DRAFT

MAG 2012 FIVE PERCENT PLAN FOR PM-10 FOR THE MARICOPA COUNTY NONATTAINMENT AREA

MARCH 2012

MARICOPA ASSOCIATION of GOVERNMENTS

MAG 2012 FIVE PERCENT PLAN FOR PM-10 FOR THE MARICOPA COUNTY NONATTAINMENT AREA

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MAG 2012 FIVE PERCENT PLAN FOR PM-10 FOR THE MARICOPA COUNTY NONATTAINMENT AREA

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MAG 2012 FIVE PERCENT PLAN FOR PM-10 FOR THE MARICOPA COUNTY NONATTAINMENT AREA

EXECUTIVE SUMMARY

MARICOPA ASSOCIATION of GOVERNMENTS

MAG 2012 FIVE PERCENT PLAN FOR PM-10
EXECUTIVE SUMMARY

Within the Maricopa County nonattainment area, the National Ambient Air Quality Standard has not yet been attained for PM-10 particulate pollution. The area is classified as a Serious Area under the Clean Air Act. The Maricopa Association of Governments (MAG) was designated by the Governor of Arizona in 1978 and recertified by the Arizona Legislature in 1992 to serve as the Regional Air Quality Planning Agency to develop plans to address air pollution problems. The plans are prepared through a coordinated effort with the Arizona Department of Environmental Quality (ADEQ), Arizona Department of Transportation, and Maricopa County Air Quality Department (MCAQD).

To meet the requirements of Section 189 (d) of the Clean Air Act, the MAG 2007 Five Percent Plan for PM-10 was submitted to the Environmental Protection Agency (EPA) by the federal deadline of December 31, 2007. Collectively, the Five Percent Plan included fifty-three control measures from the State, Maricopa County, and local governments. The plan demonstrated that the measures would reduce PM-10 emissions by at least five percent per year and demonstrated attainment of the PM-10 standard in 2010. The region needed three years of clean data at the monitors in 2008, 2009 and 2010 in order for the region to be in attainment of the PM-10 standard in 2010. There have been no violations of the standard during stagnant conditions since the plan was submitted in 2007.

On September 9, 2010, EPA had published a notice of proposed partial approval and disapproval of the plan in the Federal Register. There were two major reasons for the proposed disapproval: the EPA nonconcurrence with four high wind exceptional events at the West 43rd Avenue monitor in 2008 resulted in a violation, which negated the attainment demonstration, and that the 2005 baseline emissions inventory was inaccurate since it overestimated construction and other emissions.

On January 25, 2011, the Arizona Department of Environmental Quality voluntarily withdrew the MAG 2007 Five Percent Plan for PM-10 to address technical approvability issues and include new information, such as the new EPA equation for paved road dust emissions. While the plan was withdrawn, the measures continue to be implemented to reduce PM-10.

Consequently, the MAG 2012 Five Percent Plan for PM-10 has been prepared to meet the requirements in Section 189 (d) of the Clean Air Act and improve air quality in the Maricopa County nonattainment area. The plan is required to reduce PM-10 emissions by at least five percent per year until the standard is attained as measured by the monitors. The Clean Air Act specifies that the plan must be based upon the most recent emissions inventory for the area and also include a modeling demonstration of attainment. The 2012 Five Percent Plan is designed to be a replacement for the 2007 plan that was withdrawn.

The formation of PM-10 particulate pollution is dependent upon several factors. Among

these factors are stagnant air masses, severe temperature inversions in the winter, high winds from thunderstorms and frontal systems, and fine, silty soils characteristic of desert locations. In the nonattainment area, high PM-10 concentrations generally occur in September through March, on days with stagnant or near-stagnant conditions. High PM-10 concentrations can also occur during thunderstorm outflows and frontal systems which create high winds that entrain soil particles from bare surfaces.

The trend in PM-10 levels for the Maricopa County nonattainment area is presented in Figure ES-1. The 24-hour PM-10 standard is 150 micrograms per cubic meter. In 2008, there were 11 exceedance days of the 24-hour standard. Most of these exceedances were exceptional events. However, EPA did not concur with four high wind exceptional event days at the West 43rd Avenue monitor in 2008, resulting in a violation of the PM-10 standard. All of the seven exceedance days in 2009 have been flagged as exceptional events and EPA concurrence is pending. In 2010, only one exceedance day of the PM-10 standard occurred, which did not constitute a violation of the standard. Figure ES-2 indicates the monitors where exceedances have occurred.

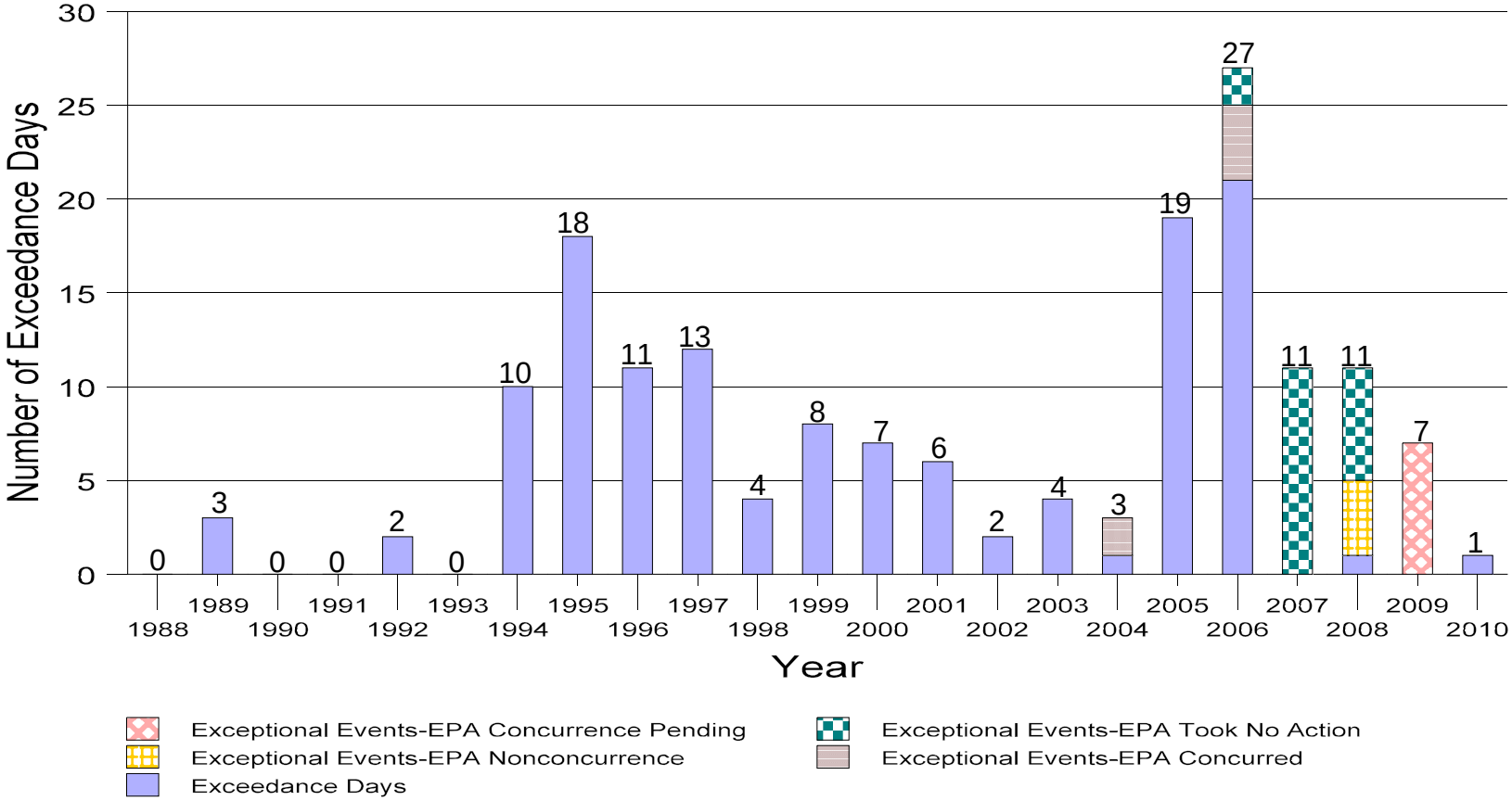
It is important to note that beginning in 2004, the Arizona Department of Environmental Quality began flagging exceptional events. These are uncontrollable natural events (e.g., high winds, wildfires) or human-caused events that are not expected to recur at a given location (e.g., fireworks). The data and a demonstration of the exceptional event are submitted to EPA for concurrence.

Based upon the Maricopa County Air Quality Department 2008 Periodic Emissions Inventory (PEI) for PM-10 for the Maricopa County Nonattainment Area, the primary sources of PM-10 are: Unpaved Road Fugitive Dust - 24 percent; Construction Activities (residential, commercial, road, and other earthmoving) - 17 percent; Paved Road Fugitive Dust - 14 percent; Windblown Dust - 10 percent; and Onroad Mobile Vehicle Exhaust, Tire Wear and Brake Wear - 7 percent. The remaining categories in the inventory individually contribute 6 percent or less to the total annual emissions. The sources are depicted in Figure ES-3.

The 2007 and 2009-2012 base case emissions were derived from the 2008 PEI emissions, using annual population and employment growth factors published in August 2011 by Marshall Vest of the Economic and Business Research Center at the University of Arizona. These projections are based on the 2010 U.S. Census and the latest economic forecasts for the Phoenix-Mesa metropolitan area. Since the economic outlook for Arizona remains extremely unstable, the actual population and employment levels in 2011 and 2012 may differ somewhat from the projections. However, the University of Arizona growth factors represent the most reliable data currently available.

The annual five percent reduction target was calculated by multiplying the total 2007 PM-10 emissions in Table ES-1 (59,218 tons) by five percent, which results in 2,961 tons. To meet the 189(d) requirement, the 2008 emissions must be at least 2,961 tons less than

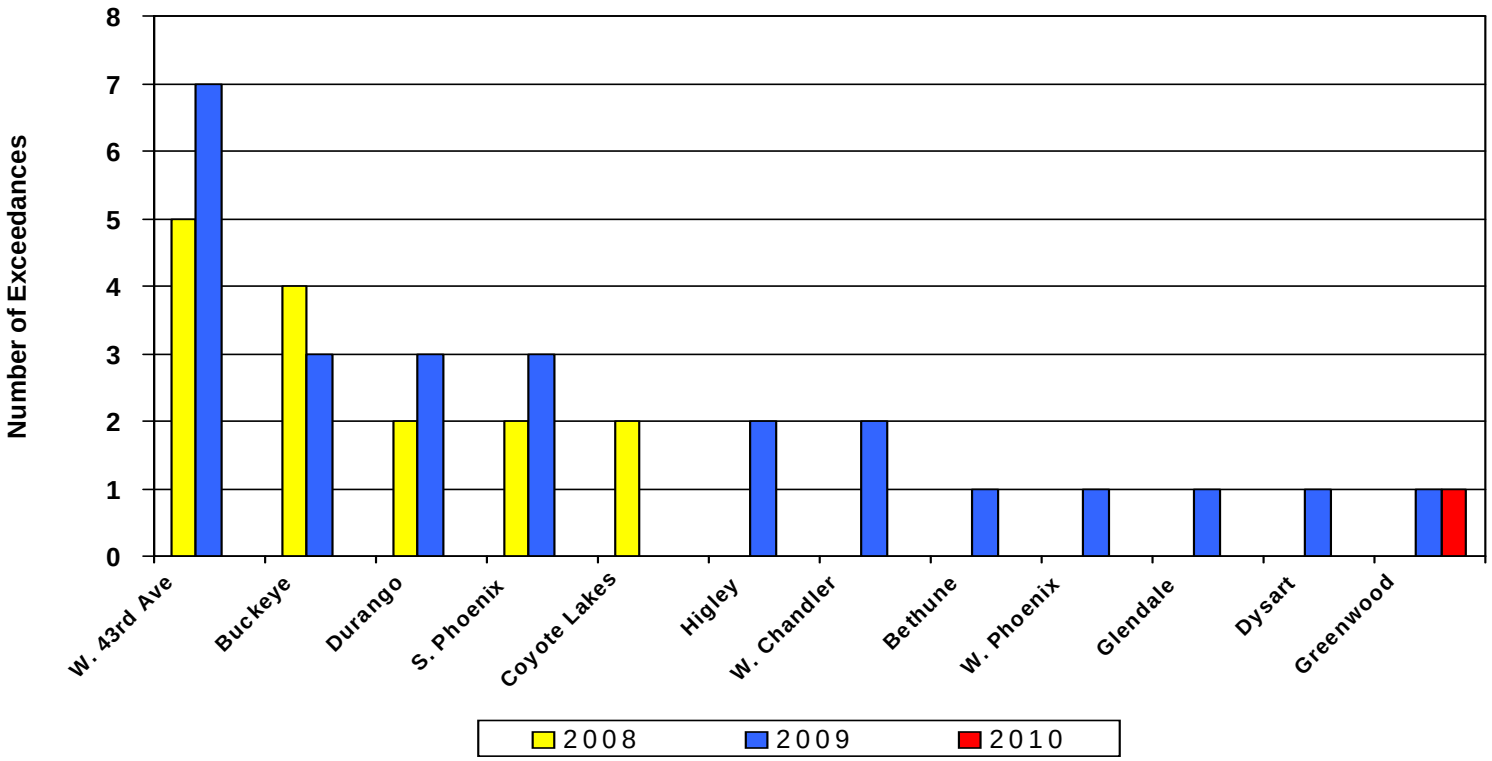
Figure ES-1
Number of 24-Hour PM-10 Exceedance Days



Notes: -The Arizona Department of Environmental Quality began flagging exceptional events in 2004.
-The chart includes exceedance days at the Buckeye monitor, which is located outside the PM-10 nonattainment area.
-On July 19, 2007, the exceedance at the Buckeye monitor was not associated with the exceptional event that also occurred on that day.

Sources: 1988 - 1997 - Revised MAG 1999 Serious Area Particulate Plan for PM-10 for the Maricopa County Nonattainment Area, February 2000.
1998 - 2010 - EPA Air Quality System.

Figure ES-2
Exceedances of the 24-Hour PM-10 Standard at Monitors in Maricopa County

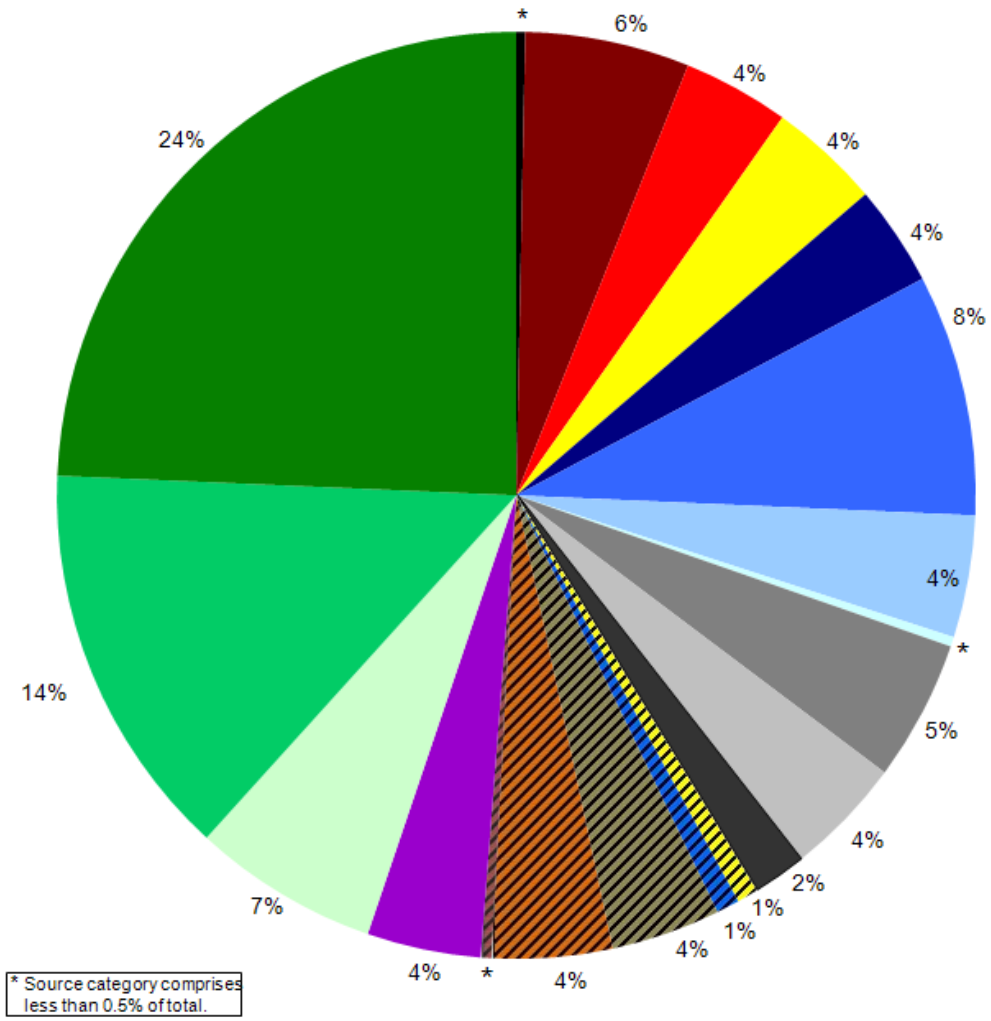


Notes:
1. Exceedances are based on data from the EPA Air Quality System (AQS).
2. All exceedances in 2008 except for one at the Durango Complex monitor have been flagged as exceptional events. EPA did not concur with four exceptional events at the West 43rd Avenue monitor and has not taken action on the remaining events.
3. All exceedances in 2009 have been flagged as exceptional events. EPA concurrence is pending.
4. The one exceedance in 2010 was not flagged as an exceptional event.
5. The chart includes exceedances from the Buckeye monitor, which is outside the PM-10 nonattainment area.

Figure ES-3

2008 PM-10 Emissions Inventory

PM-10 Nonattainment Area Total = 48,148 tons/yr



Source Categories	%
Major stationary point sources	(<0.5%)
All other industrial processes	(6%)
Fuel combustion and fires	(4%)
Agricultural tilling/harvesting	(4%)
Construction, residential	(4%)
Construction, commercial	(8%)
Construction, road	(4%)
Other earthmvg: trenching, weed control	(<0.5%)
Travel on unpaved parking lots	(5%)
Offroad recreational vehicles fugitive dust	(4%)
Leaf blowers fugitive dust	(2%)
Windblown: agricultural land	(1%)
Windblown: developing land	(1%)
Windblown: vacant land	(4%)
Windblown: open areas	(4%)
Windblown: S&G, landfills, test tracks	(<0.5%)
Nonroad mobile sources	(4%)
Vehicle exhaust, tire wear, brake wear	(7%)
Paved road fugitive dust, including trackout	(14%)
Unpaved road fugitive dust	(24%)

Table ES-1
2007-2012 Base Case PM-10 Emissions in the PM-10 Nonattainment Area

Source Category	2007	2008	2009	2010	2011	2012
	(tons/year)					
POINT	159	150	133	127	128	135
AREA						
Fuel combustion	1,276	1,301	1,307	1,311	1,316	1,328
Commercial cooking	974	993	998	1,001	1,005	1,014
Construction (includes windblown dust)	16,672	13,811	9,692	8,359	8,102	8,223
Tilling, harvesting and cotton ginning	936	893	893	893	893	893
Travel on unpaved farm roads	769	731	731	731	731	731
Livestock	261	261	261	261	261	261
Travel on unpaved parking lots	2,376	2,422	2,434	2,441	2,451	2,473
Offroad recreational vehicles	2,139	2,180	2,191	2,198	2,206	2,226
Leaf blowers	878	895	899	902	906	914
Windblown agriculture	448	448	448	448	448	448
Other windblown sources	5,430	5,430	5,430	5,430	5,430	5,430
Fires	497	497	497	497	497	497
Mining/quarrying (includes windblown dust)	752	721	661	641	643	667
Travel on industrial paved/unpaved roads	771	728	645	618	621	654
Other industrial sources	1,033	976	865	828	832	877
NONROAD						
Aircraft	194	184	152	142	143	146
Airport ground support equipment	29	27	23	21	20	20
Locomotives	34	34	34	34	34	34
Other nonroad equipment	1,710	1,683	1,661	1,641	1,595	1,513
ONROAD						
Exhaust	2,943	2,836	2,647	2,371	1,843	1,407
Tire wear	246	256	257	257	258	261
Brake wear	728	758	767	771	773	787
Paved roads	7,749	8,155	8,214	8,289	8,323	8,422
Unpaved roads and alleys	10,218	10,312	10,284	10,284	10,284	10,312
Totals	**59,218**	**56,681**	**52,123**	**50,497**	**49,743**	**49,673**

the 2007 base case emissions. Each year after 2008 imposes yet another 2,961 ton reduction requirement. Thus, the cumulative reduction requirements (relative to 2007 base case emissions) are at least 5,922 tons in 2009, 8,883 tons in 2010, 11,844 tons in 2011, and 14,805 tons in 2012.

The new MAG 2012 Five Percent Plan for PM-10 contains a wide variety of existing control measures and projects that have been implemented to reduce PM-10 and a new measure designed to reduce PM-10 during high risk conditions, including high winds. While the 2007 Five Percent Plan was withdrawn, a wide range of control measures in that plan continue to be implemented to reduce PM-10 and are being resubmitted. Table ES-2 includes the Arizona Statutes, Maricopa County Rules, a Maricopa County Ordinance, and Appendices for the resubmitted measures and a new high risk measure to be approved into the MAG 2012 Five Percent Plan for PM-10 for the Maricopa County Nonattainment Area. The 2012 Five Percent Plan also includes contingency measures that were implemented early such as PM-10 certified street sweeping on freeways and arterials, as well as the projects completed in 2008-2011 that paved and stabilized unpaved roads, alleys and shoulders; reduced speed limits; and overlaid highways with rubberized asphalt.

As described in Table ES-2, the Arizona Statutes, Maricopa County Rules, and Maricopa County Ordinance include requirements to reduce PM-10 emissions from a broad range of sources. The requirements apply to unpaved roads and shoulders, leaf blowers, unpaved parking lots, vacant lots, sweeping streets with certified sweepers, off-road vehicle use, open and recreational burning, residential woodburning, covered vehicle loads, dust generating operations, nonmetallic mineral processing, and other unpermitted sources.

To meet the annual five percent reduction requirement in Section 189 (d) of the Clean Air Act, the MAG 2012 Five Percent Plan takes credit for increases in rule effectiveness for Maricopa County Rules 310 (Fugitive Dust from Dust-Generating Operations), 310.01 (Fugitive Dust from Non-Traditional Sources of Fugitive Dust) and 316 (Nonmetallic Mineral Processing). The increases in rule effectiveness are attributable to strengthened enforcement and increased compliance with these rules. EPA has approved Rules 310 and 310.01 in 2010 and Rule 316 in 2009, as part of the State Implementation Plan. Compliance with these rules has increased every year since 2007.

These Maricopa County rules also reduce emissions from a wide variety of sources and apply to the Maricopa County area. Maricopa County Rule 310 (Fugitive Dust from Dust-Generating Operations) regulates fugitive dust emissions from sources and activities such as: land clearing, earthmoving, weed abatement, excavating, construction, demolition, bulk material handling, storage and transporting operations, outdoor equipment, motorized machinery, staging areas, parking areas, material storage areas, haul roads, disturbed surface areas, initial landscapes and trackout onto paved surfaces from these sources.

Maricopa County Rule 310.01 (Fugitive Dust from Non-Traditional Sources of Fugitive Dust) regulates fugitive dust emissions from sources and activities such as: vehicle use in

Table ES-2
Arizona Statutes, Maricopa County Rules, Maricopa County Ordinance, and Appendices to be Approved into the MAG 2012 Five Percent Plan for PM-10 for the Maricopa County Nonattainment Area

Arizona Revised Statutes (A.R.S.)	Description	Effective Dates
A.R.S. § 9-500.04. Only A.3., A.5., A.6., A.7., A.8., A.9. and H.	Air quality control; definitions [city and town requirements in Area A regarding targeting unpaved roads and shoulders; leaf blower restrictions; restrictions related to parking, maneuvering, ingress and egress areas and vacant lots; requirement for certified street sweepers]	9/19/07
A.R.S. § 9-500.27.	Off-road vehicle ordinance; applicability; violation; classification	9/19/07
A.R.S. § 11-871. Only A., B. and D.4.	Emissions control; no burn; exemptions; penalty [no burn restriction for any HPA day, increased civil penalty]	9/19/07
A.R.S. § 11-877.	Air quality control measures [county leaf blower restrictions]	9/19/07
A.R.S. § 28-1098. Only A. and C.1.	Vehicle loads; restrictions; civil penalties [for safety or air pollution prevention purpose]	9/19/07
A.R.S. § 49-424. Only 11.	Duties of department [develop and disseminate air quality dust forecasts for the Maricopa County PM-10 nonattainment area]	7/20/11
A.R.S. § 49-457.01.	Leaf blower use restrictions and training; leaf blower equipment sellers; informational material; outreach; applicability	9/19/07
A.R.S. § 49-457.03.	Off-road vehicles; pollution advisory days; applicability; penalties	9/19/07
A.R.S. § 49-457.04.	Off-highway vehicle and all-terrain vehicle dealers; informational material; outreach; applicability	9/19/07
A.R.S. § 49-457.05. Only A., B., C., D. and I.	Dust action general permit; best management practices; applicability; definitions	7/20/11
A.R.S. § 49-474.01. Only A.4., A.5., A.6., A.7., A.8., A.11., B. and H.	Additional board duties in vehicle emissions control areas; definitions [county requirements for stabilization of targeted unpaved roads, alleys and shoulders; restrictions related to parking, maneuvering, ingress and egress areas and vacant lots; requirement for certified street sweepers]	9/19/07
A.R.S. § 49-474.05.	Dust control; training; site coordinators	9/19/07
A.R.S. § 49-474.06.	Dust control; subcontractor registration; fee	9/19/07
A.R.S. § 49-501. Only A.2., B.1., C., F. and G.	Unlawful open burning; exceptions; civil penalty; definitions [ban on outdoor fires from May 1 to September 30; deletion of recreational purpose exemption; no burn day restrictions; penalty provision]	9/19/07
A.R.S. § 49-541. Only 1.	Definitions [Area A]	8/9/01

Table ES-2 Continued

Maricopa County Air Quality Department Rules	Description	Effective Dates
310	Fugitive Dust from Dust-Generating Operations Adopted 1/27/10 and submitted to EPA 4/12/10 [Notice of Final Rulemaking 75 FR 78167; 12/15/10]	EPA approved effective 1/14/11
310.01	Fugitive Dust From Non-Traditional Sources of Fugitive Dust Adopted 1/27/10 and submitted to EPA 4/12/10 [Notice of Final Rulemaking 75 FR 78167; 12/15/10]	EPA approved effective 1/14/11
314	Open Outdoor Fires and Indoor Fireplaces at Commercial and Institutional Establishments Adopted 3/12/08 and submitted to EPA 7/10/08 [Notice of Final Rulemaking 74 FR 57612; 11/9/09]	EPA approved effective 1/8/10
316	Nonmetallic Mineral Processing Adopted 3/12/08 and submitted to EPA 7/10/08 [Notice of Final Rulemaking 74 FR 58553; 11/13/09]	EPA approved effective 1/8/10
Appendix C	Fugitive Dust Test Methods Adopted 3/26/08 and submitted to EPA 7/10/08 [Notice of Final Rulemaking 75 FR 78167; 12/15/10]	EPA approved effective 1/14/11
Maricopa County Ordinance	Description	Effective Dates
P-26	Residential Woodburning Restriction Adopted 3/26/08 and submitted to EPA 7/10/08; [Notice of Final Rulemaking 74 FR 57612; 11/9/09]	EPA approved effective 1/8/10
Appendices	Description	Effective Dates
Appendix C, Exhibit 1	Arizona Revised Statutes Listed in Table 4-1	
Appendix C, Exhibit 2	Maricopa County Resolution to Evaluate Measures in the MAG 2012 Five Percent Plan for PM-10 for the Maricopa County Nonattainment Area	11/16/11
Appendix C, Exhibit 3	Arizona Department of Environmental Quality Dust Action General Permit	12/30/11
Appendix C, Exhibit 4	Arizona Department of Environmental Quality Commitment to Revise the MAG 2012 Five Percent Plan for PM-10 for the Maricopa County Nonattainment Area if Necessary for the Emerging and Voluntary Measure	

open areas and vacant lots, open areas, vacant lots, unpaved parking lots, unpaved roadways (including alleyways), easements, rights-of-way, access roads and trackout onto paved surfaces from these activities.

Maricopa County Rule 316 (Nonmetallic Mineral Processing) regulates fugitive dust and process dust emissions from sources and activities such as: mining, excavating, separating, combining, crushing and grinding any nonmetallic mineral, asphaltic concrete plants, raw material storage and distribution, concrete plants, bagging operations, open storage piles, material handling, haul roads, and trackout onto paved surfaces from these sources.

Emissions reduction credit is also taken for one new measure, the Dust Action General Permit, which was passed by the Arizona Legislature in April 2011. In accordance with A.R.S. § 49-457.05, this Dust Action General Permit identifies a series of Best Management Practices (BMPs) for specific dust generating operations. When ADEQ's Maricopa County Dust Control Forecast predicts that day is at high risk for dust generation, those dust generating operations that are not already required to control dust through a permit issued by the Arizona Department of Environmental Quality or the Maricopa County Air Quality Department are expected to choose and implement at least one BMP to reduce or prevent PM-10 emissions. Implementation of a BMP is expected to occur as soon as practicable before and during the high risk event. Although the BMPs in the Dust Action General Permit only apply to those sources that do not already have a permit, even dust generating operations with an air quality permit are also expected to implement the dust controls in their permit at the same time.

According to state statute, BMPs identified in the Dust Action General Permit are expected to be employed absent the requirement to obtain an air quality permit. If the owner or operator of a dust-generating operation is found by ADEQ's Director to have failed to choose and implement an applicable BMP as soon as practicable before and during a day that is forecast to be at high risk of dust generation, then the owner or operator can be required to obtain an Authorization to Operate under the Dust Action General Permit.

This new measure is expected to raise rule effectiveness for Rule 310.01 by one percent during high wind hours and was fully implemented by January 1, 2012. Credit for this measure is allowed under the EPA guidance, *Incorporating Emerging and Voluntary Measures in a State Implementation Plan*. The measures used to demonstrate the annual five percent reductions are also necessary to model attainment of the PM-10 standard under high wind conditions at all monitors as expeditiously as practicable, which is 2012.

Table ES-3 shows the impact of the increases in rule effectiveness on PM-10 emissions in 2008 through 2012. This table also quantifies the annual five percent reductions for 2008 through 2012. The total reduction in PM-10 emissions between 2007 and 2012 with the increases in rule effectiveness is 16,089 tons, which represents a 27.2 percent reduction in total 2007 base case emissions.

Table ES-3
2008-2012 PM-10 Emissions with Increased Rule Effectiveness

Source Category	2008	2009	2010	2011	2012
	(tons/year)				
POINT	150	133	127	128	135
AREA					
Fuel combustion	1,301	1,307	1,311	1,316	1,328
Commercial cooking	993	998	1,001	1,005	1,014
Construction (includes windblown dust)	8,355	5,333	4,139	4,014	4,073
Tilling, harvesting and cotton ginning	893	893	893	893	893
Travel on unpaved farm roads	731	731	731	731	731
Livestock	261	261	261	261	261
Travel on unpaved parking lots	2,422	2,434	2,441	2,451	2,473
Offroad recreational vehicles	2,180	2,191	2,198	2,206	2,226
Leaf blowers	895	899	902	906	914
Windblown agriculture	448	448	448	448	448
Other windblown sources	3,938	3,788	3,788	3,788	3,639
Fires	497	497	497	497	497
Mining/quarrying (includes windblown dust)	476	401	355	356	369
Travel on industrial paved/unpaved roads	472	382	331	333	351
Other industrial sources	976	865	828	832	877
NONROAD					
Aircraft	184	152	142	143	146
Airport ground support equipment	27	23	21	20	20
Locomotives	34	34	34	34	34
Other nonroad equipment	1,683	1,661	1,641	1,595	1,513
ONROAD					
Exhaust	2,836	2,647	2,371	1,843	1,407
Tire wear	256	257	257	258	261
Brake wear	758	767	771	773	787
Paved roads	8,155	8,214	8,289	8,323	8,422
Unpaved roads and alleys	10,312	10,284	10,284	10,284	10,312
Totals	**49,231**	**45,600**	**44,062**	**43,438**	**43,130**
5% Reduction Targets (tons/year)	**2,961**	**5,922**	**8,883**	**11,844**	**14,805**
Actual Plan Reductions (tons/year)	**9,987**	**13,618**	**15,157**	**15,781**	**16,089**

Table ES-4 confirms that the annual five percent reduction requirements are met in 2008-2012 and there is a surplus margin of benefit in each year. The total surplus in 2012 is 1,284 tons. This surplus is needed to model attainment at all monitors in the PM-10 nonattainment area by December 31, 2012.

In accordance with the Clean Air Act, the MAG 2012 Five Percent Plan for PM-10 also includes contingency measures. The contingency measures are required to achieve emissions reductions beyond those measures relied upon to model attainment of the standard and demonstrate progress toward attainment (five percent reductions, reasonable further progress, and milestones). They are required to be undertaken without further action by the State or the EPA Administrator if the area fails to make reasonable further progress or meet the standard by the attainment date. EPA encourages early implementation of contingency measures to reduce emissions as expeditiously as practicable.

EPA guidance indicates that contingency measures should provide emissions reductions equivalent to one year of reasonable further progress. For the Five Percent Plan, one year of reasonable further progress is equivalent to a reduction in PM-10 emissions of 3,218 tons.

The contingency requirement is met in the MAG 2012 Five Percent Plan by quantifying projects that were completed in 2008-2011. A summary of the miles of roads, alleys and shoulders impacted by the paving and stabilization, speed limit reduction, and rubberized asphalt overlay projects that were quantified to meet the contingency requirement is presented in Table ES-5. These PM-10 reduction projects were implemented in the PM-10 nonattainment area by twenty-one cities and towns, Maricopa County, Pinal County, Arizona Department of Transportation and the Gila River Indian Community. All of the projects for which credit was taken were open to traffic by September 2011.

The emissions reductions for all measures quantified to meet the contingency requirement are summarized in Table ES-6. Table ES-6 includes the benefits of the PM-10 certified street sweeping on freeways and arterials, as well as the projects completed in 2008-2011 that paved and stabilized unpaved roads, alleys and shoulders; reduced speed limits; and overlaid highways with rubberized asphalt. The total PM-10 emissions reduction in 2012 is 3,439 tons, which exceeds the contingency target of 3,218 tons by 221 tons.

The total 2012 PM-10 emissions, with the air quality benefits from the wide variety of control measures and contingency projects applied, are 39,691 tons per year (see Table ES-7). Together, these measures reduce the 2007 base case PM-10 emissions by 19,527 tons or by 33 percent. A pie chart of the 2012 nonattainment area PM-10 emissions with the five percent measures and contingency projects applied is shown in Figure ES-4.

For conformity analyses, the onroad mobile source emissions budget includes reentrained dust from travel on paved roads; vehicular exhaust, tire wear, and brake wear; travel on unpaved roads; and road construction. In 2012, the PM-10 emissions from these four source categories total 54.9 metric tons per day for the PM-10 nonattainment area. This represents the onroad mobile source emissions budget for conformity.

Table ES-4
PM-10 Emission Reductions and Five Percent Reduction Requirements

Year	5% Reduction Requirement (tons/year)	Total PM-10 Emission Reductions due to Increases in Rule Effectiveness (tons/year)	Excess Benefit = Total PM-10 Emission Reductions minus 5% Reduction Requirement (tons/year)	(%)
2008	2,961	9,987	7,026	237%
2009	5,922	13,618	7,696	130%
2010	8,883	15,157	6,274	71%
2011	11,844	15,781	3,937	33%
2012	14,805	16,089	1,284	9%

Table ES-5
Miles of Roads/Alleys/Shoulders in PM-10 Reduction Projects

Miles Impacted by Project Type	2008	2009	2010	2011	Total 2008-2011
Miles of dirt roads paved	41	18	8	16	83
Miles of dirt roads stabilized	39	39	36	31	145
Miles of dirt alleys paved	66	4	0	63	134
Miles of dirt alleys stabilized	164	106	124	106	501
Total miles of roads/alleys paved & stabilized	310	168	168	216	862
Miles of dirt shoulders paved	70	107	49	6	233
Miles of curb and gutter paved	19	0	0	0	19
Miles of dirt shoulders stabilized	235	236	236	200	906
Total miles of shoulders paved & stabilized	324	343	285	207	1,158
Miles of roads/alleys with lower speed limits	7	11	3	0	20
Miles of highway overlaid w/rubberized asphalt	13	0	0	0	13

Table ES-6
2008-2012 PM-10 Reductions to Meet Contingency Requirements

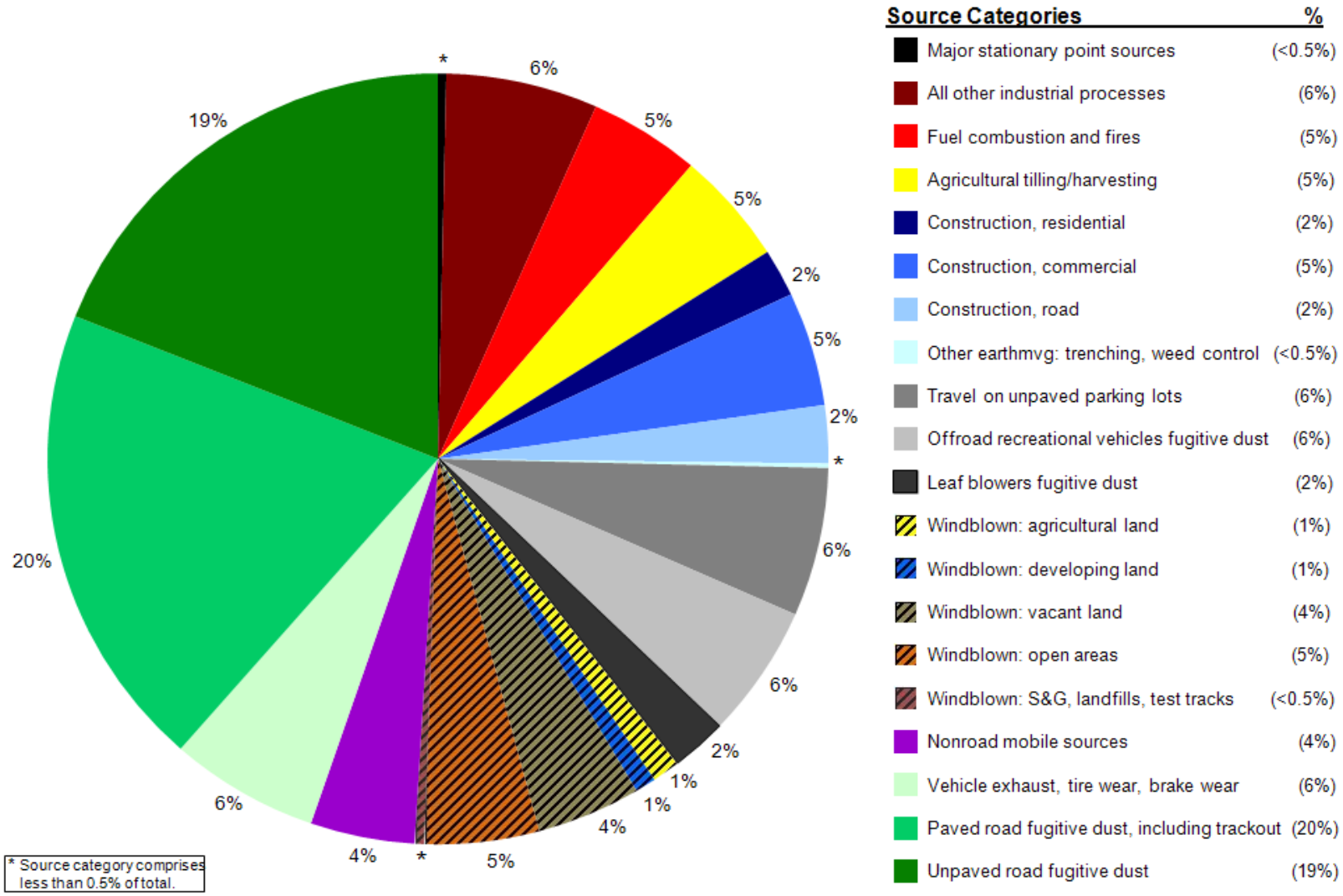
Completed Projects	Implementing Entities	2008	2009	2010	2011	2012
		(tons/year)				
Sweep streets with PM-10 certified sweepers Contracted sweeping of freeways, ramps and frontage roads - 100% compliant, effective 2/20/10 27 PM-10 certified sweepers purchased with CMAQ funds: 1/1/07-12/31/09	ADOT	0	0	294	342	344
	Cities, towns	59	116	153	154	155
	Total for Street Sweeping	**59**	**116**	**447**	**495**	**499**
Pave or stabilize existing public dirt roads and alleys Paving/stabilization projects completed in 2008-2011	Cities, towns, Maricopa and Pinal County Gila River Indian Community	461	1,352	2,124	2,662	2,625
	Total for Road/Alley Paving/Stabilization	**461**	**1,352**	**2,124**	**2,662**	**2,625**
Lower speed limits on dirt roads and alleys Speed limits lowered in 2008-2011	Cities, towns, Maricopa County	4	78	161	161	161
	Total for Lower Speed Limits	**4**	**78**	**161**	**161**	**161**
Pave or stabilize unpaved shoulders Paving/stabilization projects completed in 2008-2011	Cities, towns, Maricopa County	173	242	265	293	150
	Total for Shoulder Paving/Stabilizing	**173**	**242**	**265**	**293**	**150**
Repave or overlay paved roads with rubberized asphalt Rubberized asphalt overlays completed in 2008-2011	ADOT	0	3	3	3	3
	Total for Overlays	**0**	**3**	**3**	**3**	**3**
	Total for Completed Projects	**697**	**1,790**	**2,999**	**3,614**	**3,439**

Table ES-7
2008-2012 PM-10 Emissions with Five Percent Plan Measures and Contingency Projects

Source Category	2008	2009	2010	2011	2012
POINT	150	133	127	128	135
AREA					
Fuel combustion	1,301	1,307	1,311	1,316	1,328
Commercial cooking	993	998	1,001	1,005	1,014
Construction (includes windblown dust)	8,355	5,333	4,139	4,014	4,073
Tilling, harvesting and cotton ginning	893	893	893	893	893
Travel on unpaved farm roads	731	731	731	731	731
Livestock	261	261	261	261	261
Travel on unpaved parking lots	2,422	2,434	2,441	2,451	2,473
Offroad recreational vehicles	2,180	2,191	2,198	2,206	2,226
Leaf blowers	895	899	902	906	914
Windblown agriculture	448	448	448	448	448
Other windblown sources	3,938	3,788	3,788	3,788	3,639
Fires	497	497	497	497	497
Mining/quarrying (includes windblown dust)	476	401	355	356	369
Travel on industrial paved/unpaved roads	472	382	331	333	351
Other industrial sources	976	865	828	832	877
NONROAD					
Aircraft	184	152	142	143	146
Airport ground support equipment	27	23	21	20	20
Locomotives	34	34	34	34	34
Other nonroad equipment	1,683	1,661	1,641	1,595	1,513
ONROAD					
Exhaust	2,836	2,647	2,371	1,843	1,407
Tire wear	256	254	255	255	259
Brake wear	758	767	771	773	787
Paved roads	7,922	7,857	7,578	7,534	7,772
Unpaved roads and alleys	9,847	8,854	7,999	7,461	7,525
Totals	**48,534**	**43,810**	**41,062**	**39,823**	**39,691**
Total PM-10 Emissions Reduction 2007-2012:				**19,527 tons, 33.0%**	

Figure ES-4

2012 PM-10 Emissions Inventory with Five Percent Plan Measures and Contingency Projects
PM-10 Nonattainment Area Total = 39,691 tons/yr



CHAPTER ONE

INTRODUCTION

Within the Maricopa County nonattainment area, the National Ambient Air Quality Standard has not yet been attained for PM-10 particulate pollution. The area is classified as a Serious Area under the Clean Air Act. On February 7, 1978, the Governor of Arizona designated the Maricopa Association of Governments (MAG) as the lead planning organization for Maricopa County that, together with the State is responsible for determining which elements of the State Implementation Plan revision will be planned, implemented, and enforced by State and local governments in Arizona. This designation was made in accordance with the Clean Air Act Section 174 (a). In 1992, the Arizona Legislature recertified MAG as the regional planning agency in accordance with Section 174 of the 1990 Clean Air Act Amendments (A.R.S. Section 49-406 A.).

To meet the requirements of Section 189 (d) of the Clean Air Act, the MAG 2007 Five Percent Plan for PM-10 was submitted to the Environmental Protection Agency (EPA) by the federal deadline of December 31, 2007. Collectively, the Five Percent Plan included fifty-three control measures from the State, Maricopa County, and local governments. The plan demonstrated that the measures would reduce PM-10 emissions by at least five percent per year and demonstrated attainment of the PM-10 standard in 2010. The region needed three years of clean data at the monitors in 2008, 2009 and 2010 in order for the region to be in attainment of the PM-10 standard in 2010. There have been no violations of the standard during stagnant conditions since the plan was submitted in 2007.

On September 9, 2010, EPA had published a notice of proposed partial approval and disapproval of the plan in the Federal Register. There were two major reasons for the proposed disapproval: the EPA nonconcurrence with four high wind exceptional events at the West 43rd Avenue monitor in 2008 resulted in a violation, which negated the attainment demonstration, and that the 2005 baseline emissions inventory was inaccurate since it overestimated construction and other emissions.

On January 25, 2011, the Arizona Department of Environmental Quality (ADEQ) voluntarily withdrew the MAG 2007 Five Percent Plan for PM-10 to address technical approvability issues and include new information, such as the new EPA equation for paved road dust emissions. While the plan was withdrawn, the measures continued to be implemented to reduce PM-10.

Consequently, the MAG 2012 Five Percent Plan for PM-10 has been prepared to meet the requirements in Section 189 (d) of the Clean Air Act and improve air quality in the Maricopa County nonattainment area. The plan is required to reduce PM-10 emissions by at least five percent per year until the standard is attained as measured by the monitors. The Clean Air Act specifies that the plan must be based upon the most recent emissions inventory for the area and also include a modeling demonstration of attainment. The 2012

Five Percent Plan is designed to be a replacement for the 2007 plan that was withdrawn. The following narrative describes the historical background preceding the preparation of the MAG 2012 Five Percent Plan for PM-10.

HISTORICAL BACKGROUND

Based upon the 1990 Clean Air Act Amendments, the Maricopa County nonattainment area was initially classified as Moderate for PM-10 particulate pollution. However, on May 10, 1996, the nonattainment area was reclassified to Serious due to failure to attain the particulate standard by December 31, 1994. The Serious Area reclassification was effective on June 10, 1996.

The Revised MAG 1999 Serious Area Particulate Plan for PM-10 for the Maricopa County Nonattainment Area was submitted to the Environmental Protection Agency in February 2000. On July 25, 2002, EPA published a notice of final approval for the plan. Collectively, the plan contained approximately seventy-seven control measures from the State and local governments. The plan demonstrated attainment of the PM-10 standard by December 31, 2006.

In order to be in attainment, the region needed three years of clean data at the monitors for 2004, 2005, and 2006. However, there were numerous exceedances of the standard in 2005 and 2006. On June 6, 2007, EPA published a final notice with its findings that the Maricopa County nonattainment area had failed to attain the PM-10 standard by the federal deadline of December 31, 2006. It then became necessary for MAG to prepare a Five Percent Plan for PM-10.

In accordance with Section 189 (d) of the Clean Air Act, a Five Percent Plan for PM-10 was due to the Environmental Protection Agency by December 31, 2007. The plan was required to reduce PM-10 emissions by at least five percent per year until the standard was attained as measured by the monitors. The Clean Air Act specified that the plan must be based upon the most recent emissions inventory for the area and also include a modeling demonstration of attainment.

The MAG 2007 Five Percent Plan for PM-10 was submitted to EPA by the federal deadline of December 31, 2007. Collectively, the Five Percent Plan for PM-10 included fifty-three control measures from the State, Maricopa County, and local governments. The plan demonstrated that the measures would reduce PM-10 emissions by at least five percent per year and demonstrated attainment of the PM-10 standard in 2010. The region needed three years of clean data at the monitors in 2008, 2009 and 2010 in order for the region to be in attainment of the PM-10 standard in 2010. There have been no violations of the standard during stagnant conditions since the plan was submitted in 2007.

In 2008, there were a number of exceedances of the twenty-four hour PM-10 standard due to high winds in the Maricopa County nonattainment area. In June 2009, the Arizona Department of Environmental Quality (ADEQ) had submitted a preliminary demonstration

to EPA on the 2008 high wind events, since high wind exceptional events should not count against the region. In November 2009, the ADEQ submitted final demonstrations for the exceedances, including five at the West 43rd Avenue monitor.

On December 2, 2009, the Arizona Center for Law in the Public Interest filed a lawsuit against EPA for failure to take action on the plan by June 30, 2009 in accordance with the Clean Air Act. The Environmental Protection Agency reviewed the plan that had been submitted two years ago and issues began to emerge. The plan was based upon a 2005 emissions inventory that was outdated with the downturn in the economy; the contribution of emissions from the sources had changed. EPA had concerns with the Arizona Department of Environmental Quality exceptional events documentation of four high wind exceedances in 2008 at the West 43rd Avenue monitor.

On May 21, 2010, the Environmental Protection Agency sent a letter to the ADEQ indicating that EPA did not concur with the ADEQ documentation for the four high wind exceptional events at the West 43rd Avenue monitor. As a result, the four exceedances would constitute a violation at the monitor and the region would not have its first of three years of clean data needed to attain the standard by 2010.

On September 3, 2010, the Environmental Protection Agency signed a notice to propose partial approval and disapproval of the MAG 2007 Five Percent Plan for PM-10 based on the timetable in the consent decree with the Arizona Center for Law in the Public Interest. On September 9, 2010, the notice was published in the Federal Register. EPA proposed disapproval of the emissions inventories, attainment demonstration, five percent annual reductions in emissions, reasonable further progress and milestones, contingency measures, and the 2010 motor vehicle emissions budget. EPA proposed limited approval and disapproval for agricultural regulations. EPA proposed approval of the Arizona Revised Statutes that mandated twenty measures in the plan and the Agricultural Best Management Practices Guidance Booklet and Pocket Guide. Based upon the consent decree, EPA indicated that a notice of final action would be signed by January 28, 2011.

According to EPA, there were two major reasons for the proposed partial disapproval of the plan:

1. EPA contended that the modeling attainment demonstration in the plan cannot be approved if actual monitor data show that the area cannot attain the standard by the attainment date of December 31, 2010. This was directly resultant from the EPA nonconcurrence with the four high wind exceptional events at the West 43rd Avenue monitor in 2008. The four exceedances constituted a violation of the standard. EPA further indicated that it was not necessary to review the exceptional event claims for 2009 since the region did not have its first year of clean data in 2008 needed to attain the standard by 2010.

2. EPA contended that the 2005 baseline emissions inventory was inaccurate since it overestimated construction emissions and other emissions. The 2005 emissions

inventory prepared by the Maricopa County Air Quality Department was the foundation upon which the plan was developed. The emissions inventory was the basis for the air quality modeling prepared by MAG for the five percent reductions in emissions; impact of the plan measures and contingency measures; reasonable further progress (annual incremental emissions reductions to ensure attainment); milestone demonstrations every three years; and the attainment demonstration.

On January 25, 2011, the Arizona Department of Environmental Quality withdrew the MAG 2007 Five Percent Plan for PM-10 to address the technical approvability issues identified by EPA and include new information, such as the new EPA equation for paved road dust emissions. The new EPA equation was more accurate and would improve the emissions inventory. Although the plan was withdrawn, the measures continued to be implemented to reduce PM-10.

On February 14, 2011, the Environmental Protection Agency published a final notice in the Federal Register to make a Finding of Failure to Submit as a result of the withdrawal of the 2007 Five Percent Plan for PM-10. The Finding of Failure to Submit was effective on February 14, 2011. If a new complete plan is not submitted within eighteen months of the finding, the Clean Air Act sanction of tighter controls on major industries (two to one offsets) would be imposed by August 14, 2012. If a complete plan is not submitted within twenty-four months of the finding, the federal highway sanction and a federal implementation plan would be imposed by February 14, 2013. The submittal of a new plan and a completeness determination by EPA will stop the sanctions clocks. A plan approval action by EPA will stop the imposition of a federal plan.

OUTLINE OF THE MAG 2012 FIVE PERCENT PLAN FOR PM-10

The purpose of this document is to present the MAG 2012 Five Percent Plan for PM-10 for the Maricopa County Nonattainment Area. The plan contains a variety of existing control measures and projects that have been implemented to reduce PM-10 and a new measure designed to reduce PM-10 during high winds.

The MAG 2012 Five Percent Plan for PM-10 is composed of the following major sections:

1. Introduction (This Chapter) - Includes a general discussion of historical background and the outline of the MAG 2012 Five Percent Plan for PM-10.

2. Description of the Nonattainment Area - Includes a description of the nonattainment area; geography and climatic conditions.

3. Assessment of Air Quality Conditions - Includes a discussion of the formation of particulate pollution; PM-10 emissions inventory; and air quality monitoring data and trend analysis.

4. The Adopted Plan - Includes a table of statutes, rules, ordinance, and

appendices for the plan; Maricopa County Resolution to Evaluate Measures in the MAG 2012 Five Percent Plan for PM-10 for the Maricopa County Nonattainment Area; Arizona Department of Environmental Quality Dust Action General Permit; Arizona Department of Environmental Quality Commitment to Revise the MAG 2012 Five Percent Plan for PM-10 for the Maricopa County Nonattainment Area if Necessary for the Emerging and Voluntary Measure; tracking plan implementation; and assurances that the State has the authority to implement the measures in the plan.

5. Demonstration of Annual Five Percent Reductions in PM-10 Emissions - Includes a discussion of the measures quantified to meet the annual five percent requirement and demonstration for the five percent reduction requirement.

6. Attainment Demonstration - Includes a discussion of the Salt River area modeling; PM-10 nonattainment area modeling; reasonable further progress, contingency requirements; onroad mobile source emissions budget for conformity; expeditious attainment; and attainment date.

CHAPTER TWO

DESCRIPTION OF THE NONATTAINMENT AREA

The Maricopa County nonattainment area for particulates was formally designated in April 1974. As defined in the 1977 Clean Air Act, the term nonattainment area refers to locations which exceed any national ambient air quality standard for any pollutant based upon the data collected through air quality monitoring. A general description of the Maricopa County nonattainment area, including a discussion of the boundaries of the area and the geography and climatic conditions is provided below.

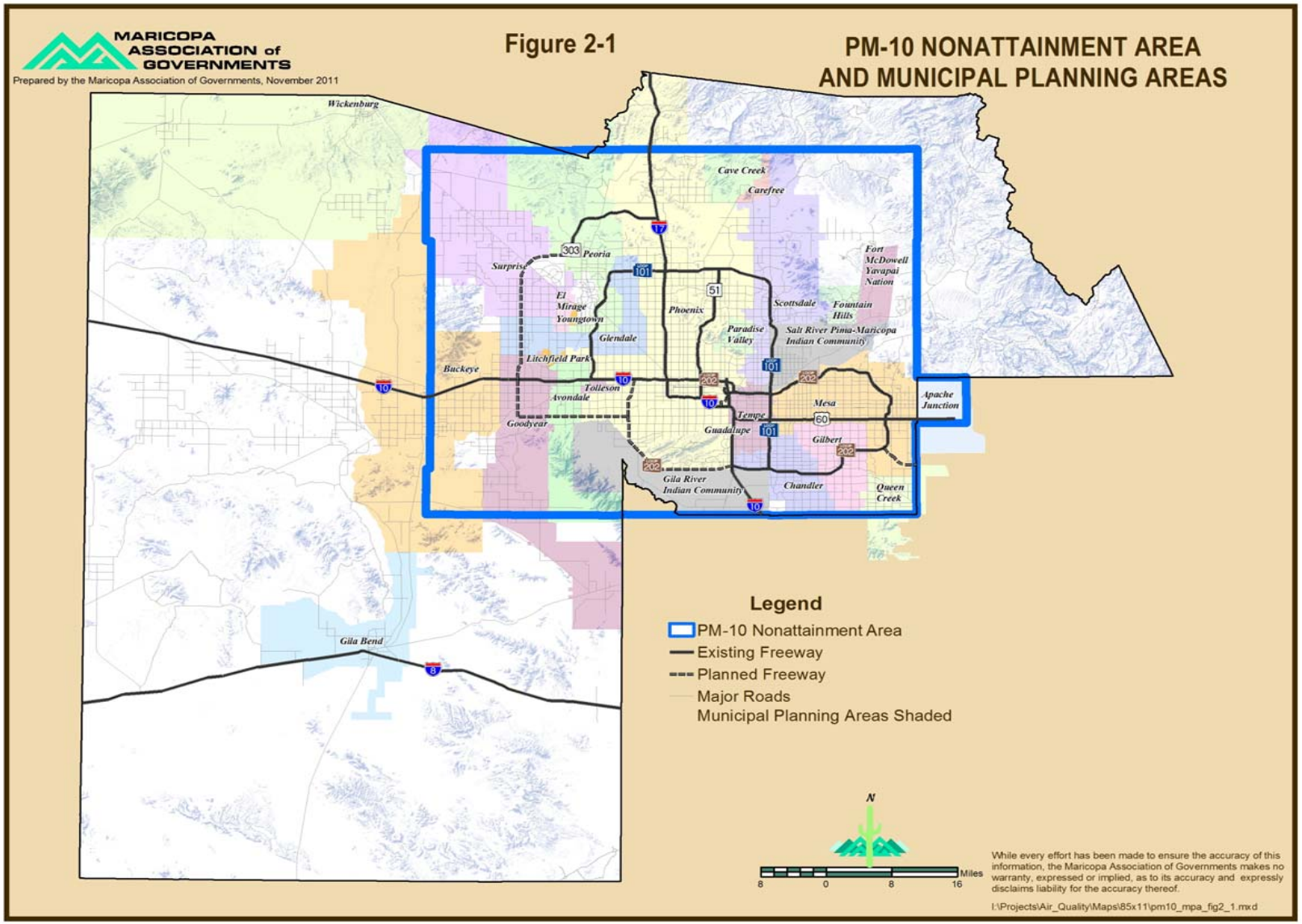
NONATTAINMENT AREA BOUNDARIES

When the Environmental Protection Agency promulgated the PM-10 National Ambient Air Quality Standard on July 1, 1987, there was little PM-10 monitoring data available for EPA to use in determining the nonattainment area boundaries. In the August 7, 1987 Federal Register, EPA promulgated its policy of categorizing areas of the country into three groups based on the probability that an area's existing State Implementation Plan (SIP) would need to be revised to protect or attain the new PM-10 standard. Group I areas were those areas which EPA identified as having a strong likelihood of violating the PM-10 standard and requiring substantial SIP revisions.

