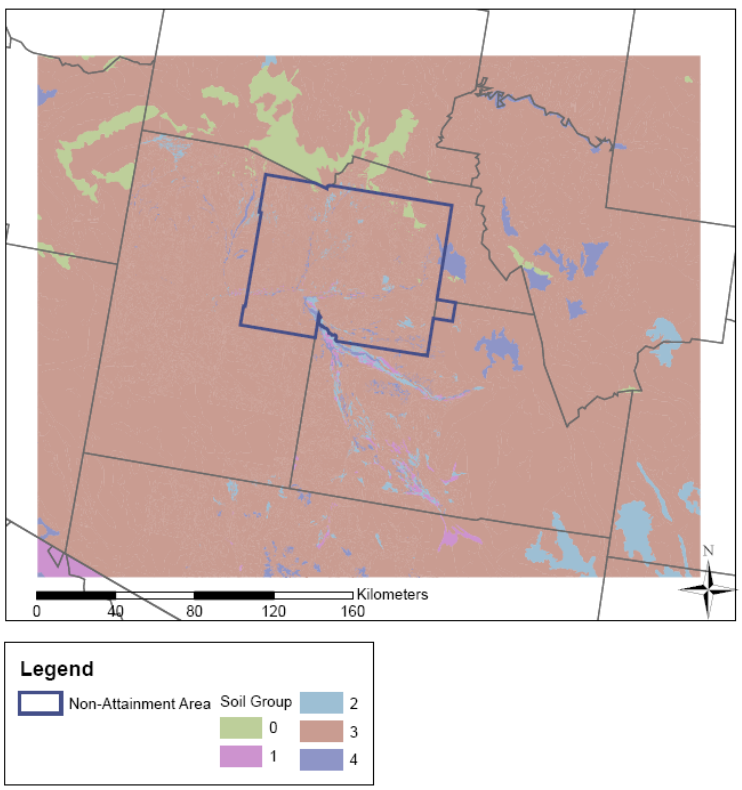


Figure 3-3. Merged soil group data for windblown dust model application.

Meteorology

The RMC windblown dust model, as used in the present application, was developed to generate hourly gridded estimates of PM dust emissions based on landuse, soils characteristics, hourly meteorological data and additional information related to agricultural practices. In previous regional applications, the necessary meteorological data have been derived from the results regional MM5 model simulations. Additionally, for local-scale applications, meteorological data has been developed from CALMET simulations using the regional MM5 simulation results as inputs to the CALMET model. For the current application to the Phoenix PM10 non-attainment area, hourly observational data was provided by MAG. These observational data were as the basis for interpolation to gridded, hourly-resolved wind speed fields. The data provided by MAG consists of comma-delimited ASCII files containing the meteorological fields shown in Table 3-4.

Table 3-4. Meteorological data provided by MAG.

Column	Description	Type
1	Julian date in dddhh.ff (ff: a fraction of minute to hour)	Real
2	Y-location (I dot-point location on coarse mesh)	Real
3	X-location (J dot-point location on coarse mesh)	Real
4	Vertical height from the ground (in meter)	Real
5	U wind (in m/sec)	Real
6	V wind (in m/sec)	Real
7	Temperature (in Kelvin)	Real
8	Water vapor mixing ratio (in kg/kg)	Real
9	Pstar (in cb) (99999. for the model in nonhydrostatic mode)	Real
10	Site ID	Char
11	Network Name	Char
12	Latitude	Real
13	Longitude	Real
14	Pressure	Real

The meteorological data tabulated above were provided for calendar year 2005 from the AZMET weather stations listed in Table 3-5. All measurements are taken at a height of 3 meters AGL.

Table 3-5. AZMET observation stations.

Site	Abbr.	Lat	Lon	UTM (Zone 12)		Elev. (m)	County
Buckeye	BCK1	33.400000	-112.683333	3696899	343454	304	Maricopa
Harquahala	HARQ	33.483333	-113.116667	3706876	303337	350	Maricopa
Paloma	PALO	32.926667	-112.895556	3644751	322765	219	Maricopa
Phx. Encanto	ENCA	33.479167	-112.096389	3704947	398135	335	Maricopa
Phx. Greenway	PGRN	33.621389	-112.108333	3720728	397193	401	Maricopa
Queen Creek	QUEE	33.258333	-111.641667	3680110	440233	430	Maricopa
Waddell	WADD	33.618056	-112.459722	3720763	364592	407	Maricopa
Coolidge	COOL	32.980000	-111.604722	3649232	443496	422	Pinal
Maricopa	MARI	33.068611	-111.971667	3659313	409299	361	Pinal
Aguila	AGUI	33.946667	-113.188889	3758401	297716	655	Maricopa

For the current windblown dust model application, these observational wind data were interpolated to the modeling grid (Figure 1-1) using a kriging algorithm. Figure 3-4 displays an example of the results of this approach for the windspeed observational data of noon on January 28, 2006. Also shown are the locations of the AZMET observational stations.

Monthly average wind speeds obtained through interpolation of the observational data are displayed in Figure 3-5 for the 12-km modeling domain used in the project.

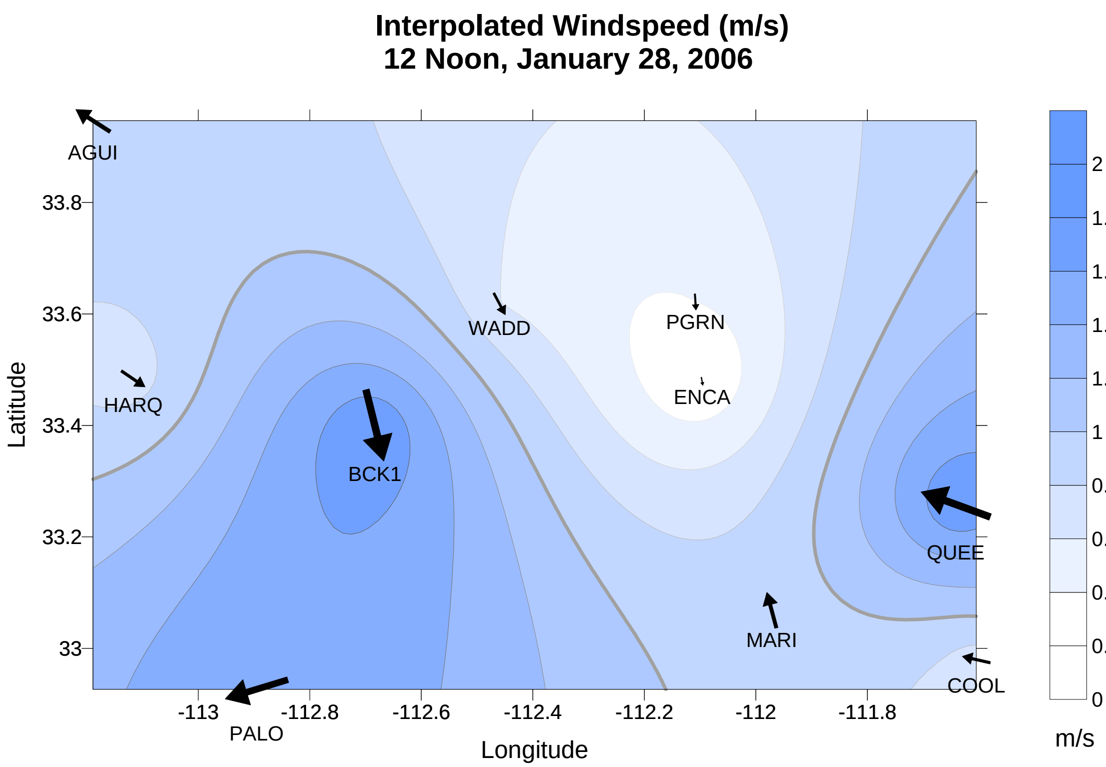


Figure 3-4. Example interpolated wind speeds for 12 Noon, January 28, 2006.

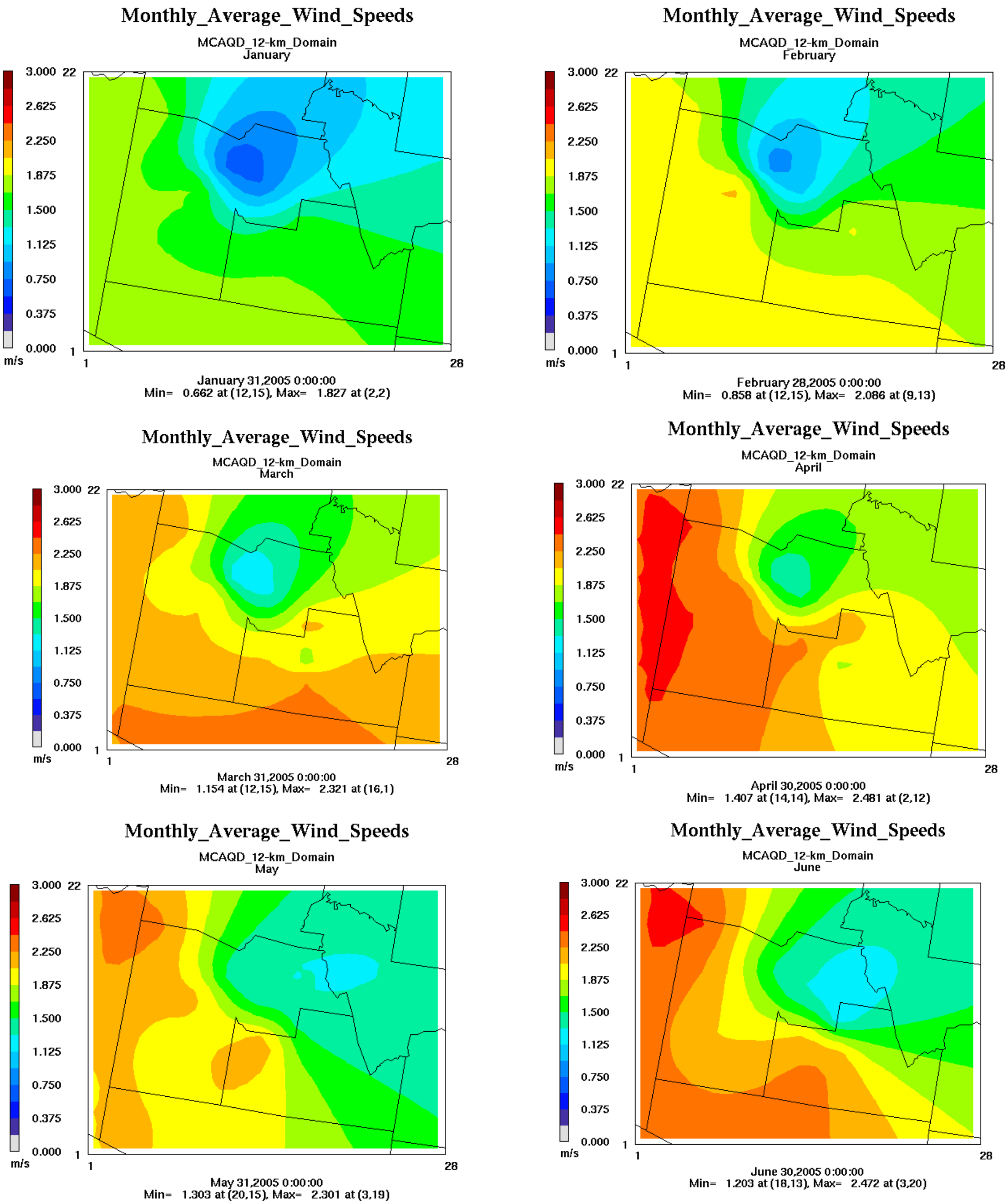


Figure 3-5. Monthly average wind speeds on the 12-km windblown dust modeling domain.

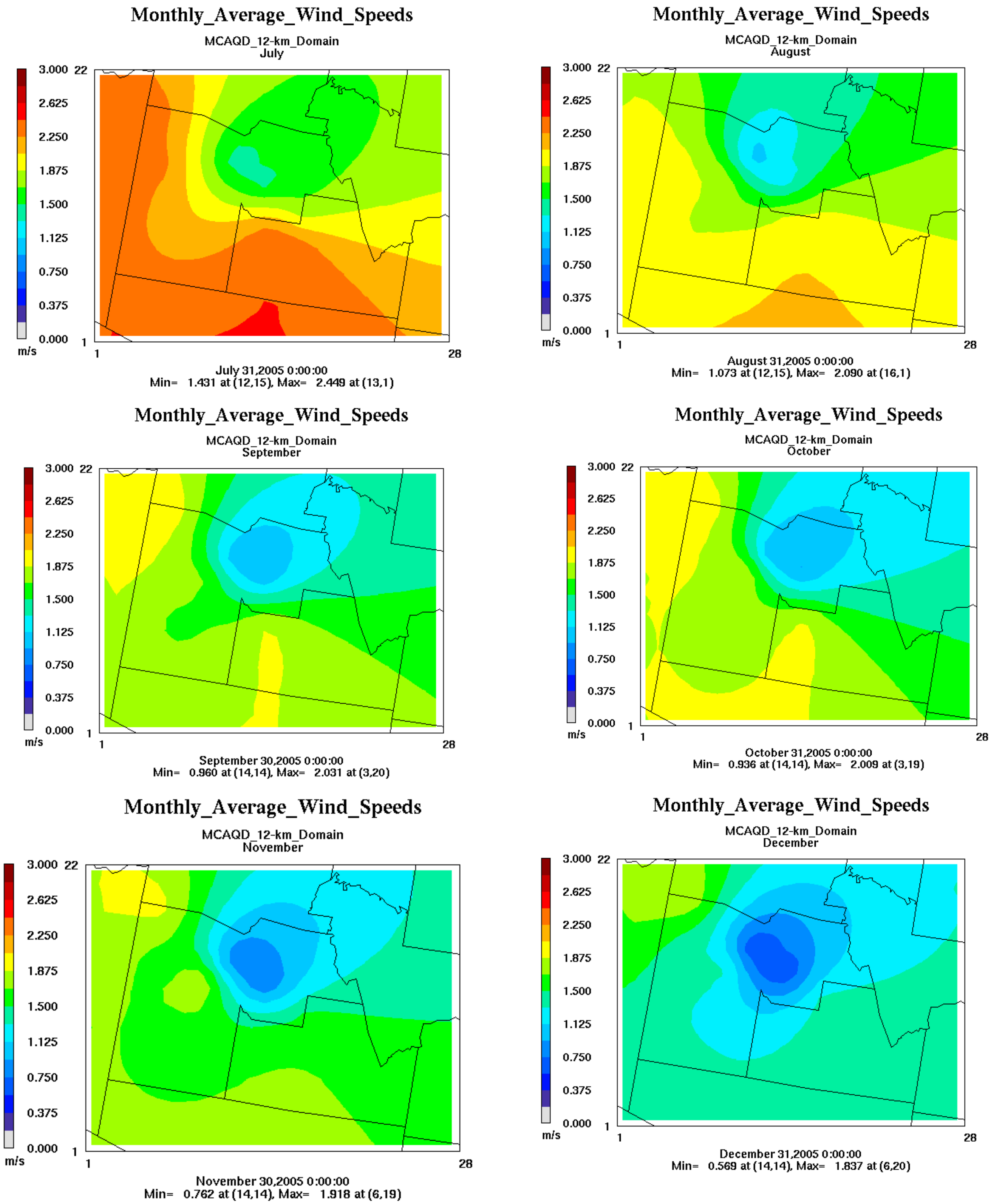


Figure 3-5. (concluded). Monthly average wind speeds on the 12-km windblown dust modeling domain

Hourly precipitation data used in the current application were based on data provided by the Maricopa County Flood Control District and consisted of a five average (2001-2005) of measured hourly rainfall rates. The locations of these monitoring stations are displayed in Figure 3-6. To generate gridded hourly rainfall for model application, a nearest neighbor interpolation scheme was utilized. Figure 3-7 displays the result of the interpolation in terms of monthly total rainfall, in inches, across the domain.

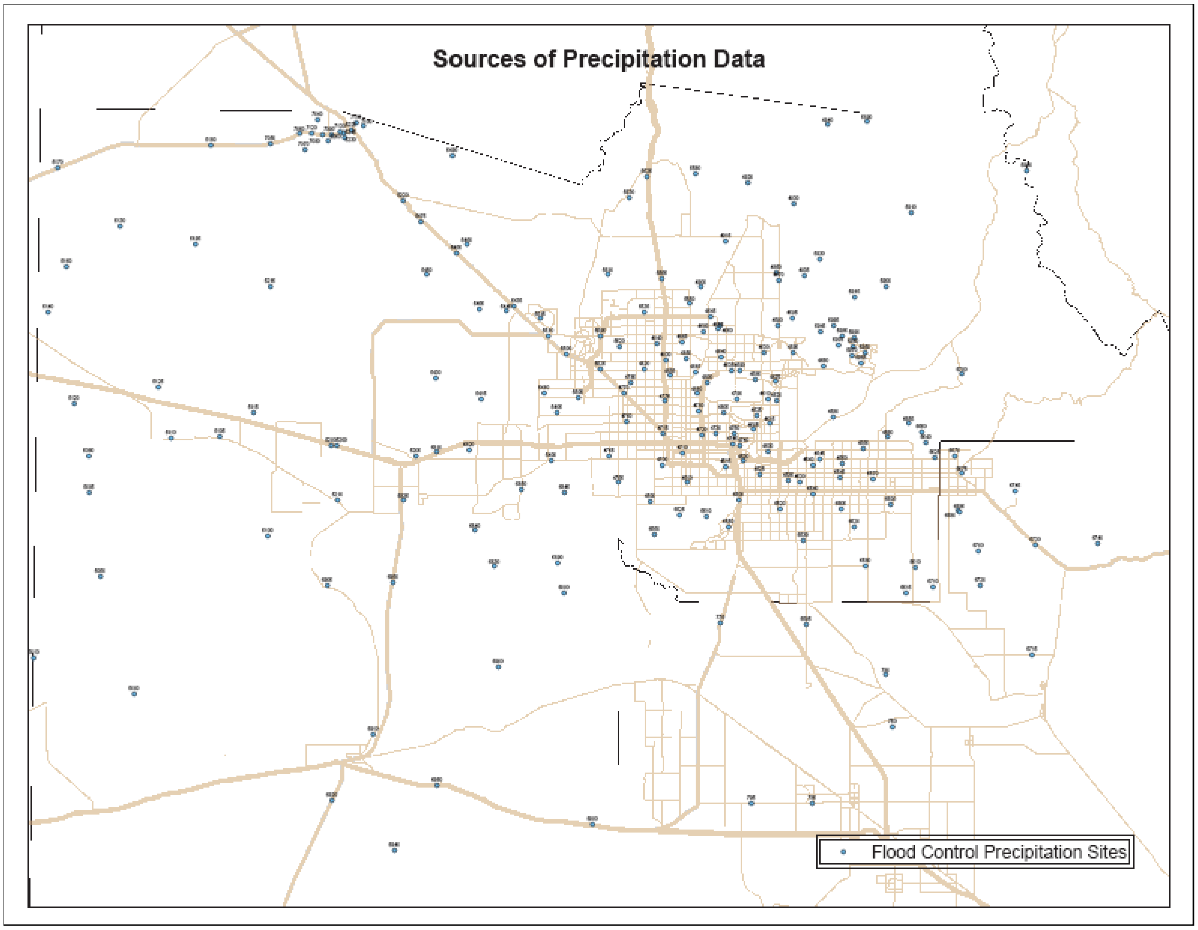
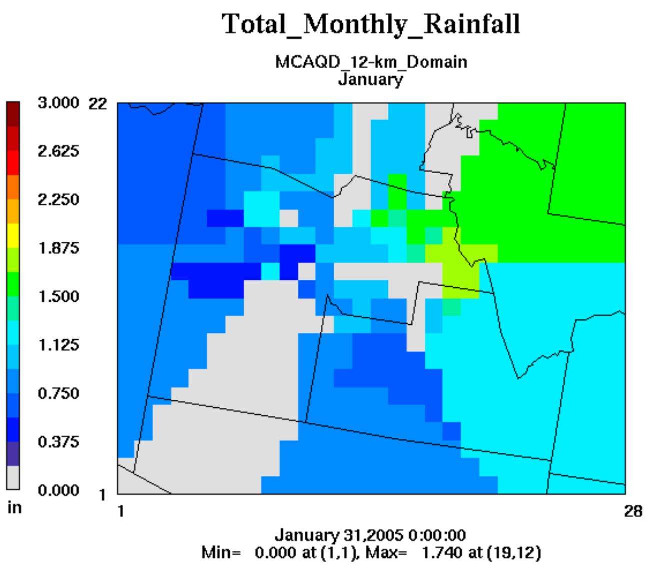
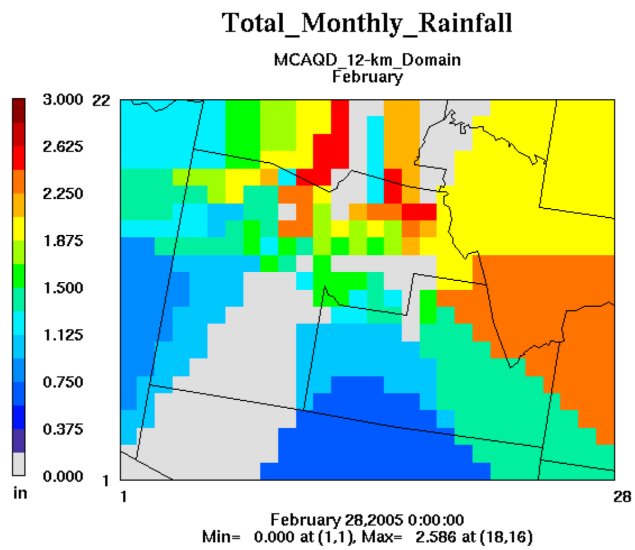
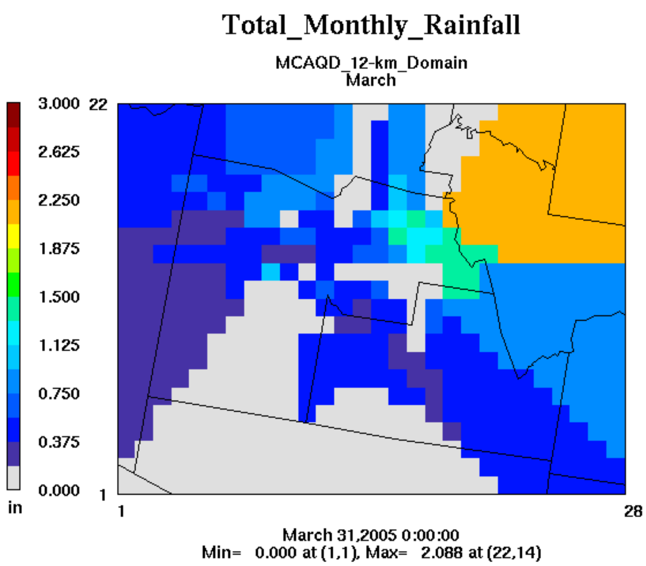
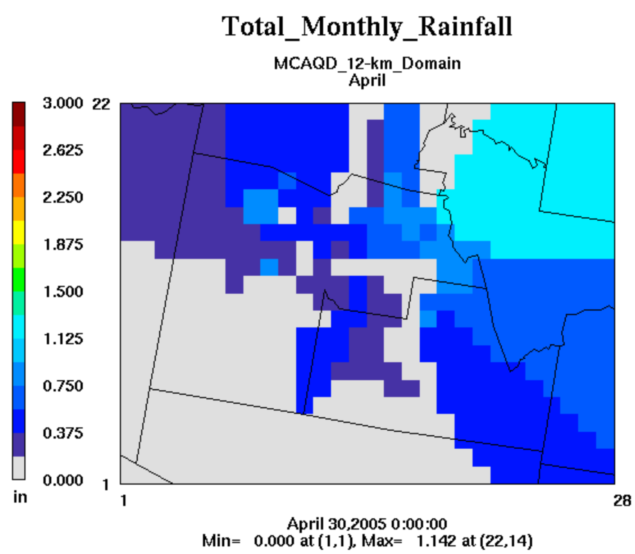


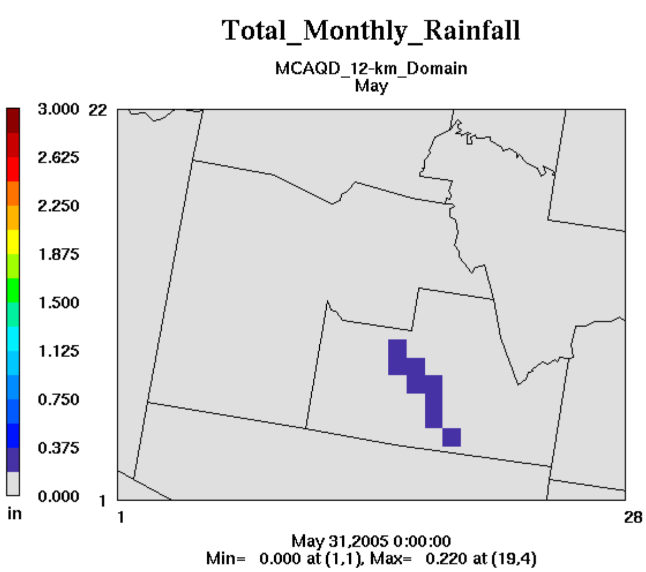
Figure 3-6. Flood Control Precipitation Sites.


Total_Monthly_Rainfall
MCAQD_12-km_Domain
January
3.000
2.625
2.250
1.875
1.500
1.125
0.750
0.375
0.000
in
22
1
1
28
January 31,2005 0:00:00
Min= 0.000 at (1,1), Max= 1.740 at (19,12)


Total_Monthly_Rainfall
MCAQD_12-km_Domain
February
3.000
2.625
2.250
1.875
1.500
1.125
0.750
0.375
0.000
in
22
1
1
28
February 28,2005 0:00:00
Min= 0.000 at (1,1), Max= 2.586 at (18,16)


Total_Monthly_Rainfall
MCAQD_12-km_Domain
March
3.000
2.625
2.250
1.875
1.500
1.125
0.750
0.375
0.000
in
22
1
1
28
March 31,2005 0:00:00
Min= 0.000 at (1,1), Max= 2.088 at (22,14)


Total_Monthly_Rainfall
MCAQD_12-km_Domain
April
3.000
2.625
2.250
1.875
1.500
1.125
0.750
0.375
0.000
in
22
1
1
28
April 30,2005 0:00:00
Min= 0.000 at (1,1), Max= 1.142 at (22,14)


Total_Monthly_Rainfall
MCAQD_12-km_Domain
May
3.000
2.625
2.250
1.875
1.500
1.125
0.750
0.375
0.000
in
22
1
1
28
May 31,2005 0:00:00
Min= 0.000 at (1,1), Max= 0.220 at (19,4)

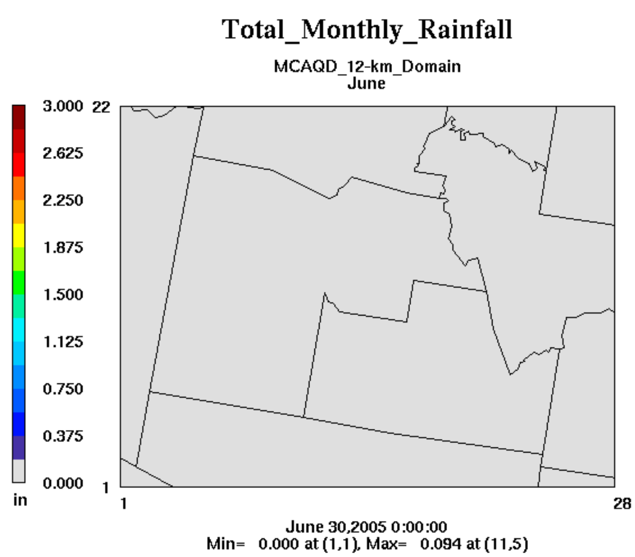

Total_Monthly_Rainfall
MCAQD_12-km_Domain
June
3.000
2.625
2.250
1.875
1.500
1.125
0.750
0.375
0.000
in
22
1
1
28
June 30,2005 0:00:00
Min= 0.000 at (1,1), Max= 0.094 at (11,5)

Figure 3-7. Monthly total rainfall in inches (2001-2005 data)

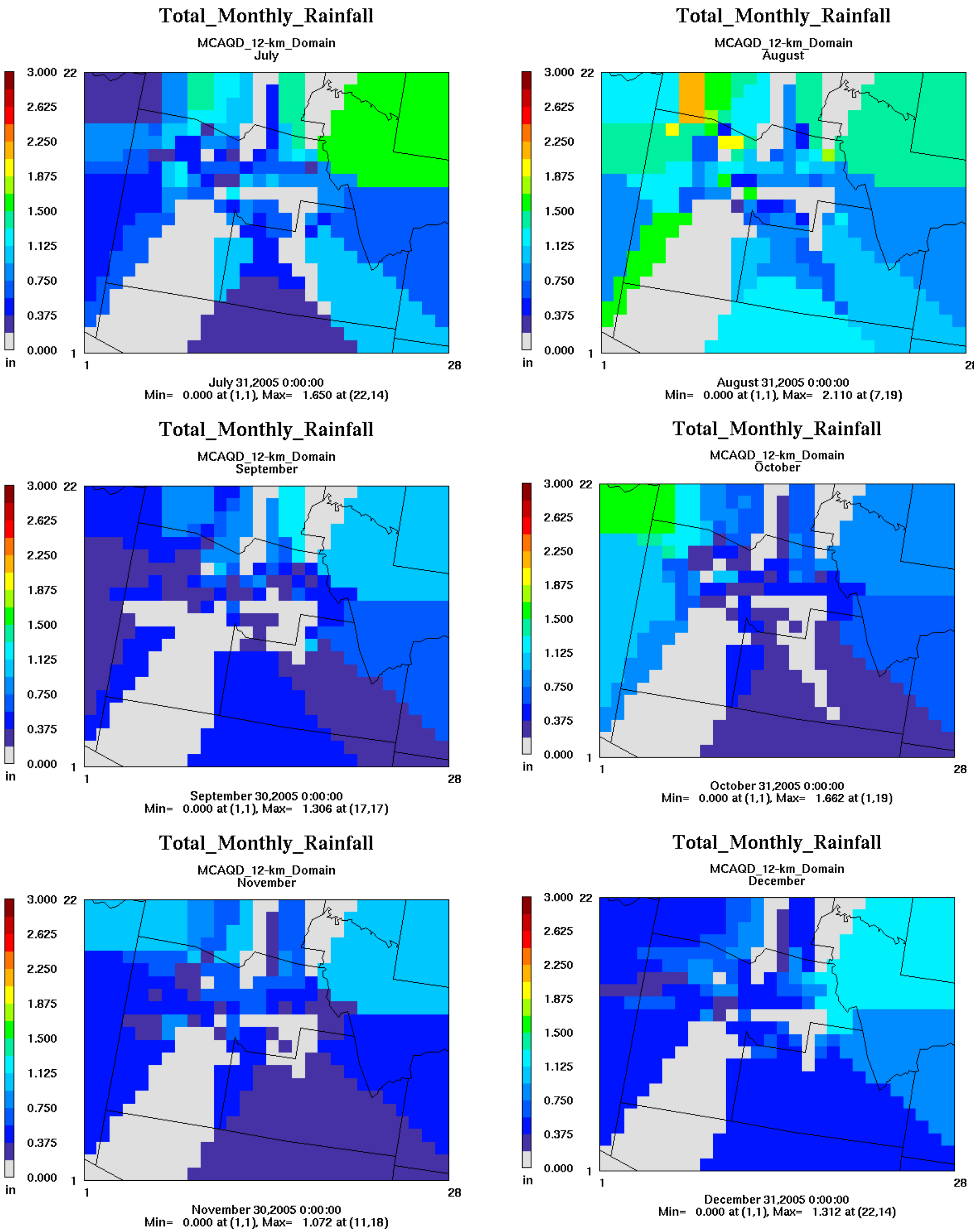


Figure 3-7. (concluded). Monthly total rainfall in inches (2001-2005 data)

Agricultural Data

Agricultural information is used in the model to adjust the estimated windblown dust emissions based on crop growth and agricultural management practices. The adjustments applied were described previously in Section 2. The primary adjustments for agricultural lands are based on the growth of crop canopy from planting to harvest. The RMC model is populated with default crop calendars derived from a variety of sources, as discussed in Section 2. The crops considered are those included in the BELD landuse database, which is based on USDA crop acreages by county.

For the current application, the crop acreages included in the BELD database were compared with the most recent USDA statistics for Maricopa and Pinal counties. This comparison is summarized in Table 3-6. Due to inconsistencies between the BELD data (based on 1997 USDA statistics) and the most recent data from the USDA, the default data sets for the windblown dust model were updated to reflect the more recent information using a combination of the 2004 and 2005 USDA data for Maricopa and Pinal counties.

Table 3-6. Agricultural crops in Maricopa and Pinal Counties.

		Maricopa			Pinal		
BELD Code	**Crop**	**BELD**	**USDA 05**	**USDA 04**	**BELD**	**USDA 05**	**USDA 04**
28	Misc	39%		13%	34%		3%
25	Cotton	38%	27%	26%	52%	57%	53%
27	Hay	13%	55%	43%	5%	28%	24%
38	Wheat	5%	9%	9%	4%	8%	12%
23	Barley	3%	8%	8%	2%	5%	7%
24	Corn	1%	1%	0%	0%	3%	1%
32	Potatoes	1%			0%		
35	Sorghum	1%			1%		
29	Oats	0%			0%		
26	Grass	0%			0%		

The current version of the RMC dust model includes default crop calendars based on crops defined in the BELD database. These data were reviewed for the study area and determined to be acceptable as is. Table 3-7 presents these data, as currently implemented in the model.

Table 3-7. Default agricultural crop calendar for Maricopa and Pinal Counties.

Plant/Harvest Dates by CMZ and BELD category (current data in WBD model "crop_plt_dates_US.txt")								
CMZ	**BELD3**	**Crop**	**Plant_Spr**	**Harv_Spr**	**Plant_Fall**	**Harv_Fall**	**Cano_Spr**	**Cano_Fall**
30	22	Alfalfa	Apr	Mar	-	-	ALF01	0
30	23	Barley	May	Aug	-	-	BAR01	0
30	24	Corn	May	Oct	-	-	COR01	0
30	25	Cotton	May	Nov	-	-	COT02	0
30	26	Grass	Apr	Apr	-	-	GRA01	0
30	27	Hay	Apr	Mar	-	-	HAY01	0
30	28	Misc	-	-	-	-	0	0
30	29	Oats	May	Aug	-	-	OAT01	0
30	32	Potatoes	May	Oct	-	-	POT01	0
30	35	Sorghum	May	Oct	-	-	SOR01	0
30	38	Wheat	-	-	Oct	Sep	0	WHE03
33	22	Alfalfa	Apr	Mar	-	-	ALF01	0
33	23	Barley	-	-	Dec	Jun	0	BAR03
33	24	Corn	Apr	Oct	-	-	COR01	0
33	25	Cotton	Apr	Oct	-	-	COT02	0
33	26	Grass	Apr	Apr	-	-	GRA01	0
33	27	Hay	Apr	Mar	-	-	HAY01	0
33	28	Misc	-	-	-	-	0	0
33	29	Oats	Mar	Sep	Dec	Aug	OAT01	OAT03
33	32	Potatoes	Jan	Jun	-	-	POT01	0
33	35	Sorghum	May	Nov	-	-	SOR01	0
33	38	Wheat	-	-	Dec	Jun	0	WHE03
Most of Maricopa and Pinal counties in CMZ 33; Only NE corner of each in CMZ 30								

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4. MODEL APPLICATION

The application of the WRAP RMC windblown fugitive dust emission model for the Phoenix PM10 non-attainment area and surrounding areas is described in this section.

Spatial Resolution and Modeling Domain

As noted previously, the RMC windblown dust model is designed to estimate fugitive windblown dust emissions for regional air quality modeling. The outputs of the model are gridded, hourly estimates of PM10 and PM2.5 dust emissions. For the current application to Marciopa and Pinal counties, the modeling domain was defined based on a 12-km grid encompassing the entirety of Maricopa and Pinal counties in Arizona. The modeling domain was displayed ion Figure 1-1 of this report.

Input datasets include soil characteristics, landuse/landcover data and gridded wind speed fields. Meteorological data were developed at a spatial resolution of 12-km, as described in the previous section. Although the winds are modeled at 12-km resolution, the modeling system is designed to allow higher resolution surface characteristics data. Soil characteristics, soil texture and soil groups, were processed at 4-km using the ArcINFO GIS software. In addition, LULC data were gridded at 4-km spatial resolution. However, higher spatial resolution of the LULC data is possible through the inclusion of the percentages of land, by LULC category, within each 4-klm model grid cell.

Temporal Period and Resolution

Windblown dust modeling for the Phoenix PM10 NAA, and all of Maricopa and Pinal counties was conducted for the entire calendar year 2005. The temporal duration of the modeling was determined by the availability of the meteorological data provided by project sponsors.

The model is run on an hourly temporal resolution and provides hourly outputs of coarse (PM10 – PM2.5) and fine (PM2.5) particulate matter dust emissions. The results are subsequently aggregated to annual emissions estimates for reporting purposes.

Model Outputs

As previously noted, the model provides hourly gridded estimates of windblown fugitive PM dust emissions. The output data files are formatted for input to regional air quality models, in particular, the CMAQ model. Using GIS tools, these gridded emission estimates are summarized on the county-level as well as at the non-attainment area level, for reporting. Model outputs were obtained with and without the application of fugitive dust transport fractions, described below.

Fugitive Dust Transport Fractions

The concept of fugitive dust transport fractions has been considered and refined in recent years. It has been recognized that, due to various mechanisms, dust particles are subject to near source removal. These mechanisms include gravitational settling, particle deposition to the ground and impaction and removal due to particle capture by the surrounding vegetation canopy and other physical structures. The EPA for many years had promoted the "divide by four" approach for reducing the emission from fugitive dust sources to account for these processes. The idea is that only a limited amount of the dust emitted by a particular source is transported significantly to affect the total available emissions in the atmosphere for air quality grid modeling.

Recent research has shown that the amount of fugitive dust captured in the surrounding canopy or on physical structures can be related to the physical characteristics of the land surface, i.e., land use/land cover. The EPA recently developed county-level transport fractions for use in emissions inventory development for air quality modeling (Pace, 2003; 2005). The county-level transport fractions were based on the percentage of land use in each county derived from the BELD3 LULC database. The transport fractions were calculated as a weighted sum of landuse-specific fractions for each landuse type.

Within the wind blown dust model, rather than applying county-level fractions, landuse-dependent transport fractions were calculated based on the gridded landuse data used in the estimation methodology. The fractions used for each of the relevant land use types are presented in Table 4-1. Note that the inclusion of the transport fractions should only be considered in situations where the results of the model are to be used in grid-based air quality modeling studies. For inventory reporting requirements and SIP development, the emissions should be developed and reported without the application of the transport fractions. For the current project, model outputs were developed without the application of transport fractions.

Table 4-1. Transport fractions as a function of landuse.