In the August 7, 1987 Federal Register, EPA identified the Group I area in Maricopa County, Arizona as the Phoenix Planning Area. In the October 31, 1990 Federal Register, EPA published technical corrections modifying the boundaries of certain areas of concern. The designation of the nonattainment area boundary is documented in the EPA letter dated September 11, 1991.

In the October 1990 Federal Register the area was defined as "The rectangle determined by, and including, T6N, R3W; T6N, R7E; T2S, R3W; T2S, R7E; T1N, R8E." The nonattainment area is generally encompassed by 259th Avenue on the west, Hunt Highway on the south, Meridian Road on the east and a boundary approximately six miles north of Carefree Highway on the north (see Figure 2-1). This area contains portions of the municipal planning areas for twenty-two cities and towns in Maricopa County, the Fort McDowell, Gila River, and Salt River Pima-Maricopa Indian Communities, as well as unincorporated areas under the jurisdiction of Maricopa County. The PM-10 nonattainment area also contains a six by six mile section in Pinal County that encompasses a portion of the Apache Junction Municipal Planning Area which includes unincorporated areas under the jurisdiction of Pinal County.

When determining the new PM-10 nonattainment area in 1987, the Environmental Protection Agency included the City of Apache Junction, a small eastern portion of Apache Junction lies in Maricopa County and the western portion lies in Pinal County. Pinal County


MARICOPA ASSOCIATION of GOVERNMENTS
Prepared by the Maricopa Association of Governments, November 2011
Figure 2-1
PM-10 NONATTAINMENT AREA AND MUNICIPAL PLANNING AREAS
Wickenburg
Cave Creek
Carefree
Peoria
Surprise
El Mirage
Youngtown
Glendale
Litchfield Park
Buckeye
Tolleson
Avondale
Goodyear
Phoenix
Paradise Valley
Scottsdale
Fountain Hills
Fort McDowell Yavapai Nation
Salt River Pima-Maricopa Indian Community
Tempe
Guadalupe
Mesa
Gilbert
Chandler
Queen Creek
Apache Junction
Gila River Indian Community
Gila Bend
Legend
PM-10 Nonattainment Area
Existing Freeway
Planned Freeway
Major Roads
Municipal Planning Areas Shaded
N
Miles
8
0
8
16
While every effort has been made to ensure the accuracy of this information, the Maricopa Association of Governments makes no warranty, expressed or implied, as to its accuracy and expressly disclaims liability for the accuracy thereof.
I:\Projects\Air_Quality\Maps\85x11\pm10_mpa_fig2_1.mxd

worked with the Arizona Department of Environmental Quality on a separate PM-10 plan for that portion of the nonattainment area.

GEOGRAPHY AND CLIMATIC CONDITIONS

Due to its valley location, the nonattainment area has an elevation of 1,105 feet above mean sea level (MSL) and is almost completely surrounded by mountains. The Salt River Mountains are located on the southern border of the nonattainment area and rise to an elevation of 2,507 feet above MSL. To the northwest, the Phoenix Mountains have an elevation of 2,310 feet above MSL. The Estrella Mountains are located to the southwest and have an elevation of 3,320 feet above MSL. On the western boundary, the White Tank Mountains rise to an elevation of 4,026 feet above MSL and on the eastern boundary, the Superstition Mountains rise to an elevation of 4,620 feet above MSL.

There are five main rivers that run through the nonattainment area: the Salt River, Agua Fria River, Gila River, New River, and Verde River. These river beds are generally dry, except during torrential rainfall, which happens infrequently.

The climate in the nonattainment area is arid continental, experiencing extreme ranges in daily temperatures. Temperatures range from a mean of 55.5 degrees Fahrenheit in December to a mean of 94.8 degrees Fahrenheit in July; the annual mean temperature is 74.2 degrees Fahrenheit. The sun shines approximately 85 percent of the time and the annual average rainfall is 8.29 inches. Most of the rainfall occurs from December through March and during the months of July and August. (Source: National Oceanic & Atmospheric Administration National Data Centers.)

In general, the morning direction for the prevailing winds in the nonattainment area is from east (southeast) to west (southwest). However, wind direction can change in the afternoon to a more westerly direction. The average annual wind speed is 6.2 miles per hour.

CHAPTER THREE

ASSESSMENT OF AIR QUALITY CONDITIONS

Within the Maricopa County nonattainment area, PM-10 is a problem throughout the year. Particulate air pollution is composed of solid particles or liquid droplets which are small enough to remain suspended in the air. The smaller the size, the more likely the particles are to reach the innermost portions of the lungs and cause damage. Major concerns for human health from exposure to particle pollution include: increased respiratory symptoms, such as irritation of the airways, coughing, or difficulty breathing; decreased lung function; aggravated asthma; development of chronic bronchitis; irregular heartbeat; nonfatal heart attacks; and premature death in people with heart or lung disease. The elderly, children, and people with heart and lung disease are especially sensitive to the effects of particulate matter. Particles that are 2.5 micrometers in diameter and smaller (PM-2.5) can lodge deep in the lungs and are believed to be the largest health risk. The EPA designated Maricopa County as an attainment area for PM-2.5 in September 2005.

In order to effectively reduce PM-10, it is important to assess air quality conditions in the PM-10 nonattainment area. This chapter presents a discussion of PM-10 formation, the Maricopa County Air Quality Department 2005 Periodic Emissions Inventory for PM-10 for the Maricopa County, Arizona, Nonattainment Area, and air quality monitoring data.

FORMATION OF PM-10 PARTICULATE POLLUTION

The formation of PM-10 particulate pollution is dependent upon several factors. Among these factors are stagnant air masses, severe temperature inversions in the winter, high winds from thunderstorms and frontal systems, and fine, silty soils characteristic of desert locations. In the nonattainment area, high PM-10 concentrations generally occur in September through March, on days with stagnant or near-stagnant conditions. High PM-10 concentrations can also occur during thunderstorm outflows and frontal systems which create high winds that entrain soil particles from bare surfaces.

The PM-10 in the arid Southwest largely consists of coarse particles (i.e., aerodynamic diameter greater than 2.5 microns but less than or equal to 10 microns) which are typically crustal in nature and derive mainly from windblown dust, resuspended road dust (from paved and unpaved roads), unpaved parking lots, disturbed vacant land, mining operations, construction, and agricultural activities (e.g., tilling and harvesting, travel on unpaved farm roads). Other components of particulate matter, such as sulfates, nitrates, and organic and elemental carbons, are typically found in the fine fraction of particulate matter (i.e., aerodynamic diameter less than or equal to 2.5 microns), but can also contribute to coarse particulate matter. Previous analyses of PM-2.5 data in the Phoenix area have shown that mobile source exhaust, burning, and industrial sources are important constituents of PM-2.5. The co-located PM-10 and PM-2.5 monitors at the Durango Complex site indicate that PM-2.5 readings on days with high PM-10 concentrations range from 6 to 15 percent of the

PM-10 on high wind days and 14 to 22 percent on low wind days. Therefore, the PM-10 problem in the nonattainment area is largely attributable to coarse particles, comprised primarily of geologic material (MAG, 2008).

PM-10 EMISSIONS INVENTORY

The Clean Air Act requires a comprehensive, accurate, and current inventory of actual emissions from all sources. In June 2011, the Maricopa County Air Quality Department compiled a revised 2008 periodic emissions inventory which includes primary emissions of PM-10 and PM-2.5 as well as three particulate matter precursors: nitrogen oxides (NOx), sulfur dioxides (SOx) and ammonia (NH3). The inventory provides emission estimates for Maricopa County and the PM-10 nonattainment area. Maricopa County encompasses approximately 9,223 square miles and the PM-10 nonattainment area is about 2,888 square miles.

Emission sources included in the 2008 Periodic Emissions Inventory for PM-10 are Point Sources, Area Sources, Nonroad Mobile Sources, Onroad Mobile Sources, and Biogenic Sources. The inventory provides the typical daily emissions and annual emissions for these categories. Table 3-1 includes a breakdown of annual emissions for the PM-10 nonattainment area.

The point source category includes stationary sources which emit a significant amount of pollution into the air. Examples of point sources include power plants, industrial processes, and large manufacturing facilities. Area sources are stationary sources which are too small or too numerous to be treated as point sources. Examples include residential wood burning, commercial cooking, waste incineration, and wildfires. Nonroad mobile sources include off-highway vehicles and engines that move or are moved in a 12-month period such as construction and mining equipment, lawn and garden equipment, and aircraft. The onroad mobile sources category includes exhaust, paved road fugitive dust, unpaved road fugitive dust, tire wear, and break wear. Biogenic sources (plant life) were estimated using the Model of Emissions of Gases and Aerosols from Nature (MEGAN) Biogenic Emissions Inventory System. Among the chemical species included in the MEGAN Model, only NOx is attributable to particulate matter formation and therefore only NOx emissions are included in the 2008 inventory.

Collectively, the source categories are estimated to have contributed 48,148.00 (English) tons of PM-10; 13,512.16 tons of PM-2.5; 109,662.87 tons of NOx; 1,808.84 tons of SOx; and 12,458.87 tons of NH3 in calendar year 2008 within the PM-10 nonattainment area. A complete description of these sources and the corresponding methodology used to calculate the emissions for 2008 are included in the 2008 Periodic Emissions Inventory for PM-10 for the Maricopa County, Arizona, Nonattainment Area, Revised June 2011. This inventory is provided in Appendix A, Exhibit 1. Projected emission inventories for years 2007 through 2012 are based upon the 2008 periodic inventory for PM-10 and are provided in Chapter Five.

Table 3-1
Annual Emissions for the PM-10 Nonattainment Area from All Source Categories Included in the 2008 Periodic Emissions Inventory for PM-10
(English Tons/Year)

Source Category	PM-10	PM-2.5	NOx	SOx	NH3
POINT TOTAL	**149.84**	**132.94**	**1,317.85**	**28.76**	**132.18**
AREA					
Fuel Combustion	1,300.65	1,268.35	12,248.07	895.83	51.11
Industrial Processes	10,655.39	2,771.19	360.48	129.58	1,724.27
Waste Treatment/Disposal	120.77	95.42	50.30	56.85	1,494.12
Miscellaneous Area Sources	12,444.36	2,143.52	115.94	29.74	7,693.04
AREA TOTAL	**24,521.17**	**6,278.48**	**12,774.79**	**1,112.00**	**10,962.54**
NONROAD MOBILE					
Agricultural	15.13	14.67	161.35	0.06	0.30
Airport Ground Support	26.99	26.48	578.95	26.22	---
Commercial	117.66	112.69	1,391.61	2.39	21.06
Construction and Mining	1,249.88	1,210.00	14,666.42	6.55	27.85
Industrial	101.42	98.71	2,586.39	3.21	56.09
Lawn and Garden	183.02	169.48	801.41	3.17	19.71
Pleasure Craft	7.02	6.48	59.03	0.64	1.32
Railway Maintenance	1.13	1.10	9.26	0.00	0.02
Recreational	7.68	7.08	10.76	0.07	0.35
Aircraft	183.80	177.61	2,620.31	316.00	---
Locomotives	34.16	31.88	907.76	9.11	2.16
NONROAD MOBILE TOTAL	**1,927.89**	**1,856.18**	**23,793.26**	**367.42**	**128.87**
ONROAD MOBILE					
Exhaust, Tire Wear and Brake Wear	3,144.17	2,300.80	71,444.20	300.66	1,235.28
Paved Road Fugitive Dust	6,694.22	1,774.76	---	---	---
Unpaved Road Fugitive Dust	11,710.70	1,169.00	---	---	---
ONROAD MOBILE TOTAL	**21,549.09**	**5,244.56**	**71,444.20**	**300.66**	**1,235.28**
BIOGENIC TOTAL	---	---	**332.77**	---	---
TOTAL ALL SOURCES	**48,148.00**	**13,512.16**	**109,662.87**	**1,808.84**	**12,458.87**

Notes: Totals shown may not equal the sum of individual values due to independent rounding.

A pie chart of the 2008 PM-10 annual emissions in the PM-10 nonattainment area is shown in Figure 3-1. The largest single source category is unpaved road fugitive dust at 24 percent. Construction activities contribute a combined 17 percent (residential, commercial, road, and other earthmoving), while paved road fugitive dust contributes 14 percent. Windblown dust accounts for 10 percent of the annual inventory. Onroad mobile vehicle exhaust, tire wear and brake wear contribute seven percent. The remaining categories in the figure individually contribute six percent or less to the total annual emissions.

AIR QUALITY MONITORING DATA AND TREND ANALYSIS

In addition to identifying sources of PM-10 emissions, it is important to examine the impact of these emissions on the ambient concentrations. This section includes discussions of the National Ambient Air Quality Standards (NAAQS) for PM-10 and the air quality data recorded by the areawide monitoring network.

The 24-hour PM-10 standard is 150 micrograms per cubic meter (ug/m^3). The standard is attained when the expected number of exceedances per year at each monitoring site is less than or equal to one. The number of expected exceedances at a site is determined by recording the number of exceedances in each calendar year and then averaging them over the past three years. At some sites, PM-10 sampling is scheduled less frequently than every day. To account for this, an adjustment must be made to the data collected at each site to estimate the number of exceedances in a calendar year. Due to possible seasonal imbalance, the adjustment is made quarterly. The estimate of the expected number of exceedances for the quarter is equal to the observed number of exceedances plus an increment associated with the missing data. The expected number of exceedances is then estimated by averaging the annual estimates over the three-year period. Due to the rounding criteria used by EPA, a recorded average PM-10 concentration must be under 155 ug/m^3 to not be considered an exceedance and the three-year expected exceedance rate for any site must be less than 1.05 for the region to be in attainment of the 24-hour standard. The annual PM-10 standard of 50 ug/m^3 was revoked by EPA effective December 18, 2006.

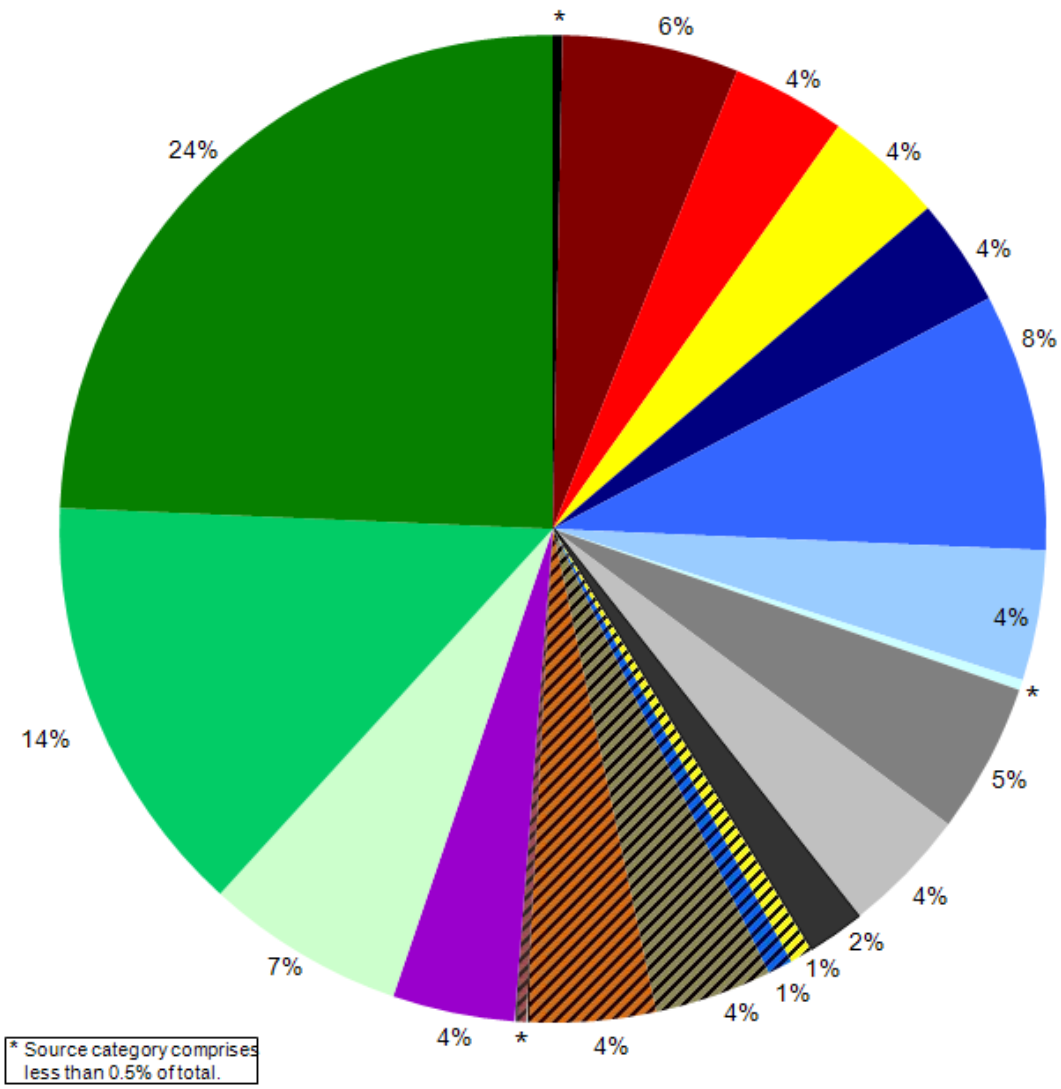
In order to determine the extent of the regional PM-10 pollution problem, it is necessary to examine the air quality data collected by the areawide monitoring network. A total of 27 criteria pollutant monitoring stations are currently operated by the Maricopa County Air Quality Department (MCAQD), Pinal County Air Quality Control District (PCAQCD), and Arizona Department of Environmental Quality (ADEQ) in the PM-10 nonattainment area. Sixteen of these sites monitor PM-10. The Buckeye monitoring site is located just outside the western boundary of the nonattainment area and also monitors PM-10. Site-specific information regarding the PM-10 monitoring stations is provided in Table 3-2, and the geographic location of each site is indicated in Figure 3-2.

As mentioned previously, not all PM-10 samples are collected every day. Most of the exceedances prior to 2004 were recorded by filter-based monitors that measured PM-10

Figure 3-1

2008 PM-10 Emissions Inventory

PM-10 Nonattainment Area Total = 48,148 tons/yr



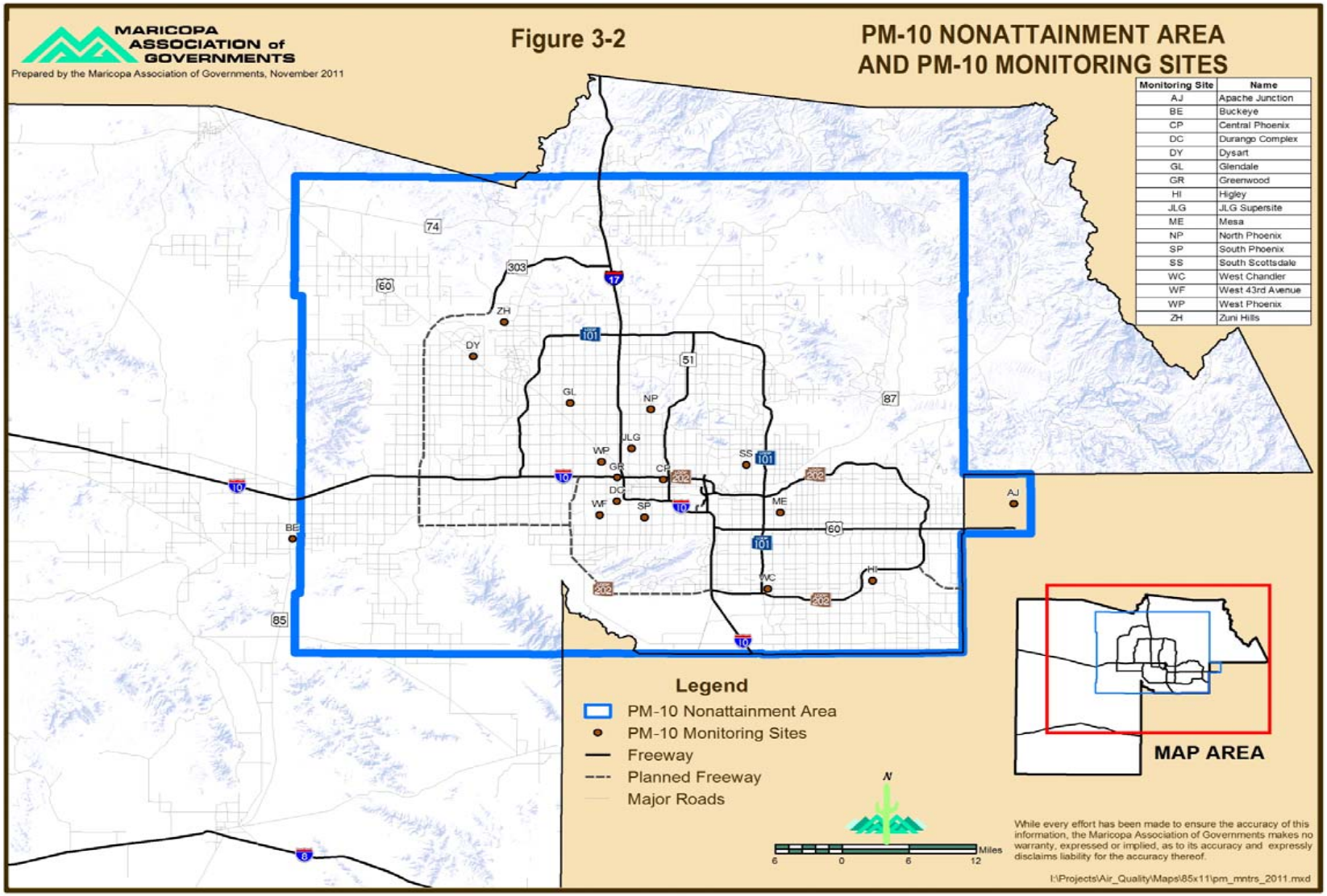
Source Categories	%
Major stationary point sources	(<0.5%)
All other industrial processes	(6%)
Fuel combustion and fires	(4%)
Agricultural tilling/harvesting	(4%)
Construction, residential	(4%)
Construction, commercial	(8%)
Construction, road	(4%)
Other earthmvg: trenching, weed control	(<0.5%)
Travel on unpaved parking lots	(5%)
Offroad recreational vehicles fugitive dust	(4%)
Leaf blowers fugitive dust	(2%)
Windblown: agricultural land	(1%)
Windblown: developing land	(1%)
Windblown: vacant land	(4%)
Windblown: open areas	(4%)
Windblown: S&G, landfills, test tracks	(<0.5%)
Nonroad mobile sources	(4%)
Vehicle exhaust, tire wear, brake wear	(7%)
Paved road fugitive dust, including trackout	(14%)
Unpaved road fugitive dust	(24%)

Table 3-2
PM-10 Monitoring Stations

FIGURE 3-2 MAP INDEX	SITE	ADDRESS	OPERATING AGENCY	SAMPLING SCHEDULE
AJ	Apache Junction Fire Station	3955 E. Superstition Blvd.	PCAQCD	Continuous
BE*	Buckeye	26449 W. 100th Dr.	MCAQD	Continuous
CP	Central Phoenix	1645 E. Roosevelt	MCAQD	Continuous
DC	Durango Complex	2702 RC Esterbrooks Blvd.	MCAQD	Continuous
DY	Dysart	16825 N. Dysart Rd.	MCAQD/ADEQ	Continuous
GL	Glendale	6001 W. Olive	MCAQD	Continuous
GR	Greenwood	1128 N. 27th Ave.	MCAQD	Continuous
HI	Higley	15400 S. Higley Rd.	MCAQD	Continuous
JLG	JLG Supersite	4530 N. 17th Ave.	ADEQ	Continuous
ME	Mesa	310 S. Brooks	MCAQD	1 in 6 day
NP	North Phoenix	601 E. Butler Dr.	MCAQD	Continuous
SP	South Phoenix	33 W. Tamarisk	MCAQD	Continuous
SS	South Scottsdale	2857 N. Miller Rd.	MCAQD	1 in 6 day
WC	West Chandler	275 S. Ellis	MCAQD	Continuous
WF	West 43rd Avenue	3940 W. Broadway	MCAQD	Continuous
WP	West Phoenix	3847 W. Earll	MCAQD	Continuous
ZH	Zuni Hills	10851 W. Williams Rd.	MCAQD	Continuous

* The Buckeye monitor is located outside the western boundary of the PM-10 nonattainment area.

Sources: Pinal County Air Quality Website; Arizona Department of Environmental Quality State of Arizona Air Monitoring Network Plan for the Year 2011; Maricopa County Air Quality Department 2010 Air Monitoring Network Review.


MARICOPA ASSOCIATION of GOVERNMENTS
Prepared by the Maricopa Association of Governments, November 2011
Figure 3-2
PM-10 NONATTAINMENT AREA AND PM-10 MONITORING SITES
Monitoring Site | Name
AJ | Apache Junction
BE | Buckeye
CP | Central Phoenix
DC | Durango Complex
DY | Dysart
GL | Glendale
GR | Greenwood
HI | Higley
JLG | JLG Supersite
ME | Mesa
NP | North Phoenix
SP | South Phoenix
SS | South Scottsdale
WC | West Chandler
WF | West 43rd Avenue
WP | West Phoenix
ZH | Zuni Hills
Legend
PM-10 Nonattainment Area
PM-10 Monitoring Sites
Freeway
Planned Freeway
Major Roads
MAP AREA
N
Miles
6 0 6 12
While every effort has been made to ensure the accuracy of this information, the Maricopa Association of Governments makes no warranty, expressed or implied, as to its accuracy and expressly disclaims liability for the accuracy thereof.
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concentrations every sixth day. Since 2004, the filter-based monitors that have exceeded the PM-10 standard have been replaced with monitors that measure PM-10 concentrations continuously. Currently, within the nonattainment area samples are collected every sixth day at two of the PM-10 monitoring stations while 14 sites now sample continuously. The sampling schedule for each site is provided in Table 3-2.

One method of assessing the overall air quality of a region is to examine the concentrations measured at the monitoring stations. The trend in the number of 24-hour PM-10 exceedance days is presented in Figure 3-3. Tables 3-3 and 3-4 provide detailed information on exceedances of the 24-hour PM-10 standard for the past six years.

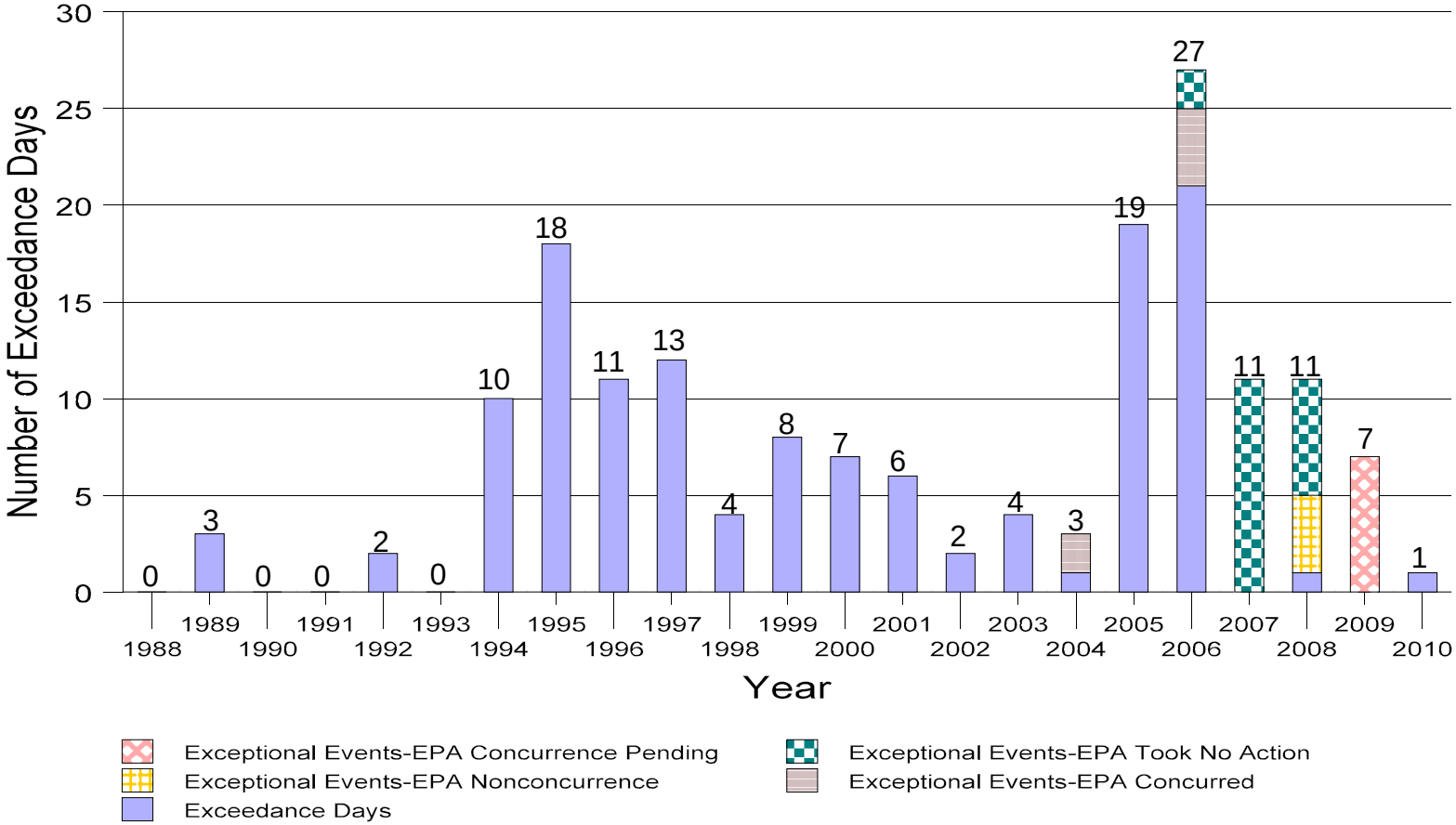
It is important to note that beginning in 2004, the Arizona Department of Environmental Quality (ADEQ) began flagging exceptional events. This is an uncontrollable natural event (e.g., high winds, wildfires) or a human-caused event that is not expected to recur at a given location (e.g., fireworks). The data and a demonstration of the event are submitted to EPA for concurrence. Once approved, the data is not used in determining compliance with the PM-10 standard. Tables 3-3 and 3-4 note the exceptional events that have occurred since 2005.

Figure 3-3, which presents the trend in number of exceedance days of the 24-hour standard from 1988 to 2010, shows a noticeable increase in the number of exceedance days since 1994. Between 1988 and 1993, there were zero to three exceedance days per year. The number of exceedance days increased from zero in 1993 to 10 in 1994. This increase in 1994 is attributable to the installation of a new site (Salt River monitor). This site was located in the Salt River Area and sources nearby included sand and gravel, metal recycling, precast manufacturing, and paved and unpaved haul road. The Salt River site was shut down as of December 31, 2002. Efforts were made to find a suitable replacement site with comparable PM-10 concentrations and industrial emissions. The West 43rd Avenue site was identified and began operating in the Salt River Area in the second quarter of 2002.

There was also an increase in the number of exceedance days from November 2005 through March 2006. During this period, the region experienced stagnant conditions and an unusually long period with no rain, which may have contributed to the exceedances. Exceedances have also occurred since 2006; however, the majority of these have been flagged as high wind exceptional events.

Tables 3-3 and 3-4 list the date, day, reading, and location of each exceedance of the 24-hour PM-10 standard recorded from 2005 to 2010, including the data flagged as exceptional events. In 2005, there were 19 exceedance days in the region. The number increased to 27 exceedance days in 2006 with six being exceptional events. The EPA concurred with four of the exceptional event days and took no action on the remaining two. In both 2007 and 2008 there were 11 days where the region exceeded the PM-10 standard. Most of these exceedances were exceptional events where EPA has yet to take

Figure 3-3
Number of 24-Hour PM-10 Exceedance Days



Notes: -The Arizona Department of Environmental Quality began flagging exceptional events in 2004.
-The chart includes exceedance days at the Buckeye monitor, which is located outside the PM-10 nonattainment area.
-On July 19, 2007, the exceedance at the Buckeye monitor was not associated with the exceptional event that also occurred on that day.

Sources: 1988 - 1997 - Revised MAG 1999 Serious Area Particulate Plan for PM-10 for the Maricopa County Nonattainment Area, February 2000.
1998 - 2010 - EPA Air Quality System.

Table 3-3
Exceedances of the 24-Hour PM-10 Standard, 2005 to 2007

2005				2006				2007			
DATE	DAY	READING	LOCATION	DATE	DAY	READING	LOCATION	DATE	DAY	READING	LOCATION
4/4/05	Mon	172	WF	1/10/06	Tue	155	DC	3/27/07	Tue	227+	WF
6/21/05	Tue	157	BE[1]	1/10/06	Tue	190	WF	4/12/07	Thu	171+	SP
11/1/05	Tue	166	WF	1/11/06	Wed	168	DC	4/12/07	Thu	202+	WF
11/2/05	Wed	173	WF	1/11/06	Wed	165	WF	5/4/07	Fri	196+	WF
11/3/05	Thu	163	DC	1/12/06	Thu	169	DC	6/6/07	Wed	180+	HI
11/10/05	Thu	165	WF	1/12/06	Thu	169	WF	6/6/07	Wed	225+	WF
11/17/05	Thu	155	DC	1/13/06	Fri	156	WF	7/19/07	Thu	194	BE[1]
11/18/05	Fri	169	BE[1]	1/19/06	Thu	183	DC	7/19/07	Thu	267+	CP
11/22/05	Tue	189	DC	1/19/06	Thu	183	WF	7/19/07	Thu	272+	CL[2]
11/22/05	Tue	173	WF	1/24/06	Tue	170	HI	7/19/07	Thu	199+	HI
11/23/05	Wed	164	DC	2/8/06	Wed	183	WF	7/19/07	Thu	521+	JLG
11/23/05	Wed	175	WF	2/9/06	Thu	171	DC	7/19/07	Thu	177+	WF
12/1/05	Thu	158	DC	2/9/06	Thu	204	WF	8/13/07	Mon	159+	SP
12/2/05	Fri	164	DC	2/13/06	Mon	159	BE[1]	8/16/07	Thu	195+	HI
12/2/05	Fri	194	WF	2/14/06	Tue	272	BE[1]	8/16/07	Thu	214+	WF
12/12/05	Mon	198	BN	2/15/06	Wed	157	DC	8/23/07	Thu	230+	HI
12/12/05	Mon	206	DC	2/15/06	Wed	201	WF	10/21/07	Sun	312+	CL[2]
12/12/05	Mon	172	GR	2/17/06	Fri	191	BE[1]	10/24/07	Wed	174+	HI
12/12/05	Mon	232	WF	3/10/06	Fri	240+	DC	11/15/07	Thu	165+	BE[1]
12/12/05	Mon	155	WP	3/10/06	Fri	166+	GR	11/15/07	Thu	155+	DC
12/13/05	Tue	165	DC	3/10/06	Fri	260+	WF				
12/13/05	Tue	167	WF	4/14/06	Fri	211++	BE[1]				
12/14/05	Wed	180	DC	4/14/06	Fri	189++	CP				
12/14/05	Wed	176	WF	4/14/06	Fri	253++	DC				
12/15/05	Thu	155	DC	4/14/06	Fri	212++	GR				
12/21/05	Wed	200	DC	4/14/06	Fri	221++	HI				
12/21/05	Wed	200	WF	4/14/06	Fri	312++	WF				
12/22/05	Thu	178	DC	4/14/06	Fri	177++	WP				
12/22/05	Thu	167	WF	4/15/06	Sat	187++	CP				
12/23/05	Fri	157	DC	4/15/06	Sat	179++	DC				
12/23/05	Fri	156	WF	4/15/06	Sat	170++	GR				
				4/15/06	Sat	274++	HI				
				4/15/06	Sat	191++	WF				
				5/22/06	Mon	174++	WF				
				6/2/06	Fri	159	WF				
				6/6/06	Tue	155++	HI				
				10/5/06	Fri	165+	HI				
				11/16/06	Thu	163	WF				
				11/17/06	Fri	174	WF				
				11/27/06	Mon	164	WF				
				12/5/06	Tue	173	WF				
				12/6/06	Wed	167	DC				
				12/6/06	Wed	159	WF				
				12/7/06	Thu	174	DC				
				12/7/06	Thu	159	WF				
				12/14/06	Thu	163	WF				
				12/15/06	Thu	177	WF				

[1] The Buckeye monitor is located outside the PM-10 nonattainment area.
[2] The Coyote Lakes monitor was a special purpose monitoring site that was shut down in February 2009.
+ Exceptional events where EPA took no action.
++ Exceptional events with EPA concurrence.

Source: EPA Air Quality System.

Table 3-4
Exceedances of the 24-Hour PM-10 Standard, 2008 to 2010

2008				2009				2010			
DATE	DAY	READING	LOCATION	DATE	DAY	READING	LOCATION	DATE	DAY	READING	LOCATION
3/2/08	Sun	159+	BE[1]	3/22/09	Sun	198**	WF	10/15/10	Fri	158	GR
3/14/08	Fri	250*	WF	3/26/09	Thu	209**	WF				
4/30/08	Wed	172*	WF	4/3/09	Fri	213**	WF				
5/21/08	Wed	278*	WF	7/17/09	Fri	400**	BE[1]				
6/4/08	Wed	203+	BE[1]	7/17/09	Fri	161**	DC				
6/4/08	Wed	186+	CL[2]	7/17/09	Fri	275**	HI				
6/4/08	Wed	193*	WF	7/17/09	Fri	169**	SP				
7/1/08	Tue	172+	BE[1]	7/17/09	Fri	185**	WF				
7/4/08	Fri	223+	BE[1]	7/18/09	Sat	213**	BN				
10/11/08	Sat	161+	SP	7/18/09	Sat	439**	BE[1]				
10/22/08	Wed	167+	CL[2]	7/18/09	Sat	277**	DC				
11/7/08	Fri	247	DC	7/18/09	Sat	227**	DY				
11/9/08	Sun	169+	DC	7/18/09	Sat	196**	GL				
11/9/08	Sun	230+	SP	7/18/09	Sat	229**	GR				
11/9/08	Sun	247+	WF	7/18/09	Sat	250**	SP				
				7/18/09	Sat	185**	WC				
				7/18/09	Sat	317**	WF				
				7/18/09	Sat	210**	WP				
				9/3/09	Thu	160**	SP				
				9/3/09	Thu	174**	WF				
				10/27/09	Tue	166**	BE[1]				
				10/27/09	Tue	157**	DC				
				10/27/09	Tue	177**	HI				
				10/27/09	Tue	220**	WC				
				10/27/09	Tue	188**	WF				

[1] The Buckeye monitor is located outside the PM-10 nonattainment area.
[2] The Coyote Lakes monitor was a special purpose monitoring site that was shut down in February 2009.
+ Exceptional events where EPA took no action.
* Exceptional events where EPA did not concur.
** Exceptional events where EPA concurrence is pending.

Source: EPA Air Quality System.

action. However, EPA has indicated that it does not concur with four high wind exceptional vents at the West 43rd Avenue site in 2008, resulting in a violation of the PM-10 standard. All of the exceedances in 2009 have been flagged as exceptional events and EPA concurrence is pending. In 2010, only one exceedance of the 24-hour PM-10 standard occurred, which did not constitute a violation.

In summary, the region has experienced a number of exceptional events in recent years. However, due to EPA nonconcurrence with four events at the West 43rd Avenue monitor in 2008, the region was unable to attain the PM-10 standard in 2010. The exceedances in 2009 have been flagged as exceptional events and only one exceedance occurred in 2010. Therefore, approval of the 2009 exceptional events would give the region two years of clean data.

REFERENCES

MAG, 2008. *PM-10 Source Attribution and Deposition Study.* March, 2008.

CHAPTER FOUR

THE ADOPTED PLAN AND IMPLEMENTATION SCHEDULE FOR THE MAG 2012 FIVE PERCENT PLAN FOR PM-10

The new MAG 2012 Five Percent Plan for PM-10 contains a wide variety of existing control measures and projects that have been implemented to reduce PM-10 and a new measure designed to reduce PM-10 during high risk conditions, including high winds. While the 2007 Five Percent Plan was withdrawn, a wide range of control measures in that plan continue to be implemented to reduce PM-10 and are being resubmitted. Table 4-1 includes the Arizona Statutes, Maricopa County Rules, a Maricopa County Ordinance, and Appendices for the resubmitted measures and a new high risk measure to be approved into the MAG 2012 Five Percent Plan for PM-10 for the Maricopa County Nonattainment Area. The Arizona Revised Statutes listed in Table 4-1 are included in Appendix C, Exhibit 1. The 2012 Five Percent Plan also includes contingency measures that were implemented early such as PM-10 certified street sweeping on freeways and arterials, as well as the projects completed in 2008-2011 that paved and stabilized unpaved roads, alleys and shoulders; reduced speed limits; and overlaid highways with rubberized asphalt.

As described in Table 4-1, the Arizona Statutes, Maricopa County Rules, and Maricopa County Ordinance include requirements to reduce PM-10 emissions from a broad range of sources. The requirements apply to unpaved roads and shoulders, leaf blowers, unpaved parking lots, vacant lots, sweeping streets with certified sweepers, off-road vehicle use, open and recreational burning, residential woodburning, covered vehicle loads, dust generating operations, nonmetallic mineral processing, and other unpermitted sources.

It is also important to note that the Environmental Protection Agency (EPA) has approved Maricopa County Rules 310 and 310.01 in 2010 and Rule 316 in 2009, as part of the State Implementation Plan. Compliance with these rules has increased every year since 2007. These Maricopa County rules reduce emissions from a wide variety of sources and apply to the Maricopa County area. Maricopa County Rule 310 (Fugitive Dust from Dust-Generating Operations) regulates fugitive dust emissions from sources and activities such as: land clearing, earthmoving, weed abatement, excavating, construction, demolition, bulk material handling, storage and transporting operations, outdoor equipment, motorized machinery, staging areas, parking areas, material storage areas, haul roads, disturbed surface areas, initial landscapes and trackout onto paved surfaces from these sources.

Maricopa County Rule 310.01 (Fugitive Dust from Non-Traditional Sources of Fugitive Dust) regulates fugitive dust emissions from sources and activities such as: vehicle use in open areas and vacant lots, open areas, vacant lots, unpaved parking lots, unpaved roadways (including alleyways), easements, rights-of-way, access roads and trackout onto paved surfaces from these activities.

Table 4-1
Arizona Statutes, Maricopa County Rules, Maricopa County Ordinance, and Appendices to be Approved into the MAG 2012 Five Percent Plan for PM-10 for the Maricopa County Nonattainment Area

Arizona Revised Statutes (A.R.S.)	Description	Effective Dates
A.R.S. § 9-500.04. Only A.3., A.5., A.6., A.7., A.8., A.9. and H.	Air quality control; definitions [city and town requirements in Area A regarding targeting unpaved roads and shoulders; leaf blower restrictions; restrictions related to parking, maneuvering, ingress and egress areas and vacant lots; requirement for certified street sweepers]	9/19/07
A.R.S. § 9-500.27.	Off-road vehicle ordinance; applicability; violation; classification	9/19/07
A.R.S. § 11-871. Only A., B. and D.4.	Emissions control; no burn; exemptions; penalty [no burn restriction for any HPA day, increased civil penalty]	9/19/07
A.R.S. § 11-877.	Air quality control measures [county leaf blower restrictions]	9/19/07
A.R.S. § 28-1098. Only A. and C.1.	Vehicle loads; restrictions; civil penalties [for safety or air pollution prevention purpose]	9/19/07
A.R.S. § 49-424. Only 11.	Duties of department [develop and disseminate air quality dust forecasts for the Maricopa County PM-10 nonattainment area]	7/20/11
A.R.S. § 49-457.01.	Leaf blower use restrictions and training; leaf blower equipment sellers; informational material; outreach; applicability	9/19/07
A.R.S. § 49-457.03.	Off-road vehicles; pollution advisory days; applicability; penalties	9/19/07
A.R.S. § 49-457.04.	Off-highway vehicle and all-terrain vehicle dealers; informational material; outreach; applicability	9/19/07
A.R.S. § 49-457.05. Only A., B., C., D. and I.	Dust action general permit; best management practices; applicability; definitions	7/20/11
A.R.S. § 49-474.01. Only A.4., A.5., A.6., A.7., A.8., A.11., B. and H.	Additional board duties in vehicle emissions control areas; definitions [county requirements for stabilization of targeted unpaved roads, alleys and shoulders; restrictions related to parking, maneuvering, ingress and egress areas and vacant lots; requirement for certified street sweepers]	9/19/07
A.R.S. § 49-474.05.	Dust control; training; site coordinators	9/19/07
A.R.S. § 49-474.06.	Dust control; subcontractor registration; fee	9/19/07
A.R.S. § 49-501. Only A.2., B.1., C., F. and G.	Unlawful open burning; exceptions; civil penalty; definitions [ban on outdoor fires from May 1 to September 30; deletion of recreational purpose exemption; no burn day restrictions; penalty provision]	9/19/07
A.R.S. § 49-541. Only 1.	Definitions [Area A]	8/9/01

Table 4-1 Continued

Maricopa County Air Quality Department Rules	Description	Effective Dates
310	Fugitive Dust from Dust-Generating Operations Adopted 1/27/10 and submitted to EPA 4/12/10 [Notice of Final Rulemaking 75 FR 78167; 12/15/10]	EPA approved effective 1/14/11
310.01	Fugitive Dust From Non-Traditional Sources of Fugitive Dust Adopted 1/27/10 and submitted to EPA 4/12/10 [Notice of Final Rulemaking 75 FR 78167; 12/15/10]	EPA approved effective 1/14/11
314	Open Outdoor Fires and Indoor Fireplaces at Commercial and Institutional Establishments Adopted 3/12/08 and submitted to EPA 7/10/08 [Notice of Final Rulemaking 74 FR 57612; 11/9/09]	EPA approved effective 1/8/10
316	Nonmetallic Mineral Processing Adopted 3/12/08 and submitted to EPA 7/10/08 [Notice of Final Rulemaking 74 FR 58553; 11/13/09]	EPA approved effective 1/8/10
Appendix C	Fugitive Dust Test Methods Adopted 3/26/08 and submitted to EPA 7/10/08 [Notice of Final Rulemaking 75 FR 78167; 12/15/10]	EPA approved effective 1/14/11
Maricopa County Ordinance	Description	Effective Dates
P-26	Residential Woodburning Restriction Adopted 3/26/08 and submitted to EPA 7/10/08; [Notice of Final Rulemaking 74 FR 57612; 11/9/09]	EPA approved effective 1/8/10
Appendices	Description	Effective Dates
Appendix C, Exhibit 1	Arizona Revised Statutes Listed in Table 4-1	
Appendix C, Exhibit 2	Maricopa County Resolution to Evaluate Measures in the MAG 2012 Five Percent Plan for PM-10 for the Maricopa County Nonattainment Area	11/16/11
Appendix C, Exhibit 3	Arizona Department of Environmental Quality Dust Action General Permit	12/30/11
Appendix C, Exhibit 4	Arizona Department of Environmental Quality Commitment to Revise the MAG 2012 Five Percent Plan for PM-10 for the Maricopa County Nonattainment Area if Necessary for the Emerging and Voluntary Measure	

Maricopa County Rule 316 (Nonmetallic Mineral Processing) regulates fugitive dust and process dust emissions from sources and activities such as: mining, excavating, separating, combining, crushing and grinding any nonmetallic mineral, asphaltic concrete plants, raw material storage and distribution, concrete plants, bagging operations, open storage piles, material handling, haul roads, and trackout onto paved surfaces from these sources.

MARICOPA COUNTY RESOLUTION TO EVALUATE MEASURES IN THE MAG 2012 FIVE PERCENT PLAN FOR PM-10 FOR THE MARICOPA COUNTY NONATTAINMENT AREA

Maricopa County indicates that the Maricopa Board of Supervisors adopted a resolution on November 16, 2011 that included a commitment for the Evaluation of New Innovative Control Measures and Existing Maricopa County Control Measures. Maricopa County indicates that the Maricopa County Air Quality Department will develop and assess the effectiveness of the innovative control program implemented through the dust generation forecast and Dust Action General Permit on permitted and unpermitted sources of PM-10 in Maricopa County on forecast high risk days. Maricopa County will perform a rule effectiveness study on the implementation of existing dust control rules.

The Maricopa County Board of Supervisors is authorized by A.R.S. § 49-479 to adopt rules for air pollution control and by A.R.S. § 49-480 to establish, administer and enforce a program for air quality permits. The Board adopted rules establishing an air quality permit program and pursuant to A.R.S. § 49-473, designated the Air Quality Department to issue permits and administer and enforce the permit program. In the Memorandum of Agreement developed in 1992 under A.R.S. § 49-406 (F), Maricopa County is responsible for tracking emissions from point, area and non-road mobile sources and for tracking the implementation of control measures. By operation of A.R.S. § 49-471, the executive head of the department designated under A.R.S. § 49-473 serves as the Air Pollution Control Officer. The Air Pollution Control Officer is specifically authorized to take the enforcement actions set forth in A.R.S. §§ 49-502, 49-511, 49-512 and 49-513. A.R.S. § 474.01 (A) (11) requires adoption of rule provisions by March 31, 2008, and enforcement of the provisions by October 1, 2008, regarding stabilization of disturbed surfaces of vacant lots.

Implementation Schedule:

The Air Quality Department in consultation with the U. S. Environmental Protection Agency completed a rule effectiveness study analyzing the impact of Rules 310, 310.01 and 316 for the 2008 PM-10 Periodic Emissions Inventory contained in Appendix A, Exhibit 1 of the MAG 2012 Five Percent Plan for PM-10 for the Maricopa County Nonattainment Area. The department in consultation with EPA will use a similar approach and process with an appropriate temporal period to evaluate the new innovative control measures such as the dust generation forecast and Dust Action General Permit. The Air Quality Department will conduct the program evaluations as follows:

Initial Evaluation:

January 2013	Initiate evaluation process for new innovative control measures and existing rule effectiveness studies.
March 2013	Complete draft program evaluation reports.
April 2013	Complete final program evaluation reports.

Periodic Evaluation: The department will reevaluate the effectiveness of the new innovative control measures as part of the periodic emissions inventory required by EPA every three years.

Program evaluations will be accommodated as part of the air quality compliance, enforcement and planning processes and will be coordinated by the Maricopa County Air Quality Department's existing Planning and Analysis Division.

The Maricopa County Air Quality Department administers the air quality program in Maricopa County. Currently the department has 140.6 employees. The Maricopa County Air Quality Department's FY 2010-11 revenue was approximately $15.3 million. No change in funding is anticipated for these program evaluations.

The Air Quality Department's enforcement options for regulatory programs include orders of abatement, civil actions for injunctive relief or civil penalties, and filing a class 1 misdemeanor citation. Senate Bill 1552 authorizes the county to enter the lot to stabilize the disturbed surface, issue notices of violation, and collect monetary penalties that include the cost of stabilization.

As noted above, the Air Quality Department will assess and evaluate the effectiveness of the new innovative measures as well as the complete rule effectiveness studies for the existing Rules 310, 310.01 and 316 (see Appendix C, Exhibit 2).

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY DUST ACTION GENERAL PERMIT

The Arizona Department of Environmental Quality indicates that since the start of Calendar Year 2008, the majority of exceedances of the PM-10 National Ambient Air Quality Standard (NAAQS) in the Maricopa County Serious PM-10 Nonattainment Area have been related to high wind events. High wind events, along with a number of other meteorological conditions that can lead to the generation of dust can be predicted through meteorological forecasts.

In accordance with A.R.S. § 49-424 (11), ADEQ is developing and disseminating an air quality dust forecast for the Maricopa County Serious PM-10 Nonattainment Area. Based upon knowledge of historical and recent meteorological conditions, and the prediction of

such factors as wind speed and wind direction, forecasts identify the potential risk of dust entrainment as “Low”, “Moderate” or “High” for the next five consecutive days. ADEQ updates this five-day Maricopa County Dust Control Forecast every Sunday through Friday, and posts it on its website at http://www.azdeq.gov/environ/air/ozone/mcdust.pdf.

In accordance with A.R.S. § 49-457.05, this Dust Action General Permit identifies a series of Best Management Practices (BMPs) for specific dust generating operations. When ADEQ’s Maricopa County Dust Control Forecast predicts that day is at high risk for dust generation, those dust generating operations that are not already required to control dust through a permit issued by the Arizona Department of Environmental Quality (ADEQ) or the Maricopa County Air Quality Department (MCAQD) are expected to choose and implement at least one BMP to reduce or prevent PM-10 emissions. Implementation of a BMP is expected to occur as soon as practicable before and during the high risk event. Although the BMPs in the Dust Action General Permit only apply to those sources that do not already have a permit, even dust generating operations with an air quality permit are also expected to implement the dust controls in their permit at the same time.

According to state statute, BMPs identified in the Dust Action General Permit are expected to be employed absent the requirement to obtain an air quality permit. If the owner or operator of a dust-generating operation is found by ADEQ’s Director to have failed to choose and implement an applicable BMP as soon as practicable before and during a day that is forecast to be at high risk of dust generation, then the owner or operator can be required to obtain an Authorization to Operate under the Dust Action General Permit. The process by which ADEQ’s Director makes such a finding is identified within the Dust Action General Permit. Violations of the Dust Action General Permit are subject to the enforcement requirements of Arizona Revised Statutes Title 49, Chapter 3, Article 2, including civil penalties of up to ten thousand dollars per day, per violation, pursuant to Section 463.

In accordance with A.R.S. § 49-457.05 (E) this Dust Action General Permit was subject to a 30-day public comment period and shall be effective for a period of five-years (see Appendix C, Exhibit 3).

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY COMMITMENT TO REVISE THE MAG 2012 FIVE PERCENT PLAN FOR PM-10 FOR THE MARICOPA COUNTY NONATTAINMENT AREA IF NECESSARY FOR THE EMERGING AND VOLUNTARY MEASURE

The Arizona Department of Environmental Quality indicates that A.R.S. § 49-404 requires ADEQ to maintain a State Implementation Plan that provides for the implementation, maintenance and enforcement of national ambient air quality standards. Should it be demonstrated through Maricopa County's April 2013 final program evaluation reports that the emerging and voluntary measure contained within the Five Percent Plan did not achieve the necessary emissions reductions, the Arizona Department of Environmental Quality commits to submitting a SIP revision that contains replacement measures to reduce

PM-10 emissions by an amount equal to or more than the total PM-10 emissions reductions that were not achieved by these measures. An implementation schedule for the submission of this revised plan is as follows:

May 2013	ADEQ will consult with MAG to determine if additional emissions reductions are necessary.
June 2013	If additional controls are required, ADEQ will work with MAG to identify potential replacement measures.
April 2014	If additional controls are required, ADEQ will submit a SIP revision that contains the necessary replacement measure(s).

ADEQ does not anticipate the need for additional personnel or funding to comply with this commitment as any required SIP revisions will be accommodated as part of its normal air quality planning process (see Appendix C, Exhibit 4).

CONTINGENCY REQUIREMENT

The 2012 Five Percent Plan also includes contingency measures that were implemented early such as PM-10 certified street sweeping on freeways and arterials, as well as the projects completed in 2008-2011 that paved and stabilized unpaved roads, alleys and shoulders; reduced speed limits; and overlaid highways with rubberized asphalt. These PM-10 reduction projects were implemented in the PM-10 nonattainment area by twenty-one cities and towns, Maricopa County, Pinal County, Arizona Department of Transportation and the Gila River Indian Community. All of the projects for which credit was taken were open to traffic by September 2011. EPA encourages early implementation of contingency measures to reduce emissions as expeditiously as practicable. The contingency measures and projects are described in Chapter 6.

ASSURANCES THAT THE STATE HAS THE AUTHORITY TO IMPLEMENT THE MEASURES IN THE PLAN

In order to comply with Section 110(a)(2)(E) of the Clean Air Act, a State law was passed in 1992 which provides an approach for assurances that State and local measures will be adequately implemented (A.R.S. § 49-406 I. and J.). If any person (includes State, County, local governments, regional agencies, and other entities) fails to implement a measure as described in the resolution adopted pursuant to A.R.S. § 49-406 G., the County would file an action in Superior Court to have the Court order that the measure be implemented. Likewise, the Director of the Arizona Department of Environmental Quality will backstop the County if it fails to implement a measure or if the County fails to backstop the local governments and regional agencies.

Regarding measures, A.R.S. § 49-406 G. (passed by the Legislature in 1992) requires that each agency which commits to implement any control measure contained in the State

Implementation Plan must describe the commitment in a resolution. The resolution must be adopted by the appropriate governing body of the agency. State law also requires the entity to specify the following information in the resolutions: (1) its authority for implementing the limitation or measure as provided in statute, ordinance, or rule; (2) a program for the enforcement of the limitation or measure; and (3) the level of personnel and funding allocated to the implementation of the measure.

As noted in the MAG regional air quality plans, the action taken by the MAG Regional Council to approve the Suggested Measures and Adopted Plan Measures does not commit each jurisdiction to implement those measures. As indicated in the resolutions and commitments, each jurisdiction determines which measures are reasonably available for implementation by that jurisdiction.

TRACKING PLAN IMPLEMENTATION

The Maricopa County Air Quality Department determines reasonable further progress and reviews the implementation status of the various measures contained in the air quality plans. The Maricopa County Air Quality Department will also continue to have the responsibility for conducting ambient air quality monitoring.

Supplemental to these tracking efforts, the Maricopa Association of Governments publishes regional traffic flow maps and calculates regional vehicle miles of travel from these flow maps. MAG also conducts vehicle occupancy studies and performs special traffic volume and speed studies, as needed. Phoenix Public Transit continuously monitors transit ridership for each month. The Regional Public Transportation Authority will also be collecting transit and carpooling ridership information. The Arizona Department of Environmental Quality continuously monitors the number of vehicles inspected in the Vehicle Emissions Inspection Maintenance Program, the number of vehicles failing the test, and the improvement in tail pipe emissions after failed vehicles are repaired.

In addition, the MAG Air Quality Technical Advisory Committee will review the information pertaining to the implementation of measures. The committee will also review the air quality monitoring data to assist in tracking air quality improvement over time.

CHAPTER FIVE

DEMONSTRATION OF ANNUAL FIVE PERCENT REDUCTIONS IN PM-10 EMISSIONS

Chapter Five demonstrates that the MAG 2012 Five Percent Plan for PM-10 meets the Clean Air Act requirement that PM-10 emissions be reduced by five percent per year until attainment is demonstrated. Section 189(d) of the Clean Air Act requires that the Five Percent Plan provide for an annual reduction in PM-10 emissions of not less than five percent of the total emissions in the most recent inventory prepared for the area.

This chapter describes the increases in rule effectiveness that achieve annual reductions of at least five percent of the emissions inventory for 2007, the base year for the plan. The 2007 emissions inventory is based on the revised 2008 PM-10 Periodic Emission Inventory for the Maricopa County, Arizona, Nonattainment Area (PEI), which is the most recent inventory prepared for the area (Appendix A, Exhibit 1). Since the attainment date for this Plan is December 31, 2012, annual five percent reductions are required for five years, 2008 through 2012. As discussed in detail in Chapter Six, attainment can not be achieved prior to December 31, 2012, because there have been several exceedances of the 24-hour PM-10 standard in 2009 and 2011 which may be due to exceptional events and the required documentation for these events has not yet been submitted to EPA for concurrence. Additionally, modeled attainment cannot be achieved without the credit achieved through the new Dust Action General Permit measure (described below) which is not fully implemented until January 1, 2012.

MEASURES QUANTIFIED TO MEET THE FIVE PERCENT REDUCTION REQUIREMENT

Fifty-three control measures were submitted to EPA in December 2007 as part of the MAG 2007 Five Percent Plan for PM-10. The 2007 Plan was withdrawn by the Arizona Department of Environmental Quality in January 2011. Most of the measures in the 2007 Plan were implemented during the three years before the Plan was withdrawn. The measures submitted in the MAG 2012 Five Percent Plan for approval into the Arizona State Implementation Plan are listed in Table 4-1. Many of the measures from the 2007 Plan have been included in Table 4-1.

To meet the annual five percent reduction requirement in Section 189(d) of the Clean Air Act, the MAG 2012 Five Percent Plan takes credit for increases in rule effectiveness for Maricopa County Rules 310 (Fugitive Dust from Dust-Generating Operations), 310.01 (Fugitive Dust from Non-Traditional Sources of Fugitive Dust) and 316 (Nonmetallic Mineral Processing). The increases in rule effectiveness are attributable to strengthened enforcement and increased compliance with these rules. EPA has approved Rules 310 and 310.01 (EPA, 2010) and Rule 316 (EPA, 2009), as part of the State Implementation Plan. Compliance with these rules has increased every year since 2007, as shown in Table 5-1.

These Maricopa County rules reduce emissions from a wide variety of sources and apply to the Maricopa County area. Maricopa County Rule 310 (Fugitive Dust from Dust-Generating Operations) regulates fugitive dust emissions from sources and activities such as: land clearing, earthmoving, weed abatement, excavating, construction, demolition, bulk material handling, storage and transporting operations, outdoor equipment, motorized machinery, staging areas, parking areas, material storage areas, haul roads, disturbed surface areas, initial landscapes and trackout onto paved surfaces from these sources.

Maricopa County Rule 310.01 (Fugitive Dust from Non-Traditional Sources of Fugitive Dust) regulates fugitive dust emissions from sources and activities such as: vehicle use in open areas and vacant lots, open areas, vacant lots, unpaved parking lots, unpaved roadways (including alleyways), easements, rights-of-way, access roads and trackout onto paved surfaces from these activities.

Maricopa County Rule 316 (Nonmetallic Mineral Processing) regulates fugitive dust and process dust emissions from sources and activities such as: mining, excavating, separating, combining, crushing and grinding any nonmetallic mineral, asphaltic concrete plants, raw material storage and distribution, concrete plants, bagging operations, open storage piles, material handling, haul roads, and trackout onto paved surfaces from these sources.

Emission reduction credit is also taken for one new measure, the Dust Action General Permit, which will be fully implemented by January 1, 2012, as discussed in Chapter Four. Credit for this measure is allowed under the EPA guidance, *Incorporating Emerging and Voluntary Measures in a State Implementation Plan* (EPA, 2004). The measures used to demonstrate the annual five percent reductions are also used in modeling for the attainment demonstration, as described in Chapter Six.

In addition to demonstrating five percent reductions and modeling attainment, this Plan must meet contingency requirements of the Clean Air Act. It is important to note that the contingency requirements must be satisfied by quantifying the benefit of different measures than those used to meet the five percent and attainment demonstration requirements. The contingency requirements met by this Plan are also discussed in Chapter Six.

Strengthened enforcement and increased compliance with Maricopa County Rules 310, 310.01 and 316 have raised compliance rates significantly since 2007. The benefits of increased compliance with these rules have been quantified to show the annual five percent reductions in PM-10 emissions. The rule effectiveness (RE) rates have been calculated for 2007 through 2010, using actual inspection data and a methodology developed by the Maricopa County Air Quality Department (MCAQD), in consultation with EPA.

Table 5-1 shows the rule effectiveness rates calculated for 2007 through 2010. The RE

Table 5-1
Impact of Increased Rule Effectiveness on 2008-2012 PM-10 Emissions

Categories Affected by Rule Effectiveness	Base Case Emissions (tons/year) 2007	2008	2009	2010	2011	2012	Rule Effectiveness Rates 2007	2008	2009	2010 -2011	2012
Residential Construction	3,423	2,815	1,939	1,656	1,602	1,627	76%	90%	92%	94%	94%
Commercial Construction	8,205	6,748	4,649	3,971	3,839	3,901	76%	90%	92%	94%	94%
Road Construction	4,150	3,412	2,351	2,008	1,942	1,973	76%	90%	92%	94%	94%
All Other Earthmoving	328	270	186	159	154	156	76%	90%	92%	94%	94%
Non-metallic mineral mining	306	290	257	246	247	260	40%	65%	69%	73%	73%
Mining & Quarrying	256	242	214	205	206	217	40%	65%	69%	73%	73%
Industrial paved/unpaved road travel	771	728	645	618	621	654	40%	65%	69%	73%	73%
Windblown Agriculture	448	448	448	448	448	448	n/a	n/a	n/a	n/a	n/a
Windblown Construction	566	566	566	566	566	566	76%	90%	92%	94%	94%
Windblown Vacant, Open, Landfill, Test Tracks	5,430	5,430	5,430	5,430	5,430	5,430	85%	95%	96%	96%	97%
Windblown Sand & Gravel, Mining	190	190	190	190	190	190	40%	65%	69%	73%	73%
TOTALS:	24,073	21,139	16,876	15,497	15,244	15,422					

Categories Affected by Rule Effectivenss	Controlled Emissions (tons/year) 2007	2008	2009	2010	2011	2012	Benefits from RE Increases (tons/year) 2008	2009	2010	2011	2012
Residential Construction	3,423	1,692	1,056	807	780	793	1,122	884	849	821	834
Commercial Construction	8,205	4,057	2,531	1,935	1,871	1,901	2,691	2,119	2,036	1,968	2,000
Road Construction	4,150	2,052	1,280	979	946	961	1,361	1,071	1,029	995	1,011
All Other Earthmoving	328	162	101	77	75	76	108	85	81	79	80
Non-metallic mineral mining	306	188	152	132	132	139	102	105	114	114	121
Mining & Quarrying	256	157	127	110	110	116	85	87	95	96	101
Industrial paved/unpaved road travel	771	472	382	331	333	351	256	263	287	288	304
Windblown Agriculture	448	448	448	448	448	448	0	0	0	0	0
Windblown Construction	566	391	366	341	341	341	175	200	225	225	225
Windblown Vacant, Open, Landfill, Test Tracks	5,430	3,938	3,788	3,788	3,788	3,639	1,492	1,642	1,642	1,642	1,791
Windblown Sand & Gravel, Mining	190	132	123	113	113	113	58	68	77	77	77
TOTALS:	24,073	13,689	10,353	9,062	8,939	8,879	7,450	6,523	6,435	6,305	6,543

Note: The increase of 1% for the 2012 higlighted rule effectiveness rate for windblown vacant and open lands is the result of the new Dust Action General Permit Measure.

rates have been applied to the base case emissions for the source categories shown in Table 5-1 to quantify the PM-10 emission reductions attributable to strengthened enforcement and increased compliance with Rules 310, 310.01 and 316. The RE rate increases are held constant after 2010.

As mentioned earlier, the five percent reductions also include the benefits of one new measure, the Dust Action General Permit, which was passed by the Arizona Legislature in April 2011. This new measure is expected to raise rule effectiveness for Rule 310.01 by one percent during high wind hours, resulting in the RE rate highlighted in Table 5-1 for windblown vacant land, open space, landfills and test tracks in 2012. Additional details regarding the calculation of the PM-10 emissions reduction associated with the increases in rule effectiveness are provided in the TSD (Chapter III of Appendix B, Exhibit 1).

EPA allows an emission reduction benefit to be taken for the new Dust Action General Permit, as an emerging measure (EPA, 2004). According to EPA guidance, emerging measures do not have the same high level of certainty as traditional measures for quantification purposes in a State Implementation Plan (SIP). The PM-10 emission reduction increment necessary to demonstrate attainment in 2012 (i.e., total 2012 base case emissions (in Table 5-2) minus total 2012 emissions with increased rule effectiveness (in Table 5-3), is 6,543 tons. EPA allows emerging and voluntary measures to account for up to six percent of this increment (in this case, a maximum of 393 tons). The one percent increase in RE during high wind hours will reduce PM-10 emissions by 149 tons in 2012. Since this reduction is less than 393 tons, benefit for this new measure may be used in meeting the annual five percent reduction requirement and demonstrating attainment in this Plan.

As required by EPA's emerging and voluntary measure guidance, Maricopa County has made a commitment to retrospectively assess the performance of the Dust Action General Permit. MCAQD will evaluate the effectiveness of Rules 310, 310.01 and 316 to ensure that this measure achieves at least a 149 ton reduction during calendar year 2012. The County's commitment and the method to be used in calculating rule effectiveness are described in Chapter Four and Appendix C, Exhibit 2.

DEMONSTRATION FOR THE FIVE PERCENT REDUCTION REQUIREMENT

As discussed above, increases in Rule Effectiveness (RE) for Rules 310, 310.01 and 316 have been quantified to meet the annual five percent reductions required in Section 189(d) of the Clean Air Act. Table 5-2 provides the base case emissions used to calculate the annual five percent reductions. The 2008 emissions in this table are based on the most recent version of the 2008 PEI, published in June 2011 (Appendix A, Exhibit 1).

The 2007 and 2009-2012 base case emissions were derived from the 2008 PEI emissions, using annual population and employment growth factors published in August 2011 by Marshall Vest of the Economic and Business Research Center at the University of Arizona. These projections are based on the 2010 U.S. Census and the latest economic forecasts

Table 5-2
2007-2012 Base Case PM-10 Emissions in the PM-10 Nonattainment Area

Source Category	2007	2008	2009	2010	2011	2012
	(tons/year)					
POINT	159	150	133	127	128	135
AREA						
Fuel combustion	1,276	1,301	1,307	1,311	1,316	1,328
Commercial cooking	974	993	998	1,001	1,005	1,014
Construction (includes windblown dust)	16,672	13,811	9,692	8,359	8,102	8,223
Tilling, harvesting and cotton ginning	936	893	893	893	893	893
Travel on unpaved farm roads	769	731	731	731	731	731
Livestock	261	261	261	261	261	261
Travel on unpaved parking lots	2,376	2,422	2,434	2,441	2,451	2,473
Offroad recreational vehicles	2,139	2,180	2,191	2,198	2,206	2,226
Leaf blowers	878	895	899	902	906	914
Windblown agriculture	448	448	448	448	448	448
Other windblown sources	5,430	5,430	5,430	5,430	5,430	5,430
Fires	497	497	497	497	497	497
Mining/quarrying (includes windblown dust)	752	721	661	641	643	667
Travel on industrial paved/unpaved roads	771	728	645	618	621	654
Other industrial sources	1,033	976	865	828	832	877
NONROAD						
Aircraft	194	184	152	142	143	146
Airport ground support equipment	29	27	23	21	20	20
Locomotives	34	34	34	34	34	34
Other nonroad equipment	1,710	1,683	1,661	1,641	1,595	1,513
ONROAD						
Exhaust	2,943	2,836	2,647	2,371	1,843	1,407
Tire wear	246	256	257	257	258	261
Brake wear	728	758	767	771	773	787
Paved roads	7,749	8,155	8,214	8,289	8,323	8,422
Unpaved roads and alleys	10,218	10,312	10,284	10,284	10,284	10,312
Totals	**59,218**	**56,681**	**52,123**	**50,497**	**49,743**	**49,673**

for the Phoenix-Mesa metropolitan area. Since the economic outlook for Arizona remains extremely unstable, the actual population and employment levels in 2011 and 2012 may differ somewhat from the projections. However, the University of Arizona growth factors represent the most reliable data currently available. Details regarding the population and employment projections and other technical assumptions used in generating the base case emissions are provided in the TSD (Chapter II of Appendix B, Exhibit 1).

The annual five percent reduction target was calculated by multiplying the total 2007 PM-10 emissions in Table 5-2 (59,218 tons) by five percent, which results in 2,961 tons. To meet the 189(d) requirement, the 2008 emissions with increased rule effectiveness must be at least 2,961 tons less than the 2007 base case emissions. Each year after 2008 imposes yet another 2,961 ton reduction requirement. Thus, the cumulative reduction requirements (relative to 2007 base case emissions) are at least 5,922 tons in 2009, 8,883 tons in 2010, 11,844 tons in 2011, and 14,805 tons in 2012.

Table 5-3 shows the impact of the increases in rule effectiveness on PM-10 emissions in 2008 through 2012. This table also quantifies the annual five percent reductions for 2008 through 2012. The total reduction in PM-10 emissions between 2007 and 2012 with the increases in rule effectiveness is 16,089 tons, which represents a 27.2 percent reduction in total 2007 base case emissions.

Table 5-4 confirms that the annual five percent reduction requirements are met in 2008-2012 and there is a surplus margin of benefit in each year. The total surplus in 2012 is 1,284 tons. This surplus is needed to model attainment at all monitors in the PM-10 nonattainment area by December 31, 2012. The modeling attainment demonstration is discussed in Chapter Six.

Table 5-3
2008-2012 PM-10 Emissions with Increased Rule Effectiveness

Source Category	2008	2009	2010	2011	2012
	(tons/year)				
POINT	150	133	127	128	135
AREA					
Fuel combustion	1,301	1,307	1,311	1,316	1,328
Commercial cooking	993	998	1,001	1,005	1,014
Construction (includes windblown dust)	8,355	5,333	4,139	4,014	4,073
Tilling, harvesting and cotton ginning	893	893	893	893	893
Travel on unpaved farm roads	731	731	731	731	731
Livestock	261	261	261	261	261
Travel on unpaved parking lots	2,422	2,434	2,441	2,451	2,473
Offroad recreational vehicles	2,180	2,191	2,198	2,206	2,226
Leaf blowers	895	899	902	906	914
Windblown agriculture	448	448	448	448	448
Other windblown sources	3,938	3,788	3,788	3,788	3,639
Fires	497	497	497	497	497
Mining/quarrying (includes windblown dust)	476	401	355	356	369
Travel on industrial paved/unpaved roads	472	382	331	333	351
Other industrial sources	976	865	828	832	877
NONROAD					
Aircraft	184	152	142	143	146
Airport ground support equipment	27	23	21	20	20
Locomotives	34	34	34	34	34
Other nonroad equipment	1,683	1,661	1,641	1,595	1,513
ONROAD					
Exhaust	2,836	2,647	2,371	1,843	1,407
Tire wear	256	257	257	258	261
Brake wear	758	767	771	773	787
Paved roads	8,155	8,214	8,289	8,323	8,422
Unpaved roads and alleys	10,312	10,284	10,284	10,284	10,312
Totals	**49,231**	**45,600**	**44,062**	**43,438**	**43,130**
5% Reduction Targets (tons/year)	**2,961**	**5,922**	**8,883**	**11,844**	**14,805**
Actual Plan Reductions (tons/year)	**9,987**	**13,618**	**15,157**	**15,781**	**16,089**

Table 5-4
PM-10 Emission Reductions and Five Percent Reduction Requirements

Year	5% Reduction Requirement (tons/year)	Total PM-10 Emission Reductions due to Increases in Rule Effectiveness (tons/year)	Excess Benefit = Total PM-10 Emission Reductions minus 5% Reduction Requirement (tons/year)	(%)
2008	2,961	9,987	7,026	237%
2009	5,922	13,618	7,696	130%
2010	8,883	15,157	6,274	71%
2011	11,844	15,781	3,937	33%
2012	14,805	16,089	1,284	9%

REFERENCES

EPA, 2004. *Incorporating Emerging and Voluntary Measures in a State Implementation Plan*. Prepared by the EPA Office of Air Quality Standards. September 2004.

EPA, 2009. *Revisions to the Arizona State PM-10 Implementation Plan, Maricopa County Air Quality Department. Final Rule*. Federal Register, Volume 74, Number 218, Pages 58553-58554. November 13, 2009.

EPA, 2010. *Revisions to the State Implementation Plan, Maricopa County, Arizona. Final Rule*. Federal Register, Volume 75, Number 240, Pages 78167-78168. December 15, 2010.

CHAPTER SIX

ATTAINMENT DEMONSTRATION

Chapter Six describes the modeling that was performed to demonstrate that attainment of the 24-hour PM-10 standard will be achieved in 2012. The modeling was conducted to show attainment under high wind conditions since violations of the standard under stagnant conditions have not occurred since 2006 (see Chapter 3 for monitoring data information).

A modeling attainment demonstration was performed for a 36 square mile area in the Salt River area, which includes the West 43rd Avenue monitor that has recorded the most exceedances of the PM-10 standard under high wind conditions during 2005-2010. A regional attainment demonstration for the entirety of the nonattainment area is also provided in this chapter. Both the modeling demonstration in the Salt River area and the entire nonattainment area are based upon a distance-weighted rollback approach. Windblown PM-10 emission estimates during high wind hours are calculated from back trajectories while low wind hour emission estimates are derived from land use distribution within each modeling domain. The benefits of the control measures described in Chapter Five provide the reductions necessary to model attainment.

In addition to the modeling attainment demonstrations, this chapter addresses other requirements of a nonattainment area plan, including reasonable further progress, contingency measures, and the onroad motor vehicle emissions budget for conformity. The chapter concludes with a discussion of the control measures in the Five Percent Plan that will reduce PM-10 emissions sufficiently to achieve attainment as expeditiously as practicable and the need for an extension of the attainment date deadline to December 31, 2012.

SALT RIVER AREA MODELING

This section describes the modeling and results for the attainment demonstration in the Salt River Area. A detailed discussion of the technical methods and assumptions used to perform the modeling for the Salt River Area is provided in the TSD (Chapter V of Appendix B, Exhibit 1).

Design Day Selection

PM-10 monitors in the Maricopa County nonattainment area recorded 17 exceedances of the 24-hour average PM-10 national ambient air quality standard in 2007 (the last year before the control measures in this plan were implemented). Exceedances were recorded at six monitoring sites in the nonattainment area: Coyote Lakes, Central Phoenix, Durango, Higley, South Phoenix and West 43rd Avenue. The Buckeye monitor also exceeded the standard on two days in 2007, but this monitor is outside the nonattainment area and therefore was not modeled in this plan.

Of the 17 exceedances recorded within the nonattainment area in 2007, the West 43rd Avenue monitor recorded the highest number of exceedances with six. The Higley monitor was next highest with five. The remaining exceeding monitors in the nonattainment area recorded two or less exceedances in 2007. All but one of the exceedances in 2007 occurred under high wind conditions. For the purposes of this attainment demonstration, high wind conditions are defined as days when five-minute or hourly average wind speeds are greater than 12 miles per hour. This value is identical to the threshold for windblown dust production as identified in the 2008 PM-10 Periodic Emissions Inventory (Appendix A, Exhibit 1). Table 6-1 provides a tabulation by monitor of the exceedance days, 24-hour average concentrations and the general meteorological conditions associated with the exceedances.

The following primary criteria were applied in selecting the design days for PM-10 modeling:

1. Exceedance days with five-minute or hourly average wind speeds > 12 miles per hour; and

2. Exccedance days that are unlikely to be considered as a high wind exceptional event.

The West 43rd Avenue monitor recorded six exceedances when hourly average winds were greater than 12 miles per hour in 2007. Four of the six exceedance days were associated with high winds from a frontal storm system, while the remaining two days were associated with high winds from monsoon season thunderstorm outflows. Days on which thunderstorm outflow activity occurs have been excluded as candidate days for modeling, as these days are almost always flagged as uncontrollable exceptional events.

Two of the four frontal system exceedances days recorded at the West 43rd Avenue monitor were days in which only the West 43rd Avenue monitor exceeded the standard (March 27 and May 4). These days suggest that the local sources around the West 43rd Avenue monitor may have been important contributors to the exceedance value. Of these two dates, May 4, 2007 was chosen as the design day as wind speeds on March 27th were significantly higher making it a candidate for an exceptional event demonstration.

For a demonstration of regional attainment across the nonattainment area, the other exceedance days in 2007 were evaluated using the same criteria employed to select May 4, 2007 for the Salt River area modeling. All high wind days associated with thunderstorm outflows were removed for consideration due to their designation as uncontrollable exceptional events. Of the remaining days with high wind days, two days (April 12 and June 6) recorded exceedances at multiple monitors, indicating that the high winds had a more regional effect on PM-10 concentrations. Of the these two dates, June 6, 2007 was chosen as the design day as April 12, 2007 presented very strong state-wide high winds indicating this date was also a candidate for an exceptional event demonstration. A more

Table 6-1
Maricopa County and PM-10 Nonattainment Area 24-Hour Average PM-10 Standard Exceedance Dates, Measured Concentrations and Associated Meteorological Conditions in 2007

Monitor	Date	PM-10 Conc. ($\mu g/m^3$)	Meteorological Conditions
Buckeye	July 19	195.0	Low Winds
	November 15	166.2	Irregular Winds
Coyote Lakes	July 19	273.4	Thunderstorm Outflow
	October 21	312.9	Frontal System High Winds
Central Phoenix	July 19	267.8	Thunderstorm Outflow
Durango Complex	November 15	155.7	Irregular Winds
Higley	***June 6***	***181.0***	***Frontal System High Winds***
	July 19	199.5	Thunderstorm Outflow
	August 16	195.6	Thunderstorm Outflow
	August 23	230.4	Thunderstorm Outflow
	October 24	174.8	Frontal System High Winds
South Phoenix	April 12	171.1	Frontal System High Winds
	August 13	159.5	Thunderstorm Outflow
West 43rd Avenue	March 27	227.9	Frontal System High Winds
	April 12	202.7	Frontal System High Winds
	May 4	***197.3***	***Frontal System High Winds***
	June 6	***225.7***	***Frontal System High Winds***
	July 19	178.0	Thunderstorm Outflow
	August 16	215.1	Thunderstorm Outflow

Note: The selected design days are highlighted in bold italics. The Buckeye monitor is located outside the PM-10 nonattainment area and is not part of the attainment demonstration. The Coyote Lakes monitor was a special purpose monitor that no longer operates and has since been replaced by the Zuni Hills monitor in late 2009. As such, the Coyote Lakes monitor is not a good candidate for producing a design day.

detailed discussion on design day selection is presented in the TSD (Chapter V of Appendix B, Exhibit 1).

Plots of hourly wind speed and PM-10 concentration for the high wind design days of May 4, 2007 and June 6, 2007 at the West 43rd Avenue and Higley monitors are shown in Figure 6-1 through 6-3.

Modeling Domain

On a high wind design day, the areal extent impacting monitors is largely a function of wind speed. As such it is necessary to divide the selected design days into high and low wind hours. High wind hours are represented by sources located along back trajectories and low wind hours are represented by sources within a modeling domain surrounding the selected monitoring site. The basis for distinguishing between high and low wind hours is the 12 mph windblown dust aerodynamic entrainment threshold established in the 2008 PM-10 Periodic Emissions Inventory (Appendix A, Exhibit 1).

Five-minute average wind speed and direction as measured at the West 43rd Avenue monitor is employed to construct the back trajectories for each high wind hour. Past modeling of back trajectories indicate that the lands significantly contributing to elevated PM-10 concentrations recorded at the monitor lie generally within a mile of either side of the path of the upwind back trajectories (see Section entitled "Establishing the Boundaries of a High Wind Domain" in Chapter V of Appendix B, Exhibit 1).

The modeling domain used during the low wind hours for the West 43rd Avenue monitor is similar to the area initially defined in the ADEQ TSD for the 2005 PM-10 attainment plan and is bounded by Van Buren Street to the north, Baseline Road to the south, 59th Avenue to the west and 7th Street to the east. Due to the diversity and number of PM-10 sources in the Salt River area, it is considered to be a worst-case representation of sources throughout the nonattainment area.

Figure 6-4 shows the low wind domain and the high wind back trajectories on May 4, 2007 as originating from the West 43rd Avenue monitor. The highlighted area surrounding the back trajectories represent the land use domain used for calculating windblown PM-10 emissions during the high wind hours.

Inventory Development

For the high wind hours, hourly windblown PM-10 emissions are calculated based upon the land uses that fall within the hourly back trajectory. Emissions from the land uses within each hourly back trajectory are calculated per the methodology described in the 2008 PM-10 Periodic Emissions Inventory. Initially, the land uses within each back trajectory are evaluated for their potential to emit windblown dust. Some land uses are assumed to have no windblown dust emissions (office/retail), some are partially emissive (commercial/industrial) and others are assumed to be 100% emissive (vacant lands).

Figure 6-1
Summary of the Monitoring Conditions at West 43rd Avenue
on the High Wind Design Day
(May 4, 2007)

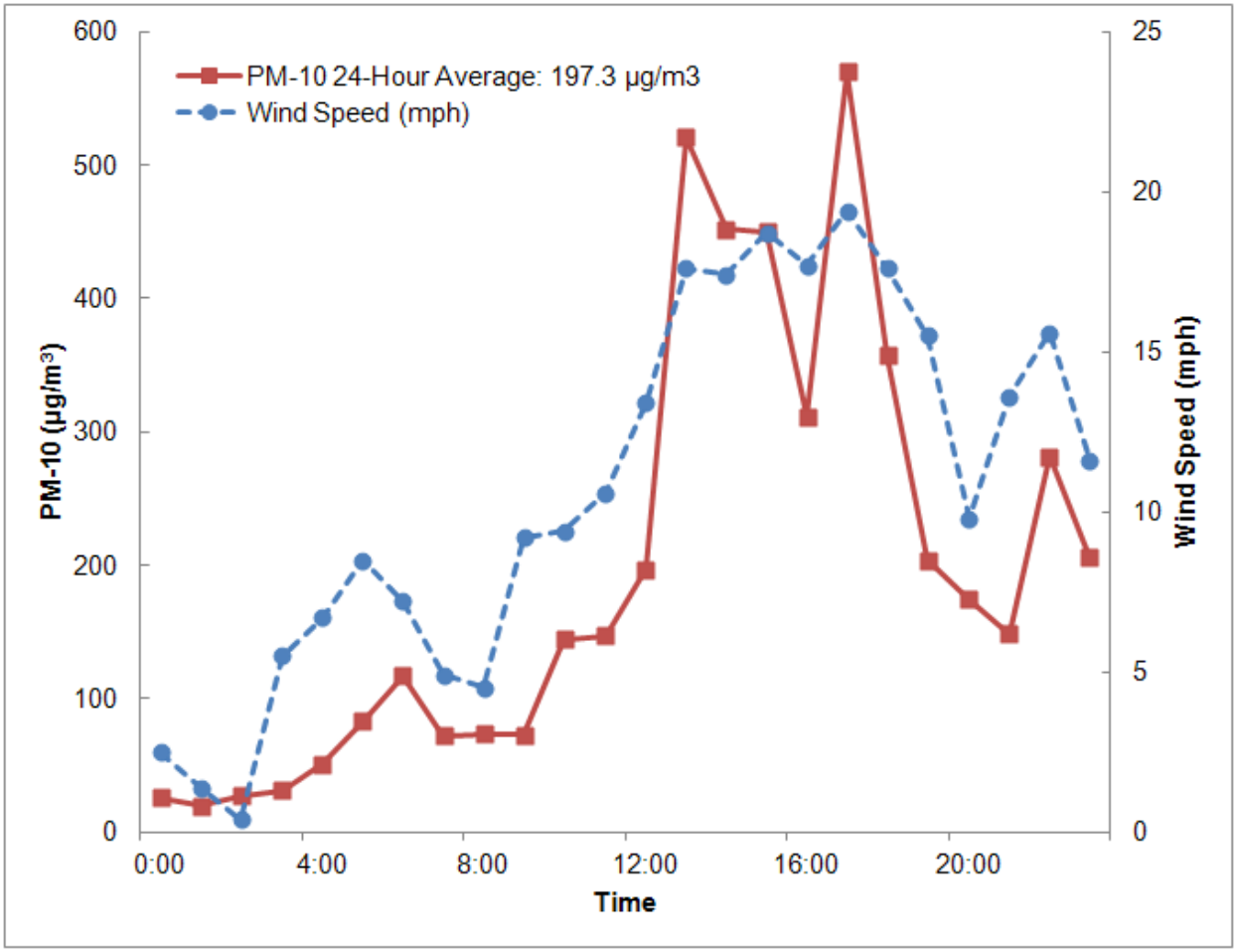


Figure 6-2
Summary of the Monitoring Conditions at West 43rd Avenue on the High Wind Design Day (June 6, 2007)

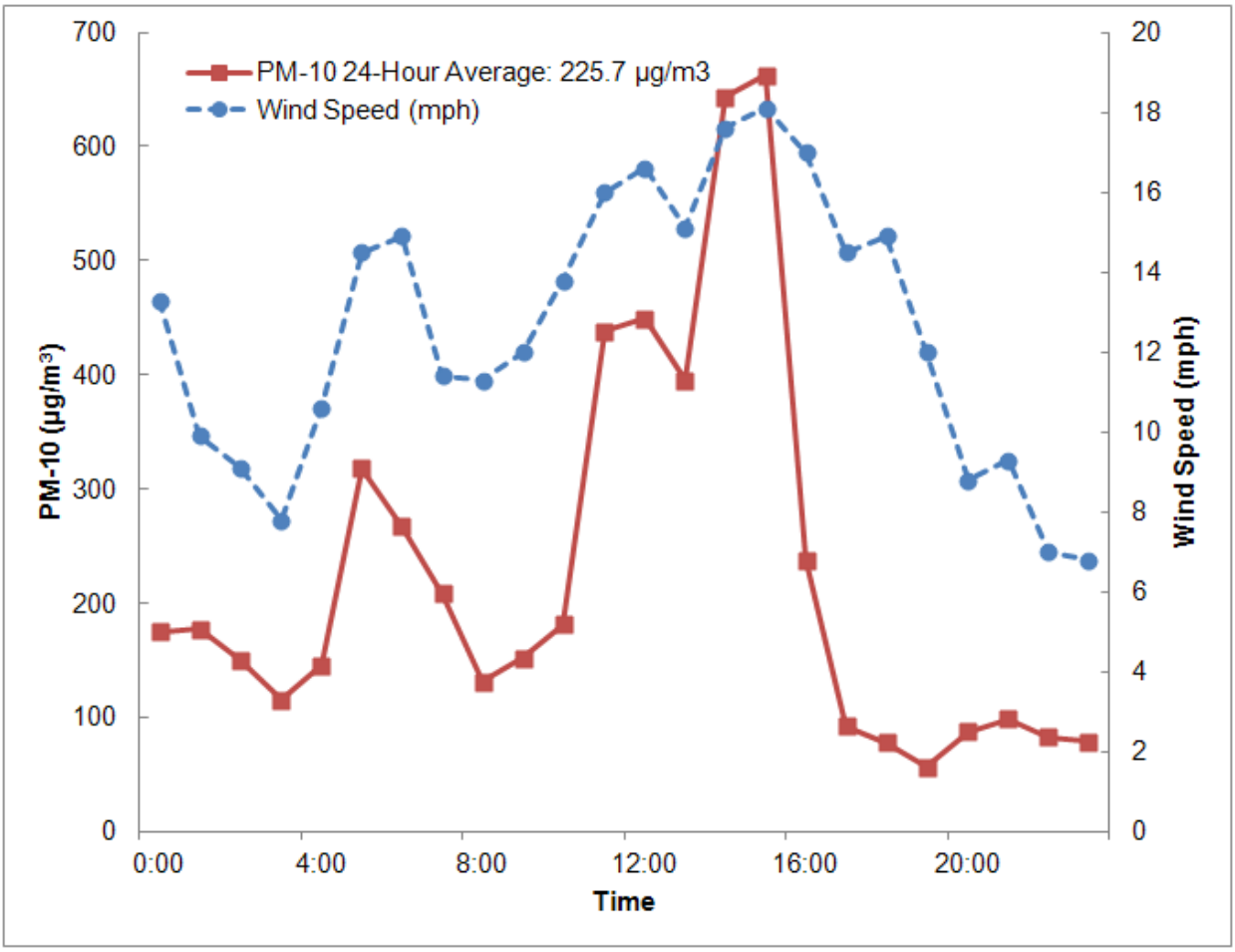


Figure 6-3
Summary of the Monitoring Conditions at Higley
on the High Wind Design Day
(June 6, 2007)

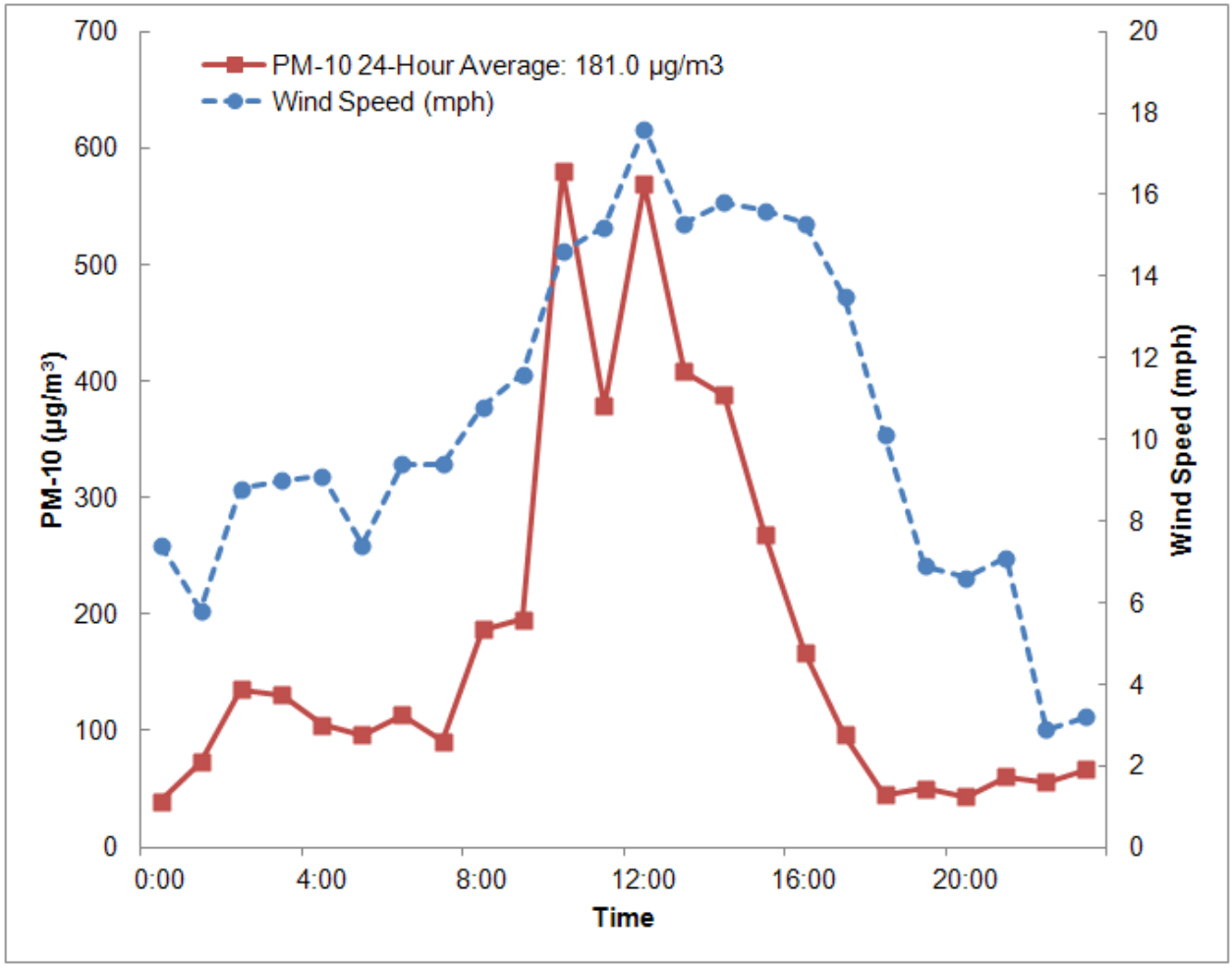
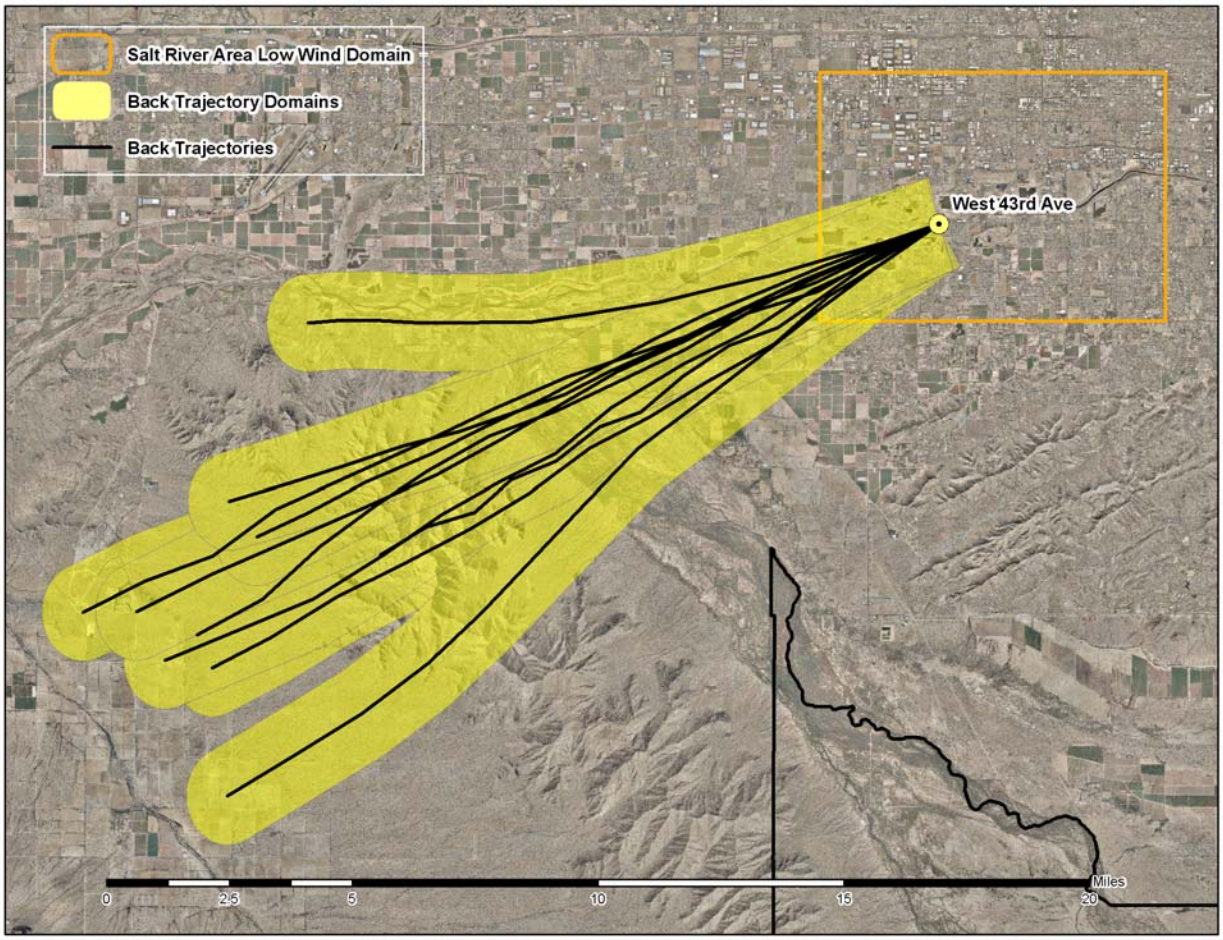


Figure 6-4
Salt River Area Low Wind Domain and
May 4, 2007 Hourly High Wind Back Trajectories
and Associated Domains as Originating from West 43rd Avenue Monitor



Land uses that are conservatively assumed to have 100% of their acreage available for windblown dust production include: vacant and open lands, sand and gravel/mining lands, lands under development, landfills and unpaved automotive test tracks. Land uses where only portions of the acreage is available for windblown dust production include: agricultural lands, industrial lands, commercial lands and large public lands.

Windblown PM-10 emissions from these land uses are calculated by use of emission factors based upon wind speed and the disturbance level of each land use. The disturbance level of each land use is derived from rule effectiveness studies of the fugitive dust rules that regulate the various land uses. The effectiveness of the rule is assumed to be an approximate surrogate for the average level of disturbance of each regulated land use. The details of the calculation of the windblown PM-10 emissions are provided in the TSD (Chapter V of Appendix B, Exhibit 1).

Since there have been no stagnation violations of the 24-hour PM-10 standard since 2006, detailed low wind design-day specific emission inventories are not needed. However, emissions reductions achieved as a result of controls in this plan during the low wind hours of the high wind design days are quantifiable and a necessary part of the attainment demonstration. In order to account for these emissions reductions, annual low wind emission inventories for the PM-10 nonattainment area are allocated to the Salt River area domain based upon land use distribution. This allows for representation of the low wind emissions, and associated control measure benefits, in the Salt River area domain without having to create a design day inventory. The details on how low wind emissions are allocated to the Salt River area domain based upon land use is included in the TSD (Chapter V of Appendix B, Exhibit 1).

Distance-Weighted Rollback Modeling

The fundamental assumption underlying any rollback method is that pollutant concentrations are directly proportional to total emissions over the area of interest. A weighted rollback approach applies a distance reduction factor to the emissions of each source in the modeling domain to help assess the impact of emissions as distance from the monitor increases. The reduction factor is calculated based upon the distance between each source and the impacting monitor.

An investigation of results from a limited-term (2010-mid 2011) saturation monitoring study conducted in the Salt River area and beyond under high wind conditions suggested the need to account for distance between emission sources and the impacted monitor. Further testing of different weighting factors through the analysis of dispersion model AERMOD confirmed that a 1/d weighting factor proved to be the best form of weight to use in adjusting PM-10 emissions developed through the back trajectory domains (See section entitled “Source Weighting” in Chapter V of Appendix B, Exhibit 1 for more information). Thus, all high wind design day emissions inventories were weighted to account for a 1/d distance from the modeled monitor.

Distance weighting was not applied to the low wind domain, as the low wind domain primarily serves to identify the predominant land uses near the monitor and thus the predominant low wind emissions associated with the land uses. The overall reduction in low wind emissions gained through the implementation of control measures was applied as the reduction factor to the low wind hourly concentrations without the need to weight these reductions by distance.

A detailed explanation of the saturation monitoring study and the AERMOD evaluation can be found in the TSD (Chapter V of Appendix B, Exhibit 1).

Background Concentrations

The temporary saturation monitoring study also provided insights into non-anthropogenic levels of PM-10 within the nonattainment area. These background values were established by comparing monitored readings under high and low wind conditions at the temporary, rural Arlington School monitor and the existing Buckeye monitor located just outside the western edge of the nonattainment area. The Arlington School monitor was located approximately 11 miles west of the Buckeye monitor, surrounded by mostly natural desert land.

Under high wind conditions (> 12 mph), when the wind is coming primarily from the west, the Arlington monitor consistently recorded lower PM-10 concentrations than the Buckeye monitor, which is primarily impacted by PM-10 emissions from agricultural activities. The median value under high wind conditions at the Arlington monitor was found to be 21.9 $\mu g/m^3$ and is assumed to be the non-anthropogenic background PM-10 concentration for the PM-10 nonattainment area under high wind conditions. A similar comparison under low wind conditions yielded a median value of 14.9 $\mu g/m^3$ and is assumed to be the non-anthropogenic background PM-10 concentration for the PM-10 nonattainment area under low wind conditions. A detailed explanation of the methods and data used to develop the background values can be found in the TSD (Chapter V of Appendix B, Exhibit 1).

Control Measure Analysis

To assess the benefits of the control measures under high wind conditions, separate hourly windblown PM-10 inventories were developed along back trajectory domains using base case soil disturbance rates in 2007 and then compared against inventories developed using the predicted soil disturbance rates in 2012. The high wind inventories are then weighted by distance from the monitor to more accurately represent the lessening impact of emission sources that are farther away from the modeled monitor. The reductions seen during the high wind hours is strictly due to the benefits of control measures in this plan, as land use is held constant between 2007 and 2012. Table 6-2 provides a summary of the hourly high wind inventories for 2007 and 2012.

Table 6-2
Base Case 2007 and Controlled 2012 High Wind PM-10 Emissions Inventories for May 4, 2007 Design Day at the West 43rd Avenue Monitor

High Wind Hour	Un-weighted Emissions (tons)		Distance-Weighted Emissions (tons/feet from monitor)		% Reduction of Weighted Emissions
	2007	2012	2007	2012	
12	3.05	2.09	2.872E-04	1.900E-04	33.8%
13	9.49	6.36	6.529E-04	4.245E-04	35.0%
14	9.94	6.67	6.866E-04	4.454E-04	35.1%
15	13.94	9.19	8.721E-04	5.581E-04	36.0%
16	13.36	8.81	8.921E-04	5.699E-04	36.1%
17	19.01	12.39	1.190E-03	7.505E-04	36.9%
18	11.84	7.86	7.837E-04	5.033E-04	35.8%
19	6.58	4.44	5.158E-04	3.364E-04	34.8%
21	4.02	2.72	3.236E-04	2.129E-04	34.2%
22	6.63	4.48	5.104E-04	3.330E-04	34.8%
Total	97.86	65.02	6.714E-03	4.324E-03	35.6%

Under low wind conditions, emissions inventories for the Salt River area domain were developed based upon land use distribution within the Salt River area. Annual 2007 base case and 2012 controlled low wind emissions were each allocated to the land uses within the domain for comparison of the benefits of the control measures in this plan. The reductions seen during the low wind hours are a result of the control measures in this plan along with adjustments to source categories based upon observed and expected economic and social growth factors. Table 6-3 provides a summary of the low wind inventories by land use for 2007 and 2012. Detailed discussions of the creation of high and low wind inventories is provided in the TSD (Chapter V of Appendix B, Exhibit 1).

Demonstration of Attainment

Assessing the impact of the control measures in this plan on concentrations within the Salt River area at the West 43rd monitor in 2012 is accomplished through a distance-weighted rollback methodology. As per the methodology, the percent PM-10 emission reductions recorded between the 2007 and 2012 high and low wind inventories provide the percent reductions to the hourly concentrations on the design day. Non-anthropogenic background concentrations under high and low wind conditions are held steady and are not reduced by the benefits seen in the contrast between the 2007 base and 2012 controlled inventories. The resulting hourly concentrations in 2012 must then be summed and averaged across the design day in order to compare the 24-Hour value against the 24-hour PM-10 standard. The 24-hour value must be less the 155 $\mu g/m^3$ in order to demonstrate attainment of the standard.

Table 6-4 provides a summary of the results of the distance-weighted rollback attainment demonstration for West 43rd Avenue monitor in the Salt River area. A 24-hour value of 133.2 $\mu g/m^3$ attests that the control measures in this plan are sufficient to demonstrate that the West 43rd Avenue monitor will have concentrations below the 24-hour PM-10 standard in 2012. This indicates that attainment has been demonstrated under high wind conditions at the West 43rd Avenue monitor within the Salt River area domain.

Table 6-3
Annual Base Case 2007 and Controlled 2012 Low Wind PM-10 Emissions Inventories for the Salt River Area Low Wind Domain

Land Use	2007 Emissions (tons)	2012 Emissions (tons)	% Reduction
Residential	61.19	62.05	(1.4%)
Commercial	61.34	62.81	(2.4%)
Agriculture	29.19	28.57	2.1%
Vacant/Open	27.97	28.62	(2.3%)
Transportation	167.28	155.42	7.1%
Industrial	465.10	350.77	24.6%
Construction	437.70	132.98	69.6%
Total	1,249.76	821.23	34.3%

Table 6-4
2012 Attainment Demonstration
High Wind Design Day (May 4, 2007) at the West 43rd Avenue Monitor

Hour	Wind Speed (mph)	May 4, 2007 PM-10 Concentration ($\mu g/m^3$)	Background Concentration ($\mu g/m^3$)	2012 Controlled PM-10 Concentration ($\mu g/m^3$)
0	2.5	25.9	14.9	22.1
1	1.4	19.8	14.9	18.1
2	0.4	27.0	14.9	22.8
3	5.5	31.5	14.9	25.8
4	6.7	50.7	14.9	38.4
5	8.5	82.7	14.9	59.4
6	7.2	117.3	14.9	82.2
7	4.9	71.9	14.9	52.3
8	4.5	73.5	14.9	53.4
9	9.2	73.0	14.9	53.1
10	9.4	144.2	14.9	99.9
11	10.6	147.0	14.9	101.7
12	***13.4***	***196.6***	***21.9***	***137.5***
13	***17.6***	***521.0***	***21.9***	***346.4***
14	***17.4***	***451.6***	***21.9***	***300.6***
15	***18.7***	***449.9***	***21.9***	***295.8***
16	***17.7***	***311.2***	***21.9***	***206.7***
17	***19.4***	***570.0***	***21.9***	***367.7***
18	***17.6***	***357.2***	***21.9***	***237.2***
19	***15.5***	***204.0***	***21.9***	***140.7***
20	9.8	174.7	14.9	119.9
21	***13.6***	***148.8***	***21.9***	***105.4***
22	***15.6***	***281.1***	***21.9***	***191.0***
23	11.6	205.6	14.9	140.2
24-Hour Avg.		197.3		134.1

Note: High wind hours are highlighted in bold italics.

PM-10 NONATTAINMENT AREA MODELING

Similar to the modeling done for the Salt River area, attainment modeling for the entire nonattainment area is performed through the use of distance-weighted rollback modeling. The design day of June 6, 2007 was chosen for the regional attainment demonstration based upon the criteria discussed earlier in this chapter. A detailed discussion of the technical methods and assumptions used to perform the modeling for the nonattainment area is provided in the TSD (Chapter V of Appendix B, Exhibit 1).

Modeling Domain

On the high wind design day of June 6, 2007, both the West 43rd Avenue and the Higley monitor exceeded the 24-hour PM-10 standard. Five other monitors in the nonattainment area recorded elevated PM-10 concentrations but did not exceed the standard; these include: Central Phoenix, Durango Complex, Greenwood, State Super Site and West Phoenix monitors. Table 6-5 lists the modeled monitors and their 24-hour average concentrations on June 6, 2007. The other official active PM-10 monitors in the nonattainment area were all 1-in-6 filter monitors that did not have June 6, 2007 scheduled as a run day and therefore did not monitor 24-hour average PM-10 concentrations. All seven monitors that did record PM-10 concentrations have been modeled to assure attainment throughout the nonattainment area.

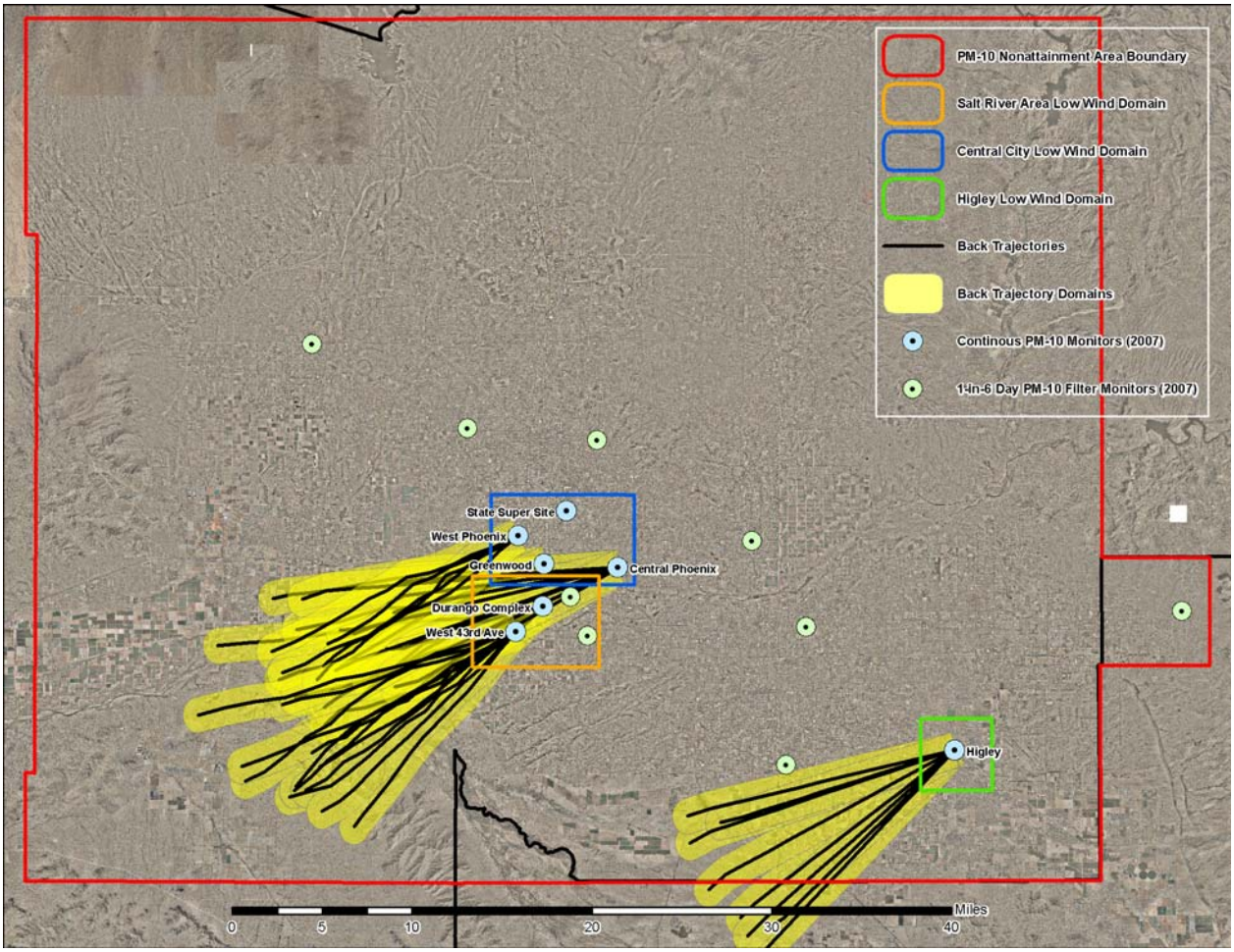
As was performed for the Salt River area modeling, a 1-mile buffer around each calculated back trajectory serve as the domain during high wind hours, as developed from each monitoring location in the nonattainment area. The number of high wind hours (> 12 mph) varies at each monitoring site depending on the unique physical characteristics of each site. In fact, the State Super Site which is located in a dense single-family and multi-family residential area had no high wind hours on June 6, 2007. Five-minute wind speed and direction was available to develop back trajectories for the Durango Complex, Greenwood, West Phoenix and West 43rd Avenue monitors. Hourly wind speed and direction was used to develop the back trajectories for the Central Phoenix and Higley monitors.

The large size of the nonattainment area requires that separate low wind domains around the modeled monitors be developed to capture the unique mix of land uses surrounding the monitors. In addition to the Salt River Area domain which includes the West 43rd Avenue and Durango Complex monitors, a new low wind domain was developed to represent the land uses around the Higley monitor located in the eastern portion of the nonattainment area. A third domain, labeled as the Central City domain, was developed to include central Phoenix monitors of Central Phoenix, Greenwood, State Super Site and West Phoenix. All four of these monitors are located in areas with dense residential and mixed retail/commercial/industrial land uses (see Table V-34 through V-36 in Chapter V of Appendix B, Exhibit 1, for distribution of land uses in low wind domains). Figure 6-5 displays the June 6, 2007 high wind back trajectory domains and the low wind domains used in the regional attainment modeling.

Table 6-5
24-Hour Average PM-10 Concentrations on the High Wind Design Day
(June 6, 2007)

Monitor	24-Hour PM-10 Concentration ($\mu g/m^3$)
Central Phoenix	107.0
Durango Complex	133.7
Greenwood	121.7
Higley	181.1
State Super Site	80.6
West Phoenix	108.8
West 43rd Avenue	225.7

Figure 6-5
PM-10 Nonattainment Area Low Wind Domains and
June 6, 2007 Hourly High Wind Back Trajectories and Associated Domains



Note: Emissions from the portions of back trajectory domains that are outside of the nonattainment area are not included as part of the attainment modeling.

Demonstration of Attainment

Both the hourly high wind back trajectory and low wind modeling domain inventories are developed using the same methodology employed in the development of the inventories for the Salt River area. Base case 2007 and controlled case 2012 inventories are thus compared to provide the high and low wind reductions to concentrations seen on the design day. Tables 6-6 through 6-11 provide a summary of the hourly high wind emission inventories and associated reduction percentages. Tables 6-12 through 6-13 provide a summary of the low wind domain inventories and associated reduction percentages for the Central City and Higley domains (the Salt River area domain has already been presented in Table 6-3).

The assumptions used to develop non-anthropogenic background values and analysis of control measure benefits in this plan carry over from the modeling demonstration for the Salt River area. Detailed discussion on all aspects of the regional nonattainment modeling can be found in the TSD (Chapter V of Appendix B, Exhibit 1).

Tables 6-14 through 6-20 provide a summary of the results of the distance-weighted rollback attainment demonstration for the seven monitors included in the regional nonattainment demonstration for the June 6, 2007 design day. All seven monitors have 24-hour average PM-10 values under 155 $\mu g/m^3$ which indicates that attainment has been demonstrated under high wind conditions throughout the PM-10 nonattainment area.