LULC	Original Transport Fractions	Revised Transport Fractions
Barren & Water	0.97	1.00
Agricultural	0.85	0.75
Grasses	0.70	0.75
Scrubland & Sparsely Wooded (Shrublands)	0.60	0.75
Urban	0.30	0.00
Forested	0.30	0.00

Specific Revisions for Maricopa and Pinal Counties

As noted previously, the amount disturbance of the vacant lands for which emissions from wind erosion are to be estimated will have a direct impact on the magnitude of those emissions. In the default configuration of the model, all lands are assumed to be undisturbed and have stable soil characteristics. The primary reason for this assumption was directly related to the lack of detailed information available in the regional-scale data sets used in previous applications. However, for small-scale applications and/or where more detailed data is available, this assumption can be relaxed.

In the case of Maricopa and Pinal counties, the disturbance levels of the vacant land parcels were revised to reflect a better understanding of the local landscapes, as well as to reflect various control measures (in the case of vacant lots and construction sites) and seasonal variations in disposition of agricultural lands (i.e., increased disturbance levels of agricultural lands prior to planting and post-harvest).

Based on consultation with the project sponsors, the percentage of disturbed acreage for each of the individual landuse types within the MAG database were revised. The percent of disturbed acreage for each LU type is presented in Table 4-2, which lists only those landuse categories available in the MAG database. Outside of the Phoenix PM10 nonattainment area where the Southwest GAP database is used, it was assumed that 30% of all barren lands were disturbed, while 8% of all shrublands were assumed disturbed. Table 4-2 also presents the assignment of each landuse category to the 8 general land categories for aggregation and reporting of modeling results. Note that the water landuse category has been re-assigned to dust code 7 (barren land) to reflect the fact that, within the MAG database, these regions are essentially alluvial fans along and dry riverbeds and washes.

The treatment of agricultural lands was further refined to reflect varying disturbance levels of the lands based on crop-specific tilling and harvesting schedules. The primary crops considered for this treatment include barley, corn, cotton and wheat. Based on the crop calendars for these crops, soil disturbance levels where assigned for each month. In general, during tilling activities, 100% of the crop-specific agricultural lands were assumed disturbed. The disturbance levels during harvesting varied by crop and month. During the growing season, the default undisturbed soil assumption is applied. Note that during the growing season, reductions to the estimated windblown dust emissions for agricultural lands are applied based on the growth of crop canopy. Table 4-3 presents the assumed soil disturbance percentages by crop and month.

Disturbed land surfaces have the effect of reducing the threshold surface friction velocities required to initiate wind erosion. Based on a review of studies found in the literature (see Tables 2-1 and 2-2) and from various sensitivity scenarios performed for the WRAP during model development, assumed percentage reductions in the threshold friction velocities were applied for disturbed vacant lands. In the present application, for disturbed shrublands, the threshold friction velocities were assumed to be 50% of the undisturbed values, while for disturbed barren lands the threshold friction velocities were assumed to be 27% of the undisturbed value.

Table 4-2. Revised disturbance assumptions for MAG Landuse/Landcover classifications.

LU_CODE	Model Output category	Description	Dust Code	Areal % Disturbance	Z0 (cm)
100	DEVELOPED	General Residential - Residential where no	1	0.00%	100
110	DEVELOPED	Rural Residential - <= 1/5 du per acre	1	0.00%	100
120	DEVELOPED	Estate Residential - 1/5 du per acre to 1	1	0.00%	100
130	DEVELOPED	Large Lot Residential (SF) - 1 du per acre	1	0.00%	100
140	DEVELOPED	Medium Lot Residential (SF) - 2-4 du per a	1	0.00%	100
150	DEVELOPED	Small Lot Residential (SF) - 4-6 du per ac	1	0.00%	100
160	DEVELOPED	Very Small Lot Residential (SF) - >6 du p	1	0.00%	100
161	DEVELOPED	Very Small Lot Res (SF-Mobile Homes) - Mob	1	0.00%	100
170	DEVELOPED	Medium Density Residential (MF) - 5-10 du	1	0.00%	100
180	DEVELOPED	High Density Residential (MF) - 10-15 du p	1	0.00%	100
190	DEVELOPED	Very High Density Residential (MF) - > 15	1	0.00%	100
198	DEVELOPED	Parking structures serving Residential - P	1	0.00%	100
199	DEVELOPED	Parking lots serving Residential - Parking	1	0.00%	100

LU_CODE	Model Output category	Description	Dust Code	Areal % Disturbance	Z0 (cm)
200	DEVELOPED	General Commercial - Commercial where no d	1	0.00%	100
201	DEVELOPED	Very Low Density Commercial - Amusement fa	1	0.00%	100
202	DEVELOPED	Low Density Commercial - Movie Theatres	1	0.00%	100
203	DEVELOPED	Greenhouse Commercial - Nurseries	1	0.00%	100
210	DEVELOPED	Specialty Commercial - <=50	1	0.00%	100
220	DEVELOPED	Neighborhood Commercial - 50	1	0.00%	100
230	DEVELOPED	Community Commercial - 100	1	0.00%	100
240	DEVELOPED	Regional Commercial - 500	1	0.00%	100
250	DEVELOPED	Super-Regional Commercial - >= 1	1	0.00%	100
298	DEVELOPED	Parking structures serving Commercial - Pa	1	0.00%	100
299	DEVELOPED	Parking lots serving Commercial - Parking	1	0.00%	100
300	DEVELOPED	General Industrial - Industrial where no d	1	0.00%	100
310	DEVELOPED	Warehouse/Distribution Centers -	1	0.00%	100
320	DEVELOPED	Industrial -	1	0.00%	100
398	DEVELOPED	Parking structures serving Industrial - Pa	1	0.00%	100
399	DEVELOPED	Parking lots serving Industrial - Parking	1	0.00%	100
400	DEVELOPED	Office General - Office where no detail av	1	0.00%	100
410	DEVELOPED	Office Low Rise - 1-4 stories	1	0.00%	100
420	DEVELOPED	Office Mid Rise - 5-12 stories	1	0.00%	100
430	DEVELOPED	Office High Rise - 13 stories or more	1	0.00%	100
498	DEVELOPED	Parking structures serving Office - Parkin	1	0.00%	100
499	DEVELOPED	Parking lots serving Office - Parking lots	1	0.00%	100
500	DEVELOPED	General Employment - Employment where no d	1	0.00%	100
510	DEVELOPED	Tourist and Visitor Accommodations - Hote	1	0.00%	100
511	DEVELOPED	Motels - Motels	1	0.00%	100
512	DEVELOPED	Hotels - Hotels	1	0.00%	100
513	DEVELOPED	Resorts - Resorts	1	0.00%	100
520	DEVELOPED	Educational - Public schools	1	0.00%	100
521	DEVELOPED	Schools (K-12 grade) - Schools	1	0.00%	100
522	DEVELOPED	Post High School Institutions - Including	1	0.00%	100
523	DEVELOPED	Arizona State University - ASU Main and Ex	1	0.00%	100
524	DEVELOPED	Dormitories - Dormitories associated with	1	0.00%	100
525	DEVELOPED	Preschool/Daycare facilities - Preschool/D	1	0.00%	100
530	DEVELOPED	Institutional - Includes hospitals	1	0.00%	100
531	DEVELOPED	Medical Institutions - Hospitals/Medical C	1	0.00%	100
532	DEVELOPED	Religious Institutions - Churches/Religiou	1	0.00%	100
533	DEVELOPED	Nursing Homes - Nursing Homes (Group Quart	1	0.00%	100
534	DEVELOPED	Assisted Care Facilities - Assisted Care F	1	0.00%	100
540	DEVELOPED	Cemeteries -	1	0.00%	100
550	DEVELOPED	Public Facilities - Includes community ce	1	0.00%	100
551	DEVELOPED	Public Offices - Includes city halls	1	0.00%	100
552	DEVELOPED	Public Services - Includes community cent	1	0.00%	100
553	DEVELOPED	Large Public Facilities - Includes power	1	0.00%	100
554	DEVELOPED	Military - Military Use	1	0.00%	100
555	DEVELOPED	Limited Use Public Facilities - Very small	1	0.00%	100
560	DEVELOPED	Special Events - Includes stadiums	1	0.00%	100
570	DEVELOPED	Other Employment (low) - Proving grounds	1	0.00%	100
571	OTHER	Landfill - Landfill	7	30.00%	0.002

LU_CODE	Model Output category	Description	Dust Code	Areal % Disturbance	Z0 (cm)
572	OTHER	Sand and Gravel - Sand and Gravel	7	30.00%	0.002
573	OTHER	Proving Grounds - Proving Grounds	7	30.00%	0.002
574	OTHER	Mining - Mining	7	30.00%	0.002
580	DEVELOPED	Other Employment (medium) -	1	0.00%	100
590	DEVELOPED	Other Employment (high) -	1	0.00%	100
598	DEVELOPED	Parking structures serving Facilities/Emp -	1	0.00%	100
599	DEVELOPED	Parking lots serving Facilities/Employment -	1	0.00%	100
600	DEVELOPED	General Transportation - Transportation wh	1	0.00%	100
610	DEVELOPED	Transportation - Includes railroads	1	0.00%	100
611	DEVELOPED	Parking Lots - Parking Lots	1	0.00%	100
612	DEVELOPED	Parking Structures - Parking Structures	1	0.00%	100
613	DEVELOPED	Park and Ride lots - Park and Ride lots	1	0.00%	100
614	DEVELOPED	Transit Center - Transit Center	1	0.00%	100
620	DEVELOPED	Airports - Includes public use airports	1	0.00%	100
621	DEVELOPED	Sky Harbor Airport - Sky Harbor Airport	1	0.00%	100
700	VACANT	General Open Space - Open Space where no d	7	30.00%	0.002
710	VACANT	Active Open Space - Includes parks	7	30.00%	0.002
720	VACANT	Golf courses -	4	0.00%	0.1
730	VACANT	Passive Open Space - Includes mountain pre	7	30.00%	0.002
731	VACANT	Restricted Open Space - Restricted Open Sp	7	30.00%	0.002
740	WATER	Water -	7	0.00%	0.002
750	AGRICULTURE	Agriculture -	3	70.00%	0.015
800	DEVELOPED	Multiple Use General - Multiple Use where	1	0.00%	100
798	DEVELOPED	Parking structures serving Open Space - Pa	1	0.00%	100
799	DEVELOPED	Parking lots serving Open Space - Parking	7	30.00%	0.002
810	DEVELOPED	Business Park - Includes enclosed industr	1	0.00%	100
820	DEVELOPED	Mixed Use - Jurisdiction defined	1	0.00%	100
821	DEVELOPED	Mixed Use/Indian Community - Mixed Use/Ind	1	0.00%	100
830	DEVELOPED	Planned Developments -	1	0.00%	100
898	DEVELOPED	Parking structures serving Multiple Use -	1	0.00%	100
899	DEVELOPED	Parking lots serving Multiple Use - Parkin	1	0.00%	100
900	VACANT	Vacant (existing land use database only) -	7	30.00%	0.002
910	RESIDENTIAL CONSTRUCTION	Developing Residential - Residential Under	7	75.00%	0.002
920	COMMERCIAL CONSTRUCTION	Developing Commercial - Commercial Under C	7	75.00%	0.002
930	COMMERCIAL CONSTRUCTION	Developing Industrial - Industrial Under C	7	75.00%	0.002
940	COMMERCIAL CONSTRUCTION	Developing Office - Office Under Construct	7	75.00%	0.002
950	COMMERCIAL CONSTRUCTION	Developing Public/Other Employment - Emplo	7	75.00%	0.002
960	TRANSPORTATION CONSTRUCTION	Developing Transportation - Transportation	7	75.00%	0.002
970	VACANT	Developing Open Space - Developing Open Sp	7	30.00%	0.002
980	COMMERCIAL CONSTRUCTION	Developing Multiple Use - Multiple Use Und	7	30.00%	0.002
999	DEVELOPED	Salvage/Unknown - Evaluate on an individua	1	0.00%	100

Table 4-3. Monthly, crop-specific soil disturbance percentages.

Month	Corn	Cotton	Barley	Wheat
January	100	100	-[1]	-
February	100	100	-	-
March	100	100	-	-
April	-	100	100	-
May	-	-	100	-
June	-	-	-	10
July	30	-	-	-
August	-	-	10	-
September	-	-	-	-
October	-	80	-	-
November	-	-	-	100
December	-	-	-	100

[1] (–) denotes no revisions to default disturbance levels

5. MODELING RESULTS

The results of the windblown PM10 dust emission modeling is presented in this section. The emission estimation methodology and required input data were described in Section 2 and Section 3 of this report. Specific revisions to the data and/or model implementation for the Phoenix PM10 Non-Attainment Area, as well as the entirety of Maricopa and Pinal counties, were discussed in Section 4.

Preliminary Model Simulations

A number of preliminary simulations were performed prior to finalizing the various inputs and assumptions associated with the development of emission estimates for windblown fugitive PM dust. These initial model simulations were performed with the assumed landuse specific soil disturbance percentages presented in Table 4-2. These results provide the base default estimates upon which the specific agricultural adjustments and revisions were built.

Preliminary default results of the windblown model for 2005 are presented in Tables 5-1 and 5-2. Table 5-1 presents the modeled monthly 2005 windblown PM10 dust emissions for the Phoenix PM10 Non-Attainment Area for each of the 8 aggregated landuse types defined in Table 4-2. Note that while nearly one third of Maricopa County is within the Phoenix PM10 NAA, only a very small portion of Pinal County is included in the NAA. Note also that the emission estimates presented in these tables do not include the application of the fugitive dust transport fraction, discussed in the previous section of this report. Thus, these estimates are appropriate for emission inventory reporting purposes and for SIP development efforts.

Monthly 2005 county-level PM10 emission estimates for Maricopa and Pinal Counties are presented in Table 5-2 for each landuse category defined in Table 4-2. As seen, the majority of the windblown dust emissions are from the vacant land and “other” category. Shrublands and grasslands are included within the “other” category, which comprises a significant portion of both Maricopa and Pinal Counties. A relatively small amount of windblown dust is estimated from the agricultural lands in each county. Based on the distribution of the landcover across the domain, and the reductions applied to agricultural lands due to crop canopy and agricultural management practices, these results appear reasonable in light of the various assumptions incorporated in the model.

Figure 5-1 provides a graphical representation of these results. As seen, the estimated dust emissions peak during the spring and summer months reflecting the impact of higher wind speeds and agricultural activity during these time periods. The corresponding results for the entire counties of Maricopa and Pinal are presented in Figure 5-2.

Table 5-1. Preliminary 2005 Monthly PM10 windblown dust emissions for the Phoenix NAA.

Preliminary 2005 PM10 Windblown Dust Emission (tons) -- Phoenix NAA													
Month	Total	Other Agricultural	Comm. Constr.	Res. Constr.	Trans. Constr.	Developed	Vacant	Water (Alluvial)	Other	Barley	Corn	Cotton	Wheat
Jan	**250.6**	1.5	4.3	27.0	0.3	0.0	176.6	17.8	23.1	0.00	0.00	0.00	0.00
Feb	**433.4**	1.4	7.4	45.4	0.5	0.0	310.5	41.7	26.5	0.00	0.00	0.00	0.00
Mar	**709.2**	3.4	11.6	69.5	0.7	0.0	503.2	65.5	55.4	0.00	0.00	0.01	0.00
Apr	**900.1**	6.5	13.9	84.4	0.8	0.0	642.3	84.5	67.5	0.00	0.00	0.02	0.00
May	**897.3**	5.8	13.6	83.8	0.8	0.0	638.4	91.0	64.0	0.00	0.00	0.01	0.00
Jun	**908.3**	2.5	14.3	87.8	0.8	0.0	659.8	101.6	41.4	0.00	0.00	0.00	0.00
Jul	**1,101.7**	4.9	17.0	100.5	1.1	0.0	786.3	114.1	77.7	0.00	0.00	0.02	0.00
Aug	**821.0**	4.4	12.9	75.2	0.9	0.0	586.2	80.0	61.4	0.00	0.00	0.02	0.00
Sep	**507.4**	2.2	7.8	49.0	0.5	0.0	363.5	51.2	33.1	0.00	0.00	0.01	0.00
Oct	**431.2**	2.4	6.6	42.7	0.4	0.0	309.9	44.1	25.1	0.00	0.00	0.01	0.00
Nov	**276.0**	1.3	4.3	30.4	0.3	0.0	201.3	22.3	16.1	0.00	0.00	0.00	0.00
Dec	**141.2**	0.0	2.3	18.3	0.1	0.0	110.0	6.8	3.7	0.00	0.00	0.00	0.00
Annual	**7,377.5**	**36.2**	**116.0**	**713.9**	**7.3**	**0.0**	**5,288.1**	**720.6**	**495.2**	**0.00**	**0.01**	**0.10**	**0.01**

Table 5-2. Preliminary 2005 Monthly PM10 windblown dust emissions for Maricopa and Pinal Counties.

Preliminary 2005 PM10 Windblown Dust Emission (tons) -- County Totals													
Month	Total	Other Agricultural	Comm. Constr.	Res. Constr.	Trans. Constr.	Developed	Vacant	Water (Alluvial)	Other	Barley	Corn	Cotton	Wheat
Jan	**2,917.2**	7.7	4.6	31.1	0.3	0.0	2,003.8	41.4	828.2	0.01	0.00	0.16	0.02
Feb	**3,663.6**	9.6	7.8	51.2	0.5	0.0	2,608.5	71.0	914.9	0.00	0.00	0.06	0.00
Mar	**5,104.0**	22.1	12.0	76.7	0.7	0.0	3,445.6	102.6	1,444.1	0.01	0.01	0.14	0.02
Apr	**6,360.6**	31.5	14.5	93.1	0.8	0.0	4,454.9	131.1	1,634.2	0.03	0.01	0.33	0.05
May	**6,214.0**	26.6	14.2	92.7	0.8	0.0	4,542.7	142.1	1,394.6	0.02	0.01	0.26	0.03
Jun	**6,739.9**	25.1	14.9	96.8	0.8	0.0	4,686.8	154.1	1,761.1	0.01	0.00	0.18	0.02
Jul	**7,938.7**	28.2	17.7	110.2	1.1	0.0	5,203.2	171.3	2,406.7	0.02	0.01	0.42	0.04
Aug	**5,859.8**	22.4	13.3	82.3	0.9	0.0	3,975.7	121.4	1,643.4	0.02	0.01	0.33	0.03
Sep	**4,147.2**	9.7	8.3	55.2	0.5	0.0	3,073.9	88.3	911.2	0.01	0.00	0.13	0.01
Oct	**3,758.5**	13.3	7.0	48.5	0.4	0.0	2,810.2	76.0	803.0	0.01	0.00	0.14	0.02
Nov	**2,625.4**	7.4	4.6	35.1	0.3	0.0	1,993.2	46.6	538.2	0.00	0.00	0.03	0.00
Dec	**1,895.4**	0.9	2.6	22.3	0.1	0.0	1,711.7	29.2	128.7	0.00	0.00	0.00	0.00
Annual	**57,224.3**	**204.5**	**121.3**	**795.0**	**7.3**	**0.0**	**40,510.1**	**1,175.1**	**14,408.4**	**0.13**	**0.05**	**2.18**	**0.26**

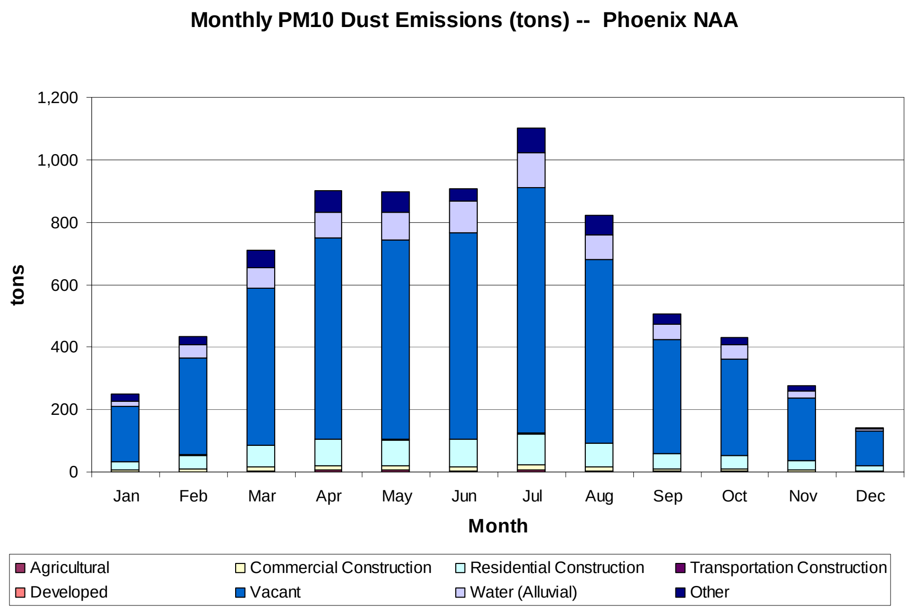

Figure 5-1. Monthly windblown PM10 dust emissions for the Phoenix Nonattainment area.