Table 6-6
Base Case 2007 and Controlled 2012 High Wind PM-10 Emissions Inventories for June 6, 2007 Design Day at the Central Phoenix Monitor

High Wind Hour	Un-weighted Emissions (tons)		Distance-Weighted Emissions (tons/feet from monitor)		% Reduction of Weighted Emissions
	2007	2012	2007	2012	
0	1.90	1.32	7.549E-05	5.230E-05	30.7%
1	0.99	0.74	5.184E-05	3.687E-05	28.9%
6	1.69	1.18	6.873E-05	4.797E-05	30.2%
7	0.99	0.74	5.254E-05	3.730E-05	29.0%
10	0.88	0.64	4.939E-05	3.485E-05	29.4%
11	2.01	1.41	7.319E-05	5.123E-05	30.0%
12	4.01	2.91	1.706E-04	1.166E-04	31.7%
13	7.52	5.04	2.448E-04	1.625E-04	33.6%
14	7.28	4.96	2.265E-04	1.520E-04	32.9%
15	4.33	3.04	1.657E-04	1.121E-04	32.3%
16	4.27	3.13	1.737E-04	1.192E-04	31.4%
17	2.29	1.60	8.494E-05	5.855E-05	31.1%
18	2.21	1.55	7.971E-05	5.545E-05	30.4%
Total	40.39	28.25	1.517E-03	1.037E-03	31.7%

Table 6-7
Base Case 2007 and Controlled 2012 High Wind PM-10 Emissions Inventories for June 6, 2007 Design Day at the Durango Complex Monitor

High Wind Hour	Un-weighted Emissions (tons)		Distance-Weighted Emissions (tons/feet from monitor)		% Reduction of Weighted Emissions
	2007	2012	2007	2012	
11	1.99	1.37	1.340E-04	9.011E-05	32.8%
12	3.69	2.55	2.267E-04	1.543E-04	31.9%
13	3.12	2.15	1.876E-04	1.281E-04	31.7%
14	8.02	5.49	4.672E-04	3.093E-04	33.8%
15	9.84	7.07	4.992E-04	3.379E-04	32.3%
16	5.62	3.79	3.247E-04	2.160E-04	33.5%
17	2.47	1.72	1.619E-04	1.110E-04	31.4%
Total	34.74	24.13	2.001E-03	1.347E-03	32.7%

Table 6-8
Base Case 2007 and Controlled 2012 High Wind PM-10 Emissions Inventories for June 6, 2007 Design Day at the Greenwood Monitor

High Wind Hour	Un-weighted Emissions (tons)		Distance-Weighted Emissions (tons/feet from monitor)		% Reduction of Weighted Emissions
	2007	2012	2007	2012	
12	1.05	0.77	5.872E-05	4.191E-05	28.6%
13	1.03	0.80	6.482E-05	4.701E-05	27.5%
14	3.03	2.16	1.618E-04	1.110E-04	31.4%
15	2.34	1.75	1.266E-04	8.868E-05	30.0%
Total	7.45	5.49	4.119E-04	2.886E-04	29.9%

Table 6-9
Base Case 2007 and Controlled 2012 High Wind PM-10 Emissions Inventories for June 6, 2007 Design Day at the Higley Monitor

High Wind Hour	Un-weighted Emissions (tons)		Distance-Weighted Emissions (tons/feet from monitor)		% Reduction of Weighted Emissions
	2007	2012	2007	2012	
10	0.74	0.55	6.103E-05	4.481E-05	26.6%
11	3.00	2.05	1.944E-04	1.330E-04	31.6%
12	2.15	1.54	1.805E-04	1.270E-04	29.6%
13	2.41	1.69	1.824E-04	1.268E-04	30.4%
14	5.61	3.83	2.282E-04	1.553E-04	31.9%
15	5.70	3.98	2.113E-04	1.442E-04	31.8%
16	5.65	3.90	2.065E-04	1.403E-04	32.1%
17	1.50	1.11	6.687E-05	4.791E-05	28.4%
Total	26.76	18.64	1.331E-03	9.195E-04	30.9%

Table 6-10
Base Case 2007 and Controlled 2012 High Wind PM-10 Emissions Inventories for June 6, 2007 Design Day at the West Phoenix Monitor

High Wind Hour	Un-weighted Emissions (tons)		Distance-Weighted Emissions (tons/feet from monitor)		% Reduction of Weighted Emissions
	2007	2012	2007	2012	
11	0.65	0.53	2.164E-05	1.680E-05	22.4%
12	1.78	1.33	5.329E-05	3.930E-05	26.2%
13	3.35	2.45	8.177E-05	5.933E-05	27.4%
14	4.27	3.08	1.123E-04	8.105E-05	27.8%
15	1.63	1.21	4.623E-05	3.396E-05	26.5%
Total	11.67	8.60	3.152E-04	2.304E-04	26.9%

Table 6-11
Base Case 2007 and Controlled 2012 High Wind PM-10 Emissions Inventories for June 6, 2007 Design Day at the West 43rd Avenue Monitor

High Wind Hour	Un-weighted Emissions (tons)		Distance-Weighted Emissions (tons/feet from monitor)		% Reduction of Weighted Emissions
	2007	2012	2007	2012	
0	2.29	1.59	2.064E-04	1.388E-04	32.8%
5	3.31	2.29	2.894E-04	1.924E-04	33.5%
6	5.05	3.43	4.359E-04	2.860E-04	34.4%
10	3.44	2.38	2.835E-04	1.898E-04	33.1%
11	6.67	4.51	4.937E-04	3.237E-04	34.4%
12	6.02	4.06	5.697E-04	3.704E-04	35.0%
13	5.66	3.82	4.721E-04	3.088E-04	34.6%
14	9.67	6.48	6.830E-04	4.425E-04	35.2%
15	13.99	9.12	9.717E-04	6.168E-04	36.5%
16	9.67	6.48	6.630E-04	4.304E-04	35.1%
17	5.10	3.45	4.285E-04	2.812E-04	34.4%
18	4.94	3.34	3.857E-04	2.526E-04	34.5%
Total	75.81	50.97	5.883E-03	3.833E-03	34.8%

Table 6-12
Annual Base Case 2007 and Controlled 2012 Low Wind PM-10 Emissions Inventories for the Central City Low Wind Domain

Land Use	2007 Emissions (tons)	2012 Emissions (tons)	% Reduction
Residential	118.19	119.87	(1.4%)
Commercial	87.33	89.43	(2.4%)
Agriculture	0.00	0.00	0.0%
Vacant/Open	25.73	26.33	(2.3%)
Transportation	102.23	93.67	7.1%
Industrial	262.58	198.03	24.6%
Construction	164.80	50.07	69.6%
Total	760.86	577.41	24.0%

Table 6-13
Annual Base Case 2007 and Controlled 2012 Low Wind PM-10 Emissions Inventories for the Higley Low Wind Domain

Land Use	2007 Emissions (tons)	2012 Emissions (tons)	% Reduction
Residential	40.97	41.55	(1.4%)
Commercial	15.28	15.65	(2.4%)
Agriculture	46.15	45.17	2.1%
Vacant/Open	16.62	17.01	(2.3%)
Transportation	162.98	149.34	7.1%
Industrial	2.58	1.95	24.6%
Construction	312.06	94.81	69.6%
Total	596.65	365.49	38.5%

Table 6-14
2012 Attainment Demonstration
High Wind Design Day (June 6, 2007) at the Central Phoenix Monitor

Hour	Wind Speed (mph)	June 6, 2007 PM-10 Concentration ($\mu g/m^3$)	Background Concentration ($\mu g/m^3$)	2012 Controlled PM-10 Concentration ($\mu g/m^3$)
0	***12.5***	***138.5***	***21.9***	***102.7***
1	***13.1***	***176.2***	***21.9***	***131.6***
2	8.6	133.6	14.9	105.1
3	8.0	109.7	14.9	86.9
4	10.9	92.9	14.9	74.2
5	10.3	81.5	14.9	65.5
6	***12.4***	***99.6***	***21.9***	***76.1***
7	***12.8***	***104.0***	***21.9***	***80.2***
8	11.1	80.2	14.9	64.5
9	11.3	73.2	14.9	59.2
10	***12.1***	***69.6***	***21.9***	***55.6***
11	***13.9***	***96.1***	***21.9***	***73.8***
12	***15.3***	***106.2***	***21.9***	***79.5***
13	***15.4***	***150.5***	***21.9***	***107.3***
14	***16.9***	***211.2***	***21.9***	***148.9***
15	***17.8***	***255.7***	***21.9***	***180.1***
16	***15.7***	***111.7***	***21.9***	***83.5***
17	***14.0***	***71.0***	***21.9***	***55.7***
18	***14.0***	***74.4***	***21.9***	***58.4***
19	11.9	72.5	14.9	58.7
20	11.1	59.8	14.9	49.0
21	11.7	70.6	14.9	57.2
22	8.8	63.0	14.9	51.5
23	8.5	66.9	14.9	54.4
24-Hour Avg.		107.0		81.7

Note: High wind hours are highlighted in bold italics.

Table 6-15
2012 Attainment Demonstration
High Wind Design Day (June 6, 2007) at the Durango Complex Monitor

Hour	Wind Speed (mph)	June 6, 2007 PM-10 Concentration ($\mu g/m^3$)	Background Concentration ($\mu g/m^3$)	2012 Controlled PM-10 Concentration ($\mu g/m^3$)
0	8.9	132.6	14.9	92.2
1	6.3	166.4	14.9	114.4
2	5.0	133.6	14.9	92.9
3	1.0	112.7	14.9	79.2
4	2.6	124.4	14.9	86.8
5	7.3	101.4	14.9	71.7
6	9.1	164.5	14.9	113.2
7	8.7	113.4	14.9	79.6
8	10.5	93.6	14.9	66.6
9	11.2	86.3	14.9	61.8
10	11.9	83.3	14.9	59.8
11	***12.5***	***130.3***	***21.9***	***94.8***
12	***13.9***	***168.1***	***21.9***	***121.4***
13	***13.5***	***202.7***	***21.9***	***145.4***
14	***15.7***	***405.5***	***21.9***	***275.9***
15	***17.9***	***398.1***	***21.9***	***276.5***
16	***14.5***	***119.9***	***21.9***	***87.1***
17	***12.9***	***70.0***	***21.9***	***54.9***
18	10.3	53.9	14.9	40.5
19	8.9	57.0	14.9	42.6
20	6.4	61.1	14.9	45.3
21	7.5	83.0	14.9	59.6
22	6.3	67.8	14.9	49.7
23	5.2	79.6	14.9	57.4
24-Hour Avg.		133.7		94.6

Note: High wind hours highlighted in bold italics.

Table 6-16
2012 Attainment Demonstration
High Wind Design Day (June 6, 2007) at the Greenwood Monitor

Hour	Wind Speed (mph)	June 6, 2007 PM-10 Concentration ($\mu g/m^3$)	Background Concentration ($\mu g/m^3$)	2012 Controlled PM-10 Concentration ($\mu g/m^3$)
0	8.1	138.4	14.9	108.8
1	5.7	159.9	14.9	125.1
2	4.9	123.4	14.9	97.4
3	2.9	105.2	14.9	83.5
4	2.1	105.6	14.9	83.8
5	5.4	86.5	14.9	69.3
6	6.7	112.6	14.9	89.2
7	7.7	103.8	14.9	82.5
8	8.3	77.9	14.9	62.8
9	10.0	79.0	14.9	63.6
10	11.0	74.7	14.9	60.3
11	10.8	103.2	14.9	82.0
12	***12.7***	***172.2***	***21.9***	***129.2***
13	***12.6***	***194.6***	***21.9***	***147.1***
14	***15.4***	***442.1***	***21.9***	***310.3***
15	***13.9***	***240.6***	***21.9***	***175.1***
16	11.9	93.5	14.9	74.6
17	11.7	96.9	14.9	77.2
18	11.4	82.5	14.9	66.3
19	8.7	68.3	14.9	55.5
20	7.4	61.3	14.9	50.2
21	7.0	67.9	14.9	55.2
22	5.1	63.5	14.9	51.8
23	4.0	68.3	14.9	55.5
24-Hour Avg.		121.7		94.0

Note: High wind hours highlighted in bold italics.

Table 6-17
2012 Attainment Demonstration
High Wind Design Day (June 6, 2007) at the Higley Monitor

Hour	Wind Speed (mph)	June 6, 2007 PM-10 Concentration ($\mu g/m^3$)	Background Concentration ($\mu g/m^3$)	2012 Controlled PM-10 Concentration ($\mu g/m^3$)
0	7.4	39.6	14.9	30.1
1	5.8	72.9	14.9	50.6
2	8.8	135.2	14.9	88.9
3	9.0	130.9	14.9	86.2
4	9.1	104.9	14.9	70.3
5	7.4	96.4	14.9	65.0
6	9.4	113.4	14.9	75.5
7	9.4	90.9	14.9	61.6
8	10.8	187.2	14.9	120.9
9	11.6	195.1	14.9	125.7
10	***14.6***	***580.2***	***21.9***	***431.9***
11	***15.2***	***379.0***	***21.9***	***266.3***
12	***17.6***	***568.8***	***21.9***	***406.7***
13	***15.3***	***408.1***	***21.9***	***290.5***
14	***15.8***	***387.9***	***21.9***	***271.1***
15	***15.6***	***268.9***	***21.9***	***190.5***
16	***15.3***	***167.5***	***21.9***	***120.8***
17	***13.5***	***96.4***	***21.9***	***75.3***
18	10.1	45.2	14.9	33.5
19	6.9	50.7	14.9	36.9
20	6.6	43.1	14.9	32.2
21	7.1	60.5	14.9	42.9
22	2.9	55.7	14.9	40.0
23	3.2	66.9	14.9	46.9
24-Hour Avg.		181.1		127.5

Note: High wind hours highlighted in bold italics.

Table 6-18
2012 Attainment Demonstration
High Wind Design Day (June 6, 2007) at the State Super Site Monitor

Hour	Wind Speed (mph)	June 6, 2007 PM-10 Concentration ($\mu g/m^3$)	Background Concentration ($\mu g/m^3$)	2012 Controlled PM-10 Concentration ($\mu g/m^3$)
0	7.6	99.3	14.9	79.0
1	6.3	149.6	14.9	117.3
2	5.4	112.2	14.9	88.8
3	5.4	95.8	14.9	76.4
4	6.7	92.4	14.9	73.8
5	7.2	80.6	14.9	64.8
6	7.2	80.2	14.9	64.5
7	6.5	82.7	14.9	66.4
8	7.2	63.5	14.9	51.8
9	6.7	60.8	14.9	49.8
10	6.9	53.6	14.9	44.3
11	9.4	65.5	14.9	53.4
12	8.9	77.8	14.9	62.7
13	9.8	107.8	14.9	85.5
14	10.5	142.1	14.9	111.6
15	11.4	109.4	14.9	86.7
16	10.1	62.3	14.9	50.9
17	9.2	54.4	14.9	44.9
18	11.2	57.5	14.9	47.3
19	9.6	53.9	14.9	44.5
20	7.8	60.9	14.9	49.9
21	6.3	62.5	14.9	51.1
22	3.8	55.1	14.9	45.5
23	3.6	54.8	14.9	45.2
24-Hour Avg.		80.6		64.8

Table 6-19
2012 Attainment Demonstration
High Wind Design Day (June 6, 2007) at the West Phoenix Monitor

Hour	Wind Speed (mph)	June 6, 2007 PM-10 Concentration ($\mu g/m^3$)	Background Concentration ($\mu g/m^3$)	2012 Controlled PM-10 Concentration ($\mu g/m^3$)
0	7.1	134.4	14.9	105.7
1	7.8	164.9	14.9	128.9
2	8.4	123.8	14.9	97.7
3	4.2	106.1	14.9	84.2
4	5.1	99.1	14.9	78.9
5	6.1	84.4	14.9	67.7
6	8.5	94.4	14.9	75.3
7	10.3	102.9	14.9	81.8
8	8.7	75.2	14.9	60.7
9	8.6	70.3	14.9	57.0
10	8.8	62.1	14.9	50.8
11	***12.1***	***122.2***	***21.9***	***99.7***
12	***13.6***	***169.6***	***21.9***	***130.8***
13	***15.1***	***256.6***	***21.9***	***192.2***
14	***15.1***	***259.8***	***21.9***	***193.6***
15	***13.5***	***132.1***	***21.9***	***102.9***
16	12.0	88.2	14.9	70.6
17	11.7	71.9	14.9	58.2
18	10.0	66.7	14.9	54.3
19	9.3	65.1	14.9	53.1
20	9.1	66.7	14.9	54.3
21	6.8	67.3	14.9	54.7
22	5.3	62.6	14.9	51.2
23	4.8	63.7	14.9	52.0
24-Hour Avg.		108.8		85.7

Note: High wind hours highlighted in bold italics.

Table 6-20
2012 Attainment Demonstration
High Wind Design Day (June 6, 2007) at the West 43rd Avenue Monitor

Hour	Wind Speed (mph)	June 6, 2007 PM-10 Concentration ($\mu g/m^3$)	Background Concentration ($\mu g/m^3$)	2012 Controlled PM-10 Concentration ($\mu g/m^3$)
0	***13.3***	***175.1***	***21.9***	***124.9***
1	9.9	177.0	14.9	121.4
2	9.1	150.0	14.9	103.7
3	7.8	115.5	14.9	81.0
4	10.6	145.0	14.9	100.4
5	***14.5***	***318.0***	***21.9***	***218.8***
6	***14.9***	***267.2***	***21.9***	***182.9***
7	11.4	208.1	14.9	141.8
8	11.3	131.4	14.9	91.4
9	12.0	152.0	14.9	105.0
10	***13.8***	***180.8***	***21.9***	***128.3***
11	***16.0***	***438.3***	***21.9***	***294.9***
12	***16.6***	***449.1***	***21.9***	***299.6***
13	***15.1***	***394.9***	***21.9***	***265.9***
14	***17.6***	***643.1***	***21.9***	***424.3***
15	***18.1***	***662.3***	***21.9***	***428.4***
16	***17.0***	***237.5***	***21.9***	***161.8***
17	***14.5***	***92.3***	***21.9***	***68.1***
18	***14.9***	***77.9***	***21.9***	***58.6***
19	12.0	56.1	14.9	42.0
20	8.8	87.3	14.9	62.5
21	9.3	98.1	14.9	69.6
22	7.0	82.6	14.9	59.4
23	6.8	78.3	14.9	56.6
24-Hour Avg.		225.7		153.8

Note: High wind hours highlighted in bold italics.

REASONABLE FURTHER PROGRESS

Section 189(c) of the Clean Air Act establishes a requirement that the plan include quantitative milestones that are to be achieved every three years until the area is redesignated to attainment and which demonstrate reasonable further progress toward attainment by the applicable date. Section 171(1) of the Clean Air Act defines reasonable further progress as annual incremental reductions in emissions for the purpose of ensuring attainment by the applicable date.

For the MAG 2012 Five Percent Plan, the applicable attainment date is December 31, 2012. The MAG 2007 Five Percent Plan included fifty-three control measures, most of which were implemented during the three years before the Plan was withdrawn in January 2011. The measures were first implemented in 2008 and continue to be implemented. The measures submitted in the MAG 2012 Five Percent Plan for PM-10 for approval into the Arizona SIP are listed in Table 4-1. Many of the measures from the 2007 Plan have been included in Table 4-1.

Although the 2007 Plan was withdrawn, EPA has approved Rules 310 and 310.01 (EPA, 2010) and Rule 316 (EPA, 2009), into the State Implementation Plan as permanent and enforceable measures. Increases in rule effectiveness are attributable to strengthened enforcement and increased compliance with these rules. Increased rule effectiveness resulted in major reductions in PM-10 emissions throughout the nonattainment area in 2008 through 2010.

Attainment can not be achieved prior to December 31, 2012, because the Dust Action General Permit measure needed for attainment modeling was not fully implemented until January, 2012. Additionally, according to the form of the PM-10 standard, three years of clean data are needed in order to demonstrate attainment (e.g., 2009-2011). There were several exceedances of the 24-hour PM-10 standard in 2009 and 2011 which may be due to high wind exceptional events and the required documentation for these events has not yet been submitted to EPA for concurrence. It is unknown if three years of clean data will be available for attainment by December 31, 2011 until ADEQ submits and EPA acts upon the exceedances due to high wind exceptional events in 2009 and 2011. Because emission reductions from the Dust Action General Permit in 2012 are needed to model attainment and EPA concurrence on exceptional events in 2009 and 2011 is outstanding, the earliest attainment date achievable by this Plan is December 31, 2012.

According to the General Preamble, nonattainment area plans must include quantitative milestones which are to be achieved every three years until the area is redesignated to attainment. The quantitative milestones allow progress to be measured. Specifically, air quality plans should identify and submit quantitative milestones providing for the amount of emission reductions adequate to achieve the standard by the attainment date. The milestone date analyzed in this Plan is 2012. The modeling for the Salt River Area and the PM-10 nonattainment area has shown that the emissions reductions due

to increased rule effectiveness for Maricopa County Rules 310, 310.01 and 316 and implementation of the Dust Action General Permit measure are adequate to achieve attainment by 2012. The requirement for a 2012 milestone has been addressed by quantifying the emission reductions resulting from the implementation of the Dust Action General Permit measure and increases in rule effectiveness for Rules 310, 310.01 and 316. As shown in Table 5-3, the milestone PM-10 emissions reduction needed to achieve attainment in 2012 is 16,089 tons.

The annual incremental reductions that demonstrate reasonable further progress (RFP) between 2007 and 2012 are graphed in Figure 6-6. After 2007, the RFP line represents total emissions in the PM-10 nonattainment area after credit is applied for the increases in rule effectiveness described in Chapter Five. The RFP requirement is met by showing incremental emission reductions sufficient to maintain linear progress towards attainment. The annual emissions in Figure 6-6 show a downward linear trend. The slope of the line becomes less steep after 2008, because most of the increases in the rule effectiveness for Rules 310, 310.01 and 316 were achieved in 2008. Figure 6-6 demonstrates that RFP will be achieved between 2007 and the attainment date of 2012.

CONTINGENCY REQUIREMENTS

Measures in the MAG 2007 Five Percent Plan that strengthen and increase enforcement of Rules 310, 310.01 and 316, as well as the Dust Action General Permit, have been quantified to meet the annual five percent requirement, model attainment, and demonstrate reasonable further progress (RFP). Additional emission reduction benefits beyond those quantified in Chapter Five are needed to meet the contingency requirements of the Clean Air Act.

Section 172(c)(9) of the Clean Air Act requires that nonattainment plans contain contingency measures. Such measures are to be undertaken without further action by the State or the EPA Administrator if the area fails to make reasonable further progress or meet the standard by the attainment date.

The contingency measures must achieve emission reductions above and beyond those relied upon for progress (five percent reductions, milestones, and reasonable further progress) and the modeled attainment demonstration. The benefits of the contingency measures must not be required to show attainment and can not hasten attainment. Although there is no mandated emissions reduction level, EPA has recommended that contingency measures provide the emissions reduction equivalent of one year's average increment of RFP. EPA encourages early implementation of contingency measures to reduce emissions as expeditiously as practicable (EPA, 1993). The contingency requirement is met in the MAG 2012 Five Percent Plan by quantifying the benefits of PM-10 reduction projects that were completed in 2008-2011.

Figure 6-6
Demonstration of Reasonable Further Progress

A large number of PM-10 reduction projects have been implemented in the PM-10 nonattainment area since the MAG 2007 Five Percent Plan was submitted to EPA in December 2007. As required for contingency measures, the emission reductions attributable to these projects are above and beyond the credit taken for the measures in Chapter Five. In the Fall of 2011, MAG updated the inventory of PM-10 reduction projects in the nonattainment area that were completed in 2008-2011 by the cities, towns, Maricopa County, Pinal County, the Arizona Department of Transportation (ADOT) and the Indian communities. These projects included paving and stabilizing unpaved roads, alleys and shoulders; reducing speed limits on unpaved roads and alleys; and overlaying state highways with rubberized asphalt. In addition, MAG quantified the benefit for the freeways being swept by an ADOT contractor with PM-10 certified street sweepers and the arterials being swept by local jurisdictions with 27 PM-10 certified street sweepers purchased with Congestion Mitigation and Air Quality Improvement (CMAQ) funds in 2007 through 2009.

Figure 6-6 indicates that the total PM-10 emissions in 2007 are 59,218 tons; after reductions due to the increases in rule effectiveness discussed in Chapter Five, PM-10 emissions are reduced to 43,130 tons in 2012. Subtracting these two values and dividing by five years produces a contingency target of 3,218 tons. Therefore, completed projects that reduce total PM-10 emissions by at least 3,218 tons in 2012 must be quantified to meet the contingency target. A summary of the miles of roads, alleys and shoulders impacted by the paving and stabilization, speed limit reduction, and rubberized asphalt overlay projects that were quantified to meet the contingency requirement is presented in Table 6-21. These PM-10 reduction projects were implemented in the PM-10 nonattainment area by twenty-one cities and towns, Maricopa County, Pinal County, ADOT and the Gila River Indian Community. All of the projects for which credit was taken were open to traffic by September 2011.

The emission reductions for all measures quantified to meet the contingency requirement are summarized in Table 6-22. Table 6-22 includes the benefits of the PM-10 certified street sweeping on freeways and arterials, as well as the projects completed in 2008-2011 that paved and stabilized unpaved roads, alleys and shoulders; reduced speed limits; and overlaid highways with rubberized asphalt. A detailed discussion of the assumptions used in quantifying the PM-10 reductions needed to meet the contingency requirement is provided in Chapter IV of the TSD (Appendix B, Exhibit 1). The total PM-10 emissions reduction in 2012 is 3,439 tons, which exceeds the contingency target of 3,218 tons by 221 tons.

Table 6-23 shows the PM-10 emissions for 2008-2012 by source category after increases in rule effectiveness and contingency reductions are applied. The total tons quantified to meet the five percent reduction, attainment modeling, RFP and contingency requirements is 19,527 in 2012. This represents a 33 percent reduction, relative to 2007 emissions. A pie chart of the 2012 nonattainment area PM-10 emissions with the five percent measures and contingency projects is shown in Figure 6-7.

Table 6-21
Miles of Roads/Alleys/Shoulders in PM-10 Reduction Projects

Miles Impacted by Project Type	2008	2009	2010	2011	Total 2008-2011
Miles of dirt roads paved	41	18	8	16	83
Miles of dirt roads stabilized	39	39	36	31	145
Miles of dirt alleys paved	66	4	0	63	134
Miles of dirt alleys stabilized	164	106	124	106	501
Total miles of roads/alleys paved & stabilized	310	168	168	216	862
Miles of dirt shoulders paved	70	107	49	6	233
Miles of curb and gutter paved	19	0	0	0	19
Miles of dirt shoulders stabilized	235	236	236	200	906
Total miles of shoulders paved & stabilized	324	343	285	207	1,158
Miles of roads/alleys with lower speed limits	7	11	3	0	20
Miles of highway overlaid w/rubberized asphalt	13	0	0	0	13

Table 6-22
2008-2012 PM-10 Reductions to Meet Contingency Requirements

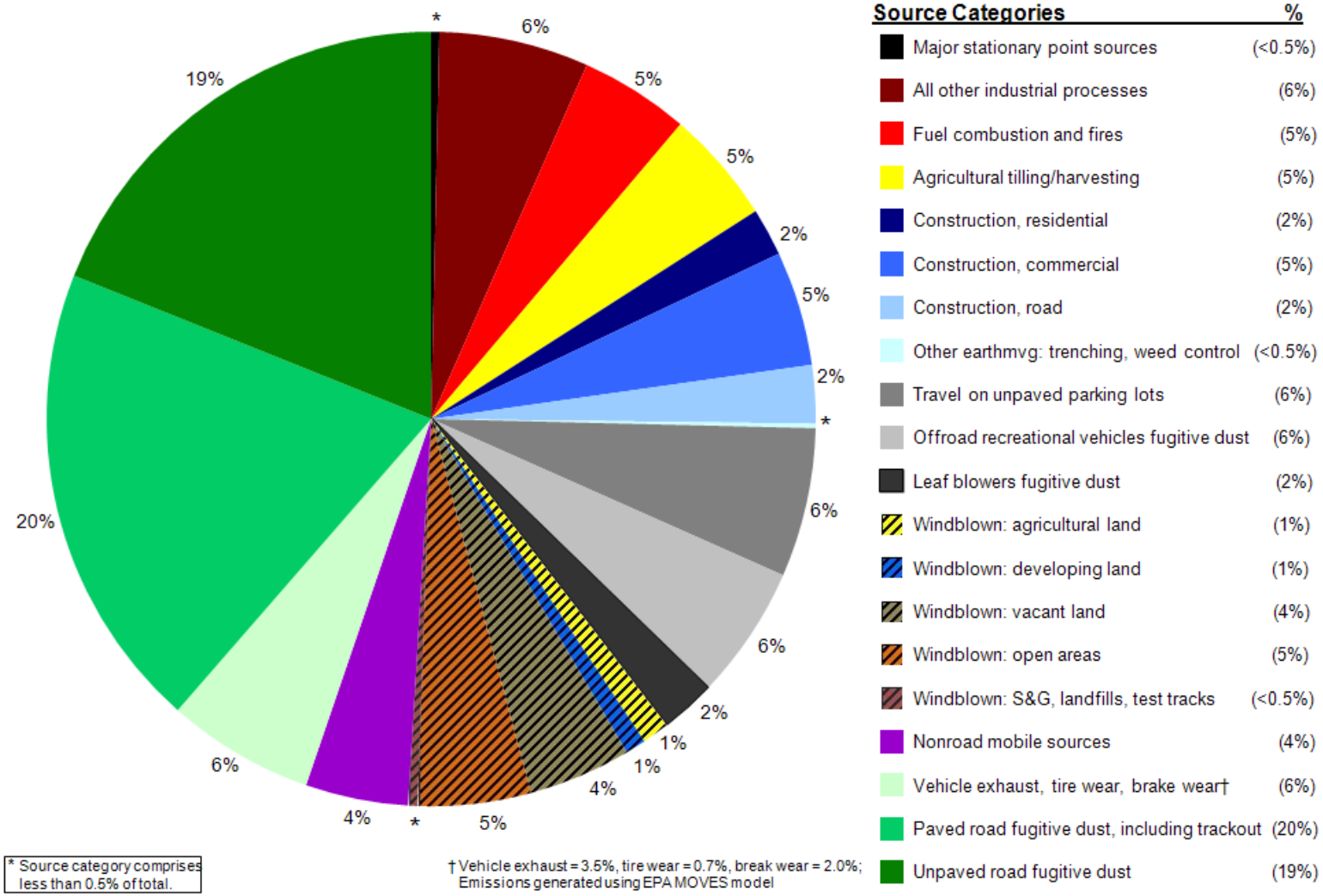
Completed Projects	Implementing Entities	2008	2009	2010	2011	2012
		(tons/year)				
Sweep streets with PM-10 certified sweepers Contracted sweeping of freeways, ramps and frontage roads - 100% compliant, effective 2/20/10 27 PM-10 certified sweepers purchased with CMAQ funds: 1/1/07-12/31/09	ADOT	0	0	294	342	344
	Cities, towns	59	116	153	154	155
	Total for Street Sweeping	**59**	**116**	**447**	**495**	**499**
Pave or stabilize existing public dirt roads and alleys Paving/stabilization projects completed in 2008-2011	Cities, towns, Maricopa and Pinal County Gila River Indian Community	461	1,352	2,124	2,662	2,625
	Total for Road/Alley Paving/Stabilization	**461**	**1,352**	**2,124**	**2,662**	**2,625**
Lower speed limits on dirt roads and alleys Speed limits lowered in 2008-2011	Cities, towns, Maricopa County	4	78	161	161	161
	Total for Lower Speed Limits	**4**	**78**	**161**	**161**	**161**
Pave or stabilize unpaved shoulders Paving/stabilization projects completed in 2008-2011	Cities, towns, Maricopa County	173	242	265	293	150
	Total for Shoulder Paving/Stabilizing	**173**	**242**	**265**	**293**	**150**
Repave or overlay paved roads with rubberized asphalt Rubberized asphalt overlays completed in 2008-2011	ADOT	0	3	3	3	3
	Total for Overlays	**0**	**3**	**3**	**3**	**3**
	Total for Completed Projects	**697**	**1,790**	**2,999**	**3,614**	**3,439**

Table 6-23
2008-2012 PM-10 Emissions with Five Percent Plan Measures and Contingency Projects

Source Category	2008	2009	2010	2011	2012
POINT	150	133	127	128	135
AREA					
Fuel combustion	1,301	1,307	1,311	1,316	1,328
Commercial cooking	993	998	1,001	1,005	1,014
Construction (includes windblown dust)	8,355	5,333	4,139	4,014	4,073
Tilling, harvesting and cotton ginning	893	893	893	893	893
Travel on unpaved farm roads	731	731	731	731	731
Livestock	261	261	261	261	261
Travel on unpaved parking lots	2,422	2,434	2,441	2,451	2,473
Offroad recreational vehicles	2,180	2,191	2,198	2,206	2,226
Leaf blowers	895	899	902	906	914
Windblown agriculture	448	448	448	448	448
Other windblown sources	3,938	3,788	3,788	3,788	3,639
Fires	497	497	497	497	497
Mining/quarrying (includes windblown dust)	476	401	355	356	369
Travel on industrial paved/unpaved roads	472	382	331	333	351
Other industrial sources	976	865	828	832	877
NONROAD					
Aircraft	184	152	142	143	146
Airport ground support equipment	27	23	21	20	20
Locomotives	34	34	34	34	34
Other nonroad equipment	1,683	1,661	1,641	1,595	1,513
ONROAD					
Exhaust	2,836	2,647	2,371	1,843	1,407
Tire wear	256	254	255	255	259
Brake wear	758	767	771	773	787
Paved roads	7,922	7,857	7,578	7,534	7,772
Unpaved roads and alleys	9,847	8,854	7,999	7,461	7,525
Totals	**48,534**	**43,810**	**41,062**	**39,823**	**39,691**
Total PM-10 Emissions Reduction 2007-2012:					**19,527 tons, 33.0%**

Figure 6-7

2012 PM-10 Emissions Inventory with Five Percent Plan Measures and Contingency Projects
PM-10 Nonattainment Area Total = 39,691 tons/yr



* Source category comprises less than 0.5% of total.

† Vehicle exhaust = 3.5%, tire wear = 0.7%, break wear = 2.0%; Emissions generated using EPA MOVES model

The emission reductions that have been quantified for contingency credit are not required to meet the five percent requirement, model attainment, or demonstrate reasonable further progress. In addition, these reductions will not hasten attainment. As discussed previously in this chapter, the earliest attainment date that can be achieved is December 31, 2012, due to the need to take PM-10 reduction credit for the new Dust Action General Permit in order to demonstrate attainment via rollback modeling. This chapter demonstrates that PM-10 emissions will be reduced by 3,439 tons more than the reductions achieved by measures used to show progress and model attainment. The early implementation of contingency projects in 2008-2011 is assisting in producing the three years of clean data necessary to attain the standard at all monitors by December 31, 2012.

ONROAD MOBILE SOURCE EMISSIONS BUDGET FOR CONFORMITY

In accordance with the 1990 Clean Air Act Amendments, conformity requirements are intended to ensure that transportation activities do not result in air quality degradation. Section 176 of the Amendments requires that transportation plans, programs, and projects conform to applicable air quality plans before the transportation action is approved by a Metropolitan Planning Organization (MPO). The designated MPO for the Maricopa area is MAG.

Section 176(c) of CAAA provides the framework for ensuring that Federal actions conform to air quality plans under section 110. Conformity to an implementation plan means that proposed activities must not (1) cause or contribute to any new violation of any standard in any area, (2) increase the frequency or severity of any existing violation of any standard in any area, or (3) delay timely attainment of any standard or any required interim emission reductions or other milestones in any area.

EPA transportation conformity regulations establish criteria involving comparison of projected transportation plan emissions with the motor vehicle emissions assumed in applicable air quality plans. The regulations define the term “motor vehicle emissions budget” as meaning “the portion of the total allowable emissions defined in a revision of the applicable implementation plan (or in an implementation plan revision which was endorsed by the Governor or his or her designee) for a certain date for the purpose of meeting reasonable further progress milestones or attainment or maintenance demonstrations, for any criteria pollutant or its precursors, allocated by the applicable implementation plan to highway and transit vehicles.”

On June 25, 2002, EPA approved the Revised MAG 1999 Serious Area Particulate Plan for PM-10 in the Maricopa County Nonattainment Area, including the transportation conformity budget for the attainment year of 2006. The 2006 onroad mobile source emissions budget established for PM-10 was 59.7 metric tons per day. The PM-10 emissions in the conformity budget included reentrained dust from paved roads, vehicle exhaust, travel on unpaved roads, and road construction.

The MAG 2012 Five Percent Plan establishes a transportation conformity budget based on the measures implemented for the attainment year of 2012. The PM-10 emissions with the measures that meet the five percent requirement, demonstrate modeled attainment, and show reasonable further progress in 2012 are summarized in the table below.

2012 PM-10 Emissions from Onroad Mobile Sources (tons/year)

Construction (road)	961
Exhaust/tire wear/brake wear	2,456
Paved roads (including trackout)	8,422
Unpaved roads	10,312
Total Onroad Mobile Source	**22,151**

Converting the annual tons per year to metric tons on an annual average day in 2012 produces PM-10 emissions of 54.9 metric tons per day for the PM-10 nonattainment area. This represents the onroad mobile source emissions budget for the attainment year of 2012.

MAG will use this new budget for conformity analyses that begin after the budget is found to be adequate or is approved by EPA as part of the MAG 2012 Five Percent Plan for PM-10. In conformity analyses that begin after the new budget is found to be adequate or is approved, onroad mobile source PM-10 emissions for 2012 or horizon years after 2012 can not exceed this budget.

The methods and assumptions used to estimate onroad mobile source emissions in 2012 are documented in Chapter II of the TSD (Appendix B, Exhibit 1). In future conformity analyses, the estimation of PM-10 emissions from onroad mobile sources may differ from the TSD estimates, because EPA requires use of the latest planning assumptions (e.g., new emissions models, vehicle registration data, vehicle speeds, population and travel projections) in effect at the time each conformity analysis begins.

EXPEDITIOUS ATTAINMENT

The measures that have been quantified are being implemented throughout the PM-10 nonattainment area. As shown in Table 6-23, the measures are already reducing PM-10 emissions from a variety of sources, including earthmoving, vacant lots, sand and gravel operations, and unpaved roads, alleys and shoulders. The attainment demonstration discussed earlier in this chapter indicates that the measures in the plan will achieve modeled attainment at all monitors in the nonattainment area in 2012. The current attainment date established by EPA's final notice of failure to attain is June 6, 2012 (72 FR 31183). However, because of the calendar year form of the PM-10 standard, a mid-year attainment date of June 6, 2012 in effect requires attainment at all monitors by December 31, 2011.

The attainment date can not be expedited (from June 6, 2012 to December 31, 2011), because the emissions reduction credit from the Dust Action General Permit needed to model attainment is not available in 2011, as this measure was not fully implemented until January 1, 2012. Expediting measures in the plan is also not feasible, because all measures except the Dust Action General Permit were already fully implemented by 2010.

In addition, the attainment modeling for the nonattainment area demonstrates that the 24-hour PM-10 standard will be met by a relatively narrow margin in 2012 (i.e., 153.8 ug/m^3 at the West 43rd Avenue monitor). The benefits of the measures in 2011 (i.e., without full implementation of the Dust Action General Permit) are not sufficient to model attainment in 2011.

For the reasons discussed above, the measures in the Five Percent Plan demonstrate attainment as expeditiously as practicable. The measures that were implemented throughout the nonattainment area in 2008-2011, along with the new Dust Action General Permit measure, (fully implemented on January 1, 2012) enables attainment of the 24-hour PM-10 standard at all monitors by December 31, 2012.

ATTAINMENT DATE

On July 25, 2002, EPA published a notice of final approval for the Revised MAG 1999 Serious Area Particulate Plan for PM-10 for the Maricopa County Nonattainment Area. In this notice EPA also approved a five-year extension of the attainment date from December 31, 2001 to December 31, 2006 (67 FR 48718).

On June 6, 2007, EPA published a final notice finding that the Maricopa County nonattainment area had failed to attain the PM-10 standard by the applicable attainment date of December 31, 2006 (72 FR 31183). The EPA finding was based upon air quality monitoring data for the years 2004 through 2006. There were numerous exceedances of the PM-10 standard during stagnant conditions in 2005 and 2006. As a result, plan provisions that reduce PM-10 emissions by five percent per year until the standard is met are required by Section 189(d) of the Clean Air Act. The MAG 2012 Five Percent Plan has been prepared to meet the five percent reduction requirements, discussed in Chapter Five, as well as the attainment modeling, reasonable further progress, and contingency requirements addressed earlier in this Chapter.

EPA's June 6, 2007 final notice of failure to attain establishes the attainment deadline for an area that misses the serious area attainment date,

> *"In accordance with CAA section 179(d)(3), the attainment deadline applicable to an area that misses the serious area attainment date is as soon as practicable, but no later than 5 years from the publication date of the nonattainment finding notice. EPA may, however, extend the attainment deadline to the extent it deems appropriate for a period no greater than 10 years from the publication*

date, 'considering the severity of nonattainment and the availability and feasability of pollution control measures.'" (72 FR 31184)

The attainment deadline based upon EPA's final notice is no later than June 6, 2012 unless EPA deems an extension is appropriate. Under stagnant conditions, the PM-10 standard has not been violated since 2006. The attainment modeling in this Chapter demonstrates that the standard will also be met under high wind conditions throughout the nonattainment area in 2012.

Attainment of the 24-hour PM-10 standard is measured in terms of the number of exceedances in a three-year period (no more than three exceedances at any monitor in the nonattainment area over a three-year period, e.g., 2010-2012). It is anticipated that attainment of the PM-10 standard will be achieved at all monitors in the nonattainment area by December 31, 2012, after three consecutive years (2010-2012) without monitored violations. As described earlier in this chapter, the MAG 2012 Five Percent Plan can not demonstrate attainment via modeling without taking credit for the Dust Action General Permit that will increase rule effectiveness for Rule 310.01 by one percent on high wind days. This emerging measure, which was fully implemented on January 1, 2012, will reduce PM-10 emissions during high wind conditions in 2012, enabling the Plan to demonstrate modeled attainment in 2012. Since modeled attainment can not be demonstrated until 2012 and three calendar years of clean data are needed to demonstrate attainment at all PM-10 monitors in the nonattainment area, the attainment date addressed by this Plan is December 31, 2012.

REQUEST FOR EXTENSION OF THE ATTAINMENT DATE FROM JUNE 6, 2012 TO DECEMBER 31, 2012

As discussed in the preceding sections, the current attainment deadline based upon EPA's final notice of failure to attain is June 6, 2012. In order to meet the current mid-year attainment date of June 6, 2012, the calendar year form of the 24-hour EPA PM-10 standard requires three years of clean data (2009-2011) at the monitors and modeled attainment by December 31, 2011. As demonstrated in the attainment modeling sections earlier in this chapter, modeled attainment can only be achieved in 2012, as the Dust Action General Permit measure does not become fully implemented until January 1, 2012. Modeled attainment cannot be demonstrated at all the monitors without taking emission reduction credit for this new measure. Also, it is unknown if clean data for years 2009-2011 will be available for attainment by December 31, 2011 until ADEQ submits and EPA acts upon documentation packages for several high wind exceptional events exceedances. As such, an extension of the attainment deadline from June 6, 2012 to December 31, 2012 is needed.

As stated in the June 6, 2007 final notice of failure to attain, authority to extend the attainment deadline beyond June 6, 2012 is available to EPA,

> *"EPA may, however, extend the attainment deadline to the extent it deems appropriate for a period no greater than 10 years from the publication date, 'considering the severity of nonattainment and the availability and feasability of pollution control measures.'"* (72 FR 31184)

For this Plan, the justification for an extension of the attainment deadline from June 6, 2012 to December 31, 2012 is centered around the availability of the new Dust Action General Permit measure, which was not fully implemented until January 1, 2012. Modeled attainment at all the monitors in the nonattainment area cannot be achieved under high wind conditions without the emissions reductions associated with the Dust Action General permit.

Development of the MAG 2012 Five Percent Plan was centered on addressing the technical approvability issues identified by EPA in their September 9, 2010 proposed partial disapproval of the MAG 2007 Five Percent Plan for PM-10 (75 FR 54806). These approvability issues established the need for a new emissions inventory and high wind modeling attainment demonstration in the MAG 2012 Five Percent Plan.

In February 2011, to begin addressing the technical approvability issues identified by EPA, a broad stakeholders group consisting of public and private entities was formed by ADEQ to discuss possible policy options for the MAG 2012 Five Percent Plan. Also meeting at the same time was a Five Percent Plan Technical Committee created to produce a new emissions inventory, conduct a high wind modeling attainment demonstration and address other technical issues as needed. EPA representatives participated regularly in both of these groups.

As of January 2012, the stakeholders group has met 16 times and the technical committee 20 times. The stakeholders group was involved in crafting a new measure to reduce fugitive dust on high wind days, the Dust Action General Permit. The Arizona Legislature passed House Bill 2208 in April 2011, which authorized the creation of the Dust Action General Permit. The Dust Action General Permit went through public notice and hearing and was signed and issued on December 30, 2011.

In order to model attainment during high winds at all the monitors in the PM-10 nonattainment area, the Five Percent Plan Technical Committee in consultation with EPA settled on the rollback modeling methodology for the MAG 2012 Five Percent Plan in August 2011. However, the high wind days to be modeled to demonstrate attainment were not agreed upon by the Five Percent Plan Technical Committee until October, 2011. After applying the rollback methodology to the selected days, it was determined that attainment could not be demonstrated without emissions reduction credit for the Dust Action General Permit. Since the Dust Action General Permit was signed on December 30, 2011, full implementation of this measure did not occur until 2012. As such, modeled attainment under high wind conditions at all monitors can only be shown in 2012, necessitating the need for an extension of the attainment deadline to December 31, 2012.

In summary, the process of addressing the technical approvability issues suggested by EPA resulted in the development of a new 2008 emissions inventory and the rollback conceptual model and design days selected for attainment modeling. These new technical pieces also identified the need for additional control of high wind fugitive dust beyond existing measures. Once identified, the feasability of fully implementing the new control in order to model attainment under high wind conditions in 2011 was not possible given the effective date of December 30, 2011 for the Dust Action General Permit. As such, an extension from June 6, 2012 to December 31, 2012 is needed to allow for a full year of implementation of the new Dust Action General Permit required to demonstrate attainment at all monitors in 2012.

REFERENCES

EPA, 1993. *Early Implementation of Contingency Measures for Ozone and Carbon Monoxide (CO) Nonattainment Areas.* August 13, 1993.

MAG, 2000. *Revised MAG 1999 Serious Area Particulate Plan for PM-10 for the Maricopa County Nonattainment Area.* February 2000.

DRAFT

MAG 2012 FIVE PERCENT PLAN FOR PM-10 FOR THE MARICOPA COUNTY NONATTAINMENT AREA

APPENDICES

VOLUME ONE

MARCH 2012

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MAG 2012 FIVE PERCENT PLAN FOR PM-10 FOR THE MARICOPA COUNTY NONATTAINMENT AREA

APPENDICES

MARCH 2012

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MAG 2012 FIVE PERCENT PLAN FOR PM-10 FOR THE MARICOPA COUNTY NONATTAINMENT AREA

APPENDICES

APPENDIX A

Exhibit 1: 2008 PM-10 Periodic Emissions Inventory for the Maricopa County, Arizona, Nonattainment Area. Maricopa County Air Quality Department. Revised June 2011.

APPENDIX B

Exhibit 1: Technical Document in Support of the MAG 2012 Five Percent Plan for PM-10 for the Maricopa County Nonattainment Area. Maricopa Association of Governments.

Exhibit 2: Calculation of Benefits from PM-10 Certified Street Sweepers Purchased with CMAQ Funds in 2001-2009.

APPENDIX C

Exhibit 1: Arizona Revised Statutes Listed in Table 4-1.

Exhibit 2: Maricopa County Resolution to Evaluate Measures in the MAG 2012 Five Percent Plan for PM-10 for the Maricopa County Nonattainment Area.

Exhibit 3: Arizona Department of Environmental Quality Dust Action General Permit.

Exhibit 4: Arizona Department of Environmental Quality Commitment to Revise the MAG 2012 Five Percent Plan for PM-10 for the Maricopa County Nonattainment Area if Necessary for the Emerging and Voluntary Measure.

APPENDIX D

Exhibit 1: Agricultural Best Management Practices Program.

APPENDIX E

Exhibit 1: Public Hearing Process Documentation.

Exhibit 2: Certification of Adoption.

APPENDIX A

APPENDIX A

EXHIBIT 1:

2008 PM-10 Periodic Emissions Inventory for the Maricopa County, Arizona, Nonattainment Area. Maricopa County Air Quality Department. Revised June 2011

Maricopa County
Air Quality Department

2008 PM_{10} Periodic Emissions Inventory

for the
Maricopa County, Arizona, Nonattainment Area

REVISED
June 2011

2008 PM_{10} Periodic Emission Inventory
for the Maricopa County, Arizona Nonattainment Area

REVISED
June 2011

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1. Introduction

1.1 Overview

This 2008 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 or equal to 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 2008 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 for this report.

Chapter	Author(s)	QA/QC contacts
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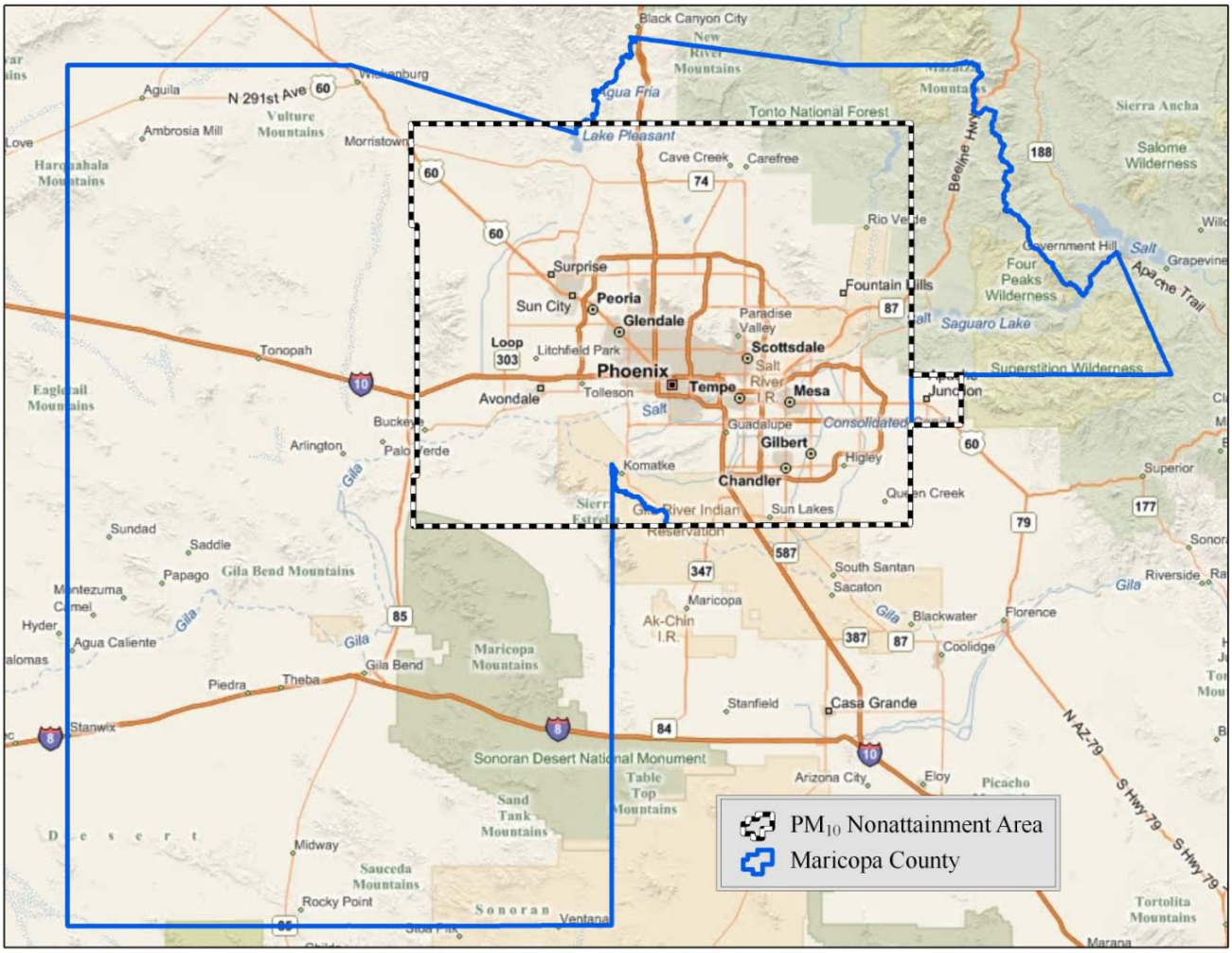
1.3 Temporal scope

Annual and typical daily emissions were estimated for the year 2008, 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 area.



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 2008, for both Maricopa County and the PM_{10} nonattainment area. Table 1.5–1 provides an overview of the demographic data used in this report. As noted throughout the text, these data are frequently used to derive estimates of activity or emissions within the PM_{10} NAA from county-level calculations. It is important to note, however, that the nonattainment area includes a portion of Pinal County, AZ (Apache Junction) as shown in Figure 1.4–1. Thus in some cases (e.g., those source categories calculated based on total population), the multiplier used to derive nonattainment area estimates from County-level values may be greater than 1, and thus the resulting NAA emission totals are larger than the County-level estimates from which they are derived.

Table 1.5–1. Demographic profile of Maricopa County and the PM_{10} nonattainment area.

Demographic variable	Maricopa County	PM_{10} NAA	Percent within PM_{10} NAA
Total resident population	4,026,000	4,024,530	99.96%
Total non-resident population	253,760	272,610	107.43%
Total population:	**4,279,760**	**4,297,140**	**100.41%**
Retail employment	537,430	536,100	99.75%
Office employment	444,170	444,980	100.18%
Industrial employment	412,580	411,520	99.74%
Public employment	278,610	274,500	98.52%
Other employment	191,770	189,010	98.56%
Construction	79,680	78,980	99.12%
Work at Home	65,620	64,940	98.96%
Total employment:	**2,009,860**	**2,000,030**	**99.51%**
Single Family/Multi-Family Household Split:			
Single-Family	75%	75%	
Multi-Family	25%	25%	

Source: Maricopa Association of Governments

1.5.2 Land use data

MAG provided draft 2009 land use data (as of March 2010). The draft 2009 land use data was assumed to be representative of 2008. Table 1.5–2 presents a summary of the land use categories and acreages used to develop emissions estimates for this inventory.

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

Land Use Category	Acreage in Maricopa County	Acreage within PM_{10} NAA	Percentage within PM_{10} NAA
General/active open space/golf course (e.g., parks)	228,295	223,290	97.81%
Passive/restricted open space (e.g., mountain preserves)	2,373,545	302,999	12.77%
Lakes	12,525	9,510	75.93%
Agriculture	295,509	130,445	44.14%
Vacant (e.g., developable land)	2,227,981	472,831	21.22%

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. MCAQD utilizes the US EPA's Annual Emissions Reporting Requirements (AERR) Rule to define which stationary sources are listed as point sources. A detailed definition of a point source can be found in Section 2.1 of Chapter 2.

Table 1.6–1 summarizes 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)				
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	601.27	555.15	2,204.91	81.15	279.06	3,323.2	3,069.1	12,151.5	449.3	1,534.2
PM_{10} NAA	149.84	132.94	1,317.85	28.76	132.18	841.2	747.7	7,254.3	158.2	727.0

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. Emissions from stationary sources that were not identified as point sources in this report have been included in the area source inventory. Examples of area source categories include residential wood burning, commercial cooking, waste incineration and wildfires.

Tables 1.6–2 and 1.6–3 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 1.6–2. 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	1,303.61	1,271.30	12,289.62	898.83	51.27	9,673.4	9,370.0	78,161.3	5,773.3	328.7
Industrial processes	11,881.57	2,953.30	362.58	129.60	1,731.34	76,667.6	19,048.2	2,816.5	1,005.8	11,077.2
Waste treatmt./disposal	230.52	204.35	77.47	58.20	1,488.07	1,613.0	1,438.8	515.3	320.0	8,131.5
Misc. area sources	29,154.21	4,012.53	126.52	32.64	13,059.05	179,712.0	27,667.0	1,676.1	446.4	71,686.1
All area sources:	**42,569.90**	**8,441.49**	**12,856.18**	**1,119.27**	**16,329.74**	**267,665.9**	**57,524.0**	**83,169.2**	**7,545.5**	**91,223.5**

Table 1.6–3. 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	1,300.65	1,268.35	12,248.07	895.83	51.11	9,653.8	9,350.6	77,895.2	5,754.1	327.6
Industrial processes	10,655.39	2,771.19	360.48	129.58	1,724.27	68,764.6	17,877.6	2,802.3	1,005.7	11,034.4
Waste treatmt./disposal	120.77	95.42	50.30	56.85	1,494.12	799.8	630.5	309.9	312.6	8,164.6
Misc. area sources	12,444.36	2,143.52	115.94	29.74	7,693.04	81,929.6	18,879.4	2,318.0	622.4	42,455.4
All area sources:	**24,521.17**	**6,278.48**	**12,774.79**	**1,112.00**	**10,962.54**	**161,147.8**	**46,738.0**	**83,325.3**	**7,694.7**	**61,982.0**

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 1.6–4 and 1.6–5 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 1.6–4. 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	34.27	33.24	365.55	0.14	0.67	219.7	213.1	2,343.3	0.9	4.3
Airport GSE (+APU)	27.21	26.68	586.73	26.43		148.7	145.8	3,206.1	144.4	
Commercial	117.97	112.98	1,395.23	2.40	21.12	756.2	724.2	8,943.8	15.4	135.4
Construction & mining	1,260.98	1,220.75	14,796.63	6.60	28.10	8,083.2	7,825.3	94,850.2	42.3	180.1
Industrial	101.69	98.96	2,593.13	3.22	56.23	651.8	634.4	16,622.7	20.6	360.5
Lawn and garden	182.28	168.79	798.14	3.16	19.63	1,250.1	1,156.9	5,571.5	23.1	144.6
Pleasure craft	9.25	8.54	77.74	0.85	1.73	124.5	114.9	1,046.5	11.4	23.3
Railway maintenance	1.13	1.10	9.23	0.00	0.02	7.8	7.6	63.9	0.0	0.1
Recreational equipment	45.58	41.98	63.80	0.42	2.10	389.6	358.8	545.3	3.6	18.0
Aircraft	187.91	181.42	2,625.94	317.64		1,026.8	991.3	14,349.4	1,735.8	
Locomotives	70.21	65.53	1,854.62	18.72	4.45	383.6	358.1	10,134.5	102.3	24.3
All nonroad mobile sources:	**2,038.46**	**1,959.96**	**25,166.75**	**379.58**	**134.06**	**13,042.0**	**12,530.3**	**157,677.4**	**2,099.8**	**890.6**

Table 1.6–5. 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	15.13	14.67	161.35	0.06	0.30	97.0	94.0	1,034.3	0.4	1.9
Airport GSE (+APU)	26.99	26.48	578.95	26.22		147.5	144.7	3,163.7	143.3	
Commercial	117.66	112.69	1,391.61	2.39	21.06	754.2	722.4	8,920.6	15.3	135.0
Construction & mining	1,249.88	1,210.00	14,666.42	6.55	27.85	8,012.1	7,756.4	94,015.6	42.0	178.5
Industrial	101.42	98.71	2,586.39	3.21	56.09	650.1	632.7	16,579.4	20.6	359.5
Lawn and garden	183.02	169.48	801.41	3.17	19.71	1,255.3	1,161.6	5,594.4	23.2	145.2
Pleasure craft	7.02	6.48	59.03	0.64	1.32	94.5	87.3	794.6	8.6	17.7
Railway maintenance	1.13	1.10	9.26	0.00	0.02	7.8	7.6	64.1	0.0	0.1
Recreational equipment	7.68	7.08	10.76	0.07	0.35	65.7	60.5	91.9	0.6	3.0
Aircraft	183.80	177.61	2,620.31	316.00		1,004.3	970.5	14,318.6	1,726.8	
Locomotives	34.16	31.88	907.76	9.11	2.16	186.7	174.2	4,960.4	49.8	11.8
All nonroad mobile sources:	**1,927.89**	**1,856.18**	**23,793.26**	**367.42**	**128.87**	**12,275.2**	**11,812.0**	**149,537.7**	**2,030.5**	**852.9**

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 breakout of emissions calculations for each area source category is contained in Chapter 5.

Tables 1.6–6 and 1.6–7 summarize annual and typical daily emissions from onroad mobile sources in Maricopa County and the PM_{10} nonattainment area, respectively.

Table 1.6–6. Annual and average daily emissions from all onroad mobile sources in Maricopa County.

Emission Category	Annual emissions (tons/year)					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, tire wear, and brake wear	3,295.74	2,417.89	75,033.9	314.5	1,294.1	18,009.2	13,212.4	410,021.3	1,718.2	7,072.1
Paved road fugitive dust	7,227.77	1,912.42	—	—	—	39,496.0	10,450.4	—	—	—
Unpaved road and alley fugitive dust	12,358.20	1,233.60	—	—	—	67,530.9	6,741.0	—	—	—
Totals:	**22,881.71**	**5,563.91**	**75,033.94**	**314.45**	**1,294.12**	**125,036.1**	**30,403.8**	**410,021.3**	**1,718.2**	**7,072.1**

Table 1.6–7. Annual and typical daily emissions from all onroad mobile sources in the PM_{10} NAA.

Emission Category	Annual emissions (tons/year)					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, tire wear, and brake wear	3,144.17	2,300.80	71,444.20	300.66	1,235.28	17,181.3	12,572.9	390,405.5	1,643.0	6,750.5
Paved road fugitive dust	6,694.22	1,774.76	—	—	—	36,580.5	9,698.1	—	—	—
Unpaved road and alley fugitive dust	11,710.70	1,169.00	—	—	—	63,993.1	6,387.8	—	—	—
Totals:	**21,549.09**	**5,244.56**	**71,444.20**	**300.66**	**1,235.28**	**117,754.9**	**28,658.8**	**390,405.5**	**1,643.0**	**6,750.5**

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 using the Model of Emissions of Gases and Aerosols from Nature (MEGAN). MEGAN is a state-of-the-art biogenic emissions model developed by the National Center for Atmospheric Research (NCAR). Some corrections and improvements were made in the latest version of MEGAN2.04. MEGAN2.04 was used to compute biogenic emissions in Maricopa County and the PM_{10} nonattainment area. Annual and daily NO_x emissions from biogenic sources are shown in Table 1.6–8 for Maricopa County and the PM_{10} nonattainment area.

Table 1.6–8. Annual and season-day NO_x emissions from biogenic sources.

Geographic area	Annual emissions (tons/yr)	Typical daily emissions (lbs/day)
Maricopa County	896.27	4,890.0
PM_{10} NAA	332.77	1,815.3

1.6.6 Summary of all source categories

Tables 1.6–9 and 1.6–10 provide summary totals of annual and typical daily emissions from all emission sources in Maricopa County and the PM_{10} nonattainment area, respectively.

Table 1.6–9. Annual and typical daily emissions from all sources in Maricopa County.

	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
Point Sources	601.27	555.15	2,204.91	81.15	279.06	3,323.2	3,069.1	12,151.5	449.3	1,534.2
Area Sources:										
Fuel combustion										
Industrial natural gas	30.78	30.78	575.29	2.42	12.70	197.3	197.3	3,687.7	15.5	81.4
Industrial fuel oil	458.79	458.79	6,375.08	609.61	26.25	2,941.0	2,941.0	40,865.9	3,907.8	168.3
Comm./ind. natural gas	66.54	66.54	1,267.11	5.23	4.20	426.5	426.5	8,122.5	33.5	26.9
Comm./ind. fuel oil	224.14	224.14	3,273.40	271.27	8.13	1,436.8	1,436.8	20,983.3	1,738.9	52.1
Residential natural gas	61.75	61.75	763.81	4.88		337.5	337.5	4,173.8	26.6	
Residential wood	461.59	429.28	34.69	5.34		4,334.2	4,030.8	325.7	50.1	
Residential fuel oil	0.01	0.01	0.25	0.10		0.1	0.1	2.3	0.9	
All combustion	1,303.61	1,271.30	12,289.62	898.83	51.27	9,673.4	9,370.0	78,161.3	5,773.3	328.7
Industrial Processes										
Chemical manufacturing	187.43	151.42	0.00	0.34	0.03	1,445.8	1,164.5	0.0	2.6	0.9
Food products										
Commercial cooking	988.99	917.18				5,434.0	5,039.5			
Grain handling	20.59	6.71				149.3	49.5			
Ammonia storage					1,678.43					10,759.2
Secondary metal prod.	60.56	52.16	49.73	18.65	0.04	442.7	386.2	358.8	142.7	0.0
Mineral processes (concrete batch, etc.)	192.82	95.47				1,337.7	659.3			
Mining & quarry (sand & gravel)	181.01	55.20				1,239.2	362.6			
Wood products	217.26	203.25				1,668.6	1,548.3			
Rubber/plastics mfg.	140.94	105.96				953.3	698.8			
Fabricated metal mfg.	51.48	42.62			4.50	538.1	460.6			28.9
Residential const.	1,845.79	184.58				11,832.0	1,183.2			
Commercial const.	4,320.77	432.08				27,697.2	2,769.7			
Road construction	2,695.73	269.57				17,280.3	1,728.0			
Construction – other	194.36	19.44				1,245.9	124.6			
Electric equip. mfg.	13.94	9.64	20.45	0.18	31.55	76.9	53.2	112.4	1.1	193.7
ADEQ portables	59.00	29.50	282.18	88.93		492.9	246.5	2,275.7	721.7	
Unpaved road travel	566.30	271.29				3,880.4	1,847.2			
Industrial proc. NEC	144.60	107.24	10.22	21.49	16.79	953.3	726.4	69.6	137.7	94.6
All Ind. Processes	11,881.57	2,953.30	362.58	129.60	1,731.34	76,667.6	19,048.2	2,816.5	1,005.8	11,077.2
Waste Treatment/Disp.										
On-site incineration	0.06	0.04	5.01	0.01		0.7	0.4	38.9	0.1	
Open burning	111.46	111.46	29.96			902.2	902.2	242.4		
Landfills	86.21	75.92	24.11	7.57		486.1	425.4	132.9	41.7	
POTWs					1,488.07					8,131.5
Other waste	32.78	16.93	18.39	50.62		224.1	110.9	101.0	278.1	
All Waste Treat/Disp.	230.52	204.35	77.47	58.20	1,488.07	1,613.0	1,438.8	515.3	320.0	8,131.5
Misc. Area Sources										
Wildfires	470.39	403.43	103.79	28.46	21.76	6,271.8	5,379.0	1,383.8	379.4	290.2
Prescribed fires	0.51	0.51	0.39	0.11	0.03	169.3	169.3	131.2	36.0	10.6
Structure fires	15.04	15.04	1.95			82.2	82.2	10.7		
Vehicle fires	30.04	30.04	1.20			164.1	164.1	6.6		
Aircraft engine testing	0.18	0.17	6.74	2.49		1.3	1.2	50.5	19.0	
Tilling	2,059.00	308.85				22,932.4	3,439.9			
Harvesting	136.93	20.54				3,938.9	590.8			
Unpaved agric. roads	1,739.52	173.95				11,150.8	1,115.1			
Cotton ginning	17.90	5.11				103.8	29.7			
Fertilizer application					2,276.43					12,439.5
Livestock	455.80	50.14			9,583.89	2,490.7	274.0			52,514.5
Crematories	0.93	0.62	12.39	1.58		7.0	4.7	93.1	11.9	
Accidental releases	0.01	0.01	0.06			0.1	0.1	0.3		
Humans					1,176.93					6,431.3
Leaf blowers fugitive dust	891.36	336.41				4,870.8	1,838.3			
Offroad rec. vehicles fugitive dust	12,082.12	1,200.11				66,022.5	6,558.0			
Travel on unpaved parking lots	4,445.36	446.24				24,291.6	2,438.5			
Windblown dust	6,809.13	1,021.37				37,214.6	5,582.2			
All Misc. Area Sources	29,154.21	4,012.53	126.52	32.64	13,059.05	179,712.0	27,667.0	1,676.1	446.4	71,686.1
All Area Sources:	42,569.90	8,441.49	12,856.18	1,119.27	16,329.74	267,665.9	57,524.0	83,169.2	7,545.5	91,223.5

Table 1.6–9 (continued). Annual and typical daily emissions from all sources in Maricopa County.

	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	34.27	33.24	365.55	0.14	0.67	219.7	213.1	2,343.3	0.9	4.3
Airport GSE (+APU)	27.21	26.68	586.73	26.43		148.7	145.8	3,206.1	144.4	
Commercial equipment	117.97	112.98	1,395.23	2.40	21.12	756.2	724.2	8,943.8	15.4	135.4
Construction and mining equipment	1,260.98	1,220.75	14,796.63	6.60	28.10	8,083.2	7,825.3	94,850.2	42.3	180.1
Industrial equipment	101.69	98.96	2,593.13	3.22	56.23	651.8	634.4	16,622.7	20.6	360.5
Lawn and garden equipment	182.28	168.79	798.14	3.16	19.63	1,250.1	1,156.9	5,571.5	23.1	144.6
Pleasure craft	9.25	8.54	77.74	0.85	1.73	124.5	114.9	1,046.5	11.4	23.3
Railway maintenance equipment	1.13	1.10	9.23	0.00	0.02	7.8	7.6	63.9	0.0	0.1
Recreational equipment	45.58	41.98	63.80	0.42	2.10	389.6	358.8	545.3	3.6	18.0
Aircraft	187.91	181.42	2,625.94	317.64		1,026.8	991.4	14,349.4	1,735.8	
Locomotives	70.21	65.53	1,854.62	18.72	4.45	383.6	358.1	10,134.5	102.3	24.3
All Nonroad Sources	2,038.46	1,959.96	25,166.75	379.58	134.06	13,042.0	12,530.4	157,677.4	2,099.8	890.6
Onroad Sources:										
Exhaust, tire wear, and brake wear	3,295.74	2,417.89	75,033.94	314.45	1,294.12	18,009.2	13,212.4	410,021.3	1,718.2	7,072.1
Paved road fugitive dust	7,227.77	1,912.42				39,496.0	10,450.4			
Unpaved road and alley fugitive dust	12,358.20	1,233.60				67,530.9	6,741.0			
All Mobile Sources:	22,881.71	5,563.91	75,033.94	314.45	1,294.12	125,036.1	30,403.8	410,021.3	1,718.2	7,072.1
Biogenic Sources:			896.27					4,890.0		
TOTAL, All Sources:	68,091.34	16,520.51	116,158.05	1,894.45	18,036.97	409,067.3	103,527.3	667,909.3	11,812.7	100,720.4

Table 1.6–10. 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
Point Sources	149.84	132.94	1,317.85	28.76	132.18	841.2	747.7	7,254.3	158.2	727.0
Area Sources:										
Fuel combustion										
Industrial natural gas	30.70	30.70	573.79	2.41	12.66	196.8	196.8	3,678.2	15.5	81.2
Industrial fuel oil	457.60	457.60	6,358.50	608.03	26.19	2,933.3	2,933.3	40,759.6	3,897.6	167.9
Comm./ind. natural gas	66.20	66.20	1,260.65	5.20	4.18	424.4	424.4	8,081.1	33.3	26.8
Comm./ind. fuel oil	223.00	223.00	3,256.70	269.88	8.09	1,429.5	1,429.5	20,876.3	1,730.0	51.8
Residential natural gas	61.73	61.73	763.51	4.87		337.3	337.3	4,172.2	26.6	
Residential wood	461.41	429.11	34.67	5.33		4,332.5	4,029.2	325.6	50.1	
Residential fuel oil	0.01	0.01	0.25	0.10		0.1	0.1	2.3	0.9	
All combustion	1,300.65	1,268.35	12,248.07	895.83	51.11	9,653.8	9,350.6	77,895.2	5,754.1	327.6
Industrial Processes										
Chemical manufacturing	186.94	151.03	0.00	0.34	0.03	1,442.0	1,161.5	0.0	2.6	0.9
Food products										
Commercial cooking	993.04	920.94				5,456.3	5,060.1			
Grain handling	16.73	5.68				125.3	43.0			
Ammonia storage					1,674.07					10,731.2
Secondary metal prod.	60.56	52.16	49.73	18.65	0.04	442.7	386.2	358.8	142.7	0.0
Mineral processes (concrete batch, etc.)	187.73	91.92				1,302.8	635.6			
Mining & quarry (sand & gravel)	156.60	46.81				1,075.7	307.2			
Wood products	216.69	202.72				1,664.3	1,544.3			
Rubber/plastics mfg.	140.57	105.68				950.9	697.0			
Fabricated metal mfg.	51.35	42.51			4.49	536.7	459.4			28.8
Residential const.	1,692.38	169.24				10,920.3	1,092.0			
Commercial const.	4,057.29	405.73				25,897.4	2,589.7			
Road construction	2,051.78	205.18				13,156.8	1,315.7			
Construction – other	162.41	16.24				1,043.9	104.4			
Electric equip. mfg.	13.94	9.64	20.45	0.18	31.55	76.9	53.2	112.4	1.1	193.7
ADEQ portable sources	59.00	29.50	282.18	88.93		492.9	246.5	2,275.7	721.7	
Unpaved road travel	472.36	217.08				3,273.9	1,500.1			
Industrial proc. NEC	136.00	99.12	8.12	21.47	14.10	906.0	681.7	55.4	137.6	79.8
All Ind. Processes	10,655.39	2,771.19	360.48	129.58	1,724.27	68,764.6	17,877.6	2,802.3	1,005.7	11,034.4
Waste Treatment/Disp.										
On-site incineration	0.06	0.04	5.01	0.01		0.7	0.4	38.9	0.1	
Open burning	27.67	27.67	7.44			232.6	232.6	62.5		
Landfills	60.25	50.78	19.47	6.22		342.4	286.6	107.4	34.3	
POTWs					1,494.12					8,164.6
Other waste	32.78	16.93	18.39	50.62		224.1	110.9	101.0	278.1	
All Waste Treat/Disp.	120.77	95.42	50.30	56.85	1,494.12	799.8	630.5	309.9	312.6	8,164.6
Misc. Area Sources										
Wildfires	423.56	363.27	93.46	25.62	19.60	9,412.5	8,072.7	2,076.8	569.4	435.5
Prescribed fires	0.21	0.21	0.16	0.04	0.01	104.0	104.0	80.6	22.1	6.5
Structure fires	15.10	15.10	1.96			82.5	82.5	10.7		
Vehicle fires	30.16	30.16	1.21			164.8	164.8	6.6		
Aircraft engine testing	0.18	0.17	6.74	2.49		1.3	1.2	50.5	19.0	
Tilling	834.20	125.13				9,327.3	1,399.1			
Harvesting	54.14	8.12				1,560.0	234.0			
Unpaved agric. roads	731.03	73.10				4,686.1	468.6			
Cotton ginning	4.86	1.39				26.7	7.6			
Fertilizer application					1,004.82					5,490.8
Livestock	260.95	28.70			5,486.90	1,426.0	156.9			30,065.2
Crematories	0.93	0.62	12.36	1.58		7.0	4.6	92.6	11.8	
Accidental releases	0.01	0.01	0.06			0.1	0.1	0.3		
Humans					1,181.71					6,457.5
Leaf blowers fugitive dust	894.98	337.78				4,890.6	1,845.8			
Offroad rec. vehicles fugitive dust	2,014.17	200.09				11,006.4	1,093.4			
Travel on unpaved parking lots	2,365.07	237.45				12,923.9	1,297.5			
Windblown dust	4,814.80	722.22				26,310.4	3,946.6			
All Misc. Area Sources	12,444.36	2,143.52	115.94	29.74	7,693.04	81,929.6	18,879.4	2,318.0	622.4	42,455.4
All Area Sources:	24,521.17	6,278.48	12,774.79	1,112.00	10,962.54	161,147.8	46,738.0	83,325.3	7,694.7	61,982.0

Table 1.6–10 (cont'd). 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	15.13	14.67	161.35	0.06	0.30	97.0	94.0	1,034.3	0.4	1.9
Airport GSE (+APU)	26.99	26.48	578.95	26.22		147.5	144.7	3,163.7	143.3	
Commercial equipment	117.66	112.69	1,391.61	2.39	21.06	754.2	722.4	8,920.6	15.3	135.0
Construction and mining equipment	1,249.88	1,210.00	14,666.42	6.55	27.85	8,012.1	7,756.4	94,015.6	42.0	178.5
Industrial equipment	101.42	98.71	2,586.39	3.21	56.09	650.1	632.7	16,579.4	20.6	359.5
Lawn and garden equipment	183.02	169.48	801.41	3.17	19.71	1,255.3	1,161.6	5,594.4	23.2	145.2
Pleasure craft	7.02	6.48	59.03	0.64	1.32	94.5	87.3	794.6	8.6	17.7
Railway maintenance equipment	1.13	1.10	9.26	0.00	0.02	7.8	7.6	64.1	0.0	0.1
Recreational equipment	7.68	7.08	10.76	0.07	0.35	65.7	60.5	91.9	0.6	3.0
Aircraft	183.80	177.61	2,620.31	316.00		1,004.3	970.5	14,318.6	1,726.8	
Locomotives	34.16	31.88	907.76	9.11	2.16	186.7	174.2	4,960.4	49.8	11.8
All Nonroad Sources:	1,927.89	1,856.18	23,793.26	367.42	128.87	12,275.2	11,812.0	149,537.7	2,030.5	852.9
Onroad Sources:										
Exhaust, tire wear, and brake wear	3,144.17	2,300.80	71,444.20	300.66	1,235.28	17,181.3	12,572.9	390,405.5	1,643.0	6,750.5
Paved road fugitive dust	6,694.22	1,774.76				36,580.5	9,698.1			
Unpaved road and alley fugitive dust	11,710.70	1,169.00				63,993.1	6,387.8			
All Mobile Sources:	21,549.09	5,244.56	71,444.20	300.66	1,235.28	117,754.9	28,658.8	390,405.5	1,643.0	6,750.5
Biogenic Sources:			332.77					1,815.3		
TOTAL, All Sources:	48,147.99	13,512.16	109,662.87	1,808.84	12,458.87	292,019.1	87,956.5	632,338.1	11,526.4	70,312.4

1.7 Public review process

Maricopa County Air Quality Department released a draft version of this document, its 2008 PM_{10} emission inventory, for a 30-day public review and comment period on April 26, 2010. (The department's news release announcing the availability of the draft report, and outlining the schedule for public review and comment, is contained in Appendix 1). The department held a public workshop on May 14, 2010 to discuss the draft inventory. No formal comments were received during the 30-day public comment period.

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 Air Emission Reporting Requirements (AERR) rule 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 2008. 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" by adopting the designation of point sources as outlined in the AERR:

> *We are basing the requirement for point source format reporting on whether the source is major under 40 CFR part 70 for the pollutants for which reporting is required, i.e., CO, VOC, NO_x, SO_2, $PM_{2.5}$, PM_{10}, lead and NH_3 but without regard to emissions of HAPs… [T]his approach will result in a more stable universe of reporting point sources, which in turn will facilitate elimination of overlaps and gaps in estimating point source emissions, as compared to nonpoint source emissions. Under this requirement, states will know well in advance of the start of the inventory year which sources will need to be reported.* (US EPA, 2008)

Additionally, EPA guidance requires emission inventories prepared for SIP development purposes to consider point sources with 25 miles of the nonattainment area boundary. No additional point sources met this reporting threshold.

Several tables have been constructed to provide the point source emissions and category totals. Table 2.2–1 provides an alphabetical listing of all point sources and their location. Table 2.4–1 shows the 2008 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 one or more of these pollutants broken out by facility. Table 2.6–1 summarizes point source emissions by source category for the county and PM_{10} nonattainment area. 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 2008 annual emissions reports submitted to the department. A total of 25 stationary sources were identified as point sources using the definition described in Section 2.1. There are no additional point sources within the 25-mile boundary around the PM_{10} nonattainment area with permits issued by 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 listing 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 in Maricopa County.

ID #	NAICS	Business name	Address	City	ZIP	
245	337122	AF Lorts Manufacturing Company	8120 W Harrison St	Tolleson	85353	
3313	221112	APS West Phx Power Plant	4606 W Hadley St	Phoenix	85043	
43063	221112	Dynegy Arlington Valley LLC	39027 W Elliot Rd	Arlington	85322	*
44439	221112	Gila River Power Station	1250 E Watermelon Rd	Gila Bend	85337	*
1418	326299	Goodrich Aircraft Interior Products	3414 S 5th St	Phoenix	85040	
355	336412	Honeywell-Engines Systems & Services	111 S 34th St	Phoenix	85034	
3300	92811	Luke AFB – 56th Fighter Wing	14002 W Marauder St	Glendale	85309	
62	33711	Mastercraft Cabinets Inc	305 S Brooks	Mesa	85202	
44186	221112	Mesquite Generating Station	37625 W Elliot Rd	Arlington	85322	*
43530	221112	New Harquahala Generating Co	2530 N 491st Ave	Tonopah	85354	*
20706	32614	New Wincup Holdings Inc	7980 W Buckeye Rd	Phoenix	85043	
1331	337122	Oak Canyon Manufacturing Inc	3021 N 29th Dr	Phoenix	85017	
52382	221112	Ocotillo Power Plant	1500 E University Dr	Tempe	85281	
1341	33992	Penn Racquet Sports Inc	306 S 45th Ave	Phoenix	85043	
42956	221112	Redhawk Generating Facility	11600 S 363rd Ave	Arlington	85322	*
303	332431	Rexam Beverage Can Company	211 N 51st Ave	Phoenix	85043	
3315	221112	Santan Generating Station	1005 S Val Vista Rd	Gilbert	85296	
4175	424710	SFPP LP Phoenix Terminal	49 N 53rd Ave	Phoenix	85043	
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	
552	337122	Thornwood Furniture Mfg	5125 E Madison St	Phoenix	85034	
1210	337122	Trendwood Inc (S. 15th Ave.)	2402 S 15th Ave	Phoenix	85007	
1211	337122	Trendwood Inc (E. University)	261 E University Dr	Phoenix	85004	
174	325998	W R Meadows of Az Inc	4220 S Sarival Ave	Goodyear	85338	
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 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 check all reports for missing and questionable data, and check the accuracy and reasonableness of all emissions calculations with AP–42, the Factor Information and REtrieval (*webFIRE*)

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 SCCs and control device combinations included in EPA's *WebFIRE*, this database 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.

MCAQD has estimated RE for three distinct groups of industrial processes. (See Appendix 3 for details on the methods and data used in computing RE rates):

- For manually controlled processes that are regulated under Maricopa County Rule 316 (Non-metallic Mineral Processing), the analysis showed an overall rule effectiveness of 65.44%.
- For most other processes that claimed emissions reductions through the use of a control device, RE calculations were performed separately for Title V and non-Title V sources. Overall RE values of 90.94% (for Title V processes) and 84.27% (for non-Title V) were calculated.

2.4 Detailed overview of point source emissions

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.

			Annual emissions (tons/yr)					Typical daily (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
245	AF Lorts Manufacturing Company	*	2.69	2.68	0.01	0.00	0.00	20.7	20.6	0.1	0.0	0.0
3313	APS West Phx Power Plant		22.94	19.47	394.24	4.51	81.39	126.0	107.0	2,166.1	24.8	447.2
43063	Dynegy Arlington Valley LLC	†*	6.40	3.58	35.50	2.20	5.38	36.5	20.9	214.4	15.2	29.6
44439	Gila River Power Station	†	99.50	92.13	343.01	17.36	5.77	546.9	506.4	1,887.5	95.4	31.8
1418	Goodrich Aircraft Interior Products	*	0.16	0.16	0.42	0.00	0.01	1.5	1.5	3.2	0.0	0.1
355	Honeywell-Engines Systems & Srvs.		3.17	3.16	51.42	9.91	0.65	17.7	17.6	282.5	54.5	4.0
3300	Luke AFB – 56th Fighter Wing	*	0.60	0.59	7.15	0.15	0.02	3.7	3.7	43.1	1.0	0.1
62	Mastercraft Cabinets Inc		0.18	0.14	0.04	0.00	0.00	1.4	1.1	0.3	0.0	0.0
44186	Mesquite Generating Station	†	152.65	144.01	243.09	17.12	15.56	838.8	791.3	1,336.4	94.1	85.5
43530	New Harquahala Generating Co	†	116.35	116.11	86.29	6.46	93.52	639.3	638.0	474.1	35.5	513.9
20706	New Wincup Holdings Inc		0.94	0.94	12.42	0.07	0.40	5.2	5.2	68.3	0.4	2.2
1331	Oak Canyon Manufacturing Inc		0.01	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0
52382	Ocotillo Power Plant		8.37	6.48	64.45	0.29	1.67	46.0	35.6	354.1	1.6	9.2
1341	Penn Racquet Sports Inc	*	1.74	1.74	3.51	0.02	0.11	13.4	13.4	27.0	0.2	0.9
42956	Redhawk Generating Facility	†	76.53	66.38	179.16	9.25	26.65	420.5	364.7	984.8	50.9	146.4
303	Rexam Beverage Can Company	*	0.33	0.33	4.39	0.03	0.14	1.8	1.8	24.1	0.1	0.8
3315	Santan Generating Station		51.88	50.33	313.85	10.59	35.55	285.1	276.5	1,724.4	58.2	195.3
4175	SFPP LP Phoenix Terminal		0.63	0.61	4.96	0.24	0.00	3.5	3.3	27.2	1.3	0.0
3316	SRP Agua Fria Generating Station		25.21	18.01	392.20	0.58	3.67	138.5	98.9	2,154.9	3.2	20.1
3317	SRP Kyrene Generating Station		26.24	25.64	60.60	2.19	8.56	144.2	140.9	333.0	12.1	47.0
552	Thornwood Furniture Mfg	*	2.66	2.42	0.10	0.00	0.00	20.5	18.6	0.8	0.0	0.0
1210	Trendwood Inc (S. 15th Ave.)		0.05	0.05	0.00	0.00	0.00	0.4	0.4	0.0	0.0	0.0
1211	Trendwood Inc (E. University)		0.01	0.01	0.00	0.00	0.00	0.1	0.0	0.0	0.0	0.0
174	W R Meadows of Az Inc		0.01	0.01	0.12	0.00	0.00	0.1	0.1	1.5	0.0	0.0
1382	Woodcase Fine Cabinetry Inc		0.23	0.18	0.00	0.00	0.00	1.8	1.4	0.0	0.0	0.0

† = Facility is outside the PM_{10} nonattainment area.
* = Facility for which rule effectiveness has been applied.

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.

		Emission reduction credits (tons/yr)		
ID	**Facility**	**PM_{10}**	**NO_x**	**SO_x**
1151	Freescale Semiconductor, Inc. (formerly Motorola Mesa)	1.80	8.00	0.16

2.6 Summary of point source emissions

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

Table 2.6–1. Annual and typical daily point source emissions (including emission reduction credits).

	Annual (tons/yr)					Typical day (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	601.27	555.15	2,204.91	81.15	279.06	3,323.2	3,069.1	12,151.5	449.3	1,534.2
PM_{10} NAA	149.84	132.94	1,317.85	28.76	132.18	841.2	747.7	7,254.3	158.2	727.0

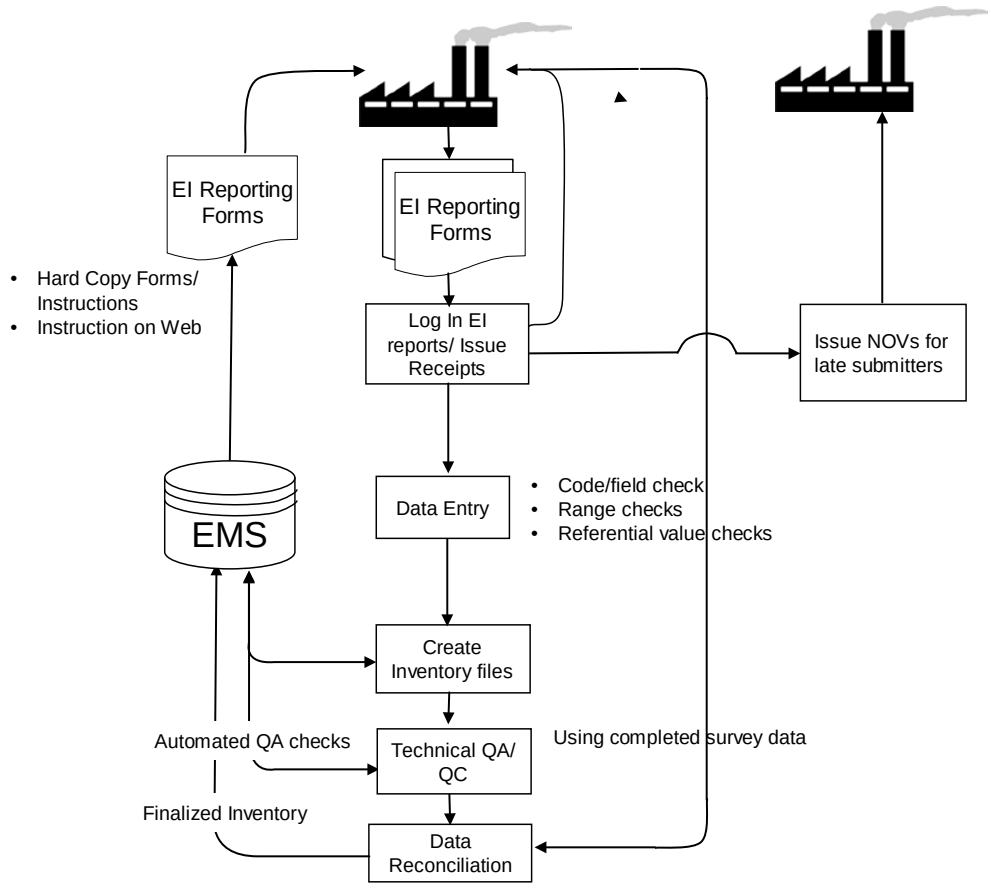
2.7 Quality assurance / quality control procedures

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). The EI Unit asks sources to verify and update the data. The EI Unit also holds workshops from February 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, a variety of 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 air quality 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 2008 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 2008 annual emissions report.

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

2.8 References

CARB, 2004. Speciation Profiles and Size Fractions. Available at: http://www.arb.ca.gov/ei/speciate/speciate.htm.

US EPA, 2008. Air Emissions Reporting Requirements. 73 Fed. Reg. 76539. Available at: http://www.epa.gov/ttn/chief/aerr/final_published_aerr.pdf.

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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 included in this PM_{10} inventory.

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	3.5.1.1
2810014000	Prescribed fires	3.5.1.2

Table 3.1–1. (continued) 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
2810060000	Livestock	3.5.3
2810060000	Health services: crematories	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) or derived from state-wide data (e.g., fuel oil use).
- For some widespread or diverse categories (e.g., ammonia cold storage), 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., wood product manufacturing), these data were combined with employment data to "scale up" reported emissions to reflect the entire source category.
- For those source categories that have detailed emissions data available from most or all of the significant sources in the category, emissions were calculated based on the detailed process-level and operational data provided by these sources.

The specific emissions estimation methodologies used for each source category (including the derivation and 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	17.07	1,543.27	15,643.15	14,911.67	6,487.35	n/a
City of Mesa	6.52	93.02	1,609.12	1,339.62	n/a	244.97
El Paso	227,608.92	201.90	n/a	n/a	n/a	6.07

* For emissions calculations, sales from transport and other 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 2008. 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
	=	8,576.57 MMCF	–	516.15 MMCF
	=	8,060.42 MMCF		

Natural gas is used for both external combustions (boilers and heaters) and internal combustion (generators), each of which have different emission factors. Thus the area-source natural gas usage derived above must be divided 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 2008.

Annual emissions for the county and the PM_{10} nonattainment area were 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:

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 lbs/ton
	=	7,934.68	×	7.6	÷ 2,000
	=	30.15 tons PM_{10}/yr			

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

Type of Combustion	% of total	Natural gas use (MMCF)	Emission factors (lb/MMCF)					Annual emissions (tons/yr)				
			PM_{10}	$PM_{2.5}$	NO_x	SO_x	NH_3	PM_{10}	$PM_{2.5}$	NO_x	SO_x	NH_3
External	98.44	7,934.68	7.6	7.6	100	0.6	3.2	30.15	30.15	396.73	2.38	12.70
Internal	1.56	125.74	10.0	10.0	2840	0.6	n/a	0.63	0.63	178.55	0.04	n/a
Total:	**100.00**	**8,060.43**						**30.78**	**30.78**	**575.29**	**2.42**	**12.70**

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

Typical daily PM_{10} emissions from industrial natural gas (lbs/day)	=	Annual PM_{10} emissions	÷ (days/week × wks/yr)	× 2,000 lbs/ton
	=	30.78 tons/yr	÷ (6 × 52)	× 2,000
	=	197.3 lbs PM_{10}/day		

Annual and typical daily emissions within the PM_{10} nonattainment area were 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	= Annual county PM_{10} emissions (tons/yr)	×	NAA:County industrial employment ratio in the PM_{10} NAA
	= 30.78	×	0.9974
	= 30.70 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	30.78	30.78	575.29	2.42	12.70	197.3	197.3	3,687.7	15.5	81.4
PM_{10} NAA	30.70	30.70	573.79	2.41	12.66	196.8	196.8	3,678.2	15.5	81.2

3.2.2 Industrial fuel oil

Area-source emissions from industrial fuel oil combustion were 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, 2010a) to Maricopa County.

To derive industrial fuel oil usage in Maricopa County, reported Arizona state-level sales of high-sulfur diesel for 2008 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 (in thousand gallons, or Mgal)	= Reported state total industrial fuel oil sales	–	Reported state high-sulfur diesel sales
	= 137,044 Mgal	–	224 Mgal
	= 136,820 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 (2010a) 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
	= 136,820 Mgal	×	0.7007
	= 95,869.77 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
	=	95,869.77 Mgal	–	11,596.87 Mgal	–	136.82 Mgal
	=	84,136.09 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 2008 (shown in Table 3.2–4 below).

Annual emissions for the county and the PM_{10} nonattainment area were 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 lbs/ton
	=	65,634.56	×	2	÷	2,000
	=	65.63 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)					Annual emissions (tons/yr)				
			PM_{10}	$PM_{2.5}$	NO_x	SO_x	NH_3	PM_{10}	$PM_{2.5}$	NO_x	SO_x	NH_3
External	78.01	65,634.56	2.0	2.0	24	7.39	0.8	65.63	65.63	787.61	242.36	26.25
Internal	21.99	18,501.53	42.5	42.5	604	39.70	–	393.16	393.16	5,587.46	367.26	n/a
Totals:	**100.00**	**84,136.09**						**458.79**	**458.79**	**6,375.08**	**609.61**	**26.25**

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

Typical daily PM_{10} emissions from industrial fuel oil	=	Annual PM_{10} emissions (tons/yr)	÷	(days/week × wks/yr)	×	2,000 lbs/ton
	=	458.79	÷	(6 × 52)	×	2,000
	=	2,941.0 lbs PM_{10}/day				

Annual and typical daily emissions in the PM_{10} nonattainment area were 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
	=	458.79 tons/yr	×	0.9974
	=	457.60 tons PM_{10}/yr		

Table 3.2–5. Annual and typical daily emissions from area-source industrial fuel oil 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	458.79	458.79	6,375.08	609.61	26.25	2,941.0	2,941.0	40,865.9	3,907.8	168.3
PM_{10} NAA	457.60	457.60	6,358.50	608.03	26.19	2,933.3	2,933.3	40,759.6	3,897.6	167.9

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 2008. 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
	=	17,503.31 MMCF	–	84.08 MMCF
	=	17,419.23 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 2008.

Annual emissions for the county were 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 lbs/ton
	=	17,130.07	×	7.6	÷	2,000
	=	65.09 tons PM_{10}/yr				

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

			Emission factors (lb/MMCF)					Annual emissions (tons/yr)				
Combustion type	**% of total**	**C&I natural gas usage (MMCF)**	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**NH_3**	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**NH_3**
External	98.34	17,130.07	7.6	7.6	100	0.6	0.49	65.09	65.09	856.50	5.14	4.20
Internal	1.66	289.16	10.0	10.0	2840	0.6	n/a	1.45	1.45	410.61	0.09	n/a
Total:	**100.00**	**17,419.23**						**66.54**	**66.54**	**1,267.11**	**5.23**	**4.20**

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

Typical daily PM_{10} emissions from comm./inst. natural gas	=	Annual PM_{10} emissions (tons/yr)	÷ (days/week × wks/yr)	×	2,000 lbs/ton
	=	66.54	÷ (6 × 52)	×	2,000
	=	426.54 lbs/day			

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

PM_{10} NAA emissions from area-source comm./inst. natural gas combustion	=	Annual county PM_{10} emissions (tons/yr)	×	NAA:County C&I employment ratio
	=	66.54	×	0.9949
	=	66.20 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	66.54	66.54	1,267.11	5.23	4.20	426.5	426.5	8,122.5	33.5	26.9
PM_{10} NAA	66.20	66.20	1,260.65	5.20	4.18	424.4	424.4	8,081.1	33.3	26.8

3.2.4 Commercial/institutional fuel oil

Area-source emissions from commercial and institutional (C&I) fuel oil combustion were 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, 2010b) to Maricopa County.

To derive commercial/institutional fuel oil usage in Maricopa County, reported Arizona state-level sales of high-sulfur diesel for 2008 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
	=	47,586 Mgal	–	367 Mgal
	=	47,219 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 (2010a) 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
	=	47,219 Mgal	×	0.7973
	=	37,647.71 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
	= 37,647.71 Mgal	–	7,291.00 Mgal	–	3.94 Mgal
	= 30,352.77 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 2008 (shown in Table 3.2–8 below).

Annual emissions for the county were calculated by multiplying comm./inst. 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 lbs/ton
	= 20,321.18	×	1.08	÷	2,000
	= 10.97 tons PM_{10}/yr				

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

			Emission factors (lb/Mgal)					Annual emissions (tons/yr)				
Combustion type	**% of total**	**C&I fuel oil sales (Mgal)**	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**NH_3**	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**NH_3**
External	66.95	20,321.18	1.08	1.08	24	7.1	0.8	10.97	10.97	243.85	72.14	8.13
Internal	33.05	10,031.59	42.5	42.5	604	39.7	n/a	213.17	213.17	3,029.54	199.13	n/a
Total:	**100.00**	**30,352.78**						**224.14**	**224.14**	**3,273.40**	**271.27**	**8.13**

Typical daily emissions for the county were 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
	= 224.14	÷ (6 × 52)	×	2,000
	= 1,436.8 lbs/day			

Annual and typical daily emissions within the PM_{10} nonattainment area were 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
	= 224.14	×	0.9949
	= 223.00 tons PM_{10}/yr		

Table 3.2–9. Annual and typical daily emissions from area-source commercial/institutional fuel oil 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	224.14	224.14	3,273.40	271.27	8.13	1,436.8	1,436.8	20,983.3	1,738.9	52.1
PM_{10} NAA	223.00	223.00	3,256.70	269.88	8.09	1,429.5	1,429.5	20,876.3	1,730.0	51.8

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.

Emission Factors (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 = Annual sales of residential natural gas (MMCF) × PM_{10} emission factor for residential natural gas (lbs/MMCF) ÷ 2,000 lbs/ton

= 16,251.29 × 7.6 ÷ 2,000

= 61.75 tons PM_{10}/yr

Typical daily emissions were calculated by dividing annual emissions by the number of days (366) 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

= 61.75 tons/yr × 2, 000 ÷ 366

= 337.4 lbs PM_{10}/day

Annual and typical daily residential natural gas emissions in the PM_{10} nonattainment area were 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 = Annual PM_{10} emissions in Maricopa County × % of County residential population in the NAA

= 61.75 × 99.96%

= 61.73 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	61.75	61.75	763.81	4.88	337.5	337.5	4,173.8	26.6
PM_{10} NAA	61.73	61.73	763.51	4.87	337.3	337.3	4,172.2	26.6

3.2.6 Residential wood combustion

Area-source emissions from residential wood combustion were calculated based on the amount of wood burned in fireplaces and woodstoves in Maricopa County, as recommended by EIIP guidance (US EPA, 2001b). Residential wood combustion in the county is estimated by multiplying data on statewide residential wood combustion usage from the US Department of Energy (US DOE, 2010c) by the ratio of county to state households that report use of wood for heating from the US Census Bureau (2010b). The latest available data on residential wood use for household heating from the US Department of Energy is for the calendar year 2007. 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 2007 data is assumed to be representative of 2008 emissions.

Maricopa County residential wood usage (cords/yr)	= Arizona residential wood usage (cords/yr)	×	Ratio of county:state households using wood for heat
	= 651,000	×	1,457 / 44,330
	= 21,397 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, 2001b). 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
	=	21,397	× 79	×	31.57	÷	2,000
	=	26,682 tons					

Annual emissions from residential wood combustion were calculated by multiplying the tons of wood used by the PM_{10} emission factor for residential woodstoves and fireplaces from Table 2.4 –1 of US EPA (2001b).

Annual PM_{10} emissions from residential wood combustion (tons/yr)	=	Residential wood usage (tons)	×	PM_{10} emission factor (lbs/ton)	÷	2,000 lbs/ton
	=	26,682	×	34.6	÷	2,000
	=	461.59 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
26,681.76	34.6	32.2	2.6	0.4	461.59	429.28	34.69	5.34

*$PM_{2.5}$ is assumed to be 93% of PM_{10} (Houck and Tiegs, 1998).

Typical daily emissions were 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, 2010) indicated that there were five months (April, plus June–September, totaling 152 days) in 2008 where no heating degree days were recorded. Assuming that no wood burning activity took place during those months, it is assumed that all residential wood burning occurred during the remaining 213 days

of the year. Thus, typical daily emissions were 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 (tons/yr)	× 2,000 lbs/ton	÷	no. days wood burning occurred
	= 461.59	× 2,000	÷ 213	
	= 4,334.2 lbs PM_{10}/day			

Annual and typical daily emissions within the PM_{10} nonattainment area (presented in Table 3.2–13) were 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.

Annual emissions from residential wood combustion in the PM_{10} NAA (tons/yr)	= County annual emissions	× NAA:county residential population ratio	
	= 461.59	× 0.9996	
	= 461.41 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	461.59	429.28	34.69	5.34	4,334.2	4,030.8	325.7	50.1
PM_{10} NAA	461.41	429.11	34.67	5.33	4,332.5	4,029.2	325.6	50.1

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 (US EIA, 2010) using the ratio of county to state households that report fuel oil use from the US Census Bureau (2010c):

Maricopa County residential fuel oil usage (Mgal/yr)	= Arizona residential fuel oil use (Mgal/yr)	× Ratio of county:state households reporting fuel oil use
	= 91	× 573 / 1,881
	= 27.72 Mgal/yr	

Annual and daily emissions were calculated using AP-42 emission factors (shown below in Table 3.2–14) and data on heating degree days and residential housing units described in Section 3.2.6. Annual and daily emissions are shown below 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	0.25	0.10	0.1	0.1	2.3	0.9
PM_{10} NAA	0.4	0.4	18	7.1	0.01	0.01	0.25	0.10	0.1	0.1	2.3	0.9

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 area-source fuel combustion in Maricopa County.

	Annual emissions (tons/yr)					Typical daily emissions (lbs/day)				
Fuel combustion type	**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	30.78	30.78	575.29	2.42	12.70	197.3	197.3	3,687.7	15.5	81.4
Industrial fuel oil	458.79	458.79	6,375.08	609.61	26.25	2,941.0	2,941.0	40,865.9	3,907.8	168.3
Comm./inst. natural gas	66.54	66.54	1,267.11	5.23	4.20	426.5	426.5	8,122.5	33.5	26.9
Comm./inst. fuel oil	224.14	224.14	3,273.40	271.27	8.13	1,436.8	1,436.8	20,983.3	1,738.9	52.1
Residential natural gas	61.75	61.75	763.81	4.88		337.5	337.5	4,173.8	26.6	
Residential wood	461.59	429.28	34.69	5.34		4,334.2	4,030.8	325.7	50.1	
Residential fuel oil	0.01	0.01	0.25	0.10		0.1	0.1	2.3	0.9	
Total:	1,303.61	1,271.30	12,289.62	898.83	51.27	9,673.4	9,370.0	78,161.3	5,773.3	328.7

Table 3.2–16. Annual and typical daily emissions from all area-source fuel combustion for the PM_{10} NAA.

	Annual emissions (tons/yr)					Typical daily emissions (lbs/day)				
Fuel combustion type	**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	30.70	30.70	573.79	2.41	12.66	196.8	196.8	3,678.2	15.5	81.2
Industrial fuel oil	457.60	457.60	6,358.50	608.03	26.19	2,933.3	2,933.3	40,759.6	3,897.6	167.9
Comm./inst. natural gas	66.20	66.20	1,260.65	5.20	4.18	424.4	424.4	8,081.1	33.3	26.8
Comm./inst. fuel oil	223.00	223.00	3,256.70	269.88	8.09	1,429.5	1,429.5	20,876.3	1,730.0	51.8
Residential natural gas	61.73	61.73	763.51	4.87		337.3	337.3	4,172.2	26.6	
Residential wood	461.41	429.11	34.67	5.33		4,332.5	4,029.2	325.6	50.1	
Residential fuel oil	0.01	0.01	0.25	0.10		0.1	0.1	2.3	0.9	
Total:	1,300.65	1,268.35	12,248.07	895.83	51.11	9,653.8	9,350.6	77,895.2	5,754.1	327.6

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 (2010a) 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 2007 employment were used. 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
325	Chemical Manufacturing	3,930
42469	Other Chemical and Allied Products Merchant Wholesalers	1,093
424910	Farm Supplies Merchant Wholesalers	229
33312	Construction Machinery Manufacturing	212
Total:		**5,464**

There were no point sources in this category. Area-source employment estimate were used to "scale up" emissions reported from those facilities surveyed in 2008 as follows:

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

$$= \frac{35.71 \text{ tons of } PM_{10}/\text{yr}}{1{,}041 \text{ employees}} \times 5{,}464 \text{ employees}$$

$$= 187.43 \text{ tons } PM_{10}/\text{yr}$$

Typical daily emissions were 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 industrial employment within the nonattainment area. (See Section 1.5.1 for a discussion of the employment data used.)

$$PM_{10} \text{ emissions from area-source chemical mfg. in the } PM_{10} \text{ NAA (tons/yr)} = \text{Annual Maricopa County emissions (tons/yr)} \times \text{NAA:county ratio of industrial employment}$$

$$= 187.43 \times 0.9974$$

$$= 186.94 \text{ tons } PM_{10}/\text{yr}$$

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.

	Annual emissions (tons/yr)					Typical daily emissions (lbs/day)				
Geographic area	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**NHx**	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**NHx**
Maricopa County	187.43	151.42	0.00	0.34	0.03	1,445.8	1,164.5	0.0	2.6	0.9
PM_{10} NAA	186.94	151.03	0.00	0.34	0.03	1,442.0	1,161.5	0.0	2.6	0.9

3.3.2 Food and kindred products

3.3.2.1 Commercial cooking

Emissions from commercial cooking were estimated for five types of commercial cooking equipment using EPA methodology (US EPA, 2006a). The equipment types include: chain-driven charbroilers, under-fired charbroilers, deep-fat fryers, flat griddles, and clamshell griddles. EPA's methodology estimates commercial cooking activity rates for restaurants with each type of cooking equipment (ethnic, family, fast food, seafood, and steak & barbeque) based on an average number of equipment pieces in each restaurant type, and also the and average quantity of meat cooked on each type of equipment per week (steak, hamburger, poultry, pork, and seafood). The estimates number of restaurants in Maricopa County for the five restaurant types was obtained from a commercial database (www.selectoryonline.com) and is shown in Table 3.3–3.

Table 3.3–3. Number of Maricopa County restaurants, by restaurant type.

Restaurant Type	No. of restaurants
Ethnic food	907
Fast food	1,068
Family	253
Seafood	37
Steak and barbecue	75
All restaurants:	**2,340**

Using EPA's emissions estimation methodology (US EPA, 2006a), commercial cooking activity data were estimated by first multiplying the county number of restaurants that use commercial cooking equipment in each category (ethnic, fast food, family, seafood, and steak and barbeque) by the percentage of restaurants with each type of cooking equipment (Table 3.3–4).

Number of ethnic food restaurants with under-fired charbroilers	=	Number of ethnic food restaurants in Maricopa County	×	% ethnic food restaurants with underfired charbroilers
	=	907	×	47.5%
	=	431		

Table 3.3–4. Percentages of restaurants with each type of cooking equipment.

Restaurant Type	Chain-driven Charbroilers	Underfired Charbroilers	Deep Fat Fryers	Flat Griddles	Clamshell Griddles
Ethnic	3.5%	47.5%	81.9%	62.7%	4.0%
Family	10.1%	60.9%	91.4%	82.9%	1.4%
Fast Food	18.6%	30.8%	96.8%	51.9%	14.7%
Seafood	0.0%	52.6%	100.0%	36.8%	10.5%
Steak and Barbeque	6.9%	55.2%	82.8%	89.7%	0.0%

The resulting product was then multiplied by the average number of equipment pieces by restaurant type (shown in Table 3.3–5) to derive an estimate of the total number of each cooking equipment type in Maricopa County restaurants (Table 3.3–6).

Table 3.3–5. Average number of equipment pieces per restaurant, by type.

Restaurant Type	Chain-driven Charbroilers	Underfired Charbroilers	Deep Fat Fryers	Flat Griddles	Clamshell Griddles
Ethnic	1.62	1.54	1.63	1.88	1.80
Family	1.71	1.29	2.34	2.03	—
Fast Food	1.07	1.58	3.10	1.43	2.09
Seafood	—	1.10	2.47	1.11	1.50
Steak and Barbeque	—	1.63	2.42	1.35	—

Number of underfired charbroilers at ethnic food restaurants	=	number of ethnic food restaurants with underfired charbroilers	×	average number of underfired char-broilers per ethnic food restaurant
	=	431	×	1.54
	=	664		

Table 3.3–6. Total pieces of cooking equipment, by restaurant type.

Restaurant Type	Chain-driven Charbroilers	Underfired Charbroilers	Deep Fat Fryers	Flat Griddles	Clamshell Griddles
Ethnic	51.43	663.47	1,210.82	1,069.14	65.30
Family	43.70	198.76	541.11	425.77	—
Fast Food	212.55	519.73	3204.85	792.64	328.12
Seafood	—	21.41	91.39	15.11	5.83
Steak and Barbeque	—	67.48	150.28	90.82	—
Totals:	**307.68**	**1,470.85**	**5,198.45**	**2,393.47**	**399.25**

The total number of each type of cooking equipment is then multiplied by average pounds of meat cooked on each type of equipment per week (Table 3.3–7) to derive the total estimate of the amount of meat cooked in Maricopa County each week (Table 3.3–8).

Table 3.3–7. Meat cooked weekly per restaurant (in pounds), by equipment type.

Type of Meat	Chain-driven Charbroilers	Underfired Charbroilers	Deep Fat Fryers	Flat Griddles	Clamshell Griddles
Steak	236	180	181	166	94
Hamburger	798	270	274	362	1314
Poultry, with Skin	147	144	365	88	113
Poultry, Skinless	266	179	208	111	108
Pork	57.6	148	58.6	112	118
Seafood	119	143	159	92.1	632
Other	0	41.5	274	57.5	0

Total steak cooked on all under-fired charbroilers (tons/wk)	=	Steak cooked on each under-fired charbroiler (lbs/wk)	× Total number of under-fired charbroilers at all restaurants	÷ 2,000 lbs/ton
	=	180 lbs/ week	× 1,470.85	÷ 2,000
	=	132.38 tons/week		

Table 3.3–8. Total meat cooked weekly (in tons), by equipment type.

Type of Meat	Chain-driven Charbroilers	Underfired Charbroilers	Deep Fat Fryers	Flat Griddles	Clamshell Griddles
Steak	36.31	132.38	470.46	198.66	18.76
Hamburger	122.76	198.56	712.19	433.22	262.31
Poultry, with Skin	22.61	105.90	948.72	105.31	22.56
Poultry, Skinless	40.92	131.64	540.64	132.84	21.56
Pork	8.86	108.84	152.31	134.03	23.56
Seafood	18.31	105.17	413.28	110.22	126.16
Other	0.00	30.52	712.19	68.81	0.00
Totals:	**249.77**	**813.01**	**3,949.78**	**1,183.09**	**474.91**

The total amount of meat cooked in Maricopa County restaurants weekly (Table 3.3–8) was then multiplied by the appropriate emission factor from Table 3.3–9 (US EPA, 2006a). The results were then summed to estimate annual emissions for each type of cooking equipment, shown in Table 3.3–10. Commercial cooking is assumed to occur uniformly throughout both the week (i.e., 7 days/week) and year.

Table 3.3–9. PM_{10} and $PM_{2.5}$ emission factors for commercial cooking equipment, by device type.

	Emission Factor (lb/ton)	
Equipment type	**PM_{10}**	**$PM_{2.5}$**
Chain-driven charbroilers	15.996058	15.506208
Underfired charbroilers	32.666124	31.577929
Deep fat fryers	0.00	0.00
Flat griddle fryers	5.922517	4.501113
Clamshell griddles	1.006137	0.852257

Table 3.3–10. Annual and daily emissions from commercial cooking equipment in Maricopa County.

	Annual Emissions (tons/yr)		Typical Daily Emissions (lbs/day)	
Equipment type	**PM_{10}**	**$PM_{2.5}$**	**PM_{10}**	**$PM_{2.5}$**
Chain-driven charbroilers	103.88	100.70	570.8	553.3
Underfired charbroilers	690.51	667.51	3,794.0	3,667.6
Deep fat fryers	0.00	0.00	0.0	0.0
Flat griddles	182.18	138.46	1,001.0	760.7
Clamshell griddles	12.42	10.52	68.3	57.8
Totals:	**988.99**	**917.18**	**5,434.0**	**5,039.5**

Annual and typical daily emissions for the PM_{10} nonattainment area were calculated by multiplying the county totals by the ratio of total population in the nonattainment area to the total population in the county (100.41%) (See Section 1.5.1 for a discussion of the population data used.) Table 3.3–11 summarizes the annual and typical daily emissions from commercial cooking for the PM_{10} NAA.

Table 3.3–11. Annual and daily PM emissions from commercial cooking equipment in the PM_{10} NAA.

	Annual emissions (tons/yr)		Typical daily emissions (lbs/day)	
Equipment type	**PM_{10}**	**$PM_{2.5}$**	**PM_{10}**	**$PM_{2.5}$**
Chain-driven charbroilers	104.31	101.11	573.1	555.6
Underfired charbroilers	693.34	670.24	3,809.6	3,682.6
Deep fat fryers	0.00	0.00	-	-
Flat griddles	182.93	139.02	1,005.1	763.9
Clamshell griddles	12.47	10.57	68.5	58.1
Totals:	**993.04**	**920.94**	**5,456.3**	**5,060.1**

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.

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. Annual and typical daily emissions for the PM_{10} nonattainment area were derived based on the location data of the individual facilities. Annual and typical daily emissions for both the County and the PM_{10} NAA are shown in Table 3.3–12.

Table 3.3–12. Annual and typical daily emissions from area-source grain handling and processing.

	Annual emissions (tons/yr)		Typical daily emissions (lbs/day)	
Geographic Area	**PM_{10}**	**$PM_{2.5}$**	**PM_{10}**	**$PM_{2.5}$**
Maricopa County	20.59	6.71	149.3	49.5
PM_{10} NAA	16.73	5.68	125.3	43.0

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 2007 County Business Patterns (US Census Bureau, 2010a). Annual emissions were 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
	= 8,128	× 413	÷ 2,000
	= 1,678.43 tons NH_3/yr		

Typical daily emissions were 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)
	= 1,678.43	× 2,000	÷ (52 × 6)
	= 10,759.2 lbs NH_3/day		

Annual and typical daily emissions for the PM_{10} nonattainment area (shown in Table 3.3–13 below) were 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 more detailed discussion of the employment data used).

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
	= 1,678.43	× 0.9974
	= 1,674.07 tons NH_3/yr	

Table 3.3–13. Annual and typical daily ammonia emissions from ammonia cold storage.

Geographic area	Annual emissions (tons/yr)	Typical daily emissions (lbs/day)
Maricopa County	1,678.43	10,759.2
PM_{10} NAA	1,674.07	10,731.2

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. Annual and daily emissions are shown in Table 3.3–14.

Table 3.3–14. Annual and typical daily emissions from secondary metal production.

	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	60.56	52.16	49.73	18.65	0.04	442.7	386.2	358.8	142.7	0.0
PM_{10} NAA	60.56	52.16	49.73	18.65	0.04	442.7	386.2	358.8	142.7	0.0

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 2008, it was assumed that there were no significant unpermitted sources within Maricopa County. 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 were 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 3.3–15 summarizes annual and typical daily emissions from non-metallic mineral processing activities in both Maricopa County and the PM_{10} nonattainment area.

Table 3.3–15. Annual and typical daily emissions from area-source non-metallic mineral products.

	Annual emissions (tons/yr)		Typical daily emissions (lbs/day)	
Geographic area	**PM_{10}**	**$PM_{2.5}$**	**PM_{10}**	**$PM_{2.5}$**
Maricopa County	192.82	95.47	1,337.7	659.3
PM_{10} NAA	187.73	91.92	1,302.8	635.6

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. 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 3.3–16.

Table 3.3–16. Annual and typical daily emissions from area-source mining and quarrying operations.

	Annual emissions (tons/yr)		Typical daily emissions (lbs/day)	
Geographic Area	**PM_{10}**	**$PM_{2.5}$**	**PM_{10}**	**$PM_{2.5}$**
Maricopa County	181.01	55.20	1,239.2	362.6
PM_{10} NAA	156.60	46.81	1,075.7	307.2

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 (2010a) to estimate an annual per-employee emission factor that is then used to estimate emissions from all sources in an industry category.

The most recent employment estimates (for the year 2007) from the US Census Bureau's County Business Patterns (CBP) were used. Table 3.3–17 shows the NAICS codes and employment estimates used to calculate emissions from wood product manufacturing.

Table 3.3–17. County-level employment estimates for wood product manufacturing, by NAICS code.

NAICS Code	NAICS Code Description	2007 employment estimate
321---	Wood products manufacturing	6,917
337---	Furniture and related products manufacturing	7,153
Total:		**14,070**

Since some larger facilities in this category are considered point sources, they have been included in the point source calculations presented earlier in Chapter 2. To avoid double-counting, employment at point sources was subtracted from total employment as follows:

Total area-source employment in wood products	= Total County employment for the sector	– Employment reported from facilities reported as point sources
	= 14,070	– 930
	= 13,140 employees	

Annual emissions for the entire wood product manufacturing sector were calculated by "scaling up" detailed area-source emissions reported from those facilities surveyed in 2008 as follows:

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

$$\text{Area-source } PM_{10} \text{ emissions from wood products} = \frac{102.99 \text{ tons } PM_{10}/\text{yr}}{6{,}229 \text{ employees}} \times 13{,}140 \text{ employees}$$

$$= 217.26 \text{ tons } PM_{10}/\text{yr}$$

Typical daily emissions were calculated in the same method, using surveyed daily emissions estimates from the subset of surveyed area sources. From these County totals, emissions estimates for the PM_{10} nonattainment area were calculated by multiplying the County 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 product manufacturing in the PM_{10} NAA (tons/yr)	= Total County emissions	×	NAA:county ratio for industrial employment
	= 217.26 tons/yr	×	0.9974
	= 216.69 tons PM_{10}/yr		

Table 3.3–18 summarizes annual and typical daily emissions from wood products manufacturing in both Maricopa County and the PM_{10} nonattainment area.

Table 3.3–18. Annual and typical daily emissions from area-source wood product manufacturing.

	Annual emissions (tons/yr)		Typical daily emissions (lbs/day)	
Geographic Area	**PM_{10}**	**$PM_{2.5}$**	**PM_{10}**	**$PM_{2.5}$**
Maricopa County	217.26	203.25	1,668.6	1,548.3
PM_{10} NAA	216.69	202.72	1,664.3	1,544.3

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 (2010a) 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 2007 employment were used. Where CBP employment estimates were presented as a range, the midpoint values were chosen for these calculations. Table 3.3–19 lists the NAICS codes and employment data used to calculate emissions from rubber and plastic manufacturing facilities.