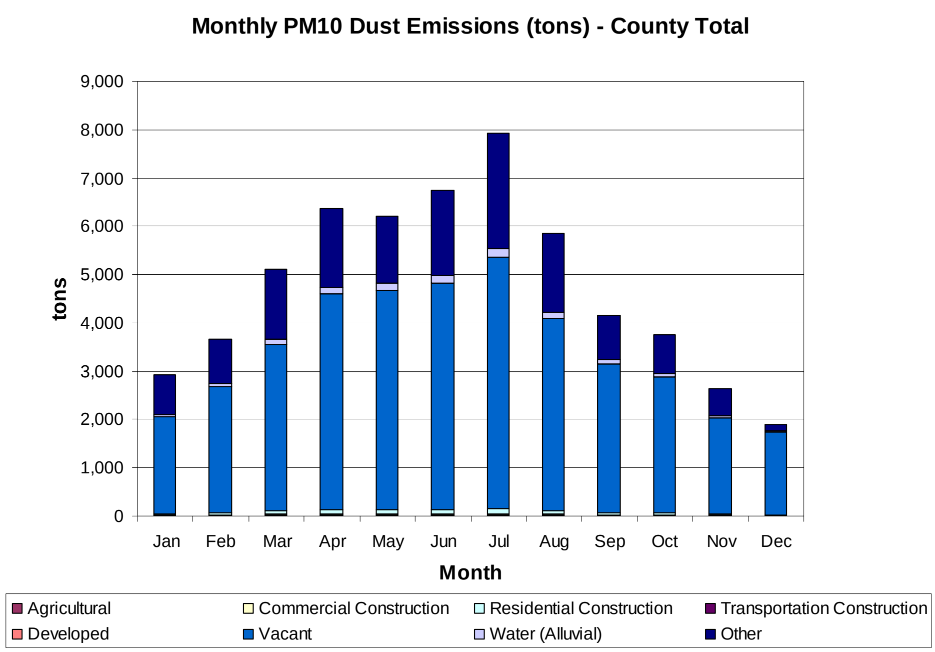

Figure 5-2. Monthly windblown PM10 dust emissions for Maricopa and Pinal Counties.

The spatial distribution of the estimated windblown dust PM emissions are presented in Figure 5-3. Figure 5-3 presents the monthly total PMC (=0.9*PM10) windblown dust emissions for calendar year 2005. Note that these displays do not reflect the monthly, crop-specific revisions to soil disturbance percentages incorporated into the final model simulations, presented below. The dependence on landuse can be seen as the spatial distribution of the estimated emissions corresponds to the distribution of the various landuse types across the domain.

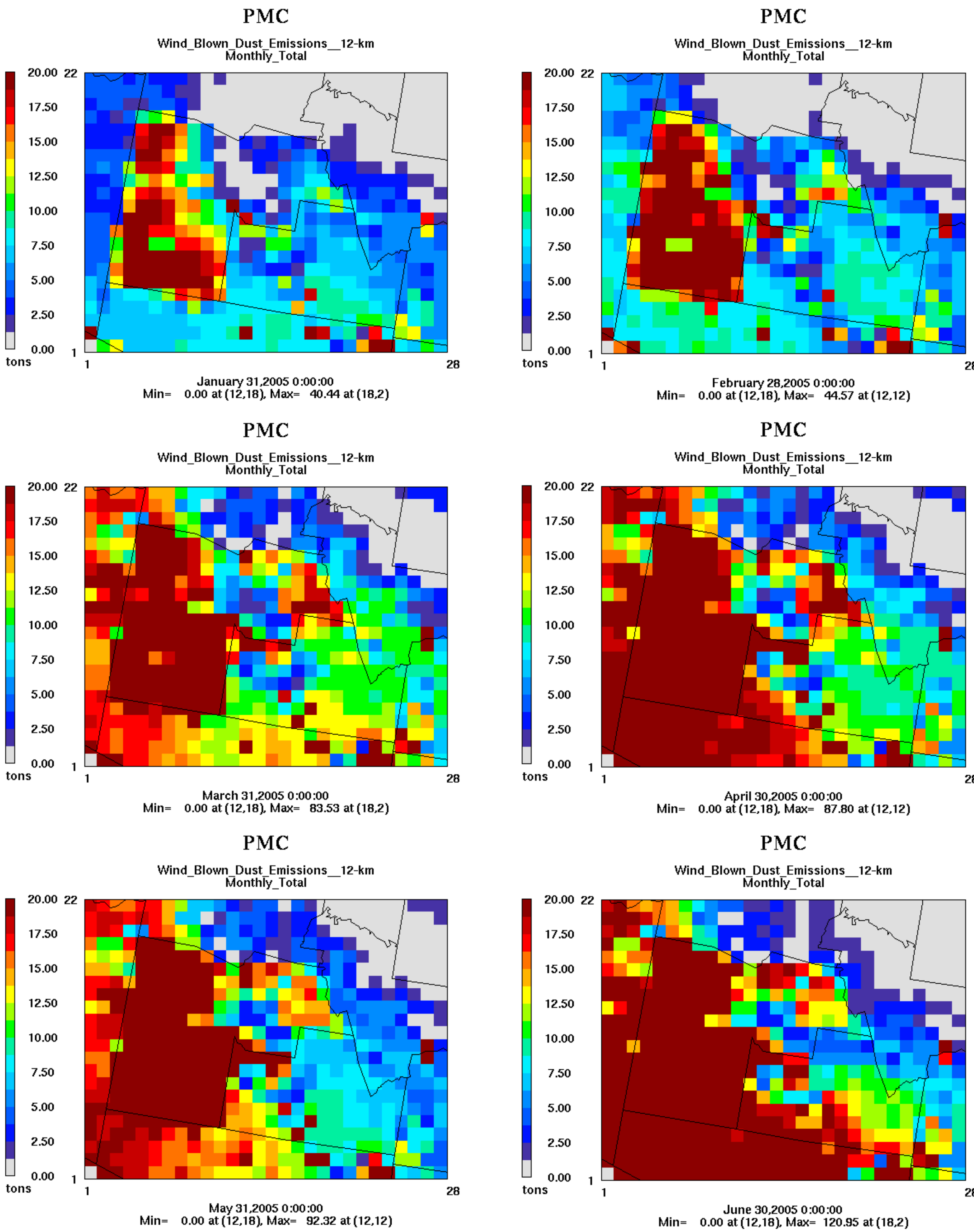

Figure 5-3. Spatial distribution of estimated PMC windblown dust emissions.

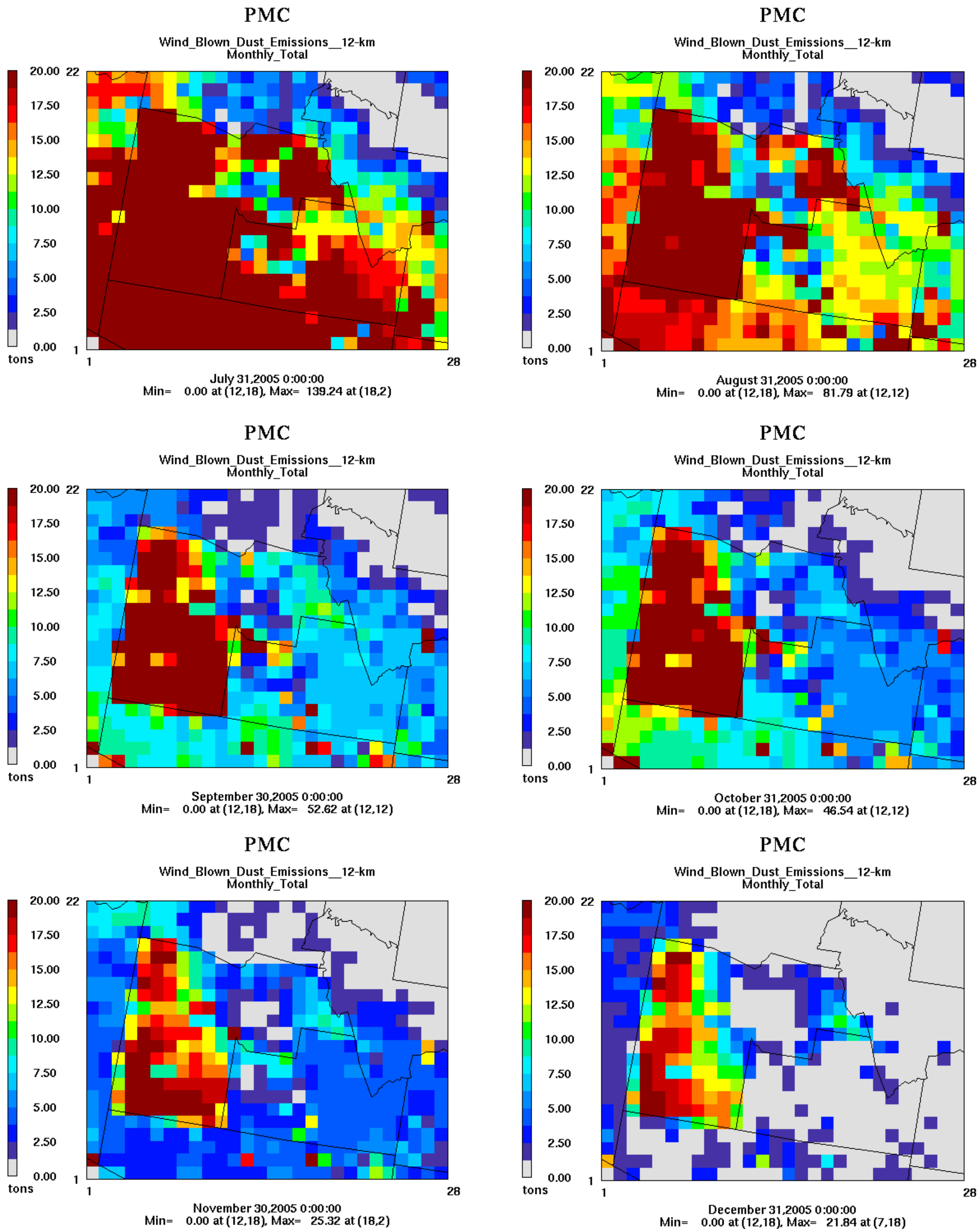

Figure 5-3 (concluded). Spatial distribution of estimated PMC windblown dust emissions.

Final Model Simulation Results

As discussed in Section 4, the final model simulations considered the monthly variation in soil disturbance levels due to agricultural activities through out the year. Table 4-3 presented the assumed monthly disturbance percentages of agricultural lands throughout the Phoenix Non-Attainment Area. These monthly variations were based on the crop calendars for 2005 for Maricopa County. The final windblown dust emission model runs incorporated these disturbance levels within the estimation methodology by reducing the threshold surface friction velocities. For those months were no assumed disturbances are listed in Table 4-3, the results of the preliminary model simulation were substituted. These results reflect the default assumptions of the estimation methodology, i.e., loose undisturbed soils. The results of the final windblown dust model simulation are presented below.

Table 5-3 presents the 2005 annual windblown PM10 dust emissions for the Phoenix Non-Attainment Area by county and landuse category. Table 5-4 presents the corresponding results for the entirety of Maricopa and Pinal Counties. As can be seen, the implementation of the monthly variation of disturbance for agricultural lands has only minor impacts on the estimated emissions. In the final model simulation only the four main crops were considered for variations in disturbance levels. The remaining croplands, approximately 10% ogf the total agricultural lands in the region, were treat4d as miscellaneous crops with the default disturbance treatment of the model. Additionally, only a very small portion of the total land area within the Phoenix NAA is categorized as cropland, thus the effects of these model revisions are minimal.

The corresponding monthly windblown PM10 dust emissions are summarized for the Phoenix NAA and Maricopa/Pinal Counties, by landuse category, in Tables 5-5 and 5-6, respectively. Figures 5-4 and 5-5 present these results graphically.

Table 5-3. 2005 Annual PM10 windblown dust emissions for the Phoenix NAA.

2005 Annual Windblown PM10 Dust Emission in Phoenix NAA (tons)													
County	Total	Other Agricultural	Comm. Constr.	Res. Constr.	Trans. Constr.	Developed	Vacant	Water (Alluvial)	Other	Barley	Corn	Cotton	Wheat
Maricopa	7,284.3	36.1	116.0	712.8	7.3	0.0	5,287.1	720.6	401.3	0.4	0.2	2.3	0.2
Pinal	96.2	0.1	0.0	1.1	0.0	0.0	1.0	0.0	93.8	0.0	0.0	0.0	0.0
Total	**7,380.4**	**36.2**	**116.0**	**713.9**	**7.3**	**0.0**	**5,288.1**	**720.6**	**495.2**	**0.4**	**0.2**	**2.3**	**0.2**

Table 5-4. 2005 Annual PM10 windblown dust emissions for Maricopa and Pinal Counties.

2005 Annual Windblown PM10 Dust Emisisons (tons) - County-wide													
County	Total	Other Agricultural	Comm. Constr.	Res. Constr.	Trans. Constr.	Developed	Vacant	Water (Alluvial)	Other	Barley	Corn	Cotton	Wheat
Maricopa	44,488.8	149.7	121.2	790.7	7.3	0.0	40,468.2	1,175.1	1,766.9	1.1	0.6	7.1	0.9
Pinal	12,769.5	54.7	0.1	4.4	0.0	0.0	41.9	0.0	12,641.4	1.1	0.7	23.9	1.2
Total	**57,258.3**	**204.5**	**121.3**	**795.0**	**7.3**	**0.0**	**40,510.1**	**1,175.1**	**14,408.4**	**2.2**	**1.3**	**31.0**	**2.1**

Table 5-5. 2005 Monthly PM10 windblown dust emissions for the Phoenix NAA.

2005 PM10 Windblown Dust Emission (tons) -- Phoenix NAA													
Month	Total	Other Agricultural	Comm. Constr.	Res. Constr.	Trans. Constr.	Developed	Vacant	Water (Alluvial)	Other	Barley	Corn	Cotton	Wheat
Jan	**250.8**	1.5	4.3	27.0	0.3	0.0	176.6	17.8	23.1	0.00	0.03	0.21	0.00
Feb	**433.9**	1.4	7.4	45.4	0.5	0.0	310.5	41.7	26.5	0.00	0.06	0.36	0.00
Mar	**709.8**	3.4	11.6	69.5	0.7	0.0	503.2	65.5	55.4	0.00	0.08	0.53	0.00
Apr	**900.9**	6.5	13.9	84.4	0.8	0.0	642.3	84.5	67.5	0.19	0.00	0.66	0.00
May	**897.5**	5.8	13.6	83.8	0.8	0.0	638.4	91.0	64.0	0.19	0.00	0.01	0.00
Jun	**908.3**	2.5	14.3	87.8	0.8	0.0	659.8	101.6	41.4	0.00	0.00	0.00	0.03
Jul	**1,101.7**	4.9	17.0	100.5	1.1	0.0	786.3	114.1	77.7	0.00	0.01	0.02	0.00
Aug	**821.0**	4.4	12.9	75.2	0.9	0.0	586.2	80.0	61.4	0.02	0.00	0.02	0.00
Sep	**507.4**	2.2	7.8	49.0	0.5	0.0	363.5	51.2	33.1	0.00	0.00	0.01	0.00
Oct	**431.5**	2.4	6.6	42.7	0.4	0.0	309.9	44.1	25.1	0.00	0.00	0.28	0.00
Nov	**276.3**	1.3	4.3	30.4	0.3	0.0	201.3	22.3	16.1	0.00	0.00	0.19	0.09
Dec	**141.3**	0.0	2.3	18.3	0.1	0.0	110.0	6.8	3.7	0.00	0.00	0.00	0.06
Annual	**7,380.4**	**36.2**	**116.0**	**713.9**	**7.3**	**0.0**	**5,288.1**	**720.6**	**495.2**	**0.40**	**0.18**	**2.29**	**0.19**

Table 5-6. 2005 Monthly PM10 windblown dust emissions for Maricopa and Pinal Counties.

2005 PM10 Windblown Dust Emission (tons) -- County Totals													
Month	Total	Other Agricultural	Comm. Constr.	Res. Constr.	Trans. Constr.	Developed	Vacant	Water (Alluvial)	Other	Barley	Corn	Cotton	Wheat
Jan	**2,921.1**	7.7	4.6	31.1	0.3	0.0	2,003.8	41.4	828.2	0.01	0.28	3.77	0.02
Feb	**3,668.7**	9.6	7.8	51.2	0.5	0.0	2,608.5	71.0	914.9	0.00	0.36	4.81	0.00
Mar	**5,110.7**	22.1	12.0	76.7	0.7	0.0	3,445.6	102.6	1,444.1	0.01	0.47	6.40	0.02
Apr	**6,368.5**	31.5	14.5	93.1	0.8	0.0	4,454.9	131.1	1,634.2	0.98	0.01	7.19	0.05
May	**6,215.0**	26.6	14.2	92.7	0.8	0.0	4,542.7	142.1	1,394.6	1.02	0.01	0.26	0.03
Jun	**6,740.1**	25.1	14.9	96.8	0.8	0.0	4,686.8	154.1	1,761.1	0.01	0.00	0.18	0.21
Jul	**7,938.9**	28.2	17.7	110.2	1.1	0.0	5,203.2	171.3	2,406.7	0.02	0.14	0.42	0.04
Aug	**5,859.9**	22.4	13.3	82.3	0.9	0.0	3,975.7	121.4	1,643.4	0.13	0.01	0.33	0.03
Sep	**4,147.2**	9.7	8.3	55.2	0.5	0.0	3,073.9	88.3	911.2	0.01	0.00	0.13	0.01
Oct	**3,762.3**	13.3	7.0	48.5	0.4	0.0	2,810.2	76.0	803.0	0.01	0.00	3.98	0.02
Nov	**2,629.8**	7.4	4.6	35.1	0.3	0.0	1,993.2	46.6	538.2	0.00	0.00	3.56	0.88
Dec	**1,896.2**	0.9	2.6	22.3	0.1	0.0	1,711.7	29.2	128.7	0.00	0.00	0.00	0.79
Annual	**57,258.3**	**204.5**	**121.3**	**795.0**	**7.3**	**0.0**	**40,510.1**	**1,175.1**	**14,408.4**	**2.21**	**1.29**	**31.03**	**2.11**

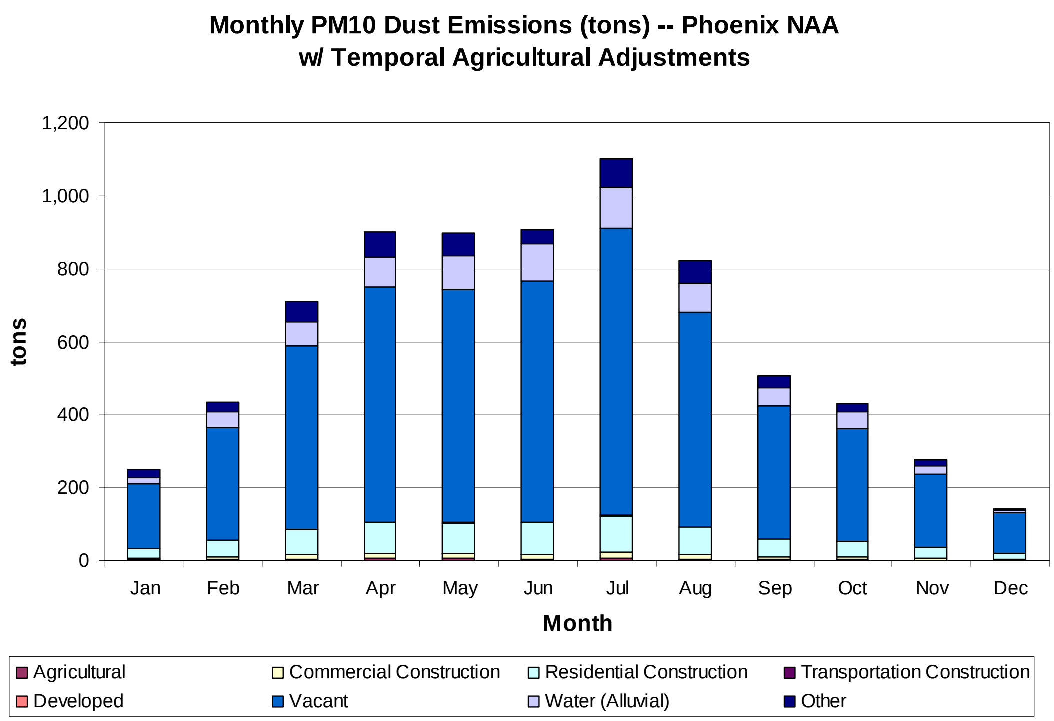

Figure 5-4. Final monthly windblown PM10 dust emissions for the Phoenix NNA.