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)
	= 11,380	–	896
	= 10,484 employees		

This area-source employment estimate is used to "scale up" emissions reported from those facilities surveyed in 2008 as follows:

Total area-source PM_{10} emissions from rubber/plastic product mfg.	= $\frac{\text{Emissions from surveyed area sources}}{\text{Employment at surveyed area sources}}$	×	Area-source employment
	= $\frac{30.37 \text{ tons } PM_{10}/\text{yr}}{2{,}256 \text{ employees}}$	×	10,484 employees
	= 140.94 tons PM_{10}/yr		

Table 3.3–19. County-level employment estimates for rubber and plastic manufacturing, by NAICS code.

NAICS Code	NAICS Code Description	2007 employment estimate
32614	Polystyrene Foam Product Manufacturing	351
32619	Other Plastics Product Manufacturing	4,178
32622	Rubber & Plastics Hoses & Belting Manufacturing	60
33992	Sporting & Athletic Goods Manufacturing	1,750
42461	Plastics Materials & Basic Forms & Shapes Merchant Wholesalers	368
325211	Plastics Material & Resin Manufacturing	10
325520	Adhesive Manufacturing	123
325991	Custom Compounding of Purchased Resins	194
326113	Unlaminated Plastics Film & Sheet (except Packaging) Mfg.	60
326122	Plastics Pipe & Pipe Fitting Manufacturing	144
326140	Polystyrene Foam Product Manufacturing	351
326160	Plastics Bottle Manufacturing	175
326199	All Other Plastics Product Manufacturing	175
326212	Tire Retreading	42
326299	All Other Rubber Product Manufacturing	71
327991	Cut Stone & Stone Product Manufacturing	583
332913	Plumbing Fixture Fitting & Trim Manufacturing	10
336612	Boat Building	53
337920	Blind & Shade Manufacturing	286
339113	Surgical Appliance & Supplies Manufacturing	88
339115	Ophthalmic Goods Manufacturing	60
441320	Tire Dealers	2,248

Typical daily emissions were 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 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
	= 140.94 tons PM_{10}/yr	×	0.9974
	= 140.57 tons PM_{10}/yr		

Table 3.3–20 summarizes annual and typical daily emissions from rubber/plastic products manufacturing in both Maricopa County and the PM_{10} nonattainment area.

Table 3.3–20. Annual and typical daily emissions from area-source rubber/plastic product manufacturing.

	Annual emissions (tons/yr)		Typical daily emissions (lbs/day)	
Geographic Area	**PM_{10}**	**$PM_{2.5}$**	**PM_{10}**	**$PM_{2.5}$**
Maricopa County	140.94	105.96	953.3	698.8
PM_{10} NAA	140.57	105.68	950.9	697.0

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 (2010a) 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 2007 employment were used. CBP employment data for NAICS code 332* (fabricated metal products manufacturing) indicated that there were 16,138 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)
	= 16,138	–	4,000
	= 12,138 employees		

Annual emissions were calculated by "scaling up" area-source emissions reported from those facilities surveyed in 2007 as follows:

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

$$\text{Area-source } PM_{10} \text{ emissions from fab. metal products} = \frac{18.07 \text{ tons of } PM_{10}/\text{yr}}{4{,}261 \text{ employees}} \times 12{,}138 \text{ employees}$$

$$= 51.48 \text{ tons } PM_{10}/\text{yr}$$

Typical daily emissions were 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 fabricated metal production in the PM_{10} NAA (tons/yr)	= Annual Maricopa County emissions (tons/yr)	×	NAA:County ratio of industrial employment
	= 51.48 tons/yr	×	0.9974
	= 51.35 tons PM_{10}/yr		

Table 3.3–21 summarizes annual and typical daily emissions from fabricated metal products manufacturing in both Maricopa County and the PM_{10} nonattainment area.

Table 3.3–21. Annual and typical daily emissions from area-source fabricated metal product manufacturing.

	Annual emissions (tons/yr)			Typical daily emissions (lbs/day)		
Geographic Area	**PM_{10}**	**$PM_{2.5}$**	**NH_x**	**PM_{10}**	**$PM_{2.5}$**	**NH_x**
Maricopa County	51.48	42.62	4.50	538.1	460.6	28.9
PM_{10} NAA	51.35	42.51	4.49	536.7	459.4	28.8

3.3.9 Construction

Maricopa County's air quality permits database was used to identify all dust control permits issued during 2008. A total of 4,622 permits were issued, comprising a total of 42,130 acres (Table 3.3–22). Data requested on each dust control permit application includes the project type and acreage. It was assumed there is no unpermitted earthmoving activity.

Table 3.3–22. Maricopa County dust control permits issued in 2008, by type.

Total Acreage, by Project Type	Reported Acres
Residential (single- and multi-family)	20,437.0
Commercial	10,850.0
Road construction	4,449.0
Trenching	3,396.1
Demolition	1,970.6
Weed control	687.0
Site prep / land development	218.9
Temp. storage yard	122.4
Totals:	**42,130.9**

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, both the South Coast Air Quality Management District (SCAQMD) and the Clark County Department of Air Quality and Environmental Management have estimated that a certain percentage of their road construction projects do not involve large-scale earthmoving activities, and thus have developed average emission factors for road construction projects (0.1895 ton PM_{10}/acre-month and 0.265 ton PM_{10}/acre-month, respectively). Since Maricopa County and Clark County have similar population growth rates, climatic conditions, 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 3.3–23.

Table 3.3–23. 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
Example:			
Annual uncontrolled PM_{10} emissions from single-family residential construction	= 15,327.8 acres/yr	× 6 months	× 0.032 tons PM_{10}/acre-month
	= 2,942.93 tons PM_{10}/yr		

As in prior years, a control efficiency of 90% was applied to the uncontrolled emissions calculations. This factor is in line with values applied in a number of earlier SIP documents for Maricopa and Clark Counties, including:

- Revised MAG 1999 Serious Area Particulate Plan for PM_{10} (Appendices volume two, page V-9, and vol. four), Feb. 2000.
- Revised MAG 1999 Serious Area Particulate Plan for PM_{10}, (Appendix C, Exhibit 3: Evaluation for Compliance with 24-Hour PM_{10} Standard for West Chandler and Gilbert Microscale Sites, Arizona Department of Environmental Quality, June 1999, pp. 3-5 and 3-9), Feb. 2000.
- "Evaluation of Fugitive Dust Control in the Maricopa Co. PM_{10} Nonattainment Area", report by ENSR in: Final Plan for Attainment of the 24-hour PM_{10} Standard, ADEQ, May 1997, Appendix B.
- Clark Co. PM_{10} State Implementation Plan, June 2001, pg. L-5. (An 87% emission reduction percentage is assumed for watering at construction activities.)

A recent rule effectiveness study by Maricopa County (contained in Appendix 3) indicated an 89.94% compliance rate with Maricopa County Rule 310 on dust control at construction sites.

Thus, an overall control effectiveness of 80.9% (= 90% × 89.94%) 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 = 2,942.93 tons/yr × [1 – (90% control × 89.94% rule effectiveness)]
= 560.75 tons PM_{10}/yr

$PM_{2.5}$ emissions were estimated to comprise 10% of PM_{10} emissions (WRAP, 2006a). Table 3.3–24 summarizes the calculations for each dust control permit category.

Table 3.3–24. Annual emissions from construction in Maricopa County, by project type.

Project Type	Total acre-months	Emission factor (tons/acre-month)	Uncontrolled PM_{10}	Controlled PM_{10}	Controlled $PM_{2.5}$
Residential: single-family	91,966.5	0.032	2,942.93	560.75	56.07
Residential: multi-unit	61,311.0	0.11	6,744.21	1,285.04	128.50
Commercial	119,349.7	0.19	22,676.44	4,320.77	432.08
Road construction	53,388.0	0.265	14,147.82	2,695.73	269.57
Trenching	3,396.1	0.11	373.57	71.18	7.12
Demolition	1,970.6	0.11	216.76	41.30	4.13
Weed control	687.0	0.11	75.56	14.40	1.44
Site prep/land development	1,750.9	0.11	192.60	36.70	3.67
Temporary storage yard	1,468.7	0.11	161.55	30.78	3.08
Totals:			**47,531.45**	**9,056.64**	**905.66**

Dust control permit site location data were 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 3.3–25 summarizes Maricopa County PM_{10} nonattainment area construction activity and calculations for each project type.

Table 3.3–25. Annual emissions from construction within the Maricopa County portion of the PM_{10} nonattainment area, by project type.

Project Type	Total Acres	Total acre-months	EF (tons/ acre-month)	Uncontrolled PM_{10}	Controlled PM_{10}	Controlled $PM_{2.5}$
Residential: single-family	13,989.0	83,934.0	0.032	2,685.89	511.77	51.18
Residential: multi-unit	4,663.0	55,956.0	0.11	6,155.16	1,172.80	117.28
Commercial	10,125.2	111,376.9	0.19	21,161.61	4,032.13	403.21
Road construction	3,383.9	40,606.8	0.265	10,760.80	2,050.36	205.04
Trenching	1,938.2	1,938.2	0.11	213.20	40.62	4.06
Demolition	1,949.0	1,949.0	0.11	214.39	40.85	4.08
Weed control	638.5	638.5	0.11	70.23	13.38	1.34
Site prep/land development	218.9	1,750.9	0.11	192.60	36.70	3.67
Temporary storage yard	122.4	1,468.7	0.11	161.55	30.78	3.08
Totals:	**37,027.9**			**41,615.42**	**7,929.40**	**792.94**

In addition, the Pinal County Air Quality Department (PCAQD) provided construction emission estimates for the Pinal County portion of the PM_{10} nonattainment. PCAQD estimated that approximately 0.8 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 0.8 percent. The PCAQD estimates (presented in Table 3.3–26 below) incorporated the same assumptions concerning relevant input variables such as the average duration of construction activity, emission factors, control efficiency, and rule effectiveness as Maricopa County's estimates.

Table 3.3–26. Annual emissions from construction in the Pinal County portion of the PM_{10} NAA, by project type.

Project Type	PM_{10}	$PM_{2.5}$
Residential: single-family	7.65	0.77
Residential: multi-family	0.16	0.02
Commercial	25.16	2.52
Road construction	1.42	0.14
Trenching	0.08	0.00
Totals:	**34.47**	**3.45**

To calculate average daily emissions from construction activity, It was assumed that construction activity typically occurs 6 days per week and remains relatively even throughout the year. Thus, typical daily emissions were calculated by dividing annual emissions for each category were divided by 312 (= 6 days/wk × 52 wks/yr) to derive the daily emissions estimates shown in Table 3.3–27.

Table 3.3–27. Annual and typical daily emissions from construction in Maricopa County and the PM_{10} NAA.

	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	1,845.79	184.58	11,832.0	1,183.2	1,692.38	169.24	10,920.3	1,092.0
Commercial	4,320.77	432.08	27,697.2	2,769.7	4,057.29	405.73	25,897.4	2,589.7
Road construction	2,695.73	269.57	17,280.3	1,728.0	2,051.78	205.18	13,156.8	1,315.7
All other*	194.36	19.44	1,245.9	124.6	162.41	16.24	1,043.9	104.4
Total:	**9,056.64**	**905.66**	**58,055.4**	**5,805.5**	**7,963.87**	**796.39**	**51,018.4**	**5,101.8**

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

3.3.10 Electrical equipment manufacturing

Annual and typical daily 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 and all electrical equipment manufacturing permitted sources are reported here as area-sources.

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 3.3–28.

Table 3.3–28. 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	13.94	9.64	20.45	0.18	31.55	76.9	53.2	112.4	1.1	193.7
PM_{10} NAA	13.94	9.64	20.45	0.18	31.55	76.9	53.2	112.4	1.1	193.7

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 2008. 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:	McNeil Brothers - Erie Strayer Portable Plant
Permit type:	Concrete batch plant
Operating schedule:	Operated from 1/1-5/15 in Mesa at SR202 and McKellips (SE Corner); operated from 10/16-12/31 in Goodyear at Northside I-10 east of Estrella.

Total annual emissions: (tons/yr)	PM_{10}	$PM_{2.5}$ *	NO_x	SO_x
	0.923	0.461	8.429	2.306

* PM2.5 was assumed to be 50% of reported PM10 for crushing/screening operations.

Using this information, calculations were made to determine:

Total operating days in 2008: 136 = 31 (Jan.) + 29 (Feb.) + …16 (Oct.) + 30 (Nov.) + 31 (Dec.)
Total operating days in Maricopa County: 136 = 31 (Jan.) + 29 (Feb.) + …16 (Oct.) + 30 (Nov.) + 31 (Dec.)

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

$$\text{Annual } PM_{10} \text{ emissions in Maricopa County} = \text{Total annual emissions (tons/yr)} \times \frac{\text{operating days in Maricopa County}}{\text{total operating days in 2008}}$$

$$= 0.923 \times \frac{136}{136}$$

$$= 0.923 \text{ tons } PM_{10}/\text{yr}$$

Typical daily emissions were then calculated as follows:

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

$$= \frac{0.923 \text{ tons}}{136 \text{ days}} \times \frac{2{,}000 \text{ lbs}}{\text{ton}}$$

$$= 13.6 \text{ lbs } PM_{10}/\text{day}$$

Table 3.3–29 summarizes the annual and typical daily emissions for all ADEQ-permitted portable sources that operated within Maricopa County at some point during 2008. Since precise location data was not available for all permits, all emissions are conservatively assumed to have originated within the PM_{10} nonattainment area; thus emission estimates for Maricopa County and the PM_{10} nonattainment area are equal.

Table 3.3–29. Annual and typical daily 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:	59.00	29.50	282.18	88.93	492.9	246.5	2,275.7	721.7

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) $PM_{2.5}$ 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. Results for each geographic area are shown in Table 3.3–30.

Table 3.3–30. 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	566.30	271.29	3,880.4	1,847.2
PM_{10} NAA	472.36	217.08	3,273.9	1,500.1

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 were calculated based on operating schedule information provided by individual facilities through MCAQD's annual emissions reporting program. Emissions estimates for the PM_{10} nonattainment area were derived using data on the location of the facilities that report other industrial processes. Emissions totals are presented in Table 3.3–31.

Table 3.3–31. 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	144.60	107.24	10.22	21.49	16.79	953.3	726.4	69.6	137.7	94.6
PM_{10} NAA	136.00	99.12	8.12	21.47	14.10	906.0	681.7	55.4	137.6	79.8

3.3.14 Summary of all area-source industrial processes

Tables 3.3–32 and 3.3–33 provide a summary of annual and typical daily emissions from all industrial sources, for Maricopa County and the PM_{10} nonattainment area, respectively.

Table 3.3–32. Annual and 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	187.43	151.42	0.00	0.34	0.03
Commercial cooking	988.99	917.18			
Grain handling/processing	20.59	6.71			
Ammonia cold storage					1,678.43
Secondary metal production	60.56	52.16	49.73	18.65	.004
Non-metallic mineral processes	195.81	97.28			
Mining and quarrying	210.39	59.56			
Wood product manufacturing.	217.26	203.25			
Rubber/plastic product manufacturing	140.94	105.96			
Fabricated metal product manufacturing	51.48	42.62			
Residential construction	2,451.72	245.17			
Commercial construction	5,739.18	573.92			
Road construction	3,580.67	358.07			
Other construction	258.18	25,82			
Electrical equipment manufacturing	13.94	9.64	20.45	0.18	31.55
ADEQ-permitted portable sources	59.00	29.50	282.18	88.93	
Road travel at industrial sites	566.30	271.29			
Industrial processes NEC	144.60	107.24	10.22	21.49	16.79
All industrial processes:	**11,881.57**	**2,953.30**	**362.58**	**129.60**	**1,731.34**

	Typical daily emissions (lbs/day)				
Source category	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**NH_3**
Chemical manufacturing	1,445.8	1,164.5	0.0	2.6	0.6
Commercial cooking	5,434.0	5,039.5			
Grain handling/processing	149.3	49.5			
Ammonia cold storage					10,759.2
Secondary metal production	442.7	386.2	358.8	142.7	0.0
Non-metallic mineral processes	1,357.4	671.7			
Mining and quarrying	1,442.1	390.8			
Wood product manufacturing.	1,668.6	1,548.3			
Rubber/plastic product manufacturing	953.3	698.8			
Fabricated metal product manufacturing	538.1	460.6			28.9
Residential construction	15,716.1	1,571.6			
Commercial construction	36,789.6	3,679.0			
Road construction	22,953.0	2,295.3			
Other construction	1,654.9	165.5			
Electrical equipment manufacturing	76.9	53.2	112.4	1.1	193.7
ADEQ-permitted portable sources	492.9	246.5	2,275.7	721.7	
Road travel at industrial sites	3,880.4	1,847.2			
Industrial processes NEC	953.3	726.4	69.6	137.7	94.6
All industrial processes:	**76,667.6**	**19,048.2**	**2,816.5**	**1,005.8**	**11,077.2**

Table 3.3–33. 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	186.94	151.03	0.00	0.34	0.03
Commercial cooking	993.04	920.94			
Grain handling/processing	16.73	5.68			
Ammonia cold storage					1,674.1
Secondary metal production	60.56	52.16	49.73	18.65	0.04
Non-metallic mineral processes	187.73	91.92			
Mining and quarrying	156.60	46.81			
Wood product manufacturing.	216.69	202.72			
Rubber/plastic product manufacturing	140.57	105.68			
Fabricated metal product manufacturing	51.35	42.51			4.49
Residential construction	1,692.38	169.24			
Commercial construction	4,057.29	405.73			
Road construction	2,051.78	205.18			
Other construction	162.41	16.24			
Electrical equipment manufacturing	13.94	9.64	20.45	0.18	31.55
ADEQ-permitted portable sources	59.00	29.50	282.18	88.93	
Road travel at industrial sites	472.36	217.08			
Industrial processes NEC	136.00	99.12	8.12	21.47	14.10
All industrial processes:	**10,655.39**	**2,771.19**	**360.48**	**129.58**	**1,724.27**

	Typical daily emissions (lbs/day)				
Source category	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**NH_3**
Chemical manufacturing	1,442.0	1,161.5	0.0	2.6	0.9
Commercial cooking	5,456.3	5,060.1			
Grain handling/processing	125.3	43.0			
Ammonia cold storage					10,731.2
Secondary metal production	442.7	386.2	358.8	142.7	0.0
Non-metallic mineral processes	1,302.8	635.6			
Mining and quarrying	1,075.7	307.2			
Wood product manufacturing.	1,664.3	1,544.3			
Rubber/plastic product manufacturing	950.9	697.0			
Fabricated metal product manufacturing	536.7	459.4			28.8
Residential construction	10,920.3	1,092.0			
Commercial construction	25,897.4	2,589.7			
Road construction	13,156.8	1,315.7			
Other construction	1,043.9	104.4			
Electrical equipment manufacturing	76.9	53.2	112.4	1.1	193.7
ADEQ-permitted portable sources	492.9	246.5	2,275.7	721.7	
Road travel at industrial sites	3,273.9	1,500.1			
Industrial processes NEC	906.0	681.7	55.4	137.6	79.8
All industrial processes:	**68,764.6**	**17,877.6**	**2,802.3**	**1,005.7**	**11,034.4**

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 2008.

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 2008. 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	0.06	0.04	5.01	0.01	0.7	0.4	38.9	0.1
PM_{10} NAA	0.06	0.04	5.01	0.01	0.7	0.4	38.9	0.1

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 2008. A total of 55 permits were issued during the year; however, not all permit applications contained the requested information that is needed to calculate emissions. Where data were missing, activity data for each permit category was grown from those permits that contained the necessary information, as follows:

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

Example:

$$\text{Total ditch-bank/fencerows} = 541{,}336 \text{ linear ft (reported)} \times \frac{32 \text{ burn permits issued}}{22 \text{ permits with data}} = 787{,}398 \text{ linear ft}$$

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

Table 3.4–2. Summary of 2008 Maricopa County burn permit activity.

Category	**Unit of measure**	**Total reported activity**	**Number of permits with activity data**	**Total permits issued**	**Estimated total annual activity level**
Ditchbank/fencerow	Linear ft	541,336	22	32	787,398
Land clearance	Acres	564	5	12	1,354
Air curtain	Tons of Material Burned	70*	0	7	70
Tumbleweeds	Piles	14	2	4	28

* Assumed that air curtain destructors burn 10 tons/day of brush/trees/vegetation.

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 (lbs/ton burned)					Fuel loading factor (tons/acre)
	PM_{10}	$PM_{2.5}$	NO_x	SO_x	NH_3	
Weeds, unspecified	15	15	4	N/A	N/A	3.2
Russian Thistle (tumbleweeds)	22	22	4	N/A	N/A	0.1
Orchard crops: Citrus	6	6	4	N/A	N/A	1.0

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:

$$\text{Material burned from ditchbanks and fence rows} = \frac{787{,}398 \text{ ft length}}{43{,}560 \text{ ft}^2/\text{acre}} \times 7 \text{ ft width} \times 3.2 \text{ tons/acre} \times 2 \text{ times/yr}$$

$$= 809.81 \text{ tons/yr}$$

Activity data for the other categories were similarly converted to derive the total mass of 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 multiplied by a factor of 2.87, based on complaints received in 2008 reporting suspected open or illegal outside burning in the County (158 complaints were received in 2008; thus 158 complaints/55 open burn permits = 2.87).

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

$$= 809.81 \text{ tons} \times 15 \text{ lbs/ton} \times 1 \text{ ton} / 2{,}000 \text{ lbs}$$

$$= 6.07 \text{ tons/yr}$$

$$\text{Total annual } PM_{10} \text{ emissions including unpermitted burning} = \text{Calculated emissions from permit data} \times \text{unpermitted burning adjustment factor}$$

$$= 6.07 \text{ tons/yr} \times 2.87$$

$$= 17.43 \text{ tons } PM_{10}/\text{yr}$$

Table 3.4–4 summarizes the 2008 emissions in Maricopa County from each category of open burning activity.

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

		Annual emissions (tons/yr)			Typical daily emissions (lbs/day)		
Category	**Ton-equivalents**	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**PM_{10}**	**$PM_{2.5}$**	**NO_x**
Ditchbank/fencerow	809.8	17.45	17.45	4.65	179.0	179.0	47.7
Land clearance	4,331.5	93.32	93.32	24.89	717.9	717.9	191.4
Air curtain	70.0	0.60	0.60	0.40	4.6	4.6	3.1
Tumbleweeds	2.8	0.09	0.09	0.02	0.7	0.7	0.1
Totals:		**111.46**	**111.46**	**29.96**	**902.2**	**902.2**	**242.4**

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 were derived as follows:

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

$$\text{Typical daily } PM_{10} \text{ emissions from ditchbank/ fence row burning} = \frac{17.45 \text{ tons/yr} \times 2000 \text{ lbs/ton}}{5 \text{ days/wk} \times 39 \text{ wks/yr}}$$

$$= 179.0 \text{ lbs } PM_{10}\text{/day}$$

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

Annual and daily emissions for the nonattainment area were calculated by multiplying the percentage of agricultural and/or vacant land use within the PM_{10} nonattainment area by the County wide emissions estimates, results are shown in Table 3.4–5. (See Section 1.5.1 for a discussion of the land use data used.) Table 3.4–6 summarizes the annual emissions for the PM_{10} nonattainment area.

Table 3.4–5. Surrogate land use classes and NAA:County activity ratios for burn permit categories.

Category	**Surrogate land use categories**	**2008 NAA:county land use ratio**
Ditchbank/fencerow	Agriculture	44.14 %
Land clearance	Vacant	21.22 %
Air curtain	Agriculture and vacant	23.91 %
Tumbleweeds	Agriculture and vacant	23.91 %

Table 3.4–6. Annual and typical daily emissions from open burning in the PM_{10} NAA.

	Annual emissions (tons/yr)			Typical daily emissions (lbs/day)		
Category	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**PM_{10}**	**$PM_{2.5}$**	**NO_x**
Ditchbank/fencerow	7.70	7.70	2.05	79.0	79.0	21.1
Land clearance	19.81	19.81	5.28	152.4	152.4	40.6
Air curtain	0.14	0.14	0.10	1.1	1.1	0.7
Tumbleweeds	0.02	0.02	0.00	0.2	0.2	0.0
Totals:	**27.67**	**27.67**	**7.44**	**232.6**	**232.6**	**62.5**

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; results are shown in Table 3.4–7 below. No landfills were considered point sources; thus all MSW landfills are reported here as an area-source activity.

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	86.21	75.92	24.11	7.57	486.1	425.4	132.9	41.7
PM_{10} NAA	60.25	50.78	19.47	6.22	342.4	286.6	107.4	34.3

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 by dividing annual emissions by 366 days, 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	2008 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	4,279,760	19.0	1,488.07	8,131.5
PM_{10} NAA	4,297,140	19.0	1,494.12	8,164.6

3.4.5 Other industrial waste disposal

Annual area-source emissions from other industrial waste disposal were derived from annual emissions reports from permitted facilities. Other industrial waste disposal processes include a wide array of industrial activities that are often specific to the permitted facility that reported the process. For this reason, it is assumed there are no significant emissions from this category, other than those reported by permitted facilities on their annual emissions reports. Typical daily emissions were calculated based on operating schedule information provided by the facilities in their annual emissions report. Emission estimates are shown in Table 3.4–9 below.

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	32.78	16.93	18.39	50.62	224.1	110.9	101.0	278.1
PM_{10} NAA	32.78	16.93	18.39	50.62	224.1	110.9	101.0	278.1

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 activity, 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	0.06	0.04	5.01	0.01		0.7	0.4	38.9	0.1	
Open burning	111.46	111.46	29.96			902.2	902.2	242.4		
Landfills	86.21	75.92	24.11	7.57		486.1	425.4	132.9	41.7	
POTWs					1,488.07					8,131.5
Other	32.78	16.93	18.39	50.62		224.1	110.9	101.0	278.1	
Total:	**230.52**	**204.35**	**77.47**	**58.20**	**1,488.07**	**1,613.0**	**1,438.8**	**515.3**	**320.0**	**8,131.5**

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	0.06	0.04	5.01	0.01		0.7	0.4	38.9	0.1	
Open burning	27.67	27.67	7.44			232.62	232.62	62.46		
Landfills	60.25	50.78	19.47	6.22		342.4	286.6	107.4	34.3	
POTWs					1,494.12					8,164.6
Other	32.78	16.93	18.39	50.62		224.1	110.9	101.0	278.1	
Total:	**120.77**	**95.42**	**50.30**	**56.85**	**1,494.12**	**799.8**	**630.5**	**309.9**	**312.6**	**8,164.6**

3.5 Miscellaneous area sources

3.5.1 Other combustion

3.5.1.1 Wildfires

Data on wildfires in 2008 within Maricopa County were obtained from the Arizona State Land Department (ASLD) Forestry Division (ASLD, 2009); the Arizona Department of Fire, Building, and Life Safety (DFBLS, 2009); and the Federal Fire Occurrence website (FFOW, 2009).

The ASLD Forestry Division provides for the prevention and suppression of wildfires on state and private lands located outside of incorporated municipalities. The wildfire data provided by ASLD includes wildfires that occur outside of local fire districts and municipalities on State, private, and U.S. Bureau of Land Management (BLM) land in 2008. The ASLD reported 25 wildfires in 2008 in Maricopa County, encompassing a total of nearly 750 acres. Wildfire data provided by ASLD were compared to that data reported in the Geospatial Multi-Agency Coordination Group (GeoMAC) Wildland Fire Support database[1] and 2008 Incident Status Summary reports (ICS-209) to identify wildfires that may have occurred outside of ASLD jurisdiction. GeoMAC and ICS-209 reports only include large wildfires, generally fires greater than 100 acres. Three Maricopa County wildfires were reported in GeoMAC and on ICS-209 reports in 2008 (USDA, 2008a; USGS, 2008). Two of these fires were included in the ASLD data, one

[1] The GeoMAC, is an internet-based mapping application designed for fire managers to access online maps of current fire locations and perimeters in the conterminous 48 States and Alaska. Historical fire data is also housed in the GeoMac database http://www.geomac.gov/.

fire, the Ethan fire, was not captured in the ASLD data because it occurred on tribal lands. The Ethan fire encompassed 6,660 acres.

The DFBLS coordinates reporting to the National Fire Incident Reporting System (NFIRS) for Arizona fire departments. NFIRS is a national reporting system used by fire departments to report fires and other incidents to which they respond and to maintain records of these incidents in a uniform manner. Twenty-one of thirty-six fire departments in Maricopa County reported over 10,000 fires to NFIRS in 2008. This included ten "forest, woods or wildland fires". The ten "forest, woods or wildland fires" were analyzed for inclusion in the wildfire emission estimates. First, the DFBLS fires were culled for duplicates by comparing the incident dates and locations with wildfires reported by ASLD. One DFBLS fire was excluded from combined data-set because it may have been a duplicate already captured in the ASLD data. Because only four of the ten DFBLS fires included acreage, an average number of acres burned per fire (= 1.05 acres) were determined from the fires with reported acreage. This average number of acres burned was then applied to the fires with no reported acreage.

The Federal Fire Occurrence Website is an official government website that provides users with the ability to query, research and download wildland fire occurrence data. The data available through this website contains over 548,000 fire records collected by Federal land management agencies for fires that occurred from 1980 through 2008 in the United States. The 2008 data for Maricopa County included eighty-one fires. The federal wildland fire occurrence data were culled for duplicates by comparing the incident names, dates and locations with wildfires reported by ASLD and DFBLS. Thirteen fires were excluded from the combined dataset as they appeared to be duplicates already captured in either the ASLD or DFBLS data and seven fires contained no acreage data. The final 2008 dataset listed 96 fires encompassing over 7,400 acres. Table 3.5–1 summarizes fire data obtained from each data source.

Table 3.5–1. Sources and input data used to estimate emissions from fires in Maricopa County.

Data Source	Number of Fires in 2008	Total Acreage
Arizona State Land Department (ASLD)	25	747.25
Arizona Department of Fire, Building, and Life Safety (DFBLS)	9	9.45
Federal Fire Occurrence website (FFOW)	61	16.79
ICS-209	1	6,660.00
Total:	**96**	**7,433.49**

Estimates for fuel loading rates were assigned using fuel model codes from the National Fire Danger Rating System (NFDRS) and a table of fuel loading values for NFDRS fuel model categories (WGA/WRAP, 2005). The department used the NFDRS Fuel Model map in ArcGIS to identify NFDRS fuel types for fires with latitude and longitude data.

Table 3.5–2. NFDRS fuel model categories and fuel loading factors for 2008 Maricopa County wildfires.

NFDRS Model Category	2008 Fires	Total Acreage	Fuel Loading Factor (tons/acre)
Agriculture*	33	744.05	4.5
California chaparral	1	0.01	19.5
Barren*	2	0.40	0.5
Pine-grass savanna	1	0.01	4.7
Intermediate brush	17	2.87	15.0
Sagebrush grass	42	6,686.15	4.5
Total	**96**	**7,433.49**	**—**

* "Agriculture" and "barren" NFDRS model descriptions were not included in WGA/WRAP 2002 fuel loading values for NFDRS fuel model categories. Therefore, it was assumed that "Agriculture" is similar to "sagebrush grass" and "Barren" is similar to "western grasses (annual) and fuel loadings were assigned accordingly.

Estimates of the material burned were derived by multiplying the number of acres burned for each category by the applicable fuel loading factor. Table 3.5–3 shows the number of wildfires and acres burned within both Maricopa County and the PM_{10} nonattainment area during 2008, as well as estimates of total material burned.

Table 3.5–3. Summary of data on fire occurrence, total acres burned, and total material burned in 2008.

Geographic Area	No. of Fires	Total Acres Burned	Material Burned (tons)
Maricopa County	96	7,433	33,479
PM_{10} NAA	55	6,699	30,147

The prescribed-fire emission factors listed in Table 3.5–4 were obtained from the Western Regional Air Partnership's (WRAP) 2002 Fire Emission Inventory (WGA/WRAP, 2005).

Table 3.5–4. Summary of emission factors for prescribed fire.

	PM_{10}	$PM_{2.5}$	NO_x	SO_x	NH_3
WRAP Emission Factors for Wildfires and Prescribed Broadcast Burning (lbs/ton)	28.1	24.1	6.2	1.7	1.3

Source: WGA/WRAP, 2005

Annual emissions from wildfires for each geographic area were calculated as follows:

$$\text{Annual } PM_{10} \text{ emissions from wildfires in Maricopa County} = \frac{\text{material burned} \times \text{emission factor (lbs/ton)}}{2{,}000 \text{ lbs/ton}}$$

$$= \frac{33{,}479 \text{ tons of material burned} \times 28.1 \text{ lbs } PM_{10}\text{/ton}}{2{,}000 \text{ lbs/ton}}$$

$$= 470.38 \text{ tons } PM_{10}\text{/yr}$$

The majority of fire data included fire locations in latitude and longitude. For those fires without longitude and latitude, the fire location address was used to determine latitude and longitude. This latitude and longitude data was used to determine the number of acres burned inside of the nonattainment areas. Fifty-five wildfires occurred within the PM_{10} nonattainment area, resulting in nearly 6,700 acres burned. The largest fire within the PM_{10} nonattainment area was the Ethan fire which occurred in July 2008 and resulted in more than 6,600 acres burned.

Annual emissions from wildfires within the nonattainment area were calculated in the same method as Maricopa County annual emissions.

Table 3.5–5. Annual emissions from wildfires in Maricopa County and the PM_{10} NAA.

	Annual emissions (tons/yr)				
Geographic Area	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**NH_3**
Maricopa County	470.39	403.43	103.79	28.46	21.76
PM_{10} NAA	423.56	363.27	93.46	25.62	19.60

Average daily emissions were estimated by dividing annual emissions by the number of burn days in 2008. There were 150 burn days in Maricopa County and 90 burn days in the PM_{10} nonattainment area in 2008; thus:

$$\text{Average daily } PM_{10} \text{ emissions from wildfires in Maricopa County} = \frac{470.39 \text{ tons } PM_{10}/\text{yr} \times 2{,}000 \text{ lbs/ton}}{150 \text{ days/yr}}$$

$$= 6{,}271.8 \text{ lbs } PM_{10}/\text{day}$$

Table 3.5–6. Average daily emissions from wildfires in Maricopa County and the PM_{10} NAA.

	Number of	Average daily emissions (lbs/day)				
Geographic Area	**Burn Days**	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**NH_3**
Maricopa County	150	6,271.8	5,379.0	1,383.8	379.4	290.2
PM_{10} NAA	90	9,412.5	8,072.7	2,076.8	569.4	435.5

3.5.1.2 Prescribed fires

Prescribed fires data were obtained from the U. S. Forest Service (USFS, 2009). The USFS reported that six prescribed fires occurred in Maricopa County in 2008. Twenty-nine acres of piled fuels were burned. Four of six prescribed fires occurred inside the PM_{10} nonattainment area. Because all 2008 prescribed fires were piled fuels, material burned was derived by multiplying the number of acres burned by tons of piles per acre for each fire. The data provided by the USFS, the resulting material burned for each fire, and whether the fire occurred within the nonattainment area are shown below in Table 3.5–7.

Table 3.5–7. Summary of data used to estimate emissions from prescribed fires.

Burn Date	**Burn Number**	**Burn Location**	**Acres Treated**	**Tons of Piles/ Acre**	**Material Burned (tons)**	**Within NAA?**
01/13/2008	TNF0106	T6N,R7E,S28	3	1	3	Yes
03/13/2008	TNF0106P	T6N,R7E,S28	3	3	9	Yes
04/04/2008	TNF0302	T3N,R7E,S34	2	5	10	Yes
04/09/2008	TNF0302	T3N,R8E,S28	5	5	25	No
09/25/2008	TNF0302	T3N,R8E,S31	10	5	50	No
11/06/2008	TNF0302	T2N,R7E,S18	6	5	30	Yes
			29	**24**	**127**	

Prescribed fire emission factors for "piled fuels" were obtained from the Western Regional Air Partnership's (WRAP) 2002 Fire Emission Inventory (WGA/WRAP, 2005). The emission factors are listed below in Table 3.5–8.

Table 3.5–8. Emission factors for prescribed fires.

	Emission factors (lbs/ton burned)				
Type of fire	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**NH_3**
Prescribed fire (piled fuels)	8.0	8.0	6.2	1.7	0.5

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

$$\text{Annual } PM_{10} \text{ emissions from prescribed fires in Maricopa County} = \frac{\text{material burned (tons/acre)} \times \text{emission factor (lbs/ton)}}{2{,}000 \text{ lbs/ton}}$$

$$= \frac{127 \text{ tons/acres} \times 8.0 \text{ lbs/ton}}{2{,}000 \text{ lbs/ton}}$$

$$= 0.508 \text{ tons } PM_{10}\text{/yr}$$

It was assumed that each prescribed fire lasted one day. Thus, daily emissions from prescribed fires were determined by dividing the annual emissions (converted to lbs/yr) by the number of burn days. Because six prescribed fires occurred in Maricopa County in 2008, it was assumed that there were 6 burn days in 2008.

$$\text{Typical daily } PM_{10} \text{ emissions} = \frac{\text{annual } PM_{10} \text{ emissions (lbs) from prescribed fires}}{\text{Number of burn days}}$$

$$= \frac{1{,}016 \text{ lbs } PM_{10}}{6 \text{ burn days}}$$

$$= 169.3 \text{ lbs } PM_{10}\text{/day}$$

Since the prescribed fire data provided by USFS (2009) included burn location, GIS was used to determine the fires that burned inside the nonattainment area. Fifty-two of the one-hundred twenty-seven acres burned were within the nonattainment area. Thus, annual emissions from prescribed fires for the nonattainment area were determined using the formula shown above with the material burned within the nonattainment area. Results are shown in Table 3.5–9 below.

Table 3.5–9. Annual and typical daily emission from prescribed fire in Maricopa County and the PM_{10} NAA.

	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	0.51	0.51	0.39	0.11	0.03	169.3	169.3	131.2	36.0	10.6
PM_{10} NAA	0.21	0.21	0.16	0.04	0.01	104.0	104.0	80.6	22.1	6.5

3.5.1.3 Structure fires

2008 structure fire data were from the Arizona Department of Fire, Building, and Life Safety (DFBLS; DFBLS, 2009). The DFBLS coordinates reporting to the National Fire Incident Reporting System (NFIRS) for Arizona fire departments. The NFIRS is a national reporting system used by fire departments to report fires and other incidents to which they respond and to maintain records of these incidents in a uniform manner. Twenty-one of thirty-six fire departments in Maricopa County reported over 10,000 fires to NFIRS in 2008. This included nearly 2,150 reported structure fires. Because the DFBLS data only included data reported by twenty-one of thirty-six 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 (ADC, 2008). Seven open burn permits were issued in 2008 for fire training; these were included in the total number of estimated structure fires for 2008. It was estimated that 2,422 structure fires occurred in Maricopa County in 2008.

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 the estimated percentage of structural loss and content loss (US EPA, 2001c). The amount (tons) of material burned was estimated as follows:

Material burned in structure fires (tons/yr) = 2,422 fires/yr × 1.15 tons/fire

= 2,785 tons material burned/yr

Table 3.5–10. Material burned, emission and fuel loading factors for structure fires.

Estimated number of structure fires	Fuel loading factor (tons/fire)	Material burned (tons)	Emission factors (lbs/ton)				
			PM_{10}	$PM_{2.5}$*	NO_x	SO_x	NH_3
2,422	1.15	2,785	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 3.5–10 (from US EPA, 2001c), as follows:

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

= 2,785 tons × 10.8 lbs/ton × (1 ton/2,000 lbs)

= 15.04 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} non-attainment area (100.41%), 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

= 15.04 tons/yr × 100.41%

= 15.10 tons PM_{10}/yr

Typical daily emissions for both Maricopa County and the PM_{10} nonattainment area were calculated by dividing annual emissions by 366, as activity is assumed to take place 7 days a week. Typical daily emissions for Maricopa County were derived using the following formula:

$$\text{Typical daily } PM_{10} \text{ emissions from structure fires} = \frac{\text{annual } PM_{10} \text{ emissions (lbs)}}{366 \text{ days/yr}}$$

$$= \frac{30{,}080 \text{ lbs}}{366}$$

$$= 82.2 \text{ lbs/day}$$

Table 3.5–11. Annual and typical daily emissions from structure fires in Maricopa County and the NAA.

Geographic area	Annual emissions (tons/yr)			Typical daily emissions (lbs/day)		
	PM_{10}	$PM_{2.5}$	NO_x	PM_{10}	$PM_{2.5}$	NO_x
Maricopa County	15.04	15.04	1.95	82.2	82.2	10.7
PM_{10} NAA	15.10	15.10	1.96	82.5	82.5	10.7

3.5.1.4 Vehicle fires

2008 vehicle fire data were from the Arizona Department of Fire, Building, and Life Safety (DFBLS) (DFBLS, 2009). The DFBLS coordinates reporting to the National Fire Incident Reporting System (NFIRS) for Arizona fire department. NFIRS is a national reporting system used by fire departments to report fires and other incidents to which they respond and to maintain records of these incidents in a uniform manner. Twenty-one of thirty-six fire departments in Maricopa County reported over 10,000 fires to NFIRS in 2008. This included over 2,100 reported vehicle fires. Because the DFBLS data only included data reported by twenty-one of thirty-six 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 (ADC, 2008). It was estimated that 2,403 vehicle fires occurred in Maricopa County in 2008.

Annual emissions from vehicle fires were 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 3.5–12 (US EPA, 1992).

Annual PM_{10} emissions from vehicle fires	= annual number of vehicle fires	× fuel loading factor	× emission factor	× unit conversion factor
	= 2,403	× 0.25 tons/vehicle	× 100 lbs/ton	× (1 ton / 2,000 lbs)
	= 30.04 tons PM_{10}/yr			

Table 3.5–12. Estimated material burned, fuel loading factors, and emission factors for vehicle fires.

Vehicle fires reported	Fuel loading factor (tons/fire)	Material burned (tons)	Emission factors (lbs/ton)				
			PM_{10}	$PM_{2.5}$*	NO_x	SO_x	NH_3
2,403	0.25	600.75	100	100	4	n/a	n/a

* All PM10 is assumed to be PM2.5.

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} non-attainment area (100.41%). 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
	= 30.04 tons/yr	× 100.41%
	= 30.16 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 366 days/year. The results are shown in Table 3.5–13 below.

Table 3.5–13. 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	30.04	30.04	1.20	164.1	164.1	6.6
PM_{10} NAA	30.16	30.16	1.21	164.8	164.8	6.6

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 3.5–14.

Table 3.5–14. 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	0.18	0.17	6.74	2.49	1.3	1.2	50.5	19.0
PM_{10} NAA	0.18	0.17	6.74	2.49	1.3	1.2	50.5	19.0

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 majority of planted acres were obtained from the 2008 Arizona Agricultural Statistics Bulletin (AASS, 2009). Planted acres for potatoes and sorghum for grain were obtained from the USDA National Agricultural Statistics Service for 2008 (USDA, 2008b) and vegetables and citrus acreage were obtained from the 2007 Census of Agriculture (USDA, 2007a). 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 (%) = 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):

$$Tillage_{Crop} = EF \times AP_{Crop} \times A_{Crop}$$

where:

$Tillage_{Crop}$ = Annual PM_{10} emissions from tilling each crop type (lbs)
EF = Tillage emission factor (lbs PM_{10}/acre-pass)
AP_{Crop} = Number of tillage passes per crop (passes)
A_{Crop} = Total number of tilled acres for each crop type (acres)

For example, annual PM_{10} emissions from cotton tilling were calculated using:

EF = 6.10 lbs PM_{10}/acre-pass
AP_{cotton} = 8.8 tillage passes for a cotton crop
AP_{cotton} = 19,300 acres cotton

Thus:

$$Tillage_{cotton} = 6.10 \times 8.8 \times 19{,}300$$
$$= 1{,}036{,}024 \text{ lbs/yr}$$
$$= 518.01 \text{ tons/yr}$$

Table 3.5–15 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 3.5–15. 2008 crop acreage, activity, and annual uncontrolled PM_{10} emissions in Maricopa County.

Crop	Acres Planted	No. of land preparation operations/yr	Acre-passes	Annual uncontrolled PM_{10} emissions (tons/yr)
Cotton	19,300	8.8	169,978	518.43
Corn	11,500	7.3	84,180	256.75
Wheat	30,500	3.1	93,488	285.14
Barley	10,100	2.1	20,856	63.61
Alfalfa (stand establishment)[1]	21,875	5.1	110,469	336.93
Potatoes	1,400	10.6	14,805	45.16
Sorghum for grain	16,500	3.1	50,575	154.25
Vegetables[2]	16,072	14.0	224,888	685.91
Citrus[3]	425	5.0	2,124	6.48
Totals:	**127,672**			**2,352.66**

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. Including melons, not including potatoes.
3. 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 November 2007, the agricultural PM_{10} general permit (Arizona Administrative Code R18-2-610 and R18-2-611) was expanded to apply to commercial farming practices within the Maricopa County portion of Area A. Previously this rule only applied to the Maricopa County PM_{10} NAA. The agricultural PM_{10} general permit revisions also resulted in the requirement for commercial farmers to implement six agricultural best management practices (BMP) (up from 3 BMPs) to control PM_{10} emissions generated from tillage and harvest, non-cropland, and cropland. Because no data is available on the additional BMPs being implemented, MCAQD used the net control efficiencies from the implementation of agricultural BMPs developed by

URS and ERG (2001) in the *Technical Support Document for Quantification of Agricultural BMPs*. URS and ERG quantified three BMPs for tillage: 1) combining tractor operations, 2) limited activity during high-wind events, and 3) multi-year crops. URS and ERG (2001) derived net control efficiencies by multiplying 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 55% (from 80%). The revised compliance factor was derived based on 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). To estimate controlled tillage emissions from agricultural operations taking place within the Maricopa County portion of Area A, the mid-point net control efficiency for each BMP were applied to 63.09% (the percent of agricultural land in the Maricopa County portion of Area A) of the uncontrolled annual emissions (MAG, 2009) as follows:

Controlled annual $\text{tillage}_{\text{Crop}}$ emissions	=	Annual uncontrolled PM_{10} emissions	×	(100% – mid-point net control $\text{efficiency}_{\text{crop}}$)	×	% agricultural land in the Area A
Controlled annual $\text{tillage}_{\text{Cotton}}$ emissions	=	518.01 tons PM_{10}/yr	×	(100% – 22.8%)	×	63.09%
	=	252.30 tons PM_{10}/yr				

The uncontrolled portion of tillage emissions from agricultural operations taking place outside Area A but within Maricopa County were estimated by multiplying the uncontrolled annual PM_{10} emissions by the percentage of agricultural land located within Maricopa County but outside of Area A (100% – 63.09%) as follows:

Uncontrolled annual $\text{tillage}_{\text{Crop}}$ emissions	=	Uncontrolled annual PM_{10} emissions	×	36.91%
	=	518.01 tons PM_{10}/yr	×	36.91%
	=	191.20 tons PM_{10}/yr		

Controlled and uncontrolled emissions were then summed to estimate total annual PM_{10} emissions from agricultural tillage in Maricopa County. Annual $PM_{2.5}$ emissions from agricultural tillage were calculated by multiplying the annual PM_{10} emissions by a conversion factor of 0.15 (WRAP, 2006b). Annual PM_{10} and $PM_{2.5}$ emissions from agricultural tillage in Maricopa County and Area A are shown in Table 3.5–16.

Table 3.5–16. Annual emissions from agricultural tillage in Maricopa County and Area A (tons/yr).

Crop	Net control efficiency (%)	Area A (controlled)		Outside Area A (uncontrolled)	Maricopa Co. (Area A + outside Area A)	
		PM_{10}	$PM_{2.5}$	PM_{10}	PM_{10}	$PM_{2.5}$
Cotton	22.8%	252.36	37.85	191.35	443.72	66.56
Corn	22.8%	124.98	18.75	94.77	219.75	32.96
Wheat	22.8%	138.80	20.82	105.24	244.04	36.61
Barley	22.8%	30.96	4.64	23.48	54.44	8.17
Alfalfa (stand establishment)	13.8%	183.23	27.49	124.36	307.60	46.14
Potatoes	16.8%	21.98	3.30	16.67	38.65	5.80
Sorghum for grain	22.8%	75.09	11.26	56.94	132.02	19.80
Vegetables	16.8%	359.82	53.97	253.17	612.99	91.95
Citrus	16.8%	3.40	0.51	2.39	5.79	0.87
Totals:		**1,190.63**	**178.59**	**868.37**	**2,059.00**	**308.85**

*Includes melons, excludes potatoes.

Annual PM_{10} emissions from agricultural tillage in the PM_{10} NAA were calculated in the same manner as the annual PM_{10} emissions for the Maricopa County portion of Area A; the only difference being the percent of agricultural land located within the Maricopa County PM_{10} NAA is 44.14% (rather than 63.09% for Area A). Results are shown in Table 3.5–17.

Table 3.5–17. Annual emissions from agricultural tillage in the PM_{10} NAA (tons/yr).

Crop	Net Control Efficiency (%)	Fraction of Ag Land in PM_{10} NAA	PM_{10} NAA annual emissions	
			PM_{10}	$PM_{2.5}$
Cotton	22.8%	44.14%	176.56	26.48
Corn	22.8%	44.14%	87.44	13.12
Wheat	22.8%	44.14%	97.11	14.57
Barley	22.8%	44.14%	21.66	3.25
Alfalfa (stand establishment)	13.8%	44.14%	128.20	19.23
Potatoes	16.8%	44.14%	16.57	2.49
Sorghum for grain	22.8%	44.14%	52.53	7.88
Vegetables	16.8%	44.14%	251.75	37.76
Citrus	16.8%	44.14%	2.38	0.36
Totals:			**834.20**	**125.13**

Typical daily emissions for Maricopa County, Area A, and the PM_{10} NAA were calculated by dividing the annual 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 3.5–18. 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 3.5–18. Controlled typical daily emissions from tillage (in lbs/day).

Crop	Tillage operations[1] (months/yr)	Tillage operations (days/yr)	Maricopa County		Area A		PM_{10} NAA	
			PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$
Cotton	12	364	2,438.0	365.7	1,386.6	208.0	970.1	145.5
Corn	5	152	2,897.8	434.7	1,648.1	247.2	1,153.1	173.0
Wheat	8	243	2,011.3	301.7	1,143.9	171.6	800.3	120.1
Barley	8	243	448.7	67.3	255.2	38.3	178.6	26.8
Alfalfa (stand establishment)	3	91	6,760.3	1,014.1	4,027.1	604.1	2,817.5	422.6
Potatoes	6	182	424.7	63.7	241.6	36.2	182.1	27.3
Sorghum for grain	8	243	1,088.1	163.2	618.9	92.8	433.0	64.9
Vegetables	6	182	6,736.2	1,010.4	3,954.1	593.1	2,766.4	415.0
Citrus	3	91	127.2	19.1	37.3	5.6	26.1	3.9
Totals:			**22,932.4**	**3,439.9**	**13,312.8**	**1,996.9**	**9,327.3**	**1,399.1**

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

3.5.2.2 Harvesting

Harvest emissions were estimated using crop-specific emission factors (CARB, 2003). The majority of harvest acres were obtained from the 2008 Arizona Agricultural Statistics Bulletin (AASS, 2009). Harvest acres for potatoes were obtained from the USDA National Agricultural Statistics Service for 2008 (USDA, 2008b) and vegetables and citrus were obtained from the 2007 Census of Agriculture (USDA, 2007a). Table 3.5–19 lists the crop types, acres harvested and associated PM_{10} emission factors used to calculate emissions from agricultural harvesting.

Table 3.5–19. Maricopa County harvested acres and emission factors.

Crop	PM_{10} emission factor (lb/acre-yr)	2008 Acreage
Cotton	3.4	18,800
Wheat	5.8	30,100
Barley	5.8	9,900
Alfalfa Hay	0.0	83,000
Other Hay	1.68	4,500
Corn	1.68	700
Sorghum for Grain**	5.8	2,200
Potatoes	2.7	1,400
Vegetables*	0.08	16,072
Citrus	0.08	2,124
Total		**168,796**

*Includes melons, exclude potatoes.
** Assumed same emission factor, control efficiency, and number of harvest days per year as wheat and barley.

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

Uncontrolled annual harvest$_{Crop}$ emissions $= EF_{crop} \times A_{Crop} \times$ ton / 2,000 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} = number of harvested acres for each crop type per year

Example:
EF_{Cotton} = 3.4 lbs PM_{10}/acre for cotton

A_{Cotton} = 18,800 acres of cotton

Uncontrolled annual Harvest$_{Cotton}$ Emissions = 3.4 lbs PM_{10}/acre ×18,800 acres × 1 ton/2,000 lbs
= 31.96 tons PM_{10}/yr

In November 2007, the agricultural PM_{10} general permit program (Arizona Administrative Code R18-2-610 and 611) was expanded to apply to commercial farming practices within the Maricopa County portion of Area A. (Previously this requirement had only applied to the Maricopa County PM_{10} NAA.) The agricultural PM_{10} general permit revisions also resulted in the requirement for commercial farmers to implement six agricultural best management practices (BMP) (up from 3 BMPs) to control PM_{10} emissions generated from tillage and harvest, non-cropland, and cropland. Because no data is available on the additional BMPs being implemented, MCAQD used the net control efficiencies from the implementation of agricultural BMPs developed by URS and ERG (2001) in the *Technical Support Document for Quantification of Agricultural BMPs*. URS and ERG quantified two BMPs for harvesting: 1) combining tractor operations, and 2) reduced harvest activity. URS and ERG (2001) derived net control efficiencies by multiplying 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 55% (from 80%). The revised compliance factor was derived based on 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). To estimate controlled harvest emissions from agricultural operations taking place within the Maricopa County portion of Area A, the mid-point net control efficiency for each BMP were applied to 63.09% of the uncontrolled annual emissions (the percent of agricultural land in the Maricopa County portion of Area A) (MAG, 2009) as follows:

Controlled annual harvest$_{Crop}$ emissions	=	annual uncontrolled PM_{10} emissions	× (100% – mid-point net control efficiency$_{crop}$)	×	% agricultural land in the Maricopa Co. portion of Area A
Controlled annual harvest$_{Cotton}$ emissions from within the Maricopa Co. portion of Area A	=	31.96 tons PM_{10}/yr	×(100% – 25.6%)	×	63.09%
	=	15.01 tons PM_{10}/yr			

The uncontrolled portion of harvest emissions from agricultural operations outside the Maricopa County portion of Area A 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 Area A (100% – 63.09%) as follows:

Uncontrolled annual Harvest$_{Cotton}$ emission from outside the Maricopa Co. portion of Area A	=	Uncontrolled PM_{10} emissions	×	36.91%
	=	31.96 tons PM_{10}/yr	×	36.91%
	=	11.80 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 Area A	+	Controlled annual $harvest_{Cotton}$ emissions from within the Maricopa Co. portion of Area A
	=	11.80	+	15.01
	=	26.81 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). Annual PM_{10} and $PM_{2.5}$ emissions from harvesting in Maricopa Co. and Area A are shown in Table 3.5–20.

Table 3.5–20. Annual emissions from harvesting in Maricopa County and Area A (in tons/yr).

Crop	Net control efficiency	Maricopa Co. Uncontrolled	Area A (controlled)		Outside Area A (uncontrolled)	Maricopa Co. (Area A + outside Area A)	
	(%)	PM_{10}	PM_{10}	$PM_{2.5}$	PM_{10}	PM_{10}	$PM_{2.5}$
Cotton	25.5%	31.96	15.02	2.25	11.80	26.81	4.02
Wheat	23.5%	87.29	42.15	6.32	32.22	74.37	11.16
Barley	23.5%	28.71	13.86	2.08	10.60	24.46	3.67
Alfalfa Hay	27.6%	0.00	0.00	0.00	0.00	0.00	0.00
Other Hay	27.6%	3.78	1.73	0.26	1.40	3.12	0.47
Corn	23.5%	0.59	0.28	0.04	0.22	0.50	0.08
Sorghum for Grain**	23.5%	6.38	3.08	0.46	2.35	5.44	0.82
Potatoes	23.5%	1.89	0.91	0.14	0.70	1.61	0.24
Vegetables*	23.5%	0.64	0.31	0.05	0.24	0.55	0.08
Citrus	23.5%	0.08	0.04	0.01	0.03	0.07	0.01
Total		161.33	77.39	11.61	59.54	136.93	20.54

*Includes melons, excludes potatoes.
** Assumed same emission factor, control efficiency, and number of harvest days per year as wheat and barley.

Annual PM_{10} emissions from agricultural harvesting in the PM_{10} NAA were calculated in the same manner as the annual PM_{10} emissions for the Maricopa County portion of Area A. The only difference being the percent of agricultural land located within the Maricopa County PM_{10} NAA is 44.14% (rather than 63.09% for Area A). Results are shown in Table 3.5–21.

Table 3.5–21. Annual emissions from harvesting in the PM_{10} NAA (tons/yr).

Crop	Net control efficiency	Fraction of Ag land in	PM_{10} NAA (controlled)	
	(%)	PM_{10} NAA	PM_{10}	$PM_{2.5}$
Cotton	25.5%	44.1%	10.51	1.58
Wheat	23.5%	44.1%	29.49	4.42
Barley	23.5%	44.1%	9.70	1.45
Alfalfa Hay	27.6%	44.1%	0.00	0.00
Other Hay	27.6%	44.1%	1.21	0.18
Corn	23.5%	44.1%	0.20	0.03
Sorghum for Grain**	23.5%	44.1%	2.16	0.32
Potatoes	23.5%	44.1%	0.64	0.10
Vegetables*	23.5%	44.1%	0.22	0.03
Citrus	23.5%	44.1%	0.03	0.00
Total			54.14	8.12

*Includes melons, excludes potatoes.
** Assumed same emission factor, control efficiency, and number of harvest days per year as wheat and barley.

Typical daily emissions for Maricopa County, Area A, and the PM_{10} NAA were calculated by dividing the annual emissions by the number of harvest days per year and multiplying the result by 2000 lbs/ton (URS and ERG, 2001). Because acres harvested were not reported for individual vegetables and citrus fruit, an average number of harvest days per year were used for vegetables and citrus (116 and 188 harvest days per year, respectively). Results are shown in Table 3.5–22.

Table 3.5–22. Typical daily emissions from harvesting, by crop (in lbs/day).

Crop	Harvest days/yr	Maricopa County		Area A		PM_{10} NAA	
		PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$
Cotton	143	375.0	56.2	210.0	31.5	146.9	22.0
Wheat	60	2,479.0	371.8	1,405.1	210.8	983.0	147.5
Barley	60	815.3	122.3	462.2	69.3	323.3	48.5
Alfalfa Hay	294	0.0	0.0	0.0	0.0	0.0	0.0
Other Hay	294	21.2	3.2	11.7	1.8	8.2	1.2
Corn	91	11.0	1.7	6.2	0.9	4.4	0.7
Sorghum for Grain**	60	181.2	27.2	102.7	15.4	71.8	10.8
Potatoes	70	46.0	6.9	26.1	3.9	18.2	2.7
Vegetables*	116	9.4	1.4	5.3	0.8	3.7	0.6
Citrus	188	0.8	0.1	0.4	0.1	0.3	0.0
Total		3,938.9	590.8	2,229.9	334.5	1,560.0	234.0

*Includes melons, excludes potatoes.
** Assumed same emission factor, control efficiency, and number of harvest days per year as wheat and barley.