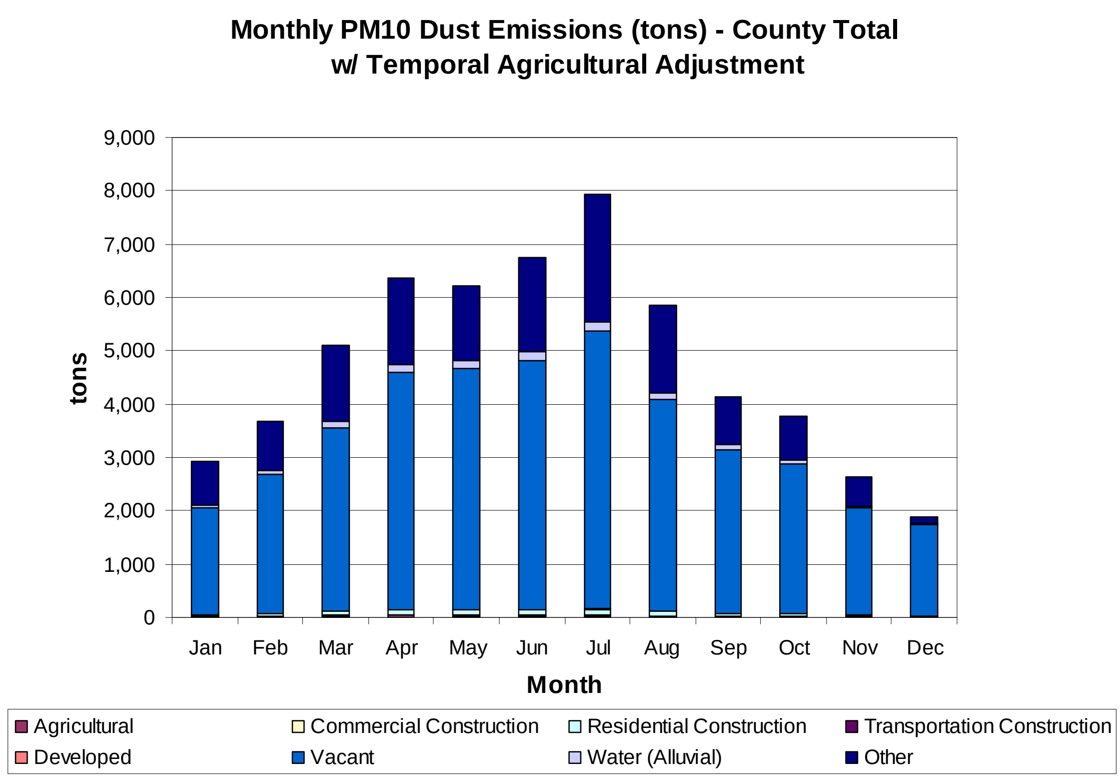

Figure 5-5. Final monthly windblown PM10 dust emissions for Maricopa and Pinal Counties.

Model Sensitivity Simulations

The sensitivity of the model results to variations in meteorology was also investigated as part of the project. For air quality planning and SIP development efforts, databases representative of typical, or average, conditions are often developed based on data from several years. Emission inventories and air quality modeling results obtained using representative conditions allow for a more consistent comparison between baseline future year modeling scenarios.

For the current application, wind speed data from the AZMET database were augmented with observed data archived by the Maricopa County Flood Control District. The hourly wind speed data from each of the monitoring stations were averaged over the 5-year period 2001-2005. Only those monitoring site with a complete five year record were considered. The monitoring station locations are displayed in Figure 5-6. All other input data and modeling assumptions remained unchanged.

The AZMET and Flood Control District monitoring networks provide observed data from different heights above ground level. AZMET station data are obtained at a height of 3 meters, while the Flood Control District monitoring network provides data at a height of 10 meters. Prior to applying the kriging algorithms to these data, the AZMET station data were re-cast to a 10 meter height using a simple power law relation assuming neutral atmospheric conditions. The resulting hourly gridded wind speeds are presented in Figure 5-7 in terms of monthly average wind speeds across the modeling domain.

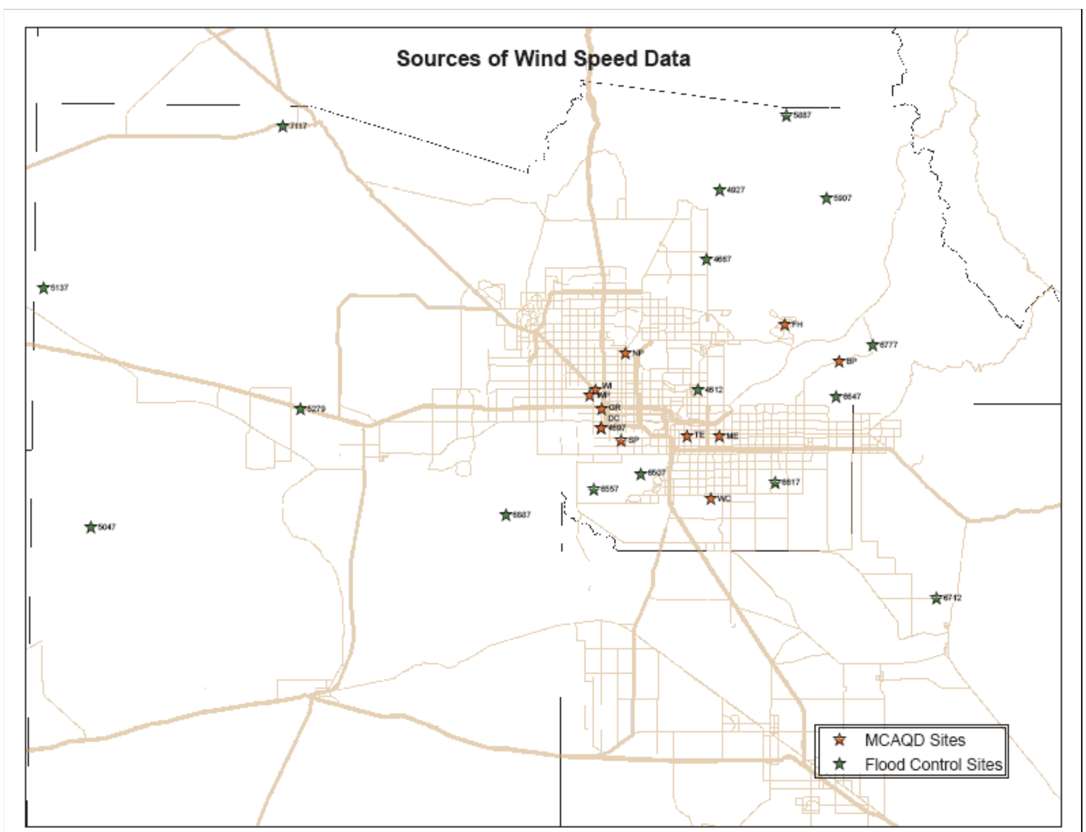

Figure 5-6. Location of meteorological monitoring stations for 5-year average wind speed data.

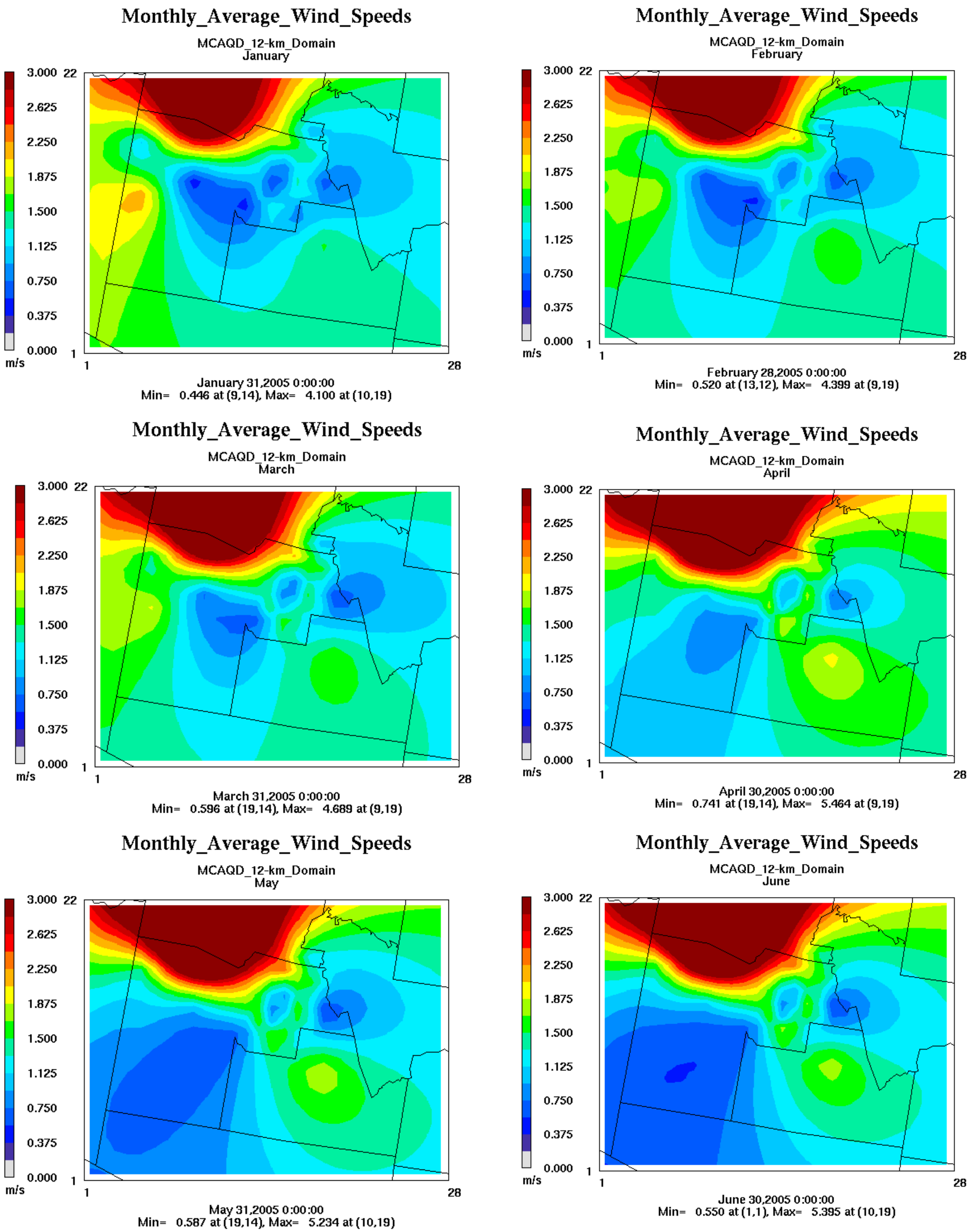

Figure 5-7. Monthly average wind speeds on the 12-km modeling domain. (2001-2005 data)

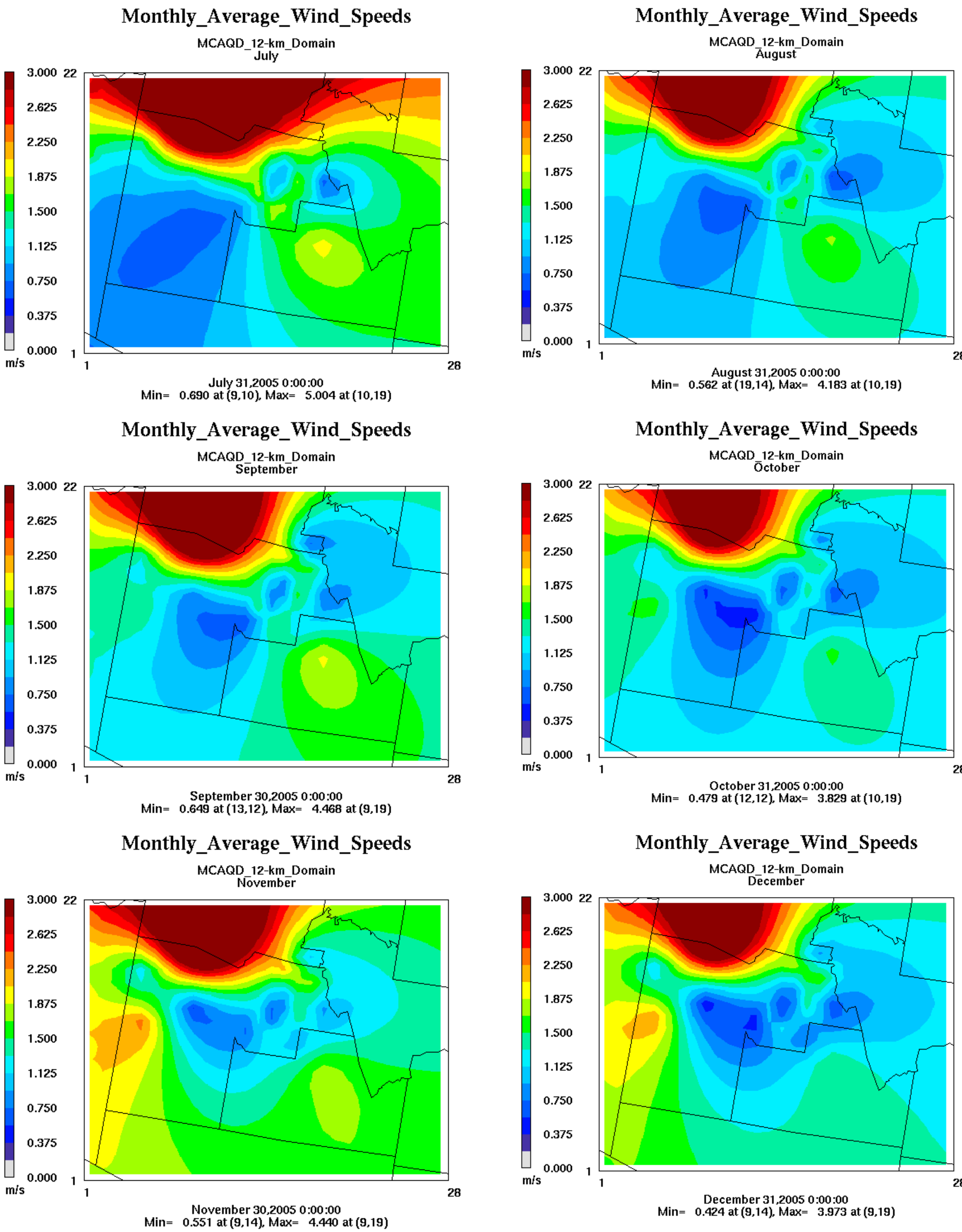

Figure 5-7. (concluded). Monthly average wind speeds on the 12-km modeling domain (2001-2005 data)

The results of the windblown dust model simulation using the 5-year average wind speed data are presented in Tables 5-7 and 5-8. Table 5-7 presents the annual 2005 windblown PM10 dust emissions for the Phoenix Nonattainment area disaggregated into the 8 generalized landuse types defined in Table 4-2. The corresponding results for the entire Maricopa and Pinal Counties are presented in Table 5-8. As seen, the resulting PM10 dust emissions are significantly decreased from those obtained using the 2005 data alone. The large reduction in estimated windblown PM10 dust emissions is directly related to the reduced wind speeds across the modeling domain resulting from the use of 5-year average meteorology.

Table 5-7. 2005 Annual PM10 windblown dust emissions for the Phoenix NAA using 5-year average (2001-2005) wind speed data.

2005 PM10 Dust Emissions (tons)									
Phoenix Non-Attainment Area									
County	Total	Agricultural	Commercial Construction	Residential Construction	Transportation Construction	Developed	Vacant	Water (Aluvial)	Other
Maricopa	2,816	29.5	34.1	218.1	2.2	0.0	2,408.6	91.9	31.8
Pinal	5	0.2	0.0	0.4	0.0	0.0	0.3	0.0	3.7
Total	**2,821**	**30**	**34**	**218**	**2**	**0**	**2,409**	**92**	**36**

Table 5-8. 2005 Annual PM10 windblown dust emissions for Maricopa and Pinal Counties using 5-year average (2001-2005) wind speed data.

2005 PM10 Dust Emissions (tons)									
County Totals									
County	Total	Agricultural	Commercial Construction	Residential Construction	Transportation Construction	Developed	Vacant	Water (Aluvial)	Other
Maricopa	18,405.3	87.0	37.4	253.2	2.2	0.0	17,288.3	163.8	573.4
Pinal	1,977.4	100.1	0.0	1.4	0.0	0.0	11.5	0.0	1,864.3
Total	**20,383**	**187**	**37**	**255**	**2**	**0**	**17,300**	**164**	**2,438**

6. SUMMARY

The WRAP RMC windblown fugitive dust emission model was applied to the Phoenix PM10 Non-Attainment Area to estimate PM10 dust emissions for calendar year 2005. Various improvements to the model input data and assumptions associated with the emission estimation methodology were considered. Summary results of the simulations for Maricopa and Pinal Counties and for the Phoenix PM10 NAA were presented in Section 5.

The modeling domain was defined on a 12-km resolution grid to encompass all of Maricopa and Pinal Counties of Arizona. Model input data were developed from local data as well as regional data sets. Local landuse/landcover data were provided by the Maricopa Association of Governments for use in the project. Landuse data from the Southwest GAP database were used to augment the local landuse data to cover the entire modeling domain. Soils data were developed from a combination of SSURGO and STATSGO databases. The necessary hourly gridded wind fields were derived from AZMET observational datasets using a kriging algorithm. Minor updates to the default agricultural crop information of the model were incorporated for Maricopa County. Assumed disturbance levels of the vacant lands within the modeling domain were also modified for the current application based on knowledge of the local landscapes.

A number of limitations are worth noting with respect to the input data and estimation methodology:

- Threshold surface friction velocities are determined as a function of the aerodynamic surface roughness lengths. In the current implementation, surface roughness lengths are assigned as a function of land types. However, only a limited number of land types are available to characterize vacant lands across the entire domain. A large degree of variation can be found within a given land type which is not being captured by the model due to a lack of detail in the land use data used for the model.

- Although some revisions were incorporated with respect to the soil disturbance of vacant lands, the default implementation of the current model assumes that all soils are loose and undisturbed with no temporal variation of disturbance levels. In addition, the effect that disturbance of soils and vacant lands has on the emission rates of dust due to wind erosion is not well characterized or fully understood.

- The treatment of dust reservoirs is too simplistic in the model. The reservoir characteristics determine the duration of wind blown dust events as well as the effects of precipitation on the erosion potential of exposed surfaces. It has been documented in the literature that depending on the type of soils, a small amount of precipitation can cause a crust to form on the surface effectively preventing dust emissions due to wind erosion. Only after these crusts have been broken does the surface again have the potential to emit dust emissions. These affects can also vary to some degree even for the same types of soils depending on soil moisture content among other factors. The amount of soil available for erosion is also important with respect to determining the duration of emissions during wind events.

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Appendix 5

MOBILE6.2 Input and Ouput Files

MOBILE6 input files

Two scenarios of Inspection/Maintenance (I/M) were developed for MOBILE6.2 inputs: with I/M program in place and no I/M program in place. I/M program affected only NOx emission factor. I/M programs were simply removed to develop MOBILE6.2 input files for No I/M program scenario. No I/M input is followed by I/M input.

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.

Header Section

1. MOBILE6 INPUT FILE: indicates that the MOBILE6.2 input file is a regular command file rather than a batch file.

Run Data Section

1. EXPAND LDT EFS: directs MOBILE6.2 to display EFs by 6 LDT classes.

   EXPAND HDDV EFS: directs MOBILE6.2 to display EFs by 8 HDDV classes.

   EXPAND HDGV EFS: directs MOBILE6.2 to display EFs by 8 HDGV classes.

   EXPAND BUS EFS: directs MOBILE6.2 to report EFs for gas, urban, and school bus categories separately.

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 5.9.2), 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 as follows:

   I/M VEHICLES: 2 22222 11111111 1 indicates that the opposite 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 CUTPNT05.d indicates that MOBILE6.2 reads the external data file “CUTPNT05.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.

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: 02reg05.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 02reg05.d.

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, 0.0009, indicates that for the most recent model year of light duty vehicles, 0.09 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: PMGZML.CSV PMGDR1.CSV PMGDR2.CSV PMDZML.CSV PMDDR1.CSV PMDDR2.CSV specifies six external data files that contain the particulate emission factors. MOBILE6.2 reads PMGZML.CSV for gasoline vehicle zero mile particulate emission factors, PMGDR1.CSV for gasoline vehicle deterioration rate particulate emission factors for all vehicle ages from 1 to the age specified variable X, PMGDR2.CSV for gasoline vehicle deterioration rate particulate emission factors for all vehicle ages from X+1 to age 25, PMDZML,CSV for diesel zero mile particulate emission factors, PMDDR1.CSV for diesel vehicle deterioration rate particulate emission factors for all vehicle ages from 1 to the age specified variable X, PMDDR2.CSV for diesel vehicle deterioration rate particulate emission factors for all vehicle ages from X+1 to age 25, The values of X for gasoline and diesel vehicles are specified in gasoline and diesel vehicle zero mile particulate emission factor files, respectively.

3. PARTICLE SIZE: 10.0 indicates that particulate matter emission factors are reported in term of PM10. PARTICLE SIZE: 2.5 indicates that particulate emission factors are reported in term of PM2.5.

4. DIESEL SULFUR: 309.0 specifies average diesel fuel sulfur level 309 ppm.

5. CALENDAR YEAR: 2005 specifies the calendar year 2005 for which emission factors are to be calculated.

6. EVALUATION MONTH: 7 indicates that the month to be modeled is July.

7. ALTITUDE:1 indicates the geographic area modeled was low altitude.

8. MIN/MAX TEMPERATURE: 56. 97. provides the model with the daily minimum and maximum temperatures.

9. FUEL RVP: 8.0 Indicates that the average Reid Vapor Pressure of the gasoline sold during this time period is 8.0 pounds per square inch. This estimate is based upon raw gasoline data provided by the Arizona Department of Weights and Measures.

10. FUEL PROGRAM: 2 S instructs MOBILE6.2 that the gasoline in use will be reformulated gasoline for the southern region.

MOBILE6.2 Input File for I/M scenario: PM10, NOx, SOx, and NH_3

```
MOBILE6 INPUT FILE :
PARTICULATES       :

RUN DATA
EXPAND LDT EFS     :
EXPAND HDDV EFS    :
EXPAND HDGV EFS    :
EXPAND BUS EFS     :
I/M PROGRAM        : 1 1977 2050 1 T/O LOADED/IDLE
I/M MODEL YEARS    : 1 1967 2050
I/M VEHICLES       : 1 11111 22222222 2
I/M STRINGENCY     : 1 28.0
I/M COMPLIANCE     : 1 97.0
I/M WAIVER RATES   : 1 1.3 1.0
I/M GRACE PERIOD   : 1 5
I/M PROGRAM        : 2 1977 2050 2 T/O IM240
I/M MODEL YEARS    : 2 1981 1995
I/M VEHICLES       : 2 22222 11111111 1
I/M STRINGENCY     : 2 28.0
I/M COMPLIANCE     : 2 97.0
I/M WAIVER RATES   : 2 1.3 1.0
I/M GRACE PERIOD   : 2 5
I/M CUTPOINTS      : 2 CUTPNT05.d
I/M PROGRAM        : 3 1977 2050 1 T/O LOADED/IDLE
I/M MODEL YEARS    : 3 1967 1980
I/M VEHICLES       : 3 22222 11111111 1
I/M STRINGENCY     : 3 28.0
I/M COMPLIANCE     : 3 97.0
I/M WAIVER RATES   : 3 1.3 1.0
I/M PROGRAM        : 4 2001 2050 2 T/O OBD I/M
I/M MODEL YEARS    : 4 1996 2050
I/M VEHICLES       : 4 22222 11111111 1
I/M STRINGENCY     : 4 28.0
I/M COMPLIANCE     : 4 97.0
I/M WAIVER RATES   : 4 1.3 1.0
I/M GRACE PERIOD   : 4 5
I/M PROGRAM        : 5 2001 2050 2 T/O EVAP OBD & GC
I/M MODEL YEARS    : 5 1996 2050
I/M VEHICLES       : 5 22222 11111111 1
I/M STRINGENCY     : 5 28.0
I/M COMPLIANCE     : 5 97.0
I/M WAIVER RATES   : 5 1.3 1.0
I/M GRACE PERIOD   : 5 5

ANTI-TAMP PROG     :
87 75 80 22222 22222222 2 11 097. 22111222
ANTI-TAMP PROG     :
87 81 95 11111 22222222 2 11 097. 22111222

*the tech12.d file must be located with Mobile6 execution file
*the user tech file tech12.1me should be renamed as tech12.d
*Two more I/M programs should not have overlapped motor vehicles.

REG DIST           : 02reg05.d
DIESEL FRACTIONS   :
0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009
0.0006 0.0001 0.0003 0.0006 0.0013 0.0004 0.0004 0.0001 0.0027 0.0032
0.0097 0.0162 0.0241 0.0510 0.0706
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0007 0.0033
0.0048 0.0120 0.0223 0.0656 0.0616
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0007 0.0033
0.0048 0.0120 0.0223 0.0656 0.0616
0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126
0.0115 0.0111 0.0145 0.0115 0.0129 0.0096 0.0083 0.0072 0.0082 0.0124
0.0135 0.0169 0.0209 0.0256 0.0013
0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126
0.0115 0.0111 0.0145 0.0115 0.0129 0.0096 0.0083 0.0072 0.0082 0.0124
0.0135 0.0169 0.0209 0.0256 0.0013
```

```
0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.1998
0.2578 0.2515 0.3263 0.2784 0.2963 0.2384 0.2058 0.1756 0.1958 0.2726
0.2743 0.3004 0.2918 0.2859 0.0138
0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.6774
0.7715 0.7910 0.8105 0.8068 0.8280 0.8477 0.7940 0.7488 0.7789 0.7842
0.6145 0.5139 0.5032 0.4277 0.0079
0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8606
0.8473 0.8048 0.8331 0.7901 0.7316 0.7275 0.7158 0.5647 0.3178 0.2207
0.1968 0.1570 0.0738 0.0341 0.0414
0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4647
0.4384 0.3670 0.4125 0.3462 0.2771 0.2730 0.2616 0.1543 0.0615 0.0383
0.0333 0.0255 0.0111 0.0049 0.0060
0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6300
0.6078 0.5246 0.5767 0.5289 0.5788 0.5617 0.4537 0.4216 0.4734 0.4705
0.4525 0.4310 0.3569 0.3690 0.4413
0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8563
0.8443 0.7943 0.8266 0.7972 0.8279 0.8177 0.7440 0.7184 0.7588 0.7567
0.7431 0.7261 0.6602 0.6717 0.7344
0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9992
0.9989 0.9987 0.9989 0.9977 0.9984 0.9982 0.9979 0.9969 0.9978 0.9980
0.9979 0.9976 0.9969 0.9978 0.9982
1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000
1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000
1.0000 1.0000 1.0000 1.0000 1.0000
0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.9585
0.8857 0.8525 0.8795 0.9900 0.9105 0.8760 0.7710 0.7502 0.7345 0.6733
0.5155 0.3845 0.3238 0.3260 0.2639

SCENARIO RECORD    : I/M Scenario
PARTICULATE EF     : PMGZML.CSV PMGDR1.CSV PMGDR2.CSV PMDZML.CSV PMDDR1.CSV PMDDR2.CSV
PARTICLE SIZE      : 10.0
DIESEL SULFUR      : 309.0
CALENDAR YEAR      : 2005
EVALUATION MONTH   : 7
ALTITUDE           : 1
MIN/MAX TEMPERATURE: 56. 97.
FUEL RVP           : 8.0
FUEL PROGRAM       : 2 S

END OF RUN
```

MOBILE6.2 Input File for I/M scenario: PM2.5

```
MOBILE6 INPUT FILE :
PARTICULATES       :


RUN DATA
EXPAND LDT EFS     :
EXPAND HDDV EFS    :
EXPAND HDGV EFS    :
EXPAND BUS EFS     :
I/M PROGRAM        : 1 1977 2050 1 T/O LOADED/IDLE
I/M MODEL YEARS    : 1 1967 2050
I/M VEHICLES       : 1 11111 22222222 2
I/M STRINGENCY     : 1 28.0
I/M COMPLIANCE     : 1 97.0
I/M WAIVER RATES   : 1 1.3 1.0
I/M GRACE PERIOD   : 1 5
I/M PROGRAM        : 2 1977 2050 2 T/O IM240
I/M MODEL YEARS    : 2 1981 1995
I/M VEHICLES       : 2 22222 11111111 1
I/M STRINGENCY     : 2 28.0
I/M COMPLIANCE     : 2 97.0
I/M WAIVER RATES   : 2 1.3 1.0
I/M GRACE PERIOD   : 2 5
I/M CUTPOINTS      : 2 CUTPNT05.d
I/M PROGRAM        : 3 1977 2050 1 T/O LOADED/IDLE
I/M MODEL YEARS    : 3 1967 1980
I/M VEHICLES       : 3 22222 11111111 1
I/M STRINGENCY     : 3 28.0
I/M COMPLIANCE     : 3 97.0
I/M WAIVER RATES   : 3 1.3 1.0
I/M PROGRAM        : 4 2001 2050 2 T/O OBD I/M
I/M MODEL YEARS    : 4 1996 2050
I/M VEHICLES       : 4 22222 11111111 1
I/M STRINGENCY     : 4 28.0
I/M COMPLIANCE     : 4 97.0
I/M WAIVER RATES   : 4 1.3 1.0
I/M GRACE PERIOD   : 4 5
I/M PROGRAM        : 5 2001 2050 2 T/O EVAP OBD & GC
I/M MODEL YEARS    : 5 1996 2050
I/M VEHICLES       : 5 22222 11111111 1
I/M STRINGENCY     : 5 28.0
I/M COMPLIANCE     : 5 97.0
I/M WAIVER RATES   : 5 1.3 1.0
I/M GRACE PERIOD   : 5 5

ANTI-TAMP PROG     :
87 75 80 22222 22222222 2 11 097. 22111222
ANTI-TAMP PROG     :
87 81 95 11111 22222222 2 11 097. 22111222

*the tech12.d file must be located with Mobile6 execution file
*the user tech file tech12.1me should be renamed as tech12.d
*Two more I/M programs should not have overlapped motor vehicles.

REG DIST           : 02reg05.d
DIESEL FRACTIONS   :
0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009
0.0006 0.0001 0.0003 0.0006 0.0013 0.0004 0.0004 0.0001 0.0027 0.0032
0.0097 0.0162 0.0241 0.0510 0.0706
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0007 0.0033
0.0048 0.0120 0.0223 0.0656 0.0616
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0007 0.0033
0.0048 0.0120 0.0223 0.0656 0.0616
0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126
0.0115 0.0111 0.0145 0.0115 0.0129 0.0096 0.0083 0.0072 0.0082 0.0124
0.0135 0.0169 0.0209 0.0256 0.0013
0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126
0.0115 0.0111 0.0145 0.0115 0.0129 0.0096 0.0083 0.0072 0.0082 0.0124
```

```
0.0135 0.0169 0.0209 0.0256 0.0013
0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.1998
0.2578 0.2515 0.3263 0.2784 0.2963 0.2384 0.2058 0.1756 0.1958 0.2726
0.2743 0.3004 0.2918 0.2859 0.0138
0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.6774
0.7715 0.7910 0.8105 0.8068 0.8280 0.8477 0.7940 0.7488 0.7789 0.7842
0.6145 0.5139 0.5032 0.4277 0.0079
0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8606
0.8473 0.8048 0.8331 0.7901 0.7316 0.7275 0.7158 0.5647 0.3178 0.2207
0.1968 0.1570 0.0738 0.0341 0.0414
0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4647
0.4384 0.3670 0.4125 0.3462 0.2771 0.2730 0.2616 0.1543 0.0615 0.0383
0.0333 0.0255 0.0111 0.0049 0.0060
0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6300
0.6078 0.5246 0.5767 0.5289 0.5788 0.5617 0.4537 0.4216 0.4734 0.4705
0.4525 0.4310 0.3569 0.3690 0.4413
0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8563
0.8443 0.7943 0.8266 0.7972 0.8279 0.8177 0.7440 0.7184 0.7588 0.7567
0.7431 0.7261 0.6602 0.6717 0.7344
0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9992
0.9989 0.9987 0.9989 0.9977 0.9984 0.9982 0.9979 0.9969 0.9978 0.9980
0.9979 0.9976 0.9969 0.9978 0.9982
1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000
1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000
1.0000 1.0000 1.0000 1.0000 1.0000
0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.9585
0.8857 0.8525 0.8795 0.9900 0.9105 0.8760 0.7710 0.7502 0.7345 0.6733
0.5155 0.3845 0.3238 0.3260 0.2639

SCENARIO RECORD    : I/M Scenario
PARTICULATE EF     : PMGZML.CSV PMGDR1.CSV PMGDR2.CSV PMDZML.CSV PMDDR1.CSV PMDDR2.CSV
PARTICLE SIZE      : 2.5
DIESEL SULFUR      : 309.0
CALENDAR YEAR      : 2005
EVALUATION MONTH   : 7
ALTITUDE           : 1
MIN/MAX TEMPERATURE: 56. 97.
FUEL RVP           : 8.0
FUEL PROGRAM       : 2 S

END OF RUN
```

MOBILE6.2 Input File for no I/M scenario: PM10, NOx, SOx, and NH_3

```
MOBILE6 INPUT FILE :
PARTICULATES       :

RUN DATA
EXPAND LDT EFS     :
EXPAND HDDV EFS    :
EXPAND HDGV EFS    :
EXPAND BUS EFS     :
REG DIST           : 02reg05.d
DIESEL FRACTIONS   :
0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009
0.0006 0.0001 0.0003 0.0006 0.0013 0.0004 0.0004 0.0001 0.0027 0.0032
0.0097 0.0162 0.0241 0.0510 0.0706
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0007 0.0033
0.0048 0.0120 0.0223 0.0656 0.0616
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0007 0.0033
0.0048 0.0120 0.0223 0.0656 0.0616
0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126
0.0115 0.0111 0.0145 0.0115 0.0129 0.0096 0.0083 0.0072 0.0082 0.0124
0.0135 0.0169 0.0209 0.0256 0.0013
0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126
0.0115 0.0111 0.0145 0.0115 0.0129 0.0096 0.0083 0.0072 0.0082 0.0124
0.0135 0.0169 0.0209 0.0256 0.0013
0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.1998
0.2578 0.2515 0.3263 0.2784 0.2963 0.2384 0.2058 0.1756 0.1958 0.2726
0.2743 0.3004 0.2918 0.2859 0.0138
0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.6774
0.7715 0.7910 0.8105 0.8068 0.8280 0.8477 0.7940 0.7488 0.7789 0.7842
0.6145 0.5139 0.5032 0.4277 0.0079
0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8606
0.8473 0.8048 0.8331 0.7901 0.7316 0.7275 0.7158 0.5647 0.3178 0.2207
0.1968 0.1570 0.0738 0.0341 0.0414
0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4647
0.4384 0.3670 0.4125 0.3462 0.2771 0.2730 0.2616 0.1543 0.0615 0.0383
0.0333 0.0255 0.0111 0.0049 0.0060
0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6300
0.6078 0.5246 0.5767 0.5289 0.5788 0.5617 0.4537 0.4216 0.4734 0.4705
0.4525 0.4310 0.3569 0.3690 0.4413
0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8563
0.8443 0.7943 0.8266 0.7972 0.8279 0.8177 0.7440 0.7184 0.7588 0.7567
0.7431 0.7261 0.6602 0.6717 0.7344
0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9992
0.9989 0.9987 0.9989 0.9977 0.9984 0.9982 0.9979 0.9969 0.9978 0.9980
0.9979 0.9976 0.9969 0.9978 0.9982
1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000
1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000
1.0000 1.0000 1.0000 1.0000 1.0000
0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.9585
0.8857 0.8525 0.8795 0.9900 0.9105 0.8760 0.7710 0.7502 0.7345 0.6733
0.5155 0.3845 0.3238 0.3260 0.2639

SCENARIO RECORD    : I/M Scenario
PARTICULATE EF     : PMGZML.CSV PMGDR1.CSV PMGDR2.CSV PMDZML.CSV PMDDR1.CSV PMDDR2.CSV
PARTICLE SIZE      : 10.0
DIESEL SULFUR      : 309.0
CALENDAR YEAR      : 2005
EVALUATION MONTH   : 7
ALTITUDE           : 1
MIN/MAX TEMPERATURE: 56. 97.
FUEL RVP           : 8.0
FUEL PROGRAM       : 2 S

END OF RUN
```