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} = unpaved road EF × VMT/1000 acres × 2008 harvested acres

emissions from ag roads = 1.444 lbs/VMT ×49.5 VMT/1000 acres × 168,796 acres
= 12,065 lbs/day

In November 2007, the agricultural PM_{10} general permit (Arizona Administrative Codes R18-2-610 and 611) was expanded to apply to commercial farming practices within the Maricopa County portion of Area A. Previously this rule only applied to the Maricopa County PM_{10} NAA. The agricultural PM_{10} general permit revisions also resulted in the requirement for commercial farmers to implement six agricultural best management practices (BMP) (up from 3 BMPs) to control PM_{10} emissions generated from tillage and harvest, non-cropland, and cropland. Because no data is available on the additional BMPs being implemented, MCAQD used the net control efficiencies from the implementation of agricultural BMPs 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. A 2001 study (URS and ERG, 2001) estimated net control efficiencies by multiplying a midpoint 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 55% (from 80%). The revised compliance factor was derived based on 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).

To estimate controlled daily emissions from travel on unpaved agricultural roads within Area A, the mid-point net control efficiency for each BMP (0.4% and 11.6 %, respectively) were applied to 63.09 % (the percent of agricultural land in Area A) of the uncontrolled daily PM_{10} emissions as follows:

Controlled daily unpaved ag road emissions within Area A	= Daily uncontrolled PM_{10} emissions	×	(100%-mid-point net control efficiency)	×	% agricultural land in Area A
	= 12,065 lbs/day	×	(100% – 12.0%)	×	63.09%
	= 6,698.4 lbs/day				

The uncontrolled portion of unpaved agricultural road daily emissions outside the Maricopa County portion of Area A 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 Area A (100% – 63.09%) as follows:

Uncontrolled daily unpaved ag road emissions from outside of Area A	= Uncontrolled PM_{10} emissions × (100% - 63.09%)
	= 12,065 lbs/day × 36.91%
	= 4,453 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 Area A	+	Controlled daily unpaved ag road emissions from within Area A
	= 4,453	+	6,698

= 11,151 lbs PM_{10}/day

Daily PM_{10} emissions from unpaved agricultural roads in the PM_{10} NAA were calculated in the same manner as the daily PM_{10} emissions for the Maricopa County portion of Area A. The only difference being the percent of agricultural land located within the Maricopa County PM_{10} NAA is 44.14% (rather than 63.09% for Area A). Results are shown in Table 3.5–21.

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

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

Annual and daily PM_{10} and $PM_{2.5}$ emissions from unpaved agricultural roads are shown in Table 3.5–23.

Table 3.5–23. 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 (Area A + outside Area A)	1,739.52	173.95	11,150.8	1,115.1
Area A (controlled)	1,044.92	104.49	6,698.2	669.8
PM_{10} NAA (controlled)	731.03	73.10	4,686.1	468.6

3.5.2.4 Cotton ginning

Annual emissions from cotton ginning were derived from annual emission reports from all permitted cotton gins in the county. Typical daily emissions were 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.

Table 3.5–24 summarizes annual and typical daily emissions from cotton gins in both Maricopa County and the PM_{10} nonattainment area.

Table 3.5–24. Annual and typical daily emissions from area-source cotton ginning.

	Annual emissions (tons/yr)		Typical daily emissions (lbs/day)	
Geographic area	**PM_{10}**	**$PM_{2.5}$**	**PM_{10}**	**$PM_{2.5}$**
Maricopa County	17.90	5.11	103.8	29.7
PM_{10} NAA	4.86	1.39	26.7	7.6

3.5.2.5 Fertilizer application

Annual NH_3 emissions from synthetic nitrogen fertilizers for 2008 were obtained from the US EPA 2008 National Emissions Inventory (US EPA, 2010).

In 2005, MCAQD used the CMU Ammonia Model v.3.6 to calculate NH_3 emissions from synthetic nitrogen fertilizers (MCAQD, 2007). The CMU Ammonia Model used semiannual sales data for 2002 from the Association of American Plant Food Control Officials and crop calendar information from National Agricultural Statistics Service (NASS) to estimate monthly

fertilizer application rates for each county. The activity data in the CMU Ammonia Model v.3.6 has not been updated and therefore, MCAQD was unable to use the model to calculated 2008 NH_3 emissions. EPA, however, obtained county-level fertilizer consumption data for 2002 and 2007 from the Fertilizer Institute's Commercial Fertilizer 2002 and 2007 reports and calculated the percent change in county-level fertilizer quantities applied between 2002 and 2007. EPA used the percent change in applied fertilizer quantity to grow the fertilizer activity files provided with the CMU Ammonia Model v.3.6. EPA then ran the CMU Ammonia Model with the updated county-level fertilizer quantities to calculate NH_3 emissions. Typical daily NH_3 emissions were derived by dividing annual emissions by 366 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 (44.1%). See Section 1.5.2 for a discussion of the land use data used. Annual and typical daily NH_3 emissions from fertilizer application are shown in Table 3.5–25.

Table 3.5–25. Annnual and typical daily NH_3 emissions from fertilizer application.

	Maricopa County		PM_{10} NAA	
Fertilizer Category	**Annual Emissions (tons/year)**	**Daily NH_3 Emissions (lbs/day)**	**Annual NH_3 Emissions (tons/year)**	**Daily NH_3 Emissions (lbs/day)**
Anhydrous ammonia	70.64	386.0	31.18	170.4
Aqueous ammonia	3.75	20.5	1.65	9.0
Ammonium nitrate	0.00	0.0	0.00	0.0
Ammonium sulfate	74.40	406.5	32.84	179.5
Ammonium thiosulfate	0.00	0.0	0.00	0.0
N-P-K (multi-grade nutrient fertilizers)	0.00	0.0	0.00	0.0
Calcium ammonium nitrate	0.00	0.0	0.00	0.0
Nitrogen solutions	1,397.66	7637.5	616.93	3371.2
Urea	496.42	2712.7	219.12	1197.4
Diammonium phosphate	2.66	14.6	1.18	6.4
Monoammonium phosphate	71.77	392.2	31.68	173.1
Liquid ammonium polyphosphate	38.94	212.8	17.19	93.9
Potassium nitrate	0.95	5.2	0.42	2.3
Miscellaneous	119.24	651.6	52.63	287.6
Total	2,276.43	12,439.5	1,004.82	5,490.8

3.5.3 Livestock

PM_{10} and $PM_{2.5}$ emissions estimates were derived using Maricopa County cattle inventory estimates for 2008 from Arizona Agricultural Statistics Bulletin (AASS, 2009) 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, 2009) for 2005 through 2008; therefore, 2004 numbers were used. Beef cows were excluded from the inventory as information provided by Arizona Agricultural Statistics staff (Koong, 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 on dairies and ranches) were included in the PM_{10} and $PM_{2.5}$ emission estimates for livestock.

The 2008 Maricopa County cattle inventory and applicable PM emission factors are contained in Table 3.5–26.

Table 3.5–26. Maricopa County cattle populations and PM emission factors.

Animal type	No. of Head	PM_{10} Emission Factor (lb/1000 head/day)	$PM_{2.5}$:PM_{10} Ratio
Cattle on feed	5,000	28.9	0.11
Milk cows	100,000	6.7	0.11
Other cattle	58,000	28.9	0.11
Total:	**170,000**		

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)
= 100 × 6.7
= 670.0 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 by 366 days/year.

NH_3 emissions from livestock in Maricopa County were estimated by growing the 2005 NH_3 emissions by the percentage change in Maricopa County cattle and calve numbers from 2002 to 2008 (AASS, 2003; AASS, 2009)[2]. The cattle and calf populations declined 8.11% from 2002 to 2008; as shown in Table 3.5–27 below. The estimated 2005 and 2008 NH_3 emissions from livestock emissions are shown in Table 3.5–28.

Table 3.5–27. Maricopa County cattle inventory for 2002 and 2008.

	Maricopa Co.		Percentage
	2002	**2008**	**Change**
All cattle & calves	185,000	170,000	-8.1%

Table 3.5–28. Annual and typical daily NH_3 emissions from livestock in Maricopa County.

	Annual emissions (tons/year)	Typical daily emissions (lbs/day)
2005 Emissions	10,429.53	57,148.1
% Change in cattle and calves, 2002 to 2008	–8.11%	-8.11%
2008 Emissions	**9,583.89**	**52,514.5**

MCAQD determined through GIS analysis of confined animal feeding operation (CAFO) locations and animal numbers in Maricopa County that 57.3% 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 57.3%.

Table 3.5–29 summarizes the annual and typical daily emissions from livestock for Maricopa County and the PM_{10} nonattainment area.

[2] The 2005 NH_3 emissions were calculated using the CMU Ammonia Model (CMU, 2004). The activity levels in the CMU model are based on the 2002 Census of Agriculture; therefore, emissions were grown using the percentage change in cattle and calve numbers from 2002 to 2008.

Table 3.5–29. Annual and typical daily emissions from livestock.

	Annual emissions (tons/yr)			Typical daily emissions (lbs/day)		
Geographic area	**PM_{10}**	**$PM_{2.5}$**	**NH_3**	**PM_{10}**	**$PM_{2.5}$**	**NH_3**
Maricopa County	455.80	50.14	9,583.89	2,490.7	274.0	52,514.5
PM_{10} NAA	260.95	28.70	5,486.90	1,426.0	156.9	30,065.2

3.5.4 Health services: crematories

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

Table 3.5–30 summarizes annual and typical daily emissions from crematories in both Maricopa County and the PM_{10} nonattainment area.

Table 3.5–30. 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	0.93	0.62	12.39	1.58	7.0	4.7	93.1	11.9
PM_{10} NAA	0.93	0.62	12.36	1.58	7.0	4.6	92.6	11.8

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 0.01 tons of PM_{10} and 0.06 tons of NO_x for the year 2008. To be conservative, $PM_{2.5}$ amounts are assumed to be equal to PM_{10} amounts. (No accidental releases of SO_x or NH_3 were reported).

Typical daily emissions were calculated by summing reported releases and dividing the total by 366 days. Emissions in the PM_{10} nonattainment area were calculated based on locations of facilities that reported releases. The resulting estimates are shown in Table 3-5–31 below.

Table 3.5–31. Annual and typical daily emissions from accidental releases.

	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	0.01	0.01	0.06	0.1	0.1	0.3
PM_{10} NAA	0.01	0.01	0.06	0.1	0.1	0.3

* As a conservative estimate, all PM10 emissions are assumed to be PM2.5.

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 366. The resulting estimates are shown in Table 3-5–32.

Table 3.5–32. 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	4,279,760	0.55	1,176.93	6,431.3
PM_{10} NAA	4,297,140	0.55	1,181.71	6,457.5

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 section of this report (Chapter 4). Fugitive dust emission estimates are developed with the use of three sources: EPA's NONROAD model, California Air Resources Board report to legislature on leaf blowers (CARB, 2000), and a recent research effort done by the University of Riverside (Fitz et al., 2005).

EPA's 2008NONROAD model was used to estimate the number of gasoline-powered leaf blowers in Maricopa County (n = 109,787), along with the average activity figures for those leaf blowers. Total leaf blower population estimates were derived from CARB (2000), which estimated that 60% of all leaf blowers sold are electric. Thus assuming the remaining 40% are gasoline-powered, the total population was estimated as:

Total leaf blower population = Gas-powered leaf blower population ÷ 40%

= 109,787 ÷ 0.4

= 274,468 units

The remaining 164,681 units [= 274,468 – 109,787] are thus assumed to be electric-powered. 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 3.5–33 lists the equipment population numbers, activity estimates and emission factors for leaf blowers in Maricopa County.

Table 3.5–33. Leaf blower equipment populations, activity levels and emission factors for Maricopa County.

Leaf blower description	Population	Annual activity (hrs/yr)	PM_{10} emission factors (mg/m^2)	$PM_{2.5}$ Emission factors (mg/m^2)
Commercial 2-stroke gasoline	3,345	626	70	30
Commercial 4-stroke gasoline	1,639	626	70	30
Residential 2-stroke gasoline	99,624	10	70	30
Residential 4-stroke gasoline	5,179	10	70	30
Electric	164,681	10	130	40
Total:	**274,468**	n/a	n/a	n/a

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

Annual PM_{10} emissions from electric leaf blowers	=	population	× activity (hrs/yr)	×	emission factor (mg/m^2)	×	area covered (m^2/hr)
	=	164,681	× 10 hrs/yr	×	130 mg/m^2	×	1600 m^2/hr
	=	342,536,480,000 mg/yr					
	=	377.24 tons PM_{10}/yr					

The activity hours associated with leaf blowers can occur at any time during the year in Maricopa County due to the temperate climate, with no substantial seasonal variation. Therefore, typical daily emissions were estimated by dividing annual totals by 366 days per year. Emissions for the PM_{10} nonattainment area are allocated based on the ratio of population in the County to the nonattainment area (see Section 1.5 for information on population). Table 3.5–34 lists annual and daily fugitive emissions from leaf blowers for Maricopa County and the PM_{10} nonattainment area.

Table 3.5–34. 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	891.36	336.41	4,870.8	1,838.3
PM_{10} NAA	894.98	337.78	4,890.6	1,845.8

3.5.8 Offroad recreation vehicles fugitive dust

The EPA NONROAD2008 model estimates exhaust emissions for offroad recreational vehicles. These emissions are included in the nonroad emissions category of the 2008 particulate emissions inventory. Particulate emissions are also generated by recreational vehicles traveling on unpaved surfaces. For the 2008 periodic inventory, these emissions were estimated by MAG using mileage and activity data for offroad recreational vehicles in Maricopa County from the NONROAD2008 model. The methodology and assumptions for calculating fugitive dust emissions from offroad recreational vehicles traveling are described in this section.

The EPA NONROAD2008 model provides annual mileage and number of vehicles by county for all-terrain vehicles (ATVs), offroad motorcycles (ORMs), and specialty vehicles/carts (SVCs). The NONROAD2008 default values for annual mileage and number of vehicles by type for Maricopa County in 2008 are shown in Table 3.5–35.

To be consistent with the 2005 Periodic Emissions Inventory for PM_{10} (MCAQD, 2007), it was assumed that 75 percent of the annual travel by offroad recreational vehicles occurs on unpaved surfaces inside Maricopa County, with the remaining 25 percent occurring on paved surfaces within Maricopa County and paved and unpaved surfaces outside of Maricopa County. The product of the mileage, number of vehicles, and 75 percent produces the annual vehicle miles traveled (VMT) on unpaved surfaces, shown in Table 3.5–35. Dividing annual VMT totals by 366 produces a daily estimated offroad recreational vehicle travel on unpaved surfaces in Maricopa County in 2008.

Table 3.5–35. 2008 offroad recreational vehicle travel on unpaved surfaces in Maricopa County.

Vehicle Type	Annual Mileage	Number of Vehicles	2008 Annual VMT	2008 Daily VMT
ATV	1,608	30,424	36,691,344	100,250
ORM	1,600	7,359	8,830,800	24,128
SVC (Non-Diesel)	65	1,718	83,753	229
SVC (Diesel)	435	150	48,938	134

The VMTs above were multiplied by emission factors for unpaved industrial roads from AP-42 (US EPA, 2006b), assuming a silt content of 11.9 percent and an average vehicle weight of one-half of a ton. The resultant PM_{10} emission factor for ATVs and SVCs is 0.594 pounds per vehicle mile traveled. This emission factor was reduced by 50 percent for ORMs (i.e., 0.297 pounds per mile) to account for two wheels generating dust instead of four. Applying the AP-42 equation results in a $PM_{2.5}$ emission factor for ATVs and SVCs of 0.059 pounds per mile, while the comparable $PM_{2.5}$ emission factor for ORMs is 0.0295 pounds per mile.

The AP-42 emission rates were multiplied by the annual and daily VMTs in Table 3.5–36 to obtain uncontrolled fugitive dust emissions in pounds per day and tons per year. The results for Maricopa County are shown in Table 3.5–37.

The emissions for the PM_{10} nonattainment area were derived by applying geographic information systems (GIS) to MAG 2009 land use data[1] to obtain the acreage of passive open space in the PM_{10} nonattainment area and Maricopa County. Passive open space includes open desert, mountains and washes. The detailed calculations for deriving the PM_{10} nonattainment area emissions are shown below:

Passive Open Space in the PM_{10} nonattainment area (NAA) = 262,662 acres

Passive Open Space in Maricopa County = 1,476,922 acres

Ratio of Passive Open Space in PM_{10} NAA vs. Maricopa County = 17.8%

PM_{10} NAA Emissions = 0.178 × Maricopa County Emissions

Application of the ratio above to Maricopa County emissions produces the uncontrolled annual and typical daily PM_{10} NAA emissions shown in Table 3.5–36. The PM_{10} and $PM_{2.5}$ emissions for all offroad recreational vehicle types (i.e., ATVs, ORMs and SVCs) are summed in this table. These uncontrolled emissions do not include the 2008 emission reductions attributed to the committed measures in the MAG 2007 Five Percent Plan.

Table 3.5–36. 2008 uncontrolled emissions from offroad recreational vehicles.

	Annual emissions (tons/yr)		Typical Daily Emissions (lbs/day)	
Geographic Area	**PM_{10}**	**$PM_{2.5}$**	**PM_{10}**	**$PM_{2.5}$**
Maricopa County	12,248.11	1,216.56	66,929.6	6,647.9
PM_{10} NAA	2,180.16	216.55	11,913.5	1,183.3

Two committed measures that reduce emissions from offroad recreational vehicles were quantified in the MAG 2007 Five Percent Plan for PM_{10} (MAG, 2007). The benefit taken in 2008 for these measures in the Five Percent Plan is shown in Table 3.5–37.

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Table 3.5–37. Benefits of measures that reduce offroad recreational vehicle emissions.

Committed Measures in Five Percent Plan	2008 PM_{10} Emission Reductions tons/yr	lbs/day
1. Reduce offroad vehicle use in areas with high offroad vehicle activity (Measure 19)	140.3	766.5
2. Ban ATV use on high pollution days (Measure 23)	25.7	140.6
Total 2008 PM_{10} emission reductions for offroad recreational vehicles	**166.0**	**907.0**

The emission benefits in Table 3.5–37 were subtracted from the uncontrolled PM_{10} emissions in Table 3.5–36. The 2008 PM_{10} emission reduction of 166.0 tons per year represents 7.6% of the uncontrolled emissions in the PM_{10} NAA of 2,180.16 tons per year. This percent reduction was applied to the uncontrolled $PM_{2.5}$ emissions in the PM_{10} NAA; then the absolute reduction in $PM_{2.5}$ emissions due to the control measures was applied to the uncontrolled $PM_{2.5}$ emissions in Maricopa County. The annual and daily controlled emission estimates are shown in Table 3.5–38 below.

Table 3.5–38. 2008 controlled emissions from offroad recreational vehicles.

	Annual Emissions (tons/yr)		Typical Daily Emissions (lbs/day)	
Geographic Area	**PM_{10}**	**$PM_{2.5}$**	**PM_{10}**	**$PM_{2.5}$**
Maricopa County	12,082.12	1,200.11	66,022.5	6,558.0
PM_{10} NAA	2,014.17	200.09	11,006.4	1,093.4

3.5.9 Unpaved parking lots fugitive dust

Fugitive dust emissions from vehicles traveling on unpaved parking lots were developed by MAG based on land area devoted to unpaved parking lots, vehicle activity on unpaved parking lots, and emission rates from AP-42 (US EPA, 2006b). The methodology, assumptions and calculations involved in estimating fugitive dust from vehicles traveling on unpaved parking lots are described in this section.

The vehicle miles traveled on unpaved parking lots in the PM_{10} nonattainment area (NAA) were derived using assumptions from the Phase I windblown dust modeling for the Western Regional Air Partnership (ENVIRON, 2004). This study estimated that eight percent of the vacant land in core urban areas is disturbed and thirty percent of the land under development is disturbed. For the 2008 periodic emissions inventory, the core urban area is defined as the carbon monoxide maintenance area. In addition, the thirty percent of disturbed land under development has been reduced by two-thirds (i.e., from thirty percent to ten percent) to mirror a 67 percent decline in total permitted construction acreage in the PM_{10} NAA between 2005 and 2008. GIS was applied to 2009 MAG land use data[2] to estimate that there are 171,785 acres of vacant land in the core urbanized area and 64,519 acres of land under development in the PM_{10} NAA. Multiplying the vacant disturbed percentages by these land areas produces:

171,785 acres × 0.08 = 13,743 acres of vacant disturbed land in the urbanized core

64,519 acres × 0.10 = 6,452 acres of vacant disturbed land under development

Summing the vacant disturbed acres in the urbanized core and areas under development produces a total of 20,195 acres of vacant disturbed land in the PM_{10} NAA. In estimating fugitive dust emissions from unpaved parking lots, the MAG Serious Area PM_{10} Plan assumed that 24 percent

2. *Ibid*.

of the disturbed vacant non-agricultural land is devoted to unpaved parking areas (MAG, 2000). Applying this percentage to the acres of vacant disturbed land results in 4,847 acres of unpaved parking lots in the PM_{10} NAA.

The MAG Serious Area PM_{10} Plan also assumed that the average size of an unpaved parking lot is 625 square meters (i.e., 0.154 acres), an average of ten vehicles travel on each lot per day, and each vehicle travels an average distance of 0.031 miles on a lot. Multiplying 10 vehicles per day times 0.031 miles per vehicle and dividing by 0.154 acres produces 2.0 vehicle miles of travel (VMT) per acre per day. Multiplying 2.0 by 4,847 acres yields 9,694 VMT per day on unpaved parking lots in the PM_{10} NAA.

The emission factors for unpaved parking lots were derived from the AP-42 equation for unpaved industrial roads (US EPA, 2006b), assuming a silt content of 11.9 percent and an average vehicle weight of 3.18 tons. The resultant AP-42 emission factors are 1.365 pounds per mile for PM_{10} and 0.137 pounds per mile for $PM_{2.5}$.

These AP-42 emission factors were applied to the unpaved parking lot VMT of 9,694 to obtain uncontrolled emissions in pounds per day. The pounds per day were converted to tons per year, assuming 366 days in 2008. The results for the PM_{10} NAA are shown in Table 3.5–40.

To estimate emissions for Maricopa County, GIS was applied to 2009 MAG land use data[3] to obtain 2,227,981 acres of vacant land in Maricopa County. Removing the vacant land in the Maricopa County portion of the PM_{10} NAA (i.e., 466,553 acres) results in 1,761,428 vacant acres located inside Maricopa County, but outside the PM_{10} NAA.

Assuming one percent of the vacant land outside the PM_{10} NAA is disturbed (Clark County, 2006) and 24 percent of the disturbed vacant land is unpaved parking areas (MAG, 2000), results in 4,227 acres of unpaved parking areas inside Maricopa County, but outside the PM_{10} NAA. Multiplying by 2.0 VMT per acre per day results in 8,454 VMT per day. Applying the AP-42 emission rates produces the unpaved parking lot emissions inside Maricopa County, but outside the PM_{10} NAA of 11,539.7 pounds per day of PM_{10} and 1,158.2 pounds per day of $PM_{2.5}$.

The final step in estimating Maricopa County emissions requires removing the Pinal County portion of the PM_{10} NAA. The unpaved parking lot emissions in the Pinal County portion of the PM_{10} NAA are assumed to be proportional to the acres of vacant land. These were derived using GIS and 2009 MAG land use data[4], with the results shown below:

Vacant land in the Pinal County portion of the PM_{10} NAA = 6,278 acres

Vacant land in the PM_{10} NAA = 472,831 acres

Ratio = 6,278/472,831 = 1.3%; Pinal County portion = 1.3% × PM_{10} NAA emissions

Pinal County portion of PM_{10} emissions = 1.3% × 13,232.3 = 172.0 pounds per day

Pinal County portion of $PM_{2.5}$ emissions = 1.3% × 1,158.2 = 17.3 pounds/day

Adding the emissions inside and outside the PM_{10} NAA and subtracting the Pinal County portion produces total Maricopa County emissions attributable to vehicles traveling on unpaved parking

3. *Ibid*.

4. *Ibid*.

lots in pounds per day. Pounds per day were multiplied by 366 [= no. days in 2008] to derive annual totals. The resultant 2008 uncontrolled emissions for Maricopa County are shown in Table 3.5–39. Uncontrolled emissions do not include the 2008 emission reductions attributed to the committed measure in the MAG 2007 Five Percent Plan.

Table 3.5–39. 2008 uncontrolled emissions from vehicles traveling on unpaved parking lots.

	Annual emissions (tons/yr)		Typical daily emissions (lbs/day)	
Geographic area	**PM_{10}**	**$PM_{2.5}$**	**PM_{10}**	**$PM_{2.5}$**
Maricopa County	4,501.80	451.83	24,600.0	2,469.0
PM_{10} NAA	2,421.51	243.04	13,232.3	1,328.1

One committed measure that reduces emissions from unpaved parking lots was quantified in the MAG 2007 Five Percent Plan for PM_{10} (MAG, 2007). The benefit taken in 2008 for this measure in the Five Percent Plan is shown in Table 3.5–40.

Table 3.5–40. Benefits of measure that reduces unpaved parking lot emissions.

	2008 PM_{10} emission reduction	
Committed Measure in Five Percent Plan	**tons/yr**	**lbs/day**
1. Pave or stabilize existing unpaved parking lots (Measure 25)	56.4	308.4

The emission benefit in Table 3.5–40 was subtracted from the uncontrolled PM_{10} emissions in Table 3.5–39. The 2008 PM_{10} emission reduction of 56.4 tons per year represents 2.3% of the uncontrolled emissions in the PM_{10} NAA of 2,421.51 tons per year. This percent reduction was applied to the uncontrolled $PM_{2.5}$ emissions in the PM_{10} NAA; then the absolute reduction in $PM_{2.5}$ emissions due to the control measure was applied to the uncontrolled $PM_{2.5}$ emissions in Maricopa County. The annual and daily controlled emission estimates are shown in Table 3.5–41 below.

Table 3.5–41. Annual and typical daily controlled emissions from unpaved parking lots.

	Annual emissions (tons/yr)		Typical daily emissions (lbs/day)	
Geographic area	**PM_{10}**	**$PM_{2.5}$**	**PM_{10}**	**$PM_{2.5}$**
Maricopa County	4,445.36	446.24	24,291.6	2,438.5
PM_{10} NAA	2,365.07	237.45	12,923.9	1,297.5

3.5.10 Windblown dust

Windblown dust emissions were calculated using a combination of local meteorology conditions, land use and vertical flux emission rates. A full description of the methodology can be found in Appendix 4. Tables 3.5–42 and 3.5–43 summarize annual and typical daily emissions from windblown dust by major land use category for Maricopa County and the PM_{10} nonattainment area.

Table 3.5–42. Annual and typical daily emissions from fugitive windblown dust for Maricopa County.

	Annual Emissions (tons/yr)		Avg. Daily Emissions (lb/day)	
Land Use Category	**PM_{10}**	**$PM_{2.5}$**	**PM_{10}**	**$PM_{2.5}$**
Active open space	215.94	32.39	1,180.0	177.0
Agriculture – active	61.69	9.25	337.1	50.6
Agriculture – inactive	345.86	51.88	1,890.1	283.5
Auto test tracks	49.23	7.38	269.0	40.4
Developing	394.98	59.25	2,158.4	323.8
Landfill	6.33	0.95	34.6	5.2
Mining	25.37	3.81	138.7	20.8
Passive open space / wash	2,755.11	413.27	15,058.1	2,258.7
Sand & gravel	108.47	16.27	592.7	88.9
Vacant	2,846.15	426.92	15,555.8	2,333.4
Total	**6,809.13**	**1,021.37**	**37,214.6**	**5,582.2**

Table 3.5–43. Annual and typical daily emissions from fugitive windblown dust for the PM_{10} NAA.

	Annual Emissions (tons/yr)		Avg. Daily Emissions (lb/day)	
Land Use Category	**PM_{10}**	**$PM_{2.5}$**	**PM_{10}**	**$PM_{2.5}$**
Active open space	213.93	32.09	1,169.0	175.4
Agriculture – active	57.82	8.67	315.9	47.4
Agriculture – inactive	296.42	44.46	1,619.8	243.0
Auto test tracks	42.93	6.44	234.6	35.2
Developing	391.00	58.65	2,136.6	320.5
Landfill	6.33	0.95	34.6	5.2
Mining	23.75	3.56	129.8	19.5
Passive open space / wash	1,822.61	273.39	9,959.6	1,493.9
Sand & gravel	107.82	16.17	589.2	88.4
Vacant	1,852.19	277.83	10,121.2	1,518.2
Total	**4,814.80**	**722.22**	**26,310.4**	**3,946.6**

3.5.11 Summary of all miscellaneous area sources

Tables 3.5–44 and 3.5–45 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 3.5–44. Annual and typical daily emissions from all miscellaneous area sources for Maricopa County.

	Annual emissions (tons/yr)					Typical daily emissions (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**
Wildfires	470.39	403.43	103.79	28.46	21.76	6,271.8	5,379.0	1,383.8	379.4	290.2
Prescribed fires	0.51	0.51	0.39	0.11	0.03	169.3	169.3	131.2	36.0	10.6
Structure fires	15.04	15.04	1.95			82.2	82.2	10.7		
Vehicle fires	30.04	30.04	1.20			164.1	164.1	6.6		
Engine testing	0.18	0.17	6.74	2.49		1.3	1.2	50.5	19.0	
Tilling	2,059.00	308.85				22,932.4	3,439.9			
Harvesting	136.93	20.54				3,938.9	590.8			
Unpaved ag roads	1,739.52	173.95				11,150.8	1,115.1			
Cotton ginning	17.90	5.11				103.8	29.7			
Fertilizer					2,276.43					12,439.5
Livestock	455.80	50.14			9,583.89	2,490.7	274.0			52,514.5
Crematories	0.93	0.62	12.39	1.58		7.0	4.7	93.1	11.9	
Accidental releases	0.01	0.01	0.06			0.1	0.1	0.3		
Humans					1,176.93					6,431.3
Leaf blowers dust	891.36	336.41				4,870.8	1,838.3			
Offroad rec. veh. dust	12,082.12	1,200.11				66,022.5	6,558.0			
Unpaved parking lots	4,445.36	446.24				24,291.6	2,438.5			
Windblown dust	6,809.13	1,021.37				37,214.6	5,582.2			
Total:	**29,154.21**	**4,012.53**	**126.52**	**32.64**	**13,059.05**	**179,712.0**	**27,667.0**	**1,676.1**	**446.4**	**71,686.1**

Table 3.5–45. Annual and typical daily emissions from all miscellaneous area sources for the PM_{10} NAA.

	Annual emissions (tons/yr)					Typical daily emissions (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**
Wildfires	423.56	363.27	93.46	25.62	19.60	9,412.5	8,072.7	2,076.8	569.4	435.5
Prescribed fires	0.21	0.21	0.16	0.04	0.01	104.0	104.0	80.6	22.1	6.5
Structure fires	15.10	15.10	1.96			82.5	82.5	10.7		
Vehicle fires	30.16	30.16	1.21			164.81	164.81	6.59		
Engine testing	0.18	0.17	6.74	2.49		1.3	1.2	50.5	19.0	
Tilling	834.20	125.13				9,327.3	1,399.1			
Harvesting	54.14	8.12				1,560.0	234.0			
Unpaved ag roads	731.03	73.10				4,686.1	468.6			
Cotton ginning	4.86	1.39				26.7	7.6			
Fertilizer					1,004.82					5,490.8
Livestock	260.95	28.70			5,486.90	1,426.0	156.9			30,065.2
Crematories	0.93	0.62	12.36	1.58		7.0	4.6	92.6	11.8	
Accidental releases	0.01	0.01	0.06			0.1	0.1	0.3		
Humans					1,181.71					6,457.5
Leaf blowers dust	894.98	337.78				4,890.6	1,845.8			
Offroad rec. veh. dust	2,014.17	200.09				11,006.4	1,093.4			
Unpaved parking lots	2,365.07	237.45				12,923.9	1,297.5			
Windblown dust	4,814.80	722.22				26,310.4	3,946.6			
Total:	**12,444.36**	**2,143.52**	**115.94**	**29.74**	**7,693.04**	**81,929.6**	**18,879.4**	**2,318.0**	**622.4**	**61,982.0**

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)				
Source 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	30.78	30.78	575.29	2.42	12.70	197.3	197.3	3,687.7	15.5	81.4
Industrial fuel oil	458.79	458.79	6,375.08	609.61	26.25	2,941.0	2,941.0	40,865.9	3,907.8	168.3
Comm./inst. natural gas	66.54	66.54	1,267.11	5.23	4.20	426.5	426.5	8,122.5	33.5	26.9
Comm./inst. fuel oil	224.14	224.14	3,273.40	271.27	8.13	1,436.8	1,436.8	20,983.3	1,738.9	52.1
Residential natural gas	61.75	61.75	763.81	4.88		337.5	337.5	4,173.8	26.6	
Residential wood	461.59	429.28	34.69	5.34		4,334.2	4,030.8	325.7	50.1	
Residential fuel oil	0.01	0.01	0.25	0.10		0.1	0.1	2.3	0.9	
All fuel combustion	**1,303.61**	**1,271.30**	**12,289.62**	**898.83**	**51.27**	**9,673.4**	**9,370.0**	**78,161.3**	**5,773.3**	**328.7**
Industrial Processes										
Chemical manufacturing	187.43	151.42	0.00	0.34	0.03	1,445.8	1,164.5	0.0	2.6	0.6
Commercial cooking	988.99	917.18				5,434.0	5,039.5			
Grain processing	20.59	6.71				149.3	49.5			
Cold storage					1,678.43					10.759.2
Secondary metal prod.	60.56	52.16	49.73	18.65	.004	442.7	386.2	358.8	142.7	0.0
Mineral processes	192.82	95.47				1,337.7	659.3			
Mining & quarrying	181.01	55.20				1,239.2	362.6			
Wood product mfg.	217.26	203.25				1,668.6	1,548.3			
Rubber/plastic mfg.	140.94	105.96				953.3	698.8			
Fabricated metal mfg.	51.48	42.62			4.50	538.1	460.6			28.9
Residential construction	1,845.79	184.58				11,832.0	1,183.2			
Commercial construction	4,320.77	432.08				27,697.2	2,769.7			
Road construction	2,695.73	269.57				17,280.3	1,728.0			
Other construction	194.36	19.44				1,245.9	124.6			
Electrical equip mfg.	13.94	9.64	20.45	0.18	31.55	76.9	53.2	112.4	1.1	193.7
ADEQ-permitted portable sources	59.00	29.50	282.18	88.93		492.9	246.5	2.275.7	721.7	
Road travel at industrial sites	566.30	271.29				3,880.4	1,847.2			
Industrial processes NEC	144.60	107.24	10.22	21.49	16.79	953.3	726.4	69.6	137.7	94.6
All Industrial Processes	**11,881.57**	**2,953.30**	**362.58**	**129.60**	**1,731.34**	**76,667.6**	**19,048.2**	**2,816.5**	**1,005.8**	**11,077.2**
Waste Treatment/disposal										
On-site incineration	0.06	0.04	5.01	0.01		0.7	0.4	38.9	0.1	
Open burning	111.46	111.46	29.96			902.2	902.2	242.4		
Landfills	86.21	75.92	24.11	7.57		486.1	425.4	132.9	41.7	
POTWs					1,484.01					8,131.5
Other waste	32.78	16.93	18.39	50.62		224.1	110.9	101.0	278.1	
All Waste Treatment/ Disposal	**230.52**	**204.35**	**77.47**	**58.20**	**1,484.01**	**1,613.0**	**1,438.8**	**515.3**	**320.0**	**8,131.5**

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**
Misc. Area Sources										
Wildfires fires	470.39	403.43	103.79	28.46	21.76	6,271.8	5,379.0	1,383.8	379.4	290.2
Prescribed fires	0.51	0.51	0.39	0.11	0.03	169.3	169.3	131.2	36.0	10.6
Structure fires	15.04	15.04	1.95			82.2	82.2	10.7		
Vehicle fires	30.04	30.04	1.20			164.1	164.1	6.6		
Engine testing	0.18	0.17	6.74	2.49		1.3	1.2	50.5	19.0	
Tilling	2,059.00	308.85				22,932.4	3,439.9			
Harvesting	136.93	20.54				3,938.9	590.8			
Unpaved ag roads	1,739.52	173.95				11,150.8	1,115.1			
Cotton ginning	17.90	5.11				103.8	29.7			
Fertilizer application					2,276.43					12,439.5
Livestock	455.80	50.14			9,583.89	2,490.7	274.0			52,514.5
Crematories	0.93	0.62	12.39	1.58		7.0	4.7	93.1	11.9	
Accidental releases	0.01	0.01	0.06			0.1	0.1	0.3		
Humans					1,176.93					6,431.3
Leaf blowers dust	891.36	336.41				4,870.8	1,838.3			
Offroad rec. veh. dust	12,082.12	1,200.11				66,022.5	6,558.0			
Unpaved parking lots	4,445.36	446.24				24,291.6	2,438.5			
Windblown dust	6,809.13	1,021.37				37,214.6	5,582.2			
All Misc. Sources	**29,154.21**	**4,012.53**	**126.52**	**32.64**	**13,059.05**	**179,712.0**	**27,667.0**	**1,676.1**	**446.4**	**71,686.1**
TOTAL, ALL AREA SOURCES	**42,569.90**	**8,441.49**	**12,856.18**	**1,119.27**	**16,329.74**	**267,665.9**	**57,524.0**	**83,169.2**	**7,545.5**	**91,223.5**

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										
Industrial natural gas	30.70	30.70	573.79	2.41	12.66	196.8	196.8	3,678.2	15.5	81.2
Industrial fuel oil	457.60	457.60	6,358.50	608.03	26.19	2,933.3	2,933.3	40,759.6	3,897.6	167.9
Comm./inst. natural gas	66.20	66.20	1,260.65	5.20	4.18	424.4	424.4	8,081.1	33.3	26.8
Comm./inst. fuel oil	223.00	223.00	3,256.70	269.88	8.09	1,429.5	1,429.5	20,876.3	1,730.0	51.8
Residential natural gas	61.73	61.73	763.51	4.87		337.3	337.3	4,172.2	26.6	
Residential wood	461.41	429.11	34.67	5.33		4,332.5	4,029.2	325.6	50.1	
Residential fuel oil	0.01	0.01	0.25	0.10		0.1	0.1	2.3	0.9	
All fuel combustion	**1,300.65**	**1,268.35**	**12,248.07**	**895.83**	**51.11**	**9,653.8**	**9,350.6**	**77,895.2**	**5,754.1**	**327.6**
Industrial Processes										
Chemical manufacturing	186.94	151.03	0.00	0.34	0.03	1,442.0	1161.5	0.0	2.6	0.9
Commercial cooking	993.04	920.94				5,456.3	5,060.1			
Grain processing	16.73	5.68				125.3	43.0			
Cold storage					1,674.1					10,731.2
Secondary metal prod.	60.56	52.16	49.73	18.65	0.04	442.7	386.2	358.8	142.7	0.0
Mineral processes	187.73	91.92				1,302.8	635.6			
Mining & quarrying	156.60	46.81				1,075.7	307.2			
Wood product mfg.	216.69	202.72				1,664.3	1,544.3			
Rubber/plastic mfg.	140.57	105.68				950.9	697.0			
Fabricated metal mfg.	51.35	42.51			4.49	536.7	459.4			28.8
Residential construction	1,692.38	169.24				10,920.3	1,092.0			
Commercial construction	4,057.29	405.73				25,897.4	2,589.7			
Road construction	2,051.78	205.18				13,156.8	1,315.7			
Other construction	162.41	16.24				1,043.9	104.4			
Electrical equip mfg	13.94	9.64	20.45	0.18	31.55	76.9	53.2	112.4	1.1	193.7
ADEQ-permitted portable sources	59.00	29.50	282.18	88.93		492.9	246.5	2,275.7	721.7	
Road travel at industrial sites	472.36	217.08				3,273.9	1,500.1			
Industrial processes NEC	136.00	99.12	8.12	21.47	14.10	906.0	681.7	55.4	137.6	79.8
All Industrial Processes	**10,655.39**	**2,771.19**	**360.48**	**129.58**	**1,724.27**	**68,764.6**	**17,877.6**	**2,802.3**	**1,005.7**	**11,034.4**

Table 3.6–2 (cont'd). 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	0.06	0.04	5.01	0.01		0.7	0.4	38.9	0.1	
Open burning	27.67	27.67	7.44			232.6	232.6	62.5		
Landfills	60.25	50.78	19.47	6.22		342.4	286.6	107.4	34.3	
POTWs					1,494.12					8,164.6
Other waste	32.78	16.93	18.39	50.62		224.1	110.9	101.0	278.1	
All Waste Treatment/ Disposal	**120.77**	**95.42**	**50.30**	**56.85**	**1,494.12**	**799.8**	**630.5**	**309.9**	**312.6**	**8,164.6**
Misc. Area Sources										
Wildfires	423.56	363.27	93.46	25.62	19.60	9,412.5	8,072.7	2,076.8	569.4	435.5
Prescribed fires	0.21	0.21	0.16	0.04	0.01	104.0	104.0	80.6	22.1	6.5
Structure fires	15.10	15.10	1.96			82.5	82.5	10.7		
Vehicle fires	30.16	30.16	1.21			164.81	164.81	6.59		
Engine testing	0.18	0.17	6.74	2.49		1.3	1.2	50.5	19.0	
Tilling	834.20	125.13				9,327.3	1,399.1			
Harvesting	54.14	8.12				1,560.0	234.0			
Unpaved ag roads	731.03	73.10				4,686.1	468.6			
Cotton ginning	4.86	1.39				26.7	7.6			
Fertilizer application					1,004.82					5,490.8
Livestock	260.95	28.70			5,486.90	1,426.0	156.9			30,065.2
Crematories	0.93	0.62	12.36	1.58		7.0	4.6	92.6	11.8	
Accidental releases	0.01	0.01	0.06			0.1	0.1	0.3		
Humans					1,181.71					6,457.5
Leaf blowers dust	894.98	337.78				4,890.6	1,845.8			
Offroad rec. veh. dust	2,014.17	200.09				11,006.4	1,093.4			
Unpaved parking lots	2,365.07	237.45				12,923.9	1,297.5			
Windblown dust	4,814.80	722.22				26,310.4	3,946.6			
All Misc. Sources	**12,444.36**	**2,143.52**	**115.94**	**29.74**	**7,693.04**	**81,929.6**	**18,879.4**	**2,318.0**	**622.4**	**42,455.4**
TOTAL, ALL AREA SOURCES:	**24,521.17**	**6,278.48**	**12,774.79**	**1,112.00**	**10,962.54**	**161,147.8**	**46,738.0**	**83,325.3**	**7,694.7**	**61,982.0**

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 2008 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 those from 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 2008 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 most nonroad mobile source categories except aircraft, airport ground support equipment (GSE) and locomotives were derived using EPA's NONROAD model, ver. 2008.1.0 (Core version 2008, April 2009). Aircraft and airport GSE emission estimates were made using the Federal Aviation Administration's EDMS (Emissions Dispersion Modeling System) model, ver. 5.1.1. Locomotive emission calculations were derived from surveys of the three 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 NON-ROAD model. Monthly temperature and fuel data were provided by the Arizona Department of Weights and Measures. The following table lists the local county inputs used:

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

Month	Temperatures (°F) Max.	Min.	Average	Fuel RVP (psi)	Diesel Sulfur (ppm)	Gasoline Sulfur (ppm)	Ethanol (EtOH) Blend EtOH (Vol %)	Market Share (%)	Total Oxygen (wt%)
January	64	45	54.90	8.8	6	35	9.47	100	3.49
February	69	48	58.45	8.4	6	23	9.24	100	3.42
March	79	54	66.84	8.4	7	49	9.18	100	3.41
April	87	61	74.23	7.8	7	23	5.57	100	2.06
May	91	66	78.74	6.8*	6 *	27*	0.00*	0*	0.00*
June	107	80	93.40	6.6	6	25	0.00	0	0.00
July	106	84	95.16	7.0	4	19	0.00	0	0.00
August	104	82	93.16	6.8	6	29	0.00	0	0.00
September	101	79	90.07	6.5	6	35	0.00	0	0.00
October	91	65	78.13	7.9	7 †	25	6.79	100	2.52
November	81	56	68.67	8.4	7 †	15	8.78	100	3.27
December	65	46	56.03	8.3†	7	28†	8.17†	100†	3.03†

* Since measurements were not available, the average of June, July, August and September data was used.
† Since measurements were not available, the average of October, November, January, February, March and April data was used.

EPA recommends adjusting default NONROAD 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 NONROAD 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 NONROAD model does not calculate emission values for NH_3. Ammonia emission calculations for the NONROAD model were derived by using a multiplier 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 NONROAD model come from EPA recommendations on weekday and weekend day activity levels for each nonroad equipment category (US EPA, 1999). Table 4.1–2 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 NONROAD model as discussed above. County-wide results are shown in Table 4.2–1.

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

PM_{10}	$PM_{2.5}$	NO_x	SO_x	NH_3
34.27	33.24	365.55	0.14	0.67

Annual emissions for the PM_{10} nonattainment area were calculated based on EIIP guidance (US EPA, 2002) which recommends using the ratio of agricultural land inside the nonattainment area to agricultural land inside the county. See Section 1.5.2 for a discussion of land use data used.

PM_{10} NAA emissions from agricultural equipment	=	Total County PM_{10} emissions from agricultural equipment	×	Agricultural land use allocation factor
	=	34.27 tons	×	44.14%
	=	15.13 tons PM_{10} /yr		

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

PM_{10}	$PM_{2.5}$	NO_x	SO_x	NH_3
15.13	14.67	161.35	0.06	0.30

County average-day emissions were calculated by multiplying annual emissions (generated by the NONROAD 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:

Average County PM_{10} daily emissions (lbs/day)	=	Annual PM_{10} emissions (tons/yr)	×	daily activity allocation factor for agricultural equipment (week/day)	×	2000 (lbs/ton)	÷	52 (wks/yr)
	=	34.27	×	0.166667	×	2000	÷	52
	=	219.7 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
219.7	213.1	2,343.3	0.9	4.3

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

PM_{10} NAA average-day emissions	=	Maricopa County PM_{10} average-day emissions	×	Agricultural land use allocation factor
	=	219.7 lbs/day	×	44.14%
	=	100.4 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
97.0	94.0	1,034.3	0.4	1.9

4.3 Airport ground support equipment and auxiliary power units

Annual emissions from airport ground support equipment (GSE) and auxiliary power units (APUs) at most airports in the county were estimated using the Emissions Dispersion Modeling System (EDMS, v. 5.1.1) from the U.S. Federal Aviation Administration (FAA). The model can estimate emissions from affiliated ground support equipment (GSE) and auxiliary power units (APUs), by using either default equipment profiles, or user-specified data on equipment populations and activity patterns. In most cases, activity data on 2008 aircraft operations and GSE / APU usage was obtained from individual airport surveys issued by MAG and/or MCAQD. Where survey responses were incomplete or information was otherwise unavailable, activity data was estimated using commercially available data, and EDMS default assumptions where appropriate. Further details concerning the modeling input data and results are presented in Section 4.11 of this report.

For Luke Air Force Base (AFB), emissions estimates for ground support equipment were obtained from a recent base-wide mobile source emissions inventory for calendar year 2008 that had recently been completed for the US Air Force (Weston, 2010). Using data on the frequency and intensity of usage for each type of equipment, annual emissions were calculated as in the following example for a light cart equipped with a diesel engine:

$$E_{pol} = ELHP \times OT \times LF \times EF / CF$$

where:

E_{pol} = Annual emissions of a particular pollutant (lb/yr)	
ELHP = Maximum horsepower rating of engine (hp)	e.g. 10.7 hp
OT = Operating time (hr/yr)	e.g. 52,560 hr/yr
LF = Typical load factor that the engine operates (% of max)	e.g. 51%
EF = Emission factor (g/hp-hr)	e.g. 7.8 g/hp-hr
CF = Conversion factor to convert grams to pounds	(453.59 g/lb)

Thus, total annual NO_x emissions all similar pieces of this type of GSE was calculated as:

$$E_{NOx} = 10.7\ (hp) \times 52{,}560\ (hrs/yr) \times 51\% \times 7.8\ (g/hp\text{-}hr) / 453.59\ (g/lb)$$
$$= 4{,}932\ (lb/yr) / 2{,}000\ (lb/ton)$$
$$= 2.47\ tpy$$

GSE emissions from the Luke AFB study were added to the EDMS-estimated emissions from the other airports in the County. (The Luke study assumed APU usage, and thus emissions, to be negligible.) A simplifying assumption was made for all airports; i.e., that activity is spread fairly evenly throughout the week and year; thus daily emissions were estimated by dividing annual totals by 366 (= days/yr in 2008). Tables 4.3–1 and 4.3–2 below present the totals for all airport GSE and APU usage within both Maricopa County and the PM_{10} nonattainment area, on an annual and typical daily basis, respectively.

Table 4.3–1. Annual emissions (tons/yr) from all airport ground support equipment (GSE) and auxiliary power units (APUs).

	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
GSE	14.92	14.39	497.97	13.62	*	14.72	14.21	490.28	13.42	*
APUs	12.29	12.29	88.76	12.82	*	12.27	12.27	88.68	12.80	*
Total:	**27.21**	**26.68**	**586.73**	**26.43**		**26.99**	**26.48**	**578.95**	**26.22**	

* At present, EDMS does not include calculation of ammonia emissions from aircraft operations.

Table 4.3–2. Typical daily emissions (lb) from airport GSE and APU usage.

	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
GSE	81.5	78.7	2,721.1	74.4	*	80.4	77.7	2,679.1	73.3	*
APUs	67.1	67.1	485.0	70.0	*	67.1	67.1	484.6	70.0	*
Total:	**148.7**	**145.8**	**3,206.1**	**144.4**		**147.5**	**144.7**	**3,163.7**	**143.3**	

* At present, EDMS does not include calculation of ammonia emissions from aircraft operations.

4.4 Commercial equipment

Annual emissions from commercial equipment in Maricopa County were calculated using EPA's NONROAD 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 non-attainment 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 (tons/yr) from commercial equipment usage.

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
117.97	112.98	1,395.23	2.40	21.12	117.66	112.69	1,391.61	2.39	21.06

County average-day emissions were calculated by multiplying Maricopa County annual emissions (generated by the NONROAD 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 (lbs/day) from commercial equipment usage.

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
756.2	724.2	8,943.8	15.4	135.4	754.2	722.4	8,920.6	15.3	135.0

4.5 Construction and mining equipment

Annual emissions from construction and mining equipment in Maricopa County were calculated using EPA's NONROAD 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 construction employment 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 employment data used.

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

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
1,260.98	1,220.75	14,796.63	6.60	28.10	1,249.88	1,210.00	14,666.42	6.55	27.85

County average-day emissions were calculated by multiplying Maricopa County annual emissions (generated by the NONROAD 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 (lbs/day) from construction and mining equipment usage.

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
8,083.2	7,825.3	94.850.2	42.3	180.1	8,012.1	7,756.4	94,015.6	42.0	178.5

4.6 Industrial equipment

Annual emissions from industrial equipment in Maricopa County were calculated using EPA's NONROAD 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 unavailable. See Section 1.5.1 for a discussion of the industrial employment data used.

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

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
101.69	98.96	2,593.13	3.22	56.23	101.42	98.71	2,586.39	3.21	56.09

County average-day emissions were calculated by multiplying Maricopa County annual emissions (generated by the NONROAD 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 (lbs/day) from industrial equipment usage.

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
651.8	634.4	16,622.7	20.6	360.5	650.1	632.7	16,579.4	20.6	359.5

4.7 Lawn and garden equipment

Annual emissions from lawn and garden equipment in Maricopa County were calculated using EPA's NONROAD model, as described in Section 4.1. These results reflect revised equipment population and usage estimates from survey work done in early 2003 for the Arizona Department of Environmental Quality (discussed in further detail 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 data on housing units was unavailable, it was not possible to implement the EIIP-recommended calculation approach (US EPA, 2002). See Section 1.5.1 for a discussion of the population data used.

Table 4.7–1. Annual emissions (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
182.28	168.79	798.14	3.16	19.63	183.02	169.48	801.41	3.17	19.71

County average-day emissions were calculated by multiplying Maricopa County annual emissions (generated by the NONROAD 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 52 (the number of weeks in a year; US EPA, 1999). PM_{10} nonattainment area average-day emissions were calculated by applying a population-based ratio as described in Section 4.7 above.

Table 4.7–2. Typical daily emissions (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
1,250.1	1,156.9	5,571.5	23.1	144.6	1,255.3	1,161.6	5,594.4	23.2	145.2

4.8 Pleasure craft

Annual emissions from pleasure craft equipment in Maricopa County were calculated using EPA's NONROAD 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 (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
9.25	8.54	77.74	0.85	1.73	7.02	6.48	59.03	0.64	1.32

County average-day emissions were calculated by multiplying Maricopa County annual emissions (generated by the NONROAD 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 (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
124.5	114.9	1,046.5	11.4	23.3	94.5	87.3	794.6	8.6	17.7

4.9 Railway maintenance equipment

Annual emissions from railway maintenance equipment in Maricopa County were calculated using EPA's NONROAD 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 (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
1.13	1.09	9.23	0.00	0.02	1.13	1.10	9.26	0.00	0.02

County average-day emissions were calculated by multiplying Maricopa County annual emissions (generated by the NONROAD 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 (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
7.8	7.6	63.9	0.0	0.1	7.8	7.6	64.1	0.0	0.1

4.10 Recreational equipment

Annual emissions from recreational equipment in Maricopa County were calculated using EPA's NONROAD 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 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 (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
45.58	41.98	63.80	0.42	2.10	7.68	7.08	10.76	0.07	0.35

County average-day emissions were calculated by multiplying Maricopa County annual emissions (generated by the NONROAD 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 (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
389.6	358.8	545.3	3.6	18.0	65.7	60.5	91.9	0.6	3.0

4.11 Aircraft

Emissions from aircraft operations at the largest civilian airports in Maricopa County were estimated using the Federal Aviation Administration's Emissions and Dispersion Model (EDMS, v. 5.1.1). The EDMS model combines specified aircraft type and activity levels with default emission factors in order to estimate annual emissions inventories for a specific airport. The model calculates emissions of sulfur oxides (SOx), oxides of nitrogen (NOx), carbon monoxide (CO), and volatile organic compounds (VOC), and, for a small subset of aircraft and engine types), PM_{10} and $PM_{2.5}$ as well. The model also estimates emissions from affiliated ground support equipment (GSE) and auxiliary power units (APUs); these emissions are reported separately and are summarized in Section 4.3.

MCAQD surveyed all medium and large airports in Maricopa County to gather data on aircraft type and activity level of aircraft operations. Specifically, the number of landing and takeoff cycles (LTO's) or touch and go operations (TGOs), along with information on the types of aircraft that comprise the airport's typical fleet mix, and other operational data, such as typical usage patterns of ground support equipment (GSE) and auxiliary power units (APUs), average taxi/idle times, etc. Where survey responses were unavailable or incomplete, aircraft activity data from publicly accessible databases, such as the FAA's Air Traffic Activity System (ATADS) and Enhanced Traffic Management System Counts (ETMSC), were used.

All emission estimates in this section have been developed using the EDMS model, with the exception of Luke Air Force Base (AFB), whose emissions calculations have been prepared as part of a base-wide 2008 mobile source emissions inventory that has recently been completed (Weston, 2010). Luke AFB's emissions reported as 'aircraft activity' actually comprise three distinct, though related, types of activity: (1) the operation of aircraft stationed at the base, (2) a much smaller level of "transient" aircraft traffic within Luke's airspace, and (3) emissions produced during on-wing engine testing – considered a "mobile source" emission category. As with all other airports included in this inventory, emissions from ground support equipment (GSE) at Luke AFB are addressed in Section 4.3, Airport ground support equipment and auxiliary power units.

In addition to the LTOs (and occasional TGO activity) reported by other airports in the area, Luke reported two additional, types of aircraft operations: aircraft low fly bys (LFB), and aircraft low fly patterns (LFP). Each of these types of operations can be characterized by a distinctive combination of the times in mode (TIM); (e.g., approach, taxi in/out, takeoff and climb out.)

Luke AFB's emissions are not based on the number of LTOs, but rather the aggregate annual operational time in modes (TIMs) for all aircraft of similar type. For the F-16, an LTO cycle includes five modes of operation: idle (taxi in/out), intermediate, approach, military and afterburner. The F-16 emissions were estimated using the annual TIMs provided by Luke AFB and emission factors from military guidance documents.

Table 4.11–1 lists the data sources for each airport's activity level, as well as fleet mix. The total number of aircraft operations in 2008 is also listed. For all airports other than Luke AFB, aircraft emissions were estimated for four aircraft categories:

- Air carriers (abbreviated "AC"): Larger commercial aircraft with at least 60 seats or 18,000 lbs payload capacity, used for scheduled service to transport passengers and/or freight;

- Air taxis ("AT"): Smaller commercial turbine- or piston-powered aircraft with less than 60 seats or 18,000 lbs payload capacity;
- General aviation ("GA"): Aircraft used on an unscheduled basis for recreational flying, personal transportation, and other activities, including business travel; and
- Military ("ML"): Aircraft used to support military operations.

Table 4.11–1. Annual airport operations (by aircraft category), and related data sources.

Airport	Airport Code	Operations Data Source[1]	Fleet Mix Data Source[2]	Aircraft Type	2008 Operations
Buckeye Municipal	BXK	airnav.com	Generic GA profile	GA	26,535
Chandler Municipal	CHD	FAA/ATADS	FAA/ETMSC	AT	2,882
				GA	233,713
				ML	247
Falcon Field	FFZ	FAA/ATADS	FAA/ETMSC	AC	6
				AT	3,813
				GA	313,448
				ML	2,152
Gila Bend Municipal	E63	airnav.com	Generic GA profile	GA	1,768
Glendale Municipal	GEU	FAA/ATADS, Survey response	FAA/ETMSC	AT	1,873
				GA	134,282
				ML	57
Luke Air Force Base	LUF	[Emission totals provided by Luke AFB are based on times-in-mode.]			
Phoenix Deer Valley	DVT	Survey response	Survey response, FAA/ETMSC	AC	284
				AT	6,217
				GA	370,003 *
				ML	130
Phoenix Goodyear	GYR	Survey response	Survey response, FAA/ETMSC	AC	140
				AT	1962
				GA	169,177 *
				ML	6,747
Phoenix-Mesa Gateway (formerly Williams Gateway)	IWA	FAA/ATADS, Survey response	FAA/ETMSC	AC	3,876
				AT	5,937
				GA	211,674
				ML	5,939
Phoenix Sky Harbor	PHX	Survey response	Survey response, FAA/ETMSC	AC	391,518
				AT	77,354
				GA	30,868
				ML	2,759
Pleasant Valley	P48	airnav.com	Generic GA profile	GA	23,535
Scottsdale	SDL	FAA/ATADS	FAA/ETMSC	AT	11,232
				GA	179,619
				ML	560
Sky Ranch at Carefree	18AZ	Survey response	Generic GA profile	GA	1,515
Stellar Airpark	P19	airnav.com	Generic GA profile	GA	19,528
Wickenburg Municipal	E25	Survey responses	Generic GA profile	GA	6,000

1. FAA/ATADS: Federal Aviation Administration's Air Traffic Activity Data System (database); http://aspm.faa.gov.
2. FAA/ETMSC: Federal Aviation Administration's Enhanced Traffic Management System Counts (database); http://aspm.faa.gov.

* includes touch-and-go (TGO) operations levels reported by the airport.

The following section describes how activity and emissions were estimated for a representative airport, Chandler Municipal (CHD). The FAA's Air Traffic Activity System (ATADS, http://www.aspm.faa.gov) provided data on 2008 activity by aircraft type; these results are contained in Table 4.11–1. While ATADS reported a total of 233,713 general aviation operations at this airport in 2008, further information on the aircraft types comprising this activity was

needed. The FAA's Enhanced Traffic Management System Counts (ETMSC) database was used to "grow" available aircraft-specific operational data as described below.