<u>MOBILE6.2 Input File for no I/M scenario: PM2.5</u>

```
MOBILE6 INPUT FILE :
PARTICULATES       :


RUN DATA
EXPAND LDT EFS     :
EXPAND HDDV EFS    :
EXPAND HDGV EFS    :
EXPAND BUS EFS     :
REG DIST           : 02reg05.d
DIESEL FRACTIONS   :
0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009 0.0009
0.0006 0.0001 0.0003 0.0006 0.0013 0.0004 0.0004 0.0001 0.0027 0.0032
0.0097 0.0162 0.0241 0.0510 0.0706
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0007 0.0033
0.0048 0.0120 0.0223 0.0656 0.0616
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000
0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0007 0.0033
0.0048 0.0120 0.0223 0.0656 0.0616
0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126
0.0115 0.0111 0.0145 0.0115 0.0129 0.0096 0.0083 0.0072 0.0082 0.0124
0.0135 0.0169 0.0209 0.0256 0.0013
0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126 0.0126
0.0115 0.0111 0.0145 0.0115 0.0129 0.0096 0.0083 0.0072 0.0082 0.0124
0.0135 0.0169 0.0209 0.0256 0.0013
0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.1998 0.1998
0.2578 0.2515 0.3263 0.2784 0.2963 0.2384 0.2058 0.1756 0.1958 0.2726
0.2743 0.3004 0.2918 0.2859 0.0138
0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.6774 0.6774
0.7715 0.7910 0.8105 0.8068 0.8280 0.8477 0.7940 0.7488 0.7789 0.7842
0.6145 0.5139 0.5032 0.4277 0.0079
0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8606 0.8606
0.8473 0.8048 0.8331 0.7901 0.7316 0.7275 0.7158 0.5647 0.3178 0.2207
0.1968 0.1570 0.0738 0.0341 0.0414
0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4647 0.4647
0.4384 0.3670 0.4125 0.3462 0.2771 0.2730 0.2616 0.1543 0.0615 0.0383
0.0333 0.0255 0.0111 0.0049 0.0060
0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6300 0.6300
0.6078 0.5246 0.5767 0.5289 0.5788 0.5617 0.4537 0.4216 0.4734 0.4705
0.4525 0.4310 0.3569 0.3690 0.4413
0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8563 0.8563
0.8443 0.7943 0.8266 0.7972 0.8279 0.8177 0.7440 0.7184 0.7588 0.7567
0.7431 0.7261 0.6602 0.6717 0.7344
0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9992 0.9992
0.9989 0.9987 0.9989 0.9977 0.9984 0.9982 0.9979 0.9969 0.9978 0.9980
0.9979 0.9976 0.9969 0.9978 0.9982
1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000
1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000
1.0000 1.0000 1.0000 1.0000 1.0000
0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.9585 0.9585
0.8857 0.8525 0.8795 0.9900 0.9105 0.8760 0.7710 0.7502 0.7345 0.6733
0.5155 0.3845 0.3238 0.3260 0.2639

SCENARIO RECORD    : I/M Scenario
PARTICULATE EF     : PMGZML.CSV PMGDR1.CSV PMGDR2.CSV PMDZML.CSV PMDDR1.CSV PMDDR2.CSV
PARTICLE SIZE      : 2.5
DIESEL SULFUR      : 309.0
CALENDAR YEAR      : 2005
EVALUATION MONTH   : 7
ALTITUDE           : 1
MIN/MAX TEMPERATURE: 56. 97.
FUEL RVP           : 8.0
FUEL PROGRAM       : 2 S

END OF RUN
```

Model Outputs

MOBILE6.2 was executed with the inputs described above to obtain composite emission factors in grams per mile (g/mi) for PM10, PM2.5, NO_x, SO_x, and NH_3. These values were obtained for the twenty-eight vehicle classes described in the onroad section 5.2 (Table 5.2-1).

MOBILE6.2 Output File for I/M scenario: PM10, SOx, and NH_3

```
***************************************************************************
* MOBILE6.2.03 (24-Sep-2003)                                              *
* Input file: PM05INV\TEST\PM10.IN (file 1, run 1).                       *
***************************************************************************

* # # # # # # # # # # # # # # # # # # # # # # # # #
* I/M Scenario
* File 1, Run 1, Scenario 1.
* # # # # # # # # # # # # # # # # # # # # # # # # #

                              Calendar Year:  2005
                                      Month:  July
               Gasoline Fuel Sulfur Content:   90. ppm
                 Diesel Fuel Sulfur Content:  309. ppm
                       Particle Size Cutoff: 10.00 Microns
                           Reformulated Gas:  Yes
```

Vehicle Type:	LDGV	LDGT12	LDGT34	LDGT	HDGV	LDDV	LDDT	HDDV	MC	All Veh
GVWR:		<6000	>6000	(All)						
VMT Distribution:	0.4132	0.3281	0.1227		0.0357	0.0008	0.0021	0.0926	0.0048	1.0000
Composite Emission Factors (g/mi):										
Lead:	0.0000	0.0000	0.0000	0.0000	0.0000	------	------	------	0.0000	0.0000
GASPM:	0.0042	0.0046	0.0050	0.0047	0.0587	------	------	------	0.0205	0.0060
ECARBON:	------	------	------	------	------	0.1420	0.0536	0.1685	------	0.0158
OCARBON:	------	------	------	------	------	0.0401	0.0771	0.0859	------	0.0081
SO4:	0.0010	0.0015	0.0016	0.0016	0.0034	0.0037	0.0057	0.0192	0.0003	0.0030
Total Exhaust PM:	0.0052	0.0061	0.0066	0.0063	0.0621	0.1857	0.1363	0.2736	0.0208	0.0331
Brake:	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125
Tire:	0.0080	0.0080	0.0080	0.0080	0.0087	0.0080	0.0080	0.0262	0.0040	0.0097
Total PM:	0.0257	0.0267	0.0272	0.0268	0.0833	0.2063	0.1569	0.3123	0.0374	0.0553
SO2:	0.0204	0.0262	0.0342	0.0284	0.0508	0.0700	0.1090	0.2741	0.0098	0.0488
NH3:	0.1015	0.1000	0.0990	0.0998	0.0451	0.0068	0.0068	0.0270	0.0113	0.0911

Veh. Type:	LDGT1	LDGT2	LDGT3	LDGT4	LDDT12	LDDT34
VMT Mix:	0.0758	0.2523	0.0840	0.0386	0.0003	0.0018
Composite Emission Factors (g/mi):						
Lead:	0.0000	0.0000	0.0000	0.0000	------	------
GASPM:	0.0046	0.0046	0.0050	0.0050	------	------
ECARBON:	------	------	------	------	0.1276	0.0418
OCARBON:	------	------	------	------	0.1836	0.0601
SO4:	0.0015	0.0015	0.0016	0.0016	0.0036	0.0060
Total Exhaust PM:	0.0061	0.0061	0.0066	0.0066	0.3148	0.1079
Brake:	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125
Tire:	0.0080	0.0080	0.0080	0.0080	0.0080	0.0080

Total PM:	0.0267	0.0267	0.0272	0.0272	0.3353	0.1285
SO2:	0.0262	0.0262	0.0342	0.0342	0.0694	0.1153
NH3:	0.1000	0.1000	0.0990	0.0990	0.0068	0.0068

Veh. Type:	HDGV2B	HDGV3	HDGV4	HDGV5	HDGV6	HDGV7	HDGV8A	HDGV8B
VMT Mix:	0.0293	0.0010	0.0004	0.0012	0.0025	0.0010	0.0000	0.0000

Composite Emission Factors (g/mi):

Lead:	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
GASPM:	0.0580	0.0636	0.0709	0.0577	0.0568	0.0581	0.0598	0.0000
ECARBON:	------	------	------	------	------	------	------	------
OCARBON:	------	------	------	------	------	------	------	------
SO4:	0.0036	0.0035	0.0022	0.0024	0.0024	0.0024	0.0022	0.0000
Total Exhaust PM:	0.0616	0.0671	0.0731	0.0602	0.0593	0.0605	0.0620	0.0000
Brake:	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0000
Tire:	0.0080	0.0120	0.0120	0.0120	0.0120	0.0120	0.0360	0.0000
Total PM:	0.0822	0.0917	0.0976	0.0847	0.0838	0.0851	0.1106	0.0000
SO2:	0.0486	0.0526	0.0542	0.0619	0.0613	0.0669	0.0710	0.0000
NH3:	0.0451	0.0451	0.0451	0.0451	0.0451	0.0451	0.0451	0.0000

Veh. Type:	HDDV2B	HDDV3	HDDV4	HDDV5	HDDV6	HDDV7	HDDV8A	HDDV8B
VMT Mix:	0.0092	0.0028	0.0030	0.0014	0.0071	0.0103	0.0124	0.0438

Composite Emission Factors (g/mi):

Lead:	------	------	------	------	------	------	------	------
GASPM:	------	------	------	------	------	------	------	------
ECARBON:	0.0636	0.0556	0.0564	0.0525	0.1240	0.1257	0.1541	0.2210
OCARBON:	0.0662	0.0579	0.0587	0.0546	0.0974	0.0988	0.1211	0.0698
SO4:	0.0107	0.0118	0.0135	0.0139	0.0158	0.0182	0.0209	0.0219
Total Exhaust PM:	0.1405	0.1252	0.1286	0.1210	0.2371	0.2427	0.2961	0.3127
Brake:	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125
Tire:	0.0080	0.0120	0.0120	0.0120	0.0120	0.0120	0.0360	0.0360
Total PM:	0.1610	0.1498	0.1531	0.1455	0.2616	0.2672	0.3446	0.3613
SO2:	0.1522	0.1686	0.1924	0.1985	0.2252	0.2597	0.2983	0.3134
NH3:	0.0270	0.0270	0.0270	0.0270	0.0270	0.0270	0.0270	0.0270

Veh. Type:	GasBUS	URBAN	SCHOOL
VMT Mix:	0.0002	0.0009	0.0017

Composite Emission Factors (g/mi):

Lead:	0.0000	------	------
GASPM:	0.1366	------	------
ECARBON:	------	0.3119	0.3293
OCARBON:	------	0.2451	0.2588
SO4:	0.0011	0.0318	0.0221
Total Exhaust PM:	0.1377	0.5888	0.6102
Brake:	0.0125	0.0125	0.0125
Tire:	0.0120	0.0120	0.0120

Total PM:	0.1622	0.6133	0.6347
SO2:	0.0788	0.4545	0.3153
NH3:	0.0451	0.0270	0.0270

MOBILE6.2 Output File for I/M scenario: PM2.5

```
**************************************************************************
* MOBILE6.2.03 (24-Sep-2003)                                             *
* Input file: PM05INV\TEST\PM25.IN (file 1, run 1).                      *
**************************************************************************

* # # # # # # # # # # # # # # # # # # # # # # # # #
* I/M Scenario
* File 1, Run 1, Scenario 1.
* # # # # # # # # # # # # # # # # # # # # # # # # #

                              Calendar Year:  2005
                                      Month:  July
               Gasoline Fuel Sulfur Content:   90. ppm
                 Diesel Fuel Sulfur Content:  309. ppm
                       Particle Size Cutoff:  2.50 Microns
                           Reformulated Gas:  Yes

       Vehicle Type:     LDGV    LDGT12    LDGT34      LDGT      HDGV      LDDV      LDDT      HDDV        MC   All Veh
               GVWR:              <6000     >6000     (All)
                       ------    ------    ------    ------    ------    ------    ------    ------    ------    ------
   VMT Distribution:   0.4132    0.3281    0.1227              0.0357    0.0008    0.0021    0.0926    0.0048    1.0000
 ------------------------------------------------------------------------------------------------------------------------
 Composite Emission Factors (g/mi):
               Lead:   0.0000    0.0000    0.0000    0.0000    0.0000    ------    ------    ------    0.0000    0.0000
              GASPM:   0.0038    0.0042    0.0045    0.0043    0.0511    ------    ------    ------    0.0142    0.0054
            ECARBON:   ------    ------    ------    ------    ------    0.1306    0.0493    0.1550    ------    0.0146
            OCARBON:   ------    ------    ------    ------    ------    0.0368    0.0709    0.0791    ------    0.0075
                SO4:   0.0010    0.0015    0.0016    0.0016    0.0034    0.0037    0.0057    0.0192    0.0003    0.0030
   Total Exhaust PM:   0.0048    0.0057    0.0061    0.0058    0.0545    0.1711    0.1259    0.2532    0.0145    0.0305
              Brake:   0.0053    0.0053    0.0053    0.0053    0.0053    0.0053    0.0053    0.0053    0.0053    0.0053
               Tire:   0.0020    0.0020    0.0020    0.0020    0.0022    0.0020    0.0020    0.0065    0.0010    0.0024
           Total PM:   0.0122    0.0131    0.0135    0.0132    0.0621    0.1785    0.1332    0.2651    0.0209    0.0383
                SO2:   0.0204    0.0262    0.0342    0.0284    0.0508    0.0700    0.1090    0.2741    0.0098    0.0488
                NH3:   0.1015    0.1000    0.0990    0.0998    0.0451    0.0068    0.0068    0.0270    0.0113    0.0911
 ------------------------------------------------------------------------------------------------------------------------
          Veh. Type:    LDGT1     LDGT2     LDGT3     LDGT4    LDDT12    LDDT34
                       ------    ------    ------    ------    ------    ------
            VMT Mix:   0.0758    0.2523    0.0840    0.0386    0.0003    0.0018
 ------------------------------------------------------------------------------------------------------------------------
 Composite Emission Factors (g/mi):
               Lead:   0.0000    0.0000    0.0000    0.0000    ------    ------
              GASPM:   0.0042    0.0042    0.0045    0.0045    ------    ------
            ECARBON:   ------    ------    ------    ------    0.1174    0.0384
            OCARBON:   ------    ------    ------    ------    0.1689    0.0553
                SO4:   0.0015    0.0015    0.0016    0.0016    0.0036    0.0060
   Total Exhaust PM:   0.0057    0.0057    0.0061    0.0061    0.2899    0.0998
              Brake:   0.0053    0.0053    0.0053    0.0053    0.0053    0.0053
```

Tire:	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020
Total PM:	0.0131	0.0131	0.0135	0.0135	0.2972	0.1071
SO2:	0.0262	0.0262	0.0342	0.0342	0.0694	0.1153
NH3:	0.1000	0.1000	0.0990	0.0990	0.0068	0.0068

Veh. Type:	HDGV2B	HDGV3	HDGV4	HDGV5	HDGV6	HDGV7	HDGV8A	HDGV8B
VMT Mix:	0.0293	0.0010	0.0004	0.0012	0.0025	0.0010	0.0000	0.0000

Composite Emission Factors (g/mi):

Lead:	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
GASPM:	0.0512	0.0547	0.0564	0.0481	0.0475	0.0483	0.0491	0.0000
ECARBON:	------	------	------	------	------	------	------	------
OCARBON:	------	------	------	------	------	------	------	------
SO4:	0.0036	0.0035	0.0022	0.0024	0.0024	0.0024	0.0022	0.0000
Total Exhaust PM:	0.0547	0.0583	0.0586	0.0505	0.0500	0.0507	0.0513	0.0000
Brake:	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0000
Tire:	0.0020	0.0030	0.0030	0.0030	0.0030	0.0030	0.0090	0.0000
Total PM:	0.0621	0.0666	0.0670	0.0589	0.0583	0.0591	0.0657	0.0000
SO2:	0.0486	0.0526	0.0542	0.0619	0.0613	0.0669	0.0710	0.0000
NH3:	0.0451	0.0451	0.0451	0.0451	0.0451	0.0451	0.0451	0.0000

Veh. Type:	HDDV2B	HDDV3	HDDV4	HDDV5	HDDV6	HDDV7	HDDV8A	HDDV8B
VMT Mix:	0.0092	0.0028	0.0030	0.0014	0.0071	0.0103	0.0124	0.0438

Composite Emission Factors (g/mi):

Lead:	------	------	------	------	------	------	------	------
GASPM:	------	------	------	------	------	------	------	------
ECARBON:	0.0585	0.0511	0.0519	0.0483	0.1140	0.1157	0.1418	0.2033
OCARBON:	0.0609	0.0532	0.0540	0.0502	0.0896	0.0909	0.1114	0.0642
SO4:	0.0107	0.0118	0.0135	0.0139	0.0158	0.0182	0.0209	0.0219
Total Exhaust PM:	0.1301	0.1162	0.1194	0.1124	0.2194	0.2247	0.2741	0.2895
Brake:	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053
Tire:	0.0020	0.0030	0.0030	0.0030	0.0030	0.0030	0.0090	0.0090
Total PM:	0.1374	0.1245	0.1277	0.1207	0.2277	0.2330	0.2884	0.3038
SO2:	0.1522	0.1686	0.1924	0.1985	0.2252	0.2597	0.2983	0.3134
NH3:	0.0270	0.0270	0.0270	0.0270	0.0270	0.0270	0.0270	0.0270

Veh. Type:	GasBUS	URBAN	SCHOOL
VMT Mix:	0.0002	0.0009	0.0017

Composite Emission Factors (g/mi):

Lead:	0.0000	------	------
GASPM:	0.0984	------	------
ECARBON:	------	0.2870	0.3030
OCARBON:	------	0.2255	0.2381
SO4:	0.0011	0.0318	0.0221
Total Exhaust PM:	0.0995	0.5442	0.5631
Brake:	0.0053	0.0053	0.0053

Tire:	0.0030	0.0030	0.0030
Total PM:	0.1079	0.5525	0.5715
SO2:	0.0788	0.4545	0.3153
NH3:	0.0451	0.0270	0.0270

MOBILE6.2 Output File for I/M scenario: NOx

```
***************************************************************************
* MOBILE6.2.03 (24-Sep-2003)                                              *
* Input file: PM05INV\TEST\PM10.IN (file 1, run 1).                       *
***************************************************************************

* Reading non-default I/M CUTPOINTS from the following external
* data file: CUTPNT05.D

* Reading Registration Distributions from the following external
* data file: 02REG05.D


* # # # # # # # # # # # # # # # # # # # # # # # # #
* I/M Scenario
* File 1, Run 1, Scenario 1.
* # # # # # # # # # # # # # # # # # # # # # # # # #

* Reading PM Gas Carbon ZML Levels
* from the external data file PMGZML.CSV

* Reading PM Gas Carbon DR1 Levels
* from the external data file PMGDR1.CSV

* Reading PM Gas Carbon DR2 Levels
* from the external data file PMGDR2.CSV

* Reading PM Diesel Zero Mile Levels
* from the external data file PMDZML.CSV

* Reading the First PM Deterioration Rates
* from the external data file PMDDR1.CSV

* Reading the Second PM Deterioration Rates
* from the external data file PMDDR2.CSV
  M616 Comment:
               User has supplied post-1999 sulfur levels.
*** I/M credits for Tech1&2 vehicles were read from the following external
    data file: TECH12.D
  M 48 Warning:
              there are no sales for vehicle class HDGV8b

* Reading Ammonia (NH3) Basic Emissiion Rates
* from the external data file PMNH3BER.D

* Reading Ammonia (NH3) Sulfur Deterioration Rates
* from the external data file PMNH3SDR.D

                    Calendar Year:  2005
```

Month: July
Altitude: Low
Minimum Temperature: 56.0 (F)
Maximum Temperature: 97.0 (F)
Absolute Humidity: 75. grains/lb
Fuel Sulfur Content: 90. ppm

Exhaust I/M Program: Yes
Evap I/M Program: Yes
ATP Program: Yes
Reformulated Gas: Yes

Vehicle Type:	LDGV	LDGT12	LDGT34	LDGT	HDGV	LDDV	LDDT	HDDV	MC	All Veh
GVWR:		<6000	>6000	(All)						
VMT Distribution:	0.4132	0.3281	0.1227		0.0357	0.0008	0.0021	0.0926	0.0048	1.0000
Composite Emission Factors (g/mi):										
Composite VOC :	0.913	1.099	1.406	1.183	1.353	0.731	0.817	0.500	3.45	1.024
Composite CO :	9.53	11.89	13.47	12.32	10.33	1.814	1.411	2.588	16.33	10.185
Composite NOX :	0.757	0.975	1.314	1.067	4.183	1.563	1.365	11.251	1.24	1.995

Veh. Type:	LDGT1	LDGT2	LDGT3	LDGT4	LDDT12	LDDT34
VMT Mix:	0.0758	0.2523	0.0840	0.0386	0.0003	0.0018
Composite Emission Factors (g/mi):						
Composite VOC :	1.058	1.111	1.388	1.445	2.635	0.528
Composite CO :	11.37	12.05	13.36	13.69	4.615	0.902
Composite NOX :	0.779	1.034	1.191	1.581	2.736	1.147

Veh. Type:	HDGV2B	HDGV3	HDGV4	HDGV5	HDGV6	HDGV7	HDGV8A	HDGV8B
VMT Mix:	0.0293	0.0010	0.0004	0.0012	0.0025	0.0010	0.0000	0.0000
Composite Emission Factors (g/mi):								
Composite VOC :	1.244	1.638	2.594	1.701	1.628	1.864	2.200	0.000
Composite CO :	9.23	16.42	20.97	12.46	11.88	14.73	16.50	0.00
Composite NOX :	4.021	4.440	4.766	4.841	4.785	5.372	5.957	0.000

Veh. Type:	HDDV2B	HDDV3	HDDV4	HDDV5	HDDV6	HDDV7	HDDV8A	HDDV8B
VMT Mix:	0.0092	0.0028	0.0030	0.0014	0.0071	0.0103	0.0124	0.0438
Composite Emission Factors (g/mi):								
Composite VOC :	0.230	0.251	0.297	0.319	0.441	0.545	0.501	0.583
Composite CO :	0.958	1.122	1.281	1.373	1.566	1.954	2.780	3.381
Composite NOX :	3.996	4.443	5.286	5.642	7.711	9.578	12.217	14.339

Veh. Type:	GasBUS	URBAN	SCHOOL

```
            VMT Mix:    0.0002    0.0009    0.0017
-----------------------------------------------------------------------------------------------------------------------
 Composite Emission Factors (g/mi):
    Composite VOC :     5.426     0.534     0.695
    Composite CO  :    65.48      4.518     2.329
    Composite NOX :     7.827    17.002    11.940
-----------------------------------------------------------------------------------------------------------------------
```

MOBILE6.2 Output File for no I/M scenario: PM10, SOx, and NH_3

```
*************************************************************************
* MOBILE6.2.03 (24-Sep-2003)                                            *
* Input file: PM05INV\TEST\PM10N.IN (file 1, run 1).                    *
*************************************************************************

* # # # # # # # # # # # # # # # # # # # # # # # # #
* I/M Scenario
* File 1, Run 1, Scenario 1.
* # # # # # # # # # # # # # # # # # # # # # # # # #

                              Calendar Year:  2005
                                      Month:  July
               Gasoline Fuel Sulfur Content:   90. ppm
                 Diesel Fuel Sulfur Content:  309. ppm
                       Particle Size Cutoff: 10.00 Microns
                           Reformulated Gas:  Yes
```

Vehicle Type:	LDGV	LDGT12	LDGT34	LDGT	HDGV	LDDV	LDDT	HDDV	MC	All Veh
GVWR:		<6000	>6000	(All)						
VMT Distribution:	0.4132	0.3281	0.1227		0.0357	0.0008	0.0021	0.0926	0.0048	1.0000
Composite Emission Factors (g/mi):										
Lead:	0.0000	0.0000	0.0000	0.0000	0.0000	------	------	------	0.0000	0.0000
GASPM:	0.0042	0.0046	0.0050	0.0047	0.0587	------	------	------	0.0205	0.0060
ECARBON:	------	------	------	------	------	0.1420	0.0536	0.1685	------	0.0158
OCARBON:	------	------	------	------	------	0.0401	0.0771	0.0859	------	0.0081
SO4:	0.0010	0.0015	0.0016	0.0016	0.0034	0.0037	0.0057	0.0192	0.0003	0.0030
Total Exhaust PM:	0.0052	0.0061	0.0066	0.0063	0.0621	0.1857	0.1363	0.2736	0.0208	0.0331
Brake:	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125
Tire:	0.0080	0.0080	0.0080	0.0080	0.0087	0.0080	0.0080	0.0262	0.0040	0.0097
Total PM:	0.0257	0.0267	0.0272	0.0268	0.0833	0.2063	0.1569	0.3123	0.0374	0.0553
SO2:	0.0204	0.0262	0.0342	0.0284	0.0508	0.0700	0.1090	0.2741	0.0098	0.0488
NH3:	0.1015	0.1000	0.0990	0.0998	0.0451	0.0068	0.0068	0.0270	0.0113	0.0911

Veh. Type:	LDGT1	LDGT2	LDGT3	LDGT4	LDDT12	LDDT34
VMT Mix:	0.0758	0.2523	0.0840	0.0386	0.0003	0.0018
Composite Emission Factors (g/mi):						
Lead:	0.0000	0.0000	0.0000	0.0000	------	------
GASPM:	0.0046	0.0046	0.0050	0.0050	------	------
ECARBON:	------	------	------	------	0.1276	0.0418
OCARBON:	------	------	------	------	0.1836	0.0601
SO4:	0.0015	0.0015	0.0016	0.0016	0.0036	0.0060
Total Exhaust PM:	0.0061	0.0061	0.0066	0.0066	0.3148	0.1079
Brake:	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125
Tire:	0.0080	0.0080	0.0080	0.0080	0.0080	0.0080
Total PM:	0.0267	0.0267	0.0272	0.0272	0.3353	0.1285

SO2:	0.0262	0.0262	0.0342	0.0342	0.0694	0.1153
NH3:	0.1000	0.1000	0.0990	0.0990	0.0068	0.0068

Veh. Type:	HDGV2B	HDGV3	HDGV4	HDGV5	HDGV6	HDGV7	HDGV8A	HDGV8B
VMT Mix:	0.0293	0.0010	0.0004	0.0012	0.0025	0.0010	0.0000	0.0000

Composite Emission Factors (g/mi):

Lead:	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
GASPM:	0.0580	0.0636	0.0709	0.0577	0.0568	0.0581	0.0598	0.0000
ECARBON:	------	------	------	------	------	------	------	------
OCARBON:	------	------	------	------	------	------	------	------
SO4:	0.0036	0.0035	0.0022	0.0024	0.0024	0.0024	0.0022	0.0000
Total Exhaust PM:	0.0616	0.0671	0.0731	0.0602	0.0593	0.0605	0.0620	0.0000
Brake:	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0000
Tire:	0.0080	0.0120	0.0120	0.0120	0.0120	0.0120	0.0360	0.0000
Total PM:	0.0822	0.0917	0.0976	0.0847	0.0838	0.0851	0.1106	0.0000
SO2:	0.0486	0.0526	0.0542	0.0619	0.0613	0.0669	0.0710	0.0000
NH3:	0.0451	0.0451	0.0451	0.0451	0.0451	0.0451	0.0451	0.0000

Veh. Type:	HDDV2B	HDDV3	HDDV4	HDDV5	HDDV6	HDDV7	HDDV8A	HDDV8B
VMT Mix:	0.0092	0.0028	0.0030	0.0014	0.0071	0.0103	0.0124	0.0438

Composite Emission Factors (g/mi):

Lead:	------	------	------	------	------	------	------	------
GASPM:	------	------	------	------	------	------	------	------
ECARBON:	0.0636	0.0556	0.0564	0.0525	0.1240	0.1257	0.1541	0.2210
OCARBON:	0.0662	0.0579	0.0587	0.0546	0.0974	0.0988	0.1211	0.0698
SO4:	0.0107	0.0118	0.0135	0.0139	0.0158	0.0182	0.0209	0.0219
Total Exhaust PM:	0.1405	0.1252	0.1286	0.1210	0.2371	0.2427	0.2961	0.3127
Brake:	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125	0.0125
Tire:	0.0080	0.0120	0.0120	0.0120	0.0120	0.0120	0.0360	0.0360
Total PM:	0.1610	0.1498	0.1531	0.1455	0.2616	0.2672	0.3446	0.3613
SO2:	0.1522	0.1686	0.1924	0.1985	0.2252	0.2597	0.2983	0.3134
NH3:	0.0270	0.0270	0.0270	0.0270	0.0270	0.0270	0.0270	0.0270

Veh. Type:	GasBUS	URBAN	SCHOOL
VMT Mix:	0.0002	0.0009	0.0017

Composite Emission Factors (g/mi):

Lead:	0.0000	------	------
GASPM:	0.1366	------	------
ECARBON:	------	0.3119	0.3293
OCARBON:	------	0.2451	0.2588
SO4:	0.0011	0.0318	0.0221
Total Exhaust PM:	0.1377	0.5888	0.6102
Brake:	0.0125	0.0125	0.0125
Tire:	0.0120	0.0120	0.0120
Total PM:	0.1622	0.6133	0.6347

SO2:	0.0788	0.4545	0.3153
NH3:	0.0451	0.0270	0.0270

MOBILE6.2 Output File for no I/M scenario: PM2.5

```
*************************************************************************
* MOBILE6.2.03 (24-Sep-2003)                                            *
* Input file: PM05INV\TEST\PM25N.IN (file 1, run 1).                    *
*************************************************************************

* # # # # # # # # # # # # # # # # # # # # # # # # #
* I/M Scenario
* File 1, Run 1, Scenario 1.
* # # # # # # # # # # # # # # # # # # # # # # # # #

                    Calendar Year:  2005
                            Month:  July
       Gasoline Fuel Sulfur Content:   90. ppm
         Diesel Fuel Sulfur Content:  309. ppm
              Particle Size Cutoff:  2.50 Microns
                  Reformulated Gas:  Yes
```

Vehicle Type:	LDGV	LDGT12	LDGT34	LDGT	HDGV	LDDV	LDDT	HDDV	MC	All Veh
GVWR:		<6000	>6000	(All)						
VMT Distribution:	0.4132	0.3281	0.1227		0.0357	0.0008	0.0021	0.0926	0.0048	1.0000
Composite Emission Factors (g/mi):										
Lead:	0.0000	0.0000	0.0000	0.0000	0.0000	------	------	------	0.0000	0.0000
GASPM:	0.0038	0.0042	0.0045	0.0043	0.0511	------	------	------	0.0142	0.0054
ECARBON:	------	------	------	------	------	0.1306	0.0493	0.1550	------	0.0146
OCARBON:	------	------	------	------	------	0.0368	0.0709	0.0791	------	0.0075
SO4:	0.0010	0.0015	0.0016	0.0016	0.0034	0.0037	0.0057	0.0192	0.0003	0.0030
Total Exhaust PM:	0.0048	0.0057	0.0061	0.0058	0.0545	0.1711	0.1259	0.2532	0.0145	0.0305
Brake:	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053
Tire:	0.0020	0.0020	0.0020	0.0020	0.0022	0.0020	0.0020	0.0065	0.0010	0.0024
Total PM:	0.0122	0.0131	0.0135	0.0132	0.0621	0.1785	0.1332	0.2651	0.0209	0.0383
SO2:	0.0204	0.0262	0.0342	0.0284	0.0508	0.0700	0.1090	0.2741	0.0098	0.0488
NH3:	0.1015	0.1000	0.0990	0.0998	0.0451	0.0068	0.0068	0.0270	0.0113	0.0911

Veh. Type:	LDGT1	LDGT2	LDGT3	LDGT4	LDDT12	LDDT34
VMT Mix:	0.0758	0.2523	0.0840	0.0386	0.0003	0.0018
Composite Emission Factors (g/mi):						
Lead:	0.0000	0.0000	0.0000	0.0000	------	------
GASPM:	0.0042	0.0042	0.0045	0.0045	------	------
ECARBON:	------	------	------	------	0.1174	0.0384
OCARBON:	------	------	------	------	0.1689	0.0553
SO4:	0.0015	0.0015	0.0016	0.0016	0.0036	0.0060
Total Exhaust PM:	0.0057	0.0057	0.0061	0.0061	0.2899	0.0998
Brake:	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053
Tire:	0.0020	0.0020	0.0020	0.0020	0.0020	0.0020
Total PM:	0.0131	0.0131	0.0135	0.0135	0.2972	0.1071

SO2:	0.0262	0.0262	0.0342	0.0342	0.0694	0.1153
NH3:	0.1000	0.1000	0.0990	0.0990	0.0068	0.0068

Veh. Type:	HDGV2B	HDGV3	HDGV4	HDGV5	HDGV6	HDGV7	HDGV8A	HDGV8B
VMT Mix:	0.0293	0.0010	0.0004	0.0012	0.0025	0.0010	0.0000	0.0000

Composite Emission Factors (g/mi):

Lead:	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
GASPM:	0.0512	0.0547	0.0564	0.0481	0.0475	0.0483	0.0491	0.0000
ECARBON:	------	------	------	------	------	------	------	------
OCARBON:	------	------	------	------	------	------	------	------
SO4:	0.0036	0.0035	0.0022	0.0024	0.0024	0.0024	0.0022	0.0000
Total Exhaust PM:	0.0547	0.0583	0.0586	0.0505	0.0500	0.0507	0.0513	0.0000
Brake:	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0000
Tire:	0.0020	0.0030	0.0030	0.0030	0.0030	0.0030	0.0090	0.0000
Total PM:	0.0621	0.0666	0.0670	0.0589	0.0583	0.0591	0.0657	0.0000
SO2:	0.0486	0.0526	0.0542	0.0619	0.0613	0.0669	0.0710	0.0000
NH3:	0.0451	0.0451	0.0451	0.0451	0.0451	0.0451	0.0451	0.0000

Veh. Type:	HDDV2B	HDDV3	HDDV4	HDDV5	HDDV6	HDDV7	HDDV8A	HDDV8B
VMT Mix:	0.0092	0.0028	0.0030	0.0014	0.0071	0.0103	0.0124	0.0438

Composite Emission Factors (g/mi):

Lead:	------	------	------	------	------	------	------	------
GASPM:	------	------	------	------	------	------	------	------
ECARBON:	0.0585	0.0511	0.0519	0.0483	0.1140	0.1157	0.1418	0.2033
OCARBON:	0.0609	0.0532	0.0540	0.0502	0.0896	0.0909	0.1114	0.0642
SO4:	0.0107	0.0118	0.0135	0.0139	0.0158	0.0182	0.0209	0.0219
Total Exhaust PM:	0.1301	0.1162	0.1194	0.1124	0.2194	0.2247	0.2741	0.2895
Brake:	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053	0.0053
Tire:	0.0020	0.0030	0.0030	0.0030	0.0030	0.0030	0.0090	0.0090
Total PM:	0.1374	0.1245	0.1277	0.1207	0.2277	0.2330	0.2884	0.3038
SO2:	0.1522	0.1686	0.1924	0.1985	0.2252	0.2597	0.2983	0.3134
NH3:	0.0270	0.0270	0.0270	0.0270	0.0270	0.0270	0.0270	0.0270

Veh. Type:	GasBUS	URBAN	SCHOOL
VMT Mix:	0.0002	0.0009	0.0017

Composite Emission Factors (g/mi):

Lead:	0.0000	------	------
GASPM:	0.0984	------	------
ECARBON:	------	0.2870	0.3030
OCARBON:	------	0.2255	0.2381
SO4:	0.0011	0.0318	0.0221
Total Exhaust PM:	0.0995	0.5442	0.5631
Brake:	0.0053	0.0053	0.0053
Tire:	0.0030	0.0030	0.0030
Total PM:	0.1079	0.5525	0.5715

SO2:	0.0788	0.4545	0.3153
NH3:	0.0451	0.0270	0.0270

MOBILE6.2 Output File for no I/M scenario: NOx

```
***************************************************************************
* MOBILE6.2.03 (24-Sep-2003)                                              *
* Input file: PM05INV\TEST\PM10N.IN (file 1, run 1).                      *
***************************************************************************

* Reading Registration Distributions from the following external
* data file: 02REG05.D
* # # # # # # # # # # # # # # # # # # # # # # # # #
* I/M Scenario
* File 1, Run 1, Scenario 1.
* # # # # # # # # # # # # # # # # # # # # # # # # #

* Reading PM Gas Carbon ZML Levels
* from the external data file PMGZML.CSV

* Reading PM Gas Carbon DR1 Levels
* from the external data file PMGDR1.CSV

* Reading PM Gas Carbon DR2 Levels
* from the external data file PMGDR2.CSV

* Reading PM Diesel Zero Mile Levels
* from the external data file PMDZML.CSV

* Reading the First PM Deterioration Rates
* from the external data file PMDDR1.CSV

* Reading the Second PM Deterioration Rates
* from the external data file PMDDR2.CSV
  M616 Comment:
             User has supplied post-1999 sulfur levels.
  M 48 Warning:
            there are no sales for vehicle class HDGV8b

* Reading Ammonia (NH3) Basic Emissiion Rates
* from the external data file PMNH3BER.D

* Reading Ammonia (NH3) Sulfur Deterioration Rates
* from the external data file PMNH3SDR.D

                    Calendar Year:  2005
                            Month:  July
                         Altitude:  Low
              Minimum Temperature:  56.0 (F)
              Maximum Temperature:  97.0 (F)
                Absolute Humidity:   75. grains/lb
              Fuel Sulfur Content:   90. ppm
```

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

Vehicle Type:	LDGV	LDGT12	LDGT34	LDGT	HDGV	LDDV	LDDT	HDDV	MC	All Veh
GVWR:		<6000	>6000	(All)						
VMT Distribution:	0.4132	0.3281	0.1227		0.0357	0.0008	0.0021	0.0926	0.0048	1.0000
Composite Emission Factors (g/mi):										
Composite VOC :	1.009	1.213	1.526	1.298	1.414	0.731	0.817	0.500	3.45	1.118
Composite CO :	11.30	13.64	15.43	14.13	11.63	1.814	1.411	2.588	16.33	11.774
Composite NOX :	0.863	1.083	1.420	1.175	4.214	1.563	1.365	11.251	1.24	2.088

Veh. Type:	LDGT1	LDGT2	LDGT3	LDGT4	LDDT12	LDDT34
VMT Mix:	0.0758	0.2523	0.0840	0.0386	0.0003	0.0018
Composite Emission Factors (g/mi):						
Composite VOC :	1.184	1.222	1.510	1.562	2.635	0.528
Composite CO :	13.25	13.76	15.36	15.58	4.615	0.902
Composite NOX :	0.888	1.141	1.298	1.688	2.736	1.147

Veh. Type:	HDGV2B	HDGV3	HDGV4	HDGV5	HDGV6	HDGV7	HDGV8A	HDGV8B
VMT Mix:	0.0293	0.0010	0.0004	0.0012	0.0025	0.0010	0.0000	0.0000
Composite Emission Factors (g/mi):								
Composite VOC :	1.298	1.724	2.725	1.778	1.702	1.954	2.313	0.000
Composite CO :	10.35	18.72	24.22	14.07	13.40	16.71	18.91	0.00
Composite NOX :	4.052	4.461	4.805	4.875	4.819	5.408	6.007	0.000

Veh. Type:	HDDV2B	HDDV3	HDDV4	HDDV5	HDDV6	HDDV7	HDDV8A	HDDV8B
VMT Mix:	0.0092	0.0028	0.0030	0.0014	0.0071	0.0103	0.0124	0.0438
Composite Emission Factors (g/mi):								
Composite VOC :	0.230	0.251	0.297	0.319	0.441	0.545	0.501	0.583
Composite CO :	0.958	1.122	1.281	1.373	1.566	1.954	2.780	3.381
Composite NOX :	3.996	4.443	5.286	5.642	7.711	9.578	12.217	14.339

Veh. Type:	GasBUS	URBAN	SCHOOL
VMT Mix:	0.0002	0.0009	0.0017
Composite Emission Factors (g/mi):			
Composite VOC :	5.806	0.534	0.695
Composite CO :	76.80	4.518	2.329
Composite NOX :	7.874	17.002	11.940