The ETMSC database on general aviation activity at CHD in 2008 comprises 152 different aircraft types, totaling 3,589 operations, (See Table 4.11–2). To simplify modeling input requirements, this aircraft-specific activity data was ranked in order of decreasing frequency and activity data for the most frequently reported aircraft was then grown to represent all general aviation ("GA") activity, as shown in Table 4.11–2 below.

Table 4.11–2. Example showing how most common aircraft-specific activity was grown for EDMS modeling.

Rank	Aircraft Type	ETMSC-reported operations	% of total reported operations	Cumulative Percent	"Grown" operations for EDMS modeling
1	BE20 - Beech 200 Super King	240	6.7%		21,919
2	BE58 - Beech 58	233	6.5%		21,280
3	PA28 - Piper Cherokee	233	6.5%		21,280
4	C525 - Cessna CitationJet/CJ1	232	6.5%		21,189
5	C182 - Cessna Skylane 182	203	5.7%	31.8%	18,540
6	C172 - Cessna Skyhawk 172/Cutlass	194	5.4%		17,718
7	TBM7 - Socata TBM-7	166	4.6%		15,161
8	R22 - Robinson R-22 Mariner	138	3.8%		12,604
9	BE9L - Beech King Air 90	106	3.0%		9,681
10	BE36 - Beech Bonanza 36	97	2.7%	51.3%	8,859
11	BE55 - Beech Baron 55	90	2.5%		8,220
12	BE35 - Beech Bonanza 35	87	2.4%		7,946
13	C210 - Cessna 210 Centurion	75	2.1%		6,850
14	PA32 - Piper Cherokee Six	73	2.0%		6,667
15	P28R - Cherokee Arrow/Turbo	71	2.0%	62.4%	6,484
16	P46T - Piper Malibu Meridian	67	1.9%		6,119
17	SR22 - Cirrus SR 22	67	1.9%		6,119
18	BE30 - Raytheon 300 Super King Air	65	1.8%		5,936
19	MO20 - Mooney M-20	62	1.7%		5,662
20	C560 - Cessna Citation V/Ultra/Encore	60	1.7%	71.3%	5,480
⋮	⋮	⋮	⋮	⋮	
152	XL2 - Liberty XL-2	1	< 0.1%	100.0%	(n/a)
	Totals:	**3,589**			**233,713**

This approach of ranking reported activity, and then growing the most frequently occurring subset of aircraft typically resulted in a set comprised of 10 to 30 aircraft types being modeled for each airport/aircraft class combination, representing 60 to 100% of all reported activity. Since the EDMS model includes estimates of PM_{10} emissions only for a relatively small number of aircraft/engine types, all model output files were reviewed for missing data. For those aircraft/engine combinations for which the EDMS model indicated zero PM_{10} emissions, the default EPA emission factors listed in Table 4.11–3 (US EPA, 2003) were incorporated into the EDMS output data files, and total PM emissions recalculated.

Table 4.11–3. EPA's default PM_{10} emission factors for aircraft, by activity type.

Activity type	PM_{10} Emission Factor (lb/LTO)
Air Carrier, Air Taxi, Military	0.60333
General Aviation	0.2367

Following EPA guidance (US EPA, 2003), $PM_{2.5}$ emissions were estimated to be 92% of PM_{10} levels. For ease in modeling computation and the assessment of emissions, all activity was assumed to occur evenly throughout the year. Thus, average daily emissions were calculated by dividing annual totals by 366 (= days per year in 2008). Tables 4.11–4 and 4.11–5 list the total annual emissions and average daily emissions of each airport and aircraft type, and for airports within and outside the PM_{10} NAA, respectively.

Table 4.11–4. Annual and average daily emissions, by airport and aircraft type, from airports within the PM_{10} NAA.

	Cate-	Annual emissions (tons/yr)				Typical daily emissions (lbs/day)			
Airport	**gory**	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**	**PM_{10}**	**$PM_{2.5}$**	**NO_x**	**SO_x**
Chandler Municipal	AT	0.27	0.27	0.94	0.24	1.5	1.5	5.1	1.3
	GA	12.68	11.79	18.51	6.43	69.3	64.4	101.1	35.1
	ML	0.04	0.04	0.12	0.02	0.2	0.2	0.6	0.1
	Total	***12.99***	***12.10***	***19.56***	***6.68***	***71.0***	***66.1***	***106.9***	***36.5***
Falcon Field	AC	0.00	0.00	0.00	-	0.0	0.0	0.0	0.0
	AT	0.23	0.23	2.94	0.49	1.3	1.2	16.0	2.7
	GA	18.49	17.07	14.34	6.16	101.0	93.3	78.3	33.7
	ML	0.31	0.29	0.40	0.13	1.7	1.6	2.2	0.7
	Total	***19.03***	***17.59***	***17.67***	***6.78***	***104.0***	***96.1***	***96.6***	***37.0***
Glendale Municipal	AT	1.06	1.05	9.70	2.43	5.8	5.7	53.0	13.3
	GA	6.90	6.41	5.51	2.20	37.7	35.0	30.1	12.0
	ML	0.01	0.01	0.12	0.02	0.0	0.0	0.6	0.1
	Total	***8.17***	***7.66***	***15.51***	***4.71***	***44.6***	***41.8***	***84.8***	***25.7***
Luke Air Force Base†	ML	***62.82***	***62.82***	***382.40***	***31.81***	***343.3***	***343.3***	***2,089.6***	***173.8***
Phoenix Deer Valley	AC	0.04	0.04	0.05	0.01	0.2	0.2	0.3	0.1
	AT	0.41	0.41	3.97	0.76	2.2	2.2	21.7	4.2
	GA	10.10	9.43	62.81	14.61	55.2	51.5	343.2	79.8
	ML	0.02	0.02	0.07	0.02	0.1	0.1	0.4	0.1
	Total	***10.57***	***9.90***	***66.91***	***15.40***	***57.8***	***54.1***	***365.6***	***84.1***
Phoenix Goodyear	AC	0.02	0.01	0.36	0.05	0.1	0.1	1.9	0.3
	AT	0.19	0.19	1.61	0.28	1.1	1.0	8.8	1.5
	GA	0.66	0.66	18.86	5.25	3.6	3.6	103.0	28.7
	ML	0.96	0.89	3.66	1.07	5.2	4.8	20.0	5.8
	Total	***1.83***	***1.74***	***24.48***	***6.64***	***10.0***	***9.5***	***133.8***	***36.3***
Phoenix Sky Harbor Intl.	AC	22.38	22.38	1,751.85	185.77	122.3	122.3	9,573.0	1,015.2
	AT	4.24	4.02	116.92	17.51	23.2	22.0	638.9	95.7
	GA	3.37	3.21	12.81	2.83	18.4	17.6	70.0	15.4
	ML	0.45	0.43	23.48	2.34	2.5	2.4	128.3	12.8
		30.45	***30.05***	***1,905.06***	***208.45***	***166.4***	***164.2***	***10,410.2***	***1,139.1***
Phoenix-Mesa Gateway Airport	AC	0.16	0.15	13.25	1.72	0.9	0.8	72.4	9.4
	AT	0.63	0.62	3.02	0.64	3.4	3.4	16.5	3.5
	GA	12.99	12.04	17.41	5.48	71.0	65.8	95.2	29.9
	ML	0.58	0.55	26.56	3.14	3.2	3.0	145.1	17.1
		14.35	***13.36***	***60.24***	***10.98***	***78.4***	***73.0***	***329.2***	***60.0***
Pleasant Valley	GA	0.36	0.33	1.65	0.34	1.9	1.8	9.0	1.8
Scottsdale	AT	1.03	1.02	7.84	1.37	5.7	5.6	42.8	7.5
	GA	19.83	18.86	116.13	21.79	108.4	103.1	634.6	119.1
	ML	0.08	0.08	0.24	0.06	0.5	0.4	1.3	0.3
		20.95	***19.96***	***124.21***	***23.22***	***114.5***	***109.1***	***678.8***	***126.9***
Skyranch at Carefree	GA	***0.18***	***0.17***	***0.39***	***0.10***	***1.0***	***0.9***	***2.1***	***0.5***
Stellar Airpark	GA	***2.31***	***2.13***	***2.42***	***0.97***	***12.6***	***11.6***	***13.2***	***5.3***
PM_{10} NAA totals:		**183.80**	**177.61**	**2,620.31**	**316.00**	**1,004.3**	**970.5**	**14,318.6**	**1,726.8**

† Sum of emissions from the following categories, as reported in Weston (2010): (1) aircraft stationed at Luke AFB, (2) transient aircraft, and (3) on-wing aircraft engine testing.

Table 4.11–5. Annual and average daily emissions, by aircraft type, from airports outside the PM_{10} NAA.

Facility	Cate-gory	Annual emissions (tons/yr)				Average daily emissions (lbs/day)			
		PM_{10}	$PM_{2.5}$	NO_x	SO_x	PM_{10}	$PM_{2.5}$	NO_x	SO_x
Buckeye Municipal	GA	3.14	2.89	2.70	0.97	17.2	15.8	14.8	5.3
Gila Bend Municipal	GA	0.21	0.19	0.18	0.06	1.1	1.1	1.0	0.3
Wickenburg Municipal	GA	0.77	0.73	2.75	0.61	4.2	4.0	15.0	3.3
Maricopa County totals:		**187.91**	**181.42**	**2,625.94**	**317.64**	**1,026.8**	**991.4**	**14,349.4**	**1,735.8**

4.12 Locomotives

Annual emissions from locomotives were calculated based on diesel fuel usage data 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 these two activity categories were calculated by multiplying diesel fuel usage by the emission factors listed in Table 4.12–1 (US EPA, 2009).

Table 4.12–1. Emission factors for locomotives.

Activity type	Emission factors (lbs/gal diesel)				
	PM_{10}	$PM_{2.5}$	NO_x	SO_x	NH_3
Class I haul line	0.015	0.014	0.394	0.004	0.0001
Yard/switch operations	0.015	0.014	0.421	0.004	0.0001

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 use (gals/yr) × PM_{10} emission factor (lbs/gal) ÷ 2,000 lbs/ton

= 7,780,284 gals/yr × 0.015 lbs/gal ÷ 2,000 lbs/ton

= 58.35 tons PM_{10}/yr

Table 4.12–2. Total diesel use and annual emissions from locomotives in Maricopa County.

Locomotive type	Diesel use (gals/yr)	Annual emissions (tons/yr)				
		PM_{10}	$PM_{2.5}$	NO_x	SO_x	NH_3
BNSF Class I haul line	750,094	5.63	5.25	147.77	1.50	0.36
UP Class I haul line	7,780,284	58.35	54.46	1,532.72	15.56	3.70
BNSF yard/switch operations	400,000	3.00	2.80	84.20	0.80	0.19
UP yard/switch operations	378,199	2.84	2.65	79.61	0.76	0.18
Amtrak	52,416	0.39	0.37	10.33	0.10	0.02
Totals:	**9,360,993**	**70.21**	**65.53**	**1,854.62**	**18.72**	**4.45**

PM_{10} nonattainment area emissions were calculated by multiplying Maricopa County emissions by the percentage of track miles within the PM_{10} nonattainment area, determined by GIS mapping. Results are shown in Table 4.12–3.

PM_{10} nonattainment area emissions from UP Class I haul lines (tons/yr) = County PM_{10} emissions (tons/yr) × Percentage of track miles within the PM_{10} nonattainment area

= 58.35 tons PM_{10}/yr × 44.27%

= 25.83 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	2.49	2.32	65.42	0.66	0.16
UP Class I haul line	44.27	25.83	24.11	678.53	6.89	1.64
BNSF yard/switch operations	100.00	3.00	2.80	84.20	0.80	0.19
UP yard/switch operations	100.00	2.84	2.65	79.61	0.76	0.18
Amtrak	0.00	0.00	0.00	0.00	0.00	0.00
Totals:		**34.16**	**31.88**	**907.76**	**9.11**	**2.16**

PM_{10} typical daily emissions for both the county (shown in Table 4.12–4) and the PM_{10} non-attainment area (Table 4.12–5) were calculated by dividing annual totals by 366 days (since 2008 was a leap 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 ÷ 366 days

= 58.35 tons PM_{10}/yr × 2000 lbs/ton ÷ 366 days

= 318.9 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	30.7	28.7	807.5	8.2	1.9
UP Class I haul line	318.9	297.6	8,375.5	85.0	20.2
BNSF yard/switch operations	16.4	15.3	460.1	4.4	1.0
UP yard/switch operations	15.5	14.5	435.0	4.1	1.0
Amtrak	2.1	2.0	56.4	0.6	0.1
Totals:	**383.6**	**358.1**	**10,134.5**	**102.3**	**24.3**

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	13.6	12.7	357.5	3.6	0.9
UP Class I haul line	141.2	131.8	3,707.8	37.6	8.9
BNSF yard/switch operations	16.4	15.3	460.1	4.4	1.0
UP yard/switch operations	15.5	14.5	435.0	4.1	1.0
Amtrak	0.0	0.0	0.0	0.0	0.0
Totals:	**186.7**	**174.2**	**4,960.4**	**49.8**	**11.8**

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. 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	34.27	33.24	365.55	0.14	0.67	219.7	213.1	2,343.3	0.9	4.3
Airport GSE	27.21	26.68	586.73	26.43		148.7	145.8	3,206.1	144.4	
Commercial	117.97	112.98	1,395.23	2.40	21.12	756.2	724.2	8,943.8	15.4	135.4
Construction & mining	1,260.98	1,220.75	14,796.63	6.60	28.10	8,083.2	7,825.3	94,850.2	42.3	180.1
Industrial	101.69	98.96	2,593.13	3.22	56.23	651.8	634.4	16,622.7	20.6	360.5
Lawn & garden	182.28	168.79	798.14	3.16	19.63	1,250.1	1,156.9	5,571.5	23.1	144.6
Pleasure craft	9.25	8.54	77.74	0.85	1.73	124.5	114.9	1,046.5	11.4	23.3
Railway maintenance	1.13	1.10	9.23	0.00	0.02	7.8	7.6	63.9	0.0	0.1
Recreational	45.58	41.98	63.80	0.42	2.10	389.6	358.8	545.3	3.6	18.0
Aircraft	187.91	181.41	2,625.94	317.64		1,026.8	991.3	14,349.4	1,735.8	
Locomotives	70.21	65.53	1,854.62	18.72	4.45	383.6	358.1	10,134.5	102.3	24.3
Totals:	**2,038.46**	**1,959.95**	**25,166.75**	**379.58**	**134.06**	**13,042.0**	**12,530.3**	**157,677.4**	**2,099.8**	**890.6**

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	15.13	14.67	161.35	0.06	0.30	97.0	94.0	1,034.3	0.4	1.9
Airport GSE	26.99	26.48	578.95	26.22		147.5	144.7	3,163.7	143.3	
Commercial	117.66	112.69	1,391.61	2.39	21.06	754.2	722.4	8,920.6	15.3	135.0
Construction & mining	1,249.88	1,210.00	14,666.42	6.55	27.85	8,012.1	7,756.4	94,015.6	42.0	178.5
Industrial	101.42	98.71	2,586.39	3.21	56.09	650.1	632.7	16,579.4	20.6	359.5
Lawn & garden	183.02	169.48	801.41	3.17	19.71	1,255.3	1,161.6	5,594.4	23.2	145.2
Pleasure craft	7.02	6.48	59.03	0.64	1.32	94.5	87.3	794.6	8.6	17.7
Railway maintenance	1.13	1.10	9.26	0.00	0.02	7.8	7.6	64.1	0.0	0.1
Recreational	7.68	7.08	10.76	0.07	0.35	65.7	60.5	91.9	0.6	3.0
Aircraft	183.80	177.60	2,620.31	316.00		1,004.3	970.5	14,318.6	1,726.8	
Locomotives	34.16	31.88	907.76	9.11	2.16	186.7	174.2	4,960.4	49.8	11.8
Totals:	**1,927.89**	**1,856.17**	**23,793.26**	**367.42**	**128.87**	**12,275.2**	**11,811.9**	**149,537.7**	**2,030.5**	**852.9**

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 not involved in developing the modeling inputs/outputs and spreadsheets being reviewed. 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 emissions have been calculated for particulate matter for the 2008 Periodic Emissions Inventory for the Maricopa County area. For the purposes of this particulate matter inventory, the following pollutants were included: PM_{10}, $PM_{2.5}$, nitrogen oxides (NO_x), sulfur dioxides (SO_2), and ammonia (NH_3). PM_{10} refers to all particles less than or equal to 10 micrometers in diameter and $PM_{2.5}$ refers to particles less than or equal to 2.5 micrometers in diameter.

Onroad mobile source emissions were estimated for the PM_{10} nonattainment area (NAA) (approximately 3,000 sq. mi.), as well as for Maricopa County (approximately 9,000 sq. mi.). Emission factors were calculated using the Motor Vehicle Emission Simulator (MOVES2010a) model, the most recent model developed by the U.S. EPA for the purpose of estimating motor vehicle emission factors, and AP-42, which is the EPA Compilation of Air Pollutant Emission Factors. AP-42 emission factors were used to calculate fugitive dust emissions, while MOVES2010a was used to estimate emissions from exhaust, tire wear, and brake wear.

The MOVES2010a modeling accounted for the oxygenated fuel and the Arizona Vehicle Inspection/Maintenance (I/M) programs applied in Maricopa County in 2008. The fuel use assumptions, including oxygen content and Reid Vapor Pressure (RVP), were derived from the 2008 fuel inspection results provided by the Arizona Department of Weights and Measures.

In order to develop the 2008 onroad mobile source emissions, the 2008 vehicle miles of travel (VMT) estimates by facility type and road type were derived from the 2008 Highway Performance Monitoring System (HPMS) data provided by the Arizona Department of Transportation (ADOT). The distribution of VMT by vehicle type is based on the July 2008 vehicle registration data for Maricopa County provided by ADOT. The VMT by vehicle type was provided as local input data for MOVES2010a to produce onroad exhaust, tire wear, and brake wear emissions.

Paved road fugitive dust emission estimates were derived from the AP-42 equation published by EPA in January 2011. The 2008 VMTs for freeways, high traffic arterials, and low traffic arterials were derived from the 2008 traffic assignment produced by the MAG travel demand model. Low traffic arterials carry less than 10,000 vehicles on an average weekday, while high traffic arterials carry 10,000 or more vehicles on an average weekday. These traffic assignment VMTs were normalized to 2008 HPMS VMTs and multiplied by the appropriate particulate emission factors derived from the AP-42 equation for paved roads. The 2008 benefits of the committed measures in the MAG 2007 Five Percent Plan for the Maricopa County PM10 Nonattainment Area (MAG, 2007) were applied to estimate 2008 paved road particulate emissions for the PEI.

Unpaved road VMT was derived from the MAG 2009 Unpaved Road Inventory (MAG, 2010). Unpaved alley VMT was derived from a GIS analysis of 2009 aerial photographs conducted by MAG. The unpaved road and alley VMTs were multiplied by the appropriate AP-42 emission factors. The 2008 benefits of the committed measures in the MAG 2007 Five Percent Plan were applied to estimate 2008 unpaved road and alley particulate emissions for this inventory.

The main references for preparing the onroad mobile source portion of the 2008 emissions inventory were:

- Emission Inventory Requirements for Ozone State Implementation Plans (EPA, 1991);
- Procedures for Emission Inventory Preparation Volume IV: Mobile Sources (EPA, 1992a);
- Compilation of Air Pollutant Emissions Factors, AP-42 (EPA, 2006);
- Technical Guidance on the Use of MOVES2010 for Emission Inventory Preparation in State Implementation Plans and Transportation Conformity (EPA, 2010a);
- User's Guide for the SMOKE-MOVES Integration Tool (EPA, 2010b); and
- Motor Vehicle Emission Simulator (MOVES) - User Guide for MOVES2010a, (EPA, 2010c).

5.2 Exhaust, tire wear, and brake wear emissions

Vehicle exhaust emission factors for PM_{10}, $PM_{2.5}$, NO_x, SO_2, and NH_3, as well as tire wear and brake wear emission factors for PM_{10} and $PM_{2.5}$, were calculated using MOVES2010a. The exhaust PM_{10} and $PM_{2.5}$ estimates include the components of sulfate and carbon (organic and elemental). The MOVES2010a runs were executed by MAG. The contact person for the MOVES2010a emission estimates is Ieesuck Jung (602-254-6300).

5.2.1 MOVES2010a model

The emissions not related to fugitive dust were calculated using MOVES2010a, the U.S. EPA's state-of-the-art emissions modeling tool, which replaces EPA's previous mobile source emissions model, MOBILE6.2. MOVES2010a is intended for official use to estimate national, state, and county level inventories of criteria air pollutants from highway vehicles. The user of MOVES2010a is allowed to specify vehicle types, time periods, geographical areas, pollutants, vehicle operating characteristics, and road types for the particular scenario to be modeled by creating a Run Specification (RunSpec).

In order to calculate vehicle emissions for the calendar year 2008, MOVES2010a was executed using local input data for each month of the year and each geographical area (Maricopa County and the PM_{10} NAA). Each scenario was created using the County Domain/Scale and the Inventory Calculation Type. The specific MOVES2010a model RunSpec and RunSpec summaries are described in Appendix 5.

5.2.2 MOVES2010a local input data

Compared with MOBILE6.2, MOVES2010a requires a more detailed level of local data, including fuel data, I/M program, meteorological data, vehicle population, source type age distribution, annual VMT, monthly/daily/hourly VMT fractions, road type distribution, average speed distribution, and ramp fraction.

5.2.2.1 Fuel data

Regarding the fuel local input data, MOVES2010a provides two MOVES tables, which are [fuelsupply] and [fuelformulation]. The fuel data for each month were derived from the 2008 fuel inspection results in Maricopa County provided by the Arizona Department of Weights and Measures. The fuel data for Maricopa County were also applied to the PM_{10} NAA. The specific MOVES tables for fuel data are presented in Appendix 5.

5.2.2.2 I/M programs

MOVES2010a has an [IMCoverage] table for I/M programs; this table was prepared using MOBILE6.2 input. This table reflects 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 Vehicle Inspection/Maintenance Program. It is important to note that participation in the I/M program is required for all vehicles registered in the PM_{10} NAA, with the exception of certain model years and vehicle classes. However, it is assumed that 91.6 percent of the vehicles operating within the PM_{10} NAA and Maricopa County participate in the I/M program and the remaining 8.4 percent do not participate in the program. These percentages reflect the control measures "Tougher Enforcement of Vehicle Registration and Emissions Test Compliance" and "Expansion of Area A Boundaries," described in the MAG Eight-Hour Ozone Redesignation Request and Maintenance Plan for the Maricopa Nonattainment Area (MAG, 2009). This percentage is directly applied to the Compliance Factor in the [IMCoverage] table. The same I/M programs were applied for Maricopa County and the PM_{10} NAA. The specific MOVES table for I/M programs is presented in Appendix 5.

5.2.2.3 Meteorological data

MOVES2010a requires hourly temperature and relative humidity data by specific month of the year. Meteorological data for the Phoenix Sky Harbor International Airport in 2008 were obtained from the National Climatic Data Center (http://www7.ncdc.noaa.gov/IPS/lcd/lcd.html?_page=1&state=AZ&wban=23183&_target2=Next+%3E). The same hourly average temperature and relative humidity data for each month were applied for Maricopa County and the PM_{10} NAA. The specific MOVES table [ZoneMonthHour] for meteorological data is presented in Appendix 5.

5.2.2.4 Vehicle population

In order to capture start, evaporative, and extended idle emissions, MOVES2010a introduced a new mobile source emission category called off-network emissions. In MOVES2010a, these off-network emissions are directly determined by the population of vehicles in an area. The vehicle population in Maricopa County was obtained from the July 2008 vehicle registration data provided by ADOT. The vehicle population data were allocated to the 28 MOBILE6.2 vehicle types based on MOBILE6.2 VMT fractions for 2008. Then, the vehicle population data allocated to the 28 MOBILE6.2 vehicle types were assigned to the 13 MOVES source types using the match-up table (Table A.1) in the EPA's technical guidance (EPA, 2010a). The vehicle population in the PM_{10} NAA was estimated by applying the population ratio of the two geographical areas to the vehicle population in Maricopa County. The population ratio for 2008 was derived from the MAG socioeconomic data, which is 4,005,000 people for the PM_{10} NAA and 3,988,000 people for Maricopa County. The specific MOVES table [SourceTypeYear] for vehicle population is presented in Appendix 5.

5.2.2.5 Source type age distribution

MOVES2010a categorizes vehicles according to different vehicle classes and model years. The source type age distribution was prepared using EPA's data converter that takes the registration distribution input file created for MOBILE6.2 and converts it to the appropriate MOVES age distribution input table [SourceTypeAgeDistribution]. The same source type age distribution was applied for Maricopa County and the PM_{10} NAA. The specific MOVES table for source type age distribution is presented in Appendix 5.

5.2.2.6 Annual VMT

The 2008 daily VMTs by facility type were used to estimate onroad exhaust, tire wear, and brake wear emissions. The 2008 VMT distributions by facility type for the PM10 NAA and Maricopa County were obtained from the 2008 Maricopa County Estimates of Daily Vehicle Travel by Highway Functional Classification provided by ADOT. The 2008 VMT distributions were multiplied by the 2008 HPMS VMT for the PM10 NAA and Maricopa County. The resultant VMT estimates by facility type for the PM10 NAA and Maricopa County are shown in Table 5.2–1.

Table 5.2–1. 2008 daily VMT by facility type (annual average daily traffic).

	Facility Type	PM_{10} NAA (thousand miles/day)	Maricopa County (thousand miles/day)
Rural	Interstate	2,581	3,223
	Other Principal Arterial	1,035	1,293
	Minor Arterial	529	661
	Major Collector	1,347	1,682
	Minor Collector	164	205
	Local	630	787
Urban	Interstate	10,606	10,939
	Other Freeway/Expressway	19,158	19,760
	Other Principal Arterial	21,961	22,651
	Minor Arterial	14,476	14,930
	Collector	4,717	4,865
	Local	9,949	10,261
Totals:		**87,153**	**91,257**

Since MOVES2010a requires annual VMTs by HPMS vehicle type as a local input, the daily VMTs by HPMS vehicle type were derived from the 2008 traffic assignment data provided by the MAG Transportation Modeling Group in March 2011 and the daily VMTs by facility type and the estimated percentages of daily vehicle travel by vehicle type and highway functional classification provided by ADOT. Then, the daily VMTs by HPMS vehicle type were multiplied by 366 days to obtain the annual VMTs by HPMS vehicle type. The specific MOVES table [HPMSvTypeYear] for annual VMT is presented in Appendix 5.

5.2.2.7 Road type distribution

MOVES2010a requires the distribution of VMTs by road type as a local input. The road type VMT distribution by HPMS vehicle type was derived from the 2008 traffic assignment data and the daily VMTs by HPMS vehicle type mentioned in the previous section. As suggested in EPA's technical guidance (EPA, 2010a), the same road type distribution by HPMS vehicle type was used for all MOVES source types within an HPMS vehicle class. The specific MOVES table [RoadTypeDistribution] for road type distribution is presented in Appendix 5.

5.2.2.8 VMT fraction

Since VMT varies by month, day of week, and hour, MOVES2010a requires month/day/hour VMT fractions as a local input in order to derive hourly VMT for each weekday/weekend and month from the annual VMT. The month/day/hour VMT fractions were developed from data recorded by continuous traffic counters on freeways (ADOT Freeway Management System) and arterials (Phoenix Automatic Traffic Recorders) during the year 2007. The specific MOVES tables [MonthVMTFraction], [DayVMTFraction], and [HourVMTFraction] for VMT fractions are presented in Appendix 5.

5.2.2.9 Average speed distribution

In MOVES2010a, vehicle power, speed, and acceleration have a significant effect on vehicle emissions for all pollutants. MOVES2010a estimates those emission effects by assigning activity to operating mode distributions, which are determined by the distribution of vehicle hours traveled (VHT) by average speed. As recommended in EPA's technical guidance (EPA, 2010a), local estimates of average speed were developed by post-processing the output from the 2008 traffic assignment data provided by the MAG Transportation Modeling Group in March 2011. To develop the average speed distribution, VHTs in sixteen speed bins were accumulated separately for each hour of the day, source type, and road type in Maricopa County. Then, the average speed distribution was calculated by normalizing VHTs in sixteen speed bins for each hour of the day, source type, and road type. The same methodology was applied to develop the speed estimates for the PM_{10} NAA. The specific MOVES table [AvgSpeedDistribution] for the average speed distribution is presented in Appendix 5.

5.2.2.10Ramp fraction

MOVES2010a requires the ramp fraction, which represents the percent of VHT on ramps, on both rural restricted roads (road type 2) and urban restricted roads (road type 4). The fraction of VHT on ramps was derived by dividing the total VHTs on ramps by the total VHTs for each restricted road type. Those VHTs were obtained from the 2008 traffic assignment data provided by the MAG Transportation Modeling Group in March 2011. The specific MOVES table [RoadType] for ramp fractions is presented in Appendix 5.

5.2.3 MOVES2010a outputs

MOVES2010a was executed with the RunSpec files described in Appendix 5 to obtain exhaust, tire wear, and brake wear emissions for PM_{10}, $PM_{2.5}$, NO_x, SO_2, and NH_3. These values were obtained for the following twelve vehicle classes: light duty gasoline vehicles (LDGV), light duty gasoline trucks 1 & 2 (LDGT1), light duty gasoline trucks 3 and 4 (LDGT2), heavy duty gasoline vehicles 2B thru 8B and gasoline buses (HDGV), motorcycles (MC), light duty diesel vehicles (LDDV), light duty diesel trucks 1 thru 4 (LDDT), heavy duty diesel vehicles class 2B (2BHDDV), heavy duty diesel vehicles class 3, 4, and 5 (LHDDV), heavy duty diesel vehicles class 6 and 7 (MHDDV), heavy duty diesel vehicles class 8A and 8B (HHDDV), and heavy duty diesel buses (BUSES); by the following thirteen facility types: rural interstate, rural principal arterial, rural minor arterial, rural major collector, rural minor collector, rural local, urban interstate, urban freeway/expressway, urban principal arterial, urban minor arterial, urban collector, urban local, and off-network, which was newly added in MOVES2010a; by weekdays and weekend days; by month.

5.2.4 MOVES2010a emission estimates

MOVES2010a was used to generate onroad emissions by vehicle class, facility type, weekdays/ weekend days, and month. The annual emissions were calculated by aggregating monthly on-road emissions derived by adding monthly weekday emissions, which is the product of daily weekday emissions estimated by MOVES2010a and the number of weekdays for a given month, and monthly weekend emissions, which is the product of daily weekend emissions estimated by MOVES2010a and the number of weekend days for a given month. The average daily emissions were calculated by dividing the annual emissions by 366 days.

Tables 5.2–2 and 5.2–3 show the calculated annual and average daily PM_{10}, $PM_{2.5}$, NO_x, SO_2, and NH_3 emissions by facility type and vehicle class in the PM_{10} NAA and Maricopa County, respectively. Emission estimates for PM_{10} and $PM_{2.5}$ in these tables represent exhaust, tire wear, and brake wear emissions.

Table 5.2–2. Annual and average daily onroad mobile source emissions by facility type and vehicle class in the PM_{10} NAA.

Facility Type	Vehicle Class	SCC	Annual emissions (tons/year)					Average daily emissions (lbs/day)				
			PM_{10}	$PM_{2.5}$	NO_x	SO_2	NH_3	PM_{10}	$PM_{2.5}$	NO_x	SO_2	NH_3
Rural Interstate	LDGV	2201001110	4.03	2.36	113.80	1.39	8.47	**PM_{10}**	**$PM_{2.5}$**	621.8	7.6	46.3
	LDGT1	2201020110	9.97	6.47	416.37	3.27	15.05	54.5	35.3	2,275.3	17.9	82.2
	LDGT2	2201040110	5.13	3.33	214.49	1.68	7.75	28.1	18.2	1,172.1	9.2	42.4
	HDGV	2201070110	2.16	1.30	116.05	0.71	2.44	11.8	7.1	634.1	3.9	13.4
	MC	2201080110	0.27	0.24	6.28	0.05	0.34	1.5	1.3	34.3	0.3	1.9
	LDDV	2230001110	0.05	0.05	0.73	0.00	0.01	0.3	0.2	4.0	0.0	0.0
	LDDT	2230060110	1.69	1.58	26.36	0.02	0.19	9.2	8.6	144.0	0.1	1.0
	2BHDDV	2230071110	0.71	0.66	11.70	0.01	0.08	3.9	3.6	63.9	0.1	0.5
	LHDDV	2230072110	4.12	3.85	62.48	0.05	0.44	22.5	21.1	341.4	0.3	2.4
	MHDDV	2230073110	14.60	13.06	299.34	0.24	0.99	79.8	71.4	1,635.7	1.3	5.4
	HHDDV	2230074110	46.97	42.91	1,072.87	0.84	2.54	256.7	234.5	5,862.7	4.6	13.9
	BUSES	2230075110	2.08	1.90	43.45	0.02	0.08	11.3	10.4	237.4	0.1	0.5
Rural Principal Arterial	LDGV	2201001130	4.47	2.00	99.90	1.25	6.86	24.4	10.9	545.9	6.9	37.5
	LDGT1	2201020130	6.17	3.02	206.39	1.67	6.98	33.7	16.5	1,127.8	9.1	38.2
	LDGT2	2201040130	3.18	1.55	106.32	0.86	3.60	17.4	8.5	581.0	4.7	19.7
	HDGV	2201070130	1.03	0.52	40.56	0.27	0.99	5.6	2.9	221.6	1.5	5.4
	MC	2201080130	0.43	0.36	11.30	0.09	0.56	2.3	2.0	61.8	0.5	3.1
	LDDV	2230001130	0.04	0.03	0.76	0.00	0.00	0.2	0.2	4.2	0.0	0.0
	LDDT	2230060130	0.94	0.85	15.35	0.01	0.09	5.1	4.7	83.9	0.1	0.5
	2BHDDV	2230071130	0.40	0.36	6.84	0.01	0.04	2.2	2.0	37.4	0.0	0.2
	LHDDV	2230072130	2.29	2.09	36.25	0.03	0.20	12.5	11.4	198.1	0.1	1.1
	MHDDV	2230073130	3.51	3.04	62.16	0.05	0.21	19.2	16.6	339.7	0.3	1.2
	HHDDV	2230074130	10.16	9.00	188.59	0.15	0.44	55.5	49.2	1,030.6	0.8	2.4
	BUSES	2230075130	0.86	0.76	15.40	0.01	0.03	4.7	4.2	84.1	0.0	0.2

Table 5.2–2. Annual and average daily onroad mobile source emissions by facility type and vehicle class in the PM_{10} NAA (continued).

Facility Type	Vehicle Class	SCC	Annual emissions (tons/year)					Average daily emissions (lbs/day)				
			PM_{10}	$PM_{2.5}$	NO_x	SO_2	NH_3	PM_{10}	$PM_{2.5}$	NO_x	SO_2	NH_3
Rural Minor Arterial	LDGV	2201001150	4.34	1.94	97.07	1.22	6.66	23.7	10.6	530.4	6.7	36.4
	LDGT1	2201020150	5.99	2.93	200.55	1.62	6.79	32.7	16.0	1,095.9	8.9	37.1
	LDGT2	2201040150	3.09	1.51	103.31	0.83	3.50	16.9	8.3	564.6	4.6	19.1
	HDGV	2201070150	1.00	0.51	39.41	0.26	0.96	5.5	2.8	215.4	1.4	5.2
	MC	2201080150	0.42	0.35	10.98	0.09	0.55	2.3	1.9	60.0	0.5	3.0
	LDDV	2230001150	0.04	0.03	0.74	0.00	0.00	0.2	0.2	4.1	0.0	0.0
	LDDT	2230060150	0.91	0.83	14.92	0.01	0.08	5.0	4.5	81.5	0.1	0.5
	2BHDDV	2230071150	0.39	0.35	6.64	0.00	0.04	2.1	1.9	36.3	0.0	0.2
	LHDDV	2230072150	2.23	2.03	35.23	0.03	0.20	12.2	11.1	192.5	0.1	1.1
	MHDDV	2230073150	3.41	2.96	60.40	0.05	0.21	18.7	16.2	330.1	0.3	1.1
	HHDDV	2230074150	9.87	8.75	183.26	0.14	0.43	54.0	47.8	1,001.4	0.8	2.3
	BUSES	2230075150	0.83	0.74	14.96	0.01	0.03	4.6	4.1	81.8	0.0	0.2
Rural Major Collector	LDGV	2201001170	0.81	0.36	18.09	0.23	1.24	4.4	2.0	98.9	1.2	6.8
	LDGT1	2201020170	1.12	0.55	37.38	0.30	1.27	6.1	3.0	204.3	1.6	6.9
	LDGT2	2201040170	0.58	0.28	19.26	0.16	0.65	3.1	1.5	105.2	0.8	3.6
	HDGV	2201070170	0.19	0.09	7.35	0.05	0.18	1.0	0.5	40.1	0.3	1.0
	MC	2201080170	0.08	0.06	2.05	0.02	0.10	0.4	0.4	11.2	0.1	0.6
	LDDV	2230001170	0.01	0.01	0.14	0.00	0.00	0.0	0.0	0.8	0.0	0.0
	LDDT	2230060170	0.17	0.15	2.78	0.00	0.02	0.9	0.8	15.2	0.0	0.1
	2BHDDV	2230071170	0.07	0.07	1.24	0.00	0.01	0.4	0.4	6.8	0.0	0.0
	LHDDV	2230072170	0.42	0.38	6.57	0.00	0.04	2.3	2.1	35.9	0.0	0.2
	MHDDV	2230073170	0.64	0.55	11.26	0.01	0.04	3.5	3.0	61.5	0.0	0.2
	HHDDV	2230074170	1.84	1.63	34.16	0.03	0.08	10.1	8.9	186.7	0.1	0.4
	BUSES	2230075170	0.16	0.14	2.79	0.00	0.01	0.9	0.8	15.2	0.0	0.0
Rural Minor Collector	LDGV	2201001190	0.19	0.08	4.19	0.05	0.29	1.0	0.5	22.9	0.3	1.6
	LDGT1	2201020190	0.26	0.13	8.65	0.07	0.29	1.4	0.7	47.3	0.4	1.6
	LDGT2	2201040190	0.13	0.07	4.46	0.04	0.15	0.7	0.4	24.4	0.2	0.8
	HDGV	2201070190	0.04	0.02	1.70	0.01	0.04	0.2	0.1	9.3	0.1	0.2
	MC	2201080190	0.02	0.02	0.47	0.00	0.02	0.1	0.1	2.6	0.0	0.1
	LDDV	2230001190	0.00	0.00	0.03	0.00	0.00	0.0	0.0	0.2	0.0	0.0
	LDDT	2230060190	0.04	0.04	0.64	0.00	0.00	0.2	0.2	3.5	0.0	0.0
	2BHDDV	2230071190	0.02	0.02	0.29	0.00	0.00	0.1	0.1	1.6	0.0	0.0
	LHDDV	2230072190	0.10	0.09	1.52	0.00	0.01	0.5	0.5	8.3	0.0	0.0
	MHDDV	2230073190	0.15	0.13	2.61	0.00	0.01	0.8	0.7	14.2	0.0	0.0
	HHDDV	2230074190	0.43	0.38	7.91	0.01	0.02	2.3	2.1	43.2	0.0	0.1
	BUSES	2230075190	0.04	0.03	0.65	0.00	0.00	0.2	0.2	3.5	0.0	0.0
Rural Local	LDGV	2201001210	1.96	0.88	43.76	0.55	3.00	10.7	4.8	239.1	3.0	16.4
	LDGT1	2201020210	2.70	1.32	90.41	0.73	3.06	14.8	7.2	494.0	4.0	16.7
	LDGT2	2201040210	1.39	0.68	46.57	0.38	1.58	7.6	3.7	254.5	2.1	8.6
	HDGV	2201070210	0.45	0.23	17.77	0.12	0.43	2.5	1.3	97.1	0.7	2.4
	MC	2201080210	0.19	0.16	4.95	0.04	0.25	1.0	0.9	27.0	0.2	1.4
	LDDV	2230001210	0.02	0.01	0.33	0.00	0.00	0.1	0.1	1.8	0.0	0.0
	LDDT	2230060210	0.41	0.37	6.73	0.00	0.04	2.2	2.0	36.7	0.0	0.2
	2BHDDV	2230071210	0.17	0.16	3.00	0.00	0.02	1.0	0.9	16.4	0.0	0.1
	LHDDV	2230072210	1.00	0.92	15.88	0.01	0.09	5.5	5.0	86.8	0.1	0.5
	MHDDV	2230073210	1.54	1.33	27.23	0.02	0.09	8.4	7.3	148.8	0.1	0.5
	HHDDV	2230074210	4.45	3.94	82.61	0.06	0.19	24.3	21.6	451.4	0.4	1.1
	BUSES	2230075210	0.38	0.33	6.74	0.00	0.01	2.1	1.8	36.9	0.0	0.1

Table 5.2–2. Annual and average daily onroad mobile source emissions by facility type and vehicle class in the PM_{10} NAA (continued).

Facility Type	Vehicle Class	SCC	Annual emissions (tons/year)					Average daily emissions (lbs/day)				
			PM_{10}	$PM_{2.5}$	NO_x	SO_2	NH_3	PM_{10}	$PM_{2.5}$	NO_x	SO_2	NH_3
Urban Interstate	LDGV	2201001230	34.07	19.77	826.32	10.12	59.49	186.2	108.0	4,515.4	55.3	325.1
	LDGT1	2201020230	61.65	38.52	2,159.31	17.31	76.76	336.9	210.5	11,799.5	94.6	419.4
	LDGT2	2201040230	31.76	19.84	1,112.37	8.92	39.54	173.6	108.4	6,078.5	48.7	216.1
	HDGV	2201070230	13.64	7.78	662.41	4.08	12.90	74.5	42.5	3,619.7	22.3	70.5
	MC	2201080230	4.11	3.60	78.03	0.65	4.24	22.4	19.6	426.4	3.5	23.2
	LDDV	2230001230	0.43	0.38	5.36	0.01	0.04	2.4	2.1	29.3	0.0	0.2
	LDDT	2230060230	9.50	8.78	145.30	0.12	0.92	51.9	48.0	794.0	0.6	5.1
	2BHDDV	2230071230	4.02	3.70	64.53	0.05	0.41	21.9	20.2	352.6	0.3	2.3
	LHDDV	2230072230	23.20	21.48	344.36	0.27	2.17	126.8	117.4	1,881.8	1.5	11.8
	MHDDV	2230073230	84.59	74.53	1,618.55	1.29	5.20	462.2	407.3	8,844.5	7.1	28.4
	HHDDV	2230074230	238.30	214.02	4,871.28	3.82	11.30	1,302.2	1,169.5	26,619.0	20.9	61.7
	BUSES	2230075230	18.04	16.38	348.55	0.19	0.65	98.6	89.5	1,904.6	1.0	3.5
Urban Freeway And Expressway	LDGV	2201001250	35.75	20.74	866.95	10.62	62.41	195.3	113.3	4,737.5	58.0	341.0
	LDGT1	2201020250	64.69	40.41	2,265.51	18.16	80.53	353.5	220.8	12,379.8	99.2	440.1
	LDGT2	2201040250	33.32	20.82	1,167.08	9.35	41.49	182.1	113.8	6,377.5	51.1	226.7
	HDGV	2201070250	14.31	8.16	694.98	4.28	13.53	78.2	44.6	3,797.7	23.4	74.0
	MC	2201080250	4.31	3.77	81.87	0.68	4.45	23.6	20.6	447.4	3.7	24.3
	LDDV	2230001250	0.45	0.40	5.63	0.01	0.04	2.5	2.2	30.7	0.0	0.2
	LDDT	2230060250	9.97	9.21	152.44	0.12	0.97	54.5	50.3	833.0	0.7	5.3
	2BHDDV	2230071250	4.21	3.88	67.70	0.05	0.43	23.0	21.2	370.0	0.3	2.4
	LHDDV	2230072250	24.34	22.53	361.30	0.28	2.27	133.0	123.1	1,974.3	1.5	12.4
	MHDDV	2230073250	88.75	78.19	1,698.15	1.36	5.45	485.0	427.3	9,279.5	7.4	29.8
	HHDDV	2230074250	250.02	224.55	5,110.85	4.00	11.85	1,366.2	1,227.0	27,928.1	21.9	64.8
	BUSES	2230075250	18.92	17.19	365.69	0.20	0.68	103.4	93.9	1,998.3	1.1	3.7
Urban Principal Arterial	LDGV	2201001270	112.79	45.15	1,898.68	24.98	123.71	616.3	246.7	10,375.3	136.5	676.0
	LDGT1	2201020270	150.63	61.39	3,540.67	31.15	114.87	823.1	335.5	19,347.9	170.2	627.7
	LDGT2	2201040270	77.59	31.63	1,823.98	16.05	59.17	424.0	172.8	9,967.1	87.7	323.4
	HDGV	2201070270	26.09	10.35	725.63	5.36	16.59	142.6	56.5	3,965.2	29.3	90.7
	MC	2201080270	6.29	5.08	130.89	1.31	6.61	34.4	27.8	715.2	7.1	36.1
	LDDV	2230001270	0.86	0.64	16.10	0.02	0.07	4.7	3.5	88.0	0.1	0.4
	LDDT	2230060270	20.07	17.65	336.50	0.22	1.35	109.7	96.4	1,838.8	1.2	7.4
	2BHDDV	2230071270	8.56	7.50	149.81	0.10	0.60	46.8	41.0	818.7	0.5	3.3
	LHDDV	2230072270	49.11	43.37	797.14	0.49	3.16	268.3	237.0	4,356.0	2.7	17.3
	MHDDV	2230073270	93.47	77.13	1,474.01	1.15	3.96	510.8	421.5	8,054.7	6.3	21.6
	HHDDV	2230074270	268.61	229.65	4,055.08	3.18	7.98	1,467.8	1,254.9	22,158.9	17.4	43.6
	BUSES	2230075270	20.39	17.43	301.38	0.16	0.50	111.4	95.2	1,646.9	0.9	2.7
Urban Minor Arterial	LDGV	2201001290	57.33	22.95	965.09	12.70	62.88	313.3	125.4	5,273.7	69.4	343.6
	LDGT1	2201020290	76.56	31.20	1,799.71	15.83	58.39	418.4	170.5	9,834.5	86.5	319.1
	LDGT2	2201040290	39.44	16.08	927.12	8.16	30.08	215.5	87.8	5,066.2	44.6	164.4
	HDGV	2201070290	13.26	5.26	368.83	2.72	8.43	72.5	28.7	2,015.5	14.9	46.1
	MC	2201080290	3.20	2.58	66.53	0.66	3.36	17.5	14.1	363.6	3.6	18.3
	LDDV	2230001290	0.44	0.33	8.18	0.01	0.04	2.4	1.8	44.7	0.1	0.2
	LDDT	2230060290	10.20	8.97	171.04	0.11	0.68	55.7	49.0	934.6	0.6	3.7
	2BHDDV	2230071290	4.35	3.81	76.15	0.05	0.31	23.8	20.8	416.1	0.3	1.7
	LHDDV	2230072290	24.96	22.05	405.18	0.25	1.61	136.4	120.5	2,214.1	1.4	8.8
	MHDDV	2230073290	47.51	39.20	749.23	0.58	2.01	259.6	214.2	4,094.2	3.2	11.0
	HHDDV	2230074290	136.53	116.73	2,061.18	1.62	4.06	746.1	637.9	11,263.3	8.8	22.2
	BUSES	2230075290	10.37	8.86	153.19	0.08	0.25	56.6	48.4	837.1	0.5	1.4

Table 5.2–2. Annual and average daily onroad mobile source emissions by facility type and vehicle class in the PM_{10} NAA (continued).

Facility Type	Vehicle Class	SCC	Annual emissions (tons/year)					Average daily emissions (lbs/day)				
			PM_{10}	$PM_{2.5}$	NO_x	SO_2	NH_3	PM_{10}	$PM_{2.5}$	NO_x	SO_2	NH_3
Urban Collector	LDGV	2201001310	11.20	4.48	188.48	2.48	12.28	61.2	24.5	1,029.9	13.6	67.1
	LDGT1	2201020310	14.95	6.09	351.47	3.09	11.40	81.7	33.3	1,920.6	16.9	62.3
	LDGT2	2201040310	7.70	3.14	181.06	1.59	5.87	42.1	17.2	989.4	8.7	32.1
	HDGV	2201070310	2.59	1.03	72.03	0.53	1.65	14.2	5.6	393.6	2.9	9.0
	MC	2201080310	0.62	0.50	12.99	0.13	0.66	3.4	2.8	71.0	0.7	3.6
	LDDV	2230001310	0.09	0.06	1.60	0.00	0.01	0.5	0.3	8.7	0.0	0.0
	LDDT	2230060310	1.99	1.75	33.40	0.02	0.13	10.9	9.6	182.5	0.1	0.7
	2BHDDV	2230071310	0.85	0.74	14.87	0.01	0.06	4.6	4.1	81.3	0.1	0.3
	LHDDV	2230072310	4.87	4.31	79.13	0.05	0.31	26.6	23.5	432.4	0.3	1.7
	MHDDV	2230073310	9.28	7.66	146.32	0.11	0.39	50.7	41.8	799.6	0.6	2.1
	HHDDV	2230074310	26.66	22.80	402.53	0.32	0.79	145.7	124.6	2,199.6	1.7	4.3
	BUSES	2230075310	2.02	1.73	29.92	0.02	0.05	11.1	9.5	163.5	0.1	0.3
Urban Local	LDGV	2201001330	54.04	21.63	909.78	11.97	59.28	295.3	118.2	4,971.5	65.4	323.9
	LDGT1	2201020330	72.17	29.42	1,696.57	14.93	55.04	394.4	160.7	9,270.9	81.6	300.8
	LDGT2	2201040330	37.18	15.15	873.99	7.69	28.35	203.2	82.8	4,775.9	42.0	154.9
	HDGV	2201070330	12.50	4.96	347.69	2.57	7.95	68.3	27.1	1,900.0	14.0	43.4
	MC	2201080330	3.01	2.44	62.72	0.63	3.17	16.5	13.3	342.7	3.4	17.3
	LDDV	2230001330	0.41	0.31	7.71	0.01	0.03	2.2	1.7	42.1	0.1	0.2
	LDDT	2230060330	9.62	8.46	161.24	0.10	0.65	52.5	46.2	881.1	0.6	3.5
	2BHDDV	2230071330	4.10	3.59	71.79	0.05	0.29	22.4	19.6	392.3	0.3	1.6
	LHDDV	2230072330	23.53	20.78	381.96	0.24	1.51	128.6	113.6	2,087.2	1.3	8.3
	MHDDV	2230073330	44.79	36.96	706.29	0.55	1.90	244.7	202.0	3,859.5	3.0	10.4
	HHDDV	2230074330	128.71	110.04	1,943.05	1.52	3.82	703.3	601.3	10,617.8	8.3	20.9
	BUSES	2230075330	9.77	8.35	144.41	0.08	0.24	53.4	45.6	789.1	0.4	1.3
Off-Network	LDGV	2201001000	69.77	64.25	4,540.27	6.29	0.00	381.3	351.1	24,810.2	34.4	0.0
	LDGT1	2201020000	20.34	18.73	1,572.71	1.46	0.00	111.2	102.4	8,594.0	8.0	0.0
	LDGT2	2201040000	10.48	9.65	810.18	0.75	0.00	57.3	52.7	4,427.2	4.1	0.0
	HDGV	2201070000	3.97	3.66	251.38	0.22	0.00	21.7	20.0	1,373.7	1.2	0.0
	MC	2201080000	0.08	0.07	2.31	0.02	0.00	0.4	0.4	12.6	0.1	0.0
	LDDV	2230001000	6.41	6.22	18.94	0.01	0.00	35.0	34.0	103.5	0.0	0.0
	LDDT	2230060000	1.48	1.44	28.27	0.01	0.00	8.1	7.9	154.5	0.0	0.0
	2BHDDV	2230071000	0.53	0.51	12.31	0.00	0.00	2.9	2.8	67.3	0.0	0.0
	LHDDV	2230072000	3.33	3.23	66.71	0.02	0.00	18.2	17.6	364.5	0.1	0.0
	MHDDV	2230073000	2.24	2.18	147.44	0.03	0.00	12.3	11.9	805.7	0.2	0.0
	HHDDV	2230074000	31.74	30.79	2,629.48	0.44	0.00	173.4	168.2	14,368.7	2.4	0.0
	BUSES	2230075000	0.24	0.24	4.00	0.01	0.00	1.3	1.3	21.9	0.0	0.0

Table 5.2–3. Annual and average daily onroad mobile source emissions by facility type and vehicle class in Maricopa County.

Facility Type	Vehicle Class	SCC	Annual emissions (tons/year)					Average daily emissions (lbs/day)				
			PM_{10}	$PM_{2.5}$	NO_x	SO_2	NH_3	PM_{10}	$PM_{2.5}$	NO_x	SO_2	NH_3
Rural Interstate	LDGV	2201001110	4.06	2.41	122.38	1.47	9.05	22.2	13.2	668.8	8.0	49.5
	LDGT1	2201020110	12.43	8.28	561.77	4.35	20.14	67.9	45.2	3,069.8	23.8	110.1
	LDGT2	2201040110	6.40	4.26	289.40	2.24	10.38	35.0	23.3	1,581.4	12.2	56.7
	HDGV	2201070110	2.48	1.56	135.09	0.84	3.05	13.6	8.6	738.2	4.6	16.7
	MC	2201080110	0.33	0.29	7.83	0.06	0.44	1.8	1.6	42.8	0.3	2.4
	LDDV	2230001110	0.05	0.05	0.77	0.00	0.01	0.3	0.3	4.2	0.0	0.0
	LDDT	2230060110	2.17	2.03	34.87	0.03	0.25	11.8	11.1	190.6	0.2	1.4
	2BHDDV	2230071110	0.91	0.86	15.47	0.01	0.11	5.0	4.7	84.5	0.1	0.6
	LHDDV	2230072110	5.28	4.96	82.73	0.07	0.59	28.9	27.1	452.1	0.4	3.2
	MHDDV	2230073110	16.74	15.10	362.98	0.29	1.15	91.5	82.5	1,983.5	1.6	6.3
	HHDDV	2230074110	62.15	57.25	1,498.95	1.17	3.49	339.6	312.8	8,191.0	6.4	19.1
	BUSES	2230075110	2.07	1.90	44.50	0.02	0.08	11.3	10.4	243.1	0.1	0.5
Rural Principal Arterial	LDGV	2201001130	4.94	2.22	111.37	1.40	7.66	27.0	12.1	608.6	7.6	41.9
	LDGT1	2201020130	7.96	3.93	270.70	2.18	9.19	43.5	21.5	1,479.2	11.9	50.2
	LDGT2	2201040130	4.10	2.02	139.45	1.12	4.73	22.4	11.1	762.0	6.1	25.9
	HDGV	2201070130	1.33	0.68	52.65	0.35	1.29	7.3	3.7	287.7	1.9	7.1
	MC	2201080130	0.54	0.45	14.17	0.12	0.71	2.9	2.4	77.4	0.6	3.9
	LDDV	2230001130	0.04	0.04	0.85	0.00	0.00	0.2	0.2	4.6	0.0	0.0
	LDDT	2230060130	1.22	1.11	19.83	0.01	0.11	6.6	6.1	108.4	0.1	0.6
	2BHDDV	2230071130	0.52	0.47	8.83	0.01	0.05	2.8	2.6	48.3	0.0	0.3
	LHDDV	2230072130	2.97	2.71	46.80	0.03	0.27	16.2	14.8	255.7	0.2	1.5
	MHDDV	2230073130	4.71	4.10	85.77	0.07	0.29	25.7	22.4	468.7	0.4	1.6
	HHDDV	2230074130	14.61	13.03	286.25	0.22	0.68	79.8	71.2	1,564.2	1.2	3.7
	BUSES	2230075130	1.09	0.97	19.60	0.01	0.04	5.9	5.3	107.1	0.1	0.2
Rural Minor Arterial	LDGV	2201001150	4.80	2.16	108.22	1.36	7.45	26.2	11.8	591.4	7.4	40.7
	LDGT1	2201020150	7.74	3.82	263.05	2.12	8.93	42.3	20.9	1,437.4	11.6	48.8
	LDGT2	2201040150	3.99	1.97	135.51	1.09	4.60	21.8	10.8	740.5	6.0	25.1
	HDGV	2201070150	1.29	0.66	51.17	0.34	1.26	7.0	3.6	279.6	1.9	6.9
	MC	2201080150	0.52	0.43	13.77	0.11	0.69	2.8	2.4	75.2	0.6	3.8
	LDDV	2230001150	0.04	0.03	0.82	0.00	0.00	0.2	0.2	4.5	0.0	0.0
	LDDT	2230060150	1.18	1.08	19.27	0.01	0.11	6.5	5.9	105.3	0.1	0.6
	2BHDDV	2230071150	0.50	0.46	8.58	0.01	0.05	2.7	2.5	46.9	0.0	0.3
	LHDDV	2230072150	2.89	2.64	45.48	0.03	0.26	15.8	14.4	248.5	0.2	1.4
	MHDDV	2230073150	4.57	3.98	83.34	0.07	0.28	25.0	21.7	455.4	0.4	1.5
	HHDDV	2230074150	14.20	12.66	278.16	0.22	0.66	77.6	69.2	1,520.0	1.2	3.6
	BUSES	2230075150	1.06	0.94	19.04	0.01	0.04	5.8	5.1	104.1	0.1	0.2
Rural Major Collector	LDGV	2201001170	0.89	0.40	20.17	0.25	1.39	4.9	2.2	110.2	1.4	7.6
	LDGT1	2201020170	1.44	0.71	49.03	0.40	1.66	7.9	3.9	267.9	2.2	9.1
	LDGT2	2201040170	0.74	0.37	25.26	0.20	0.86	4.1	2.0	138.0	1.1	4.7
	HDGV	2201070170	0.24	0.12	9.54	0.06	0.23	1.3	0.7	52.1	0.3	1.3
	MC	2201080170	0.10	0.08	2.57	0.02	0.13	0.5	0.4	14.0	0.1	0.7
	LDDV	2230001170	0.01	0.01	0.15	0.00	0.00	0.0	0.0	0.8	0.0	0.0
	LDDT	2230060170	0.22	0.20	3.59	0.00	0.02	1.2	1.1	19.6	0.0	0.1
	2BHDDV	2230071170	0.09	0.08	1.60	0.00	0.01	0.5	0.5	8.7	0.0	0.1
	LHDDV	2230072170	0.54	0.49	8.48	0.01	0.05	2.9	2.7	46.3	0.0	0.3
	MHDDV	2230073170	0.85	0.74	15.53	0.01	0.05	4.7	4.1	84.9	0.1	0.3
	HHDDV	2230074170	2.65	2.36	51.84	0.04	0.12	14.5	12.9	283.3	0.2	0.7
	BUSES	2230075170	0.20	0.18	3.55	0.00	0.01	1.1	1.0	19.4	0.0	0.0

Table 5.2–3. Annual and average daily onroad mobile source emissions by facility type and vehicle class in Maricopa County (continued).

Facility Type	Vehicle Class	SCC	Annual emissions (tons/year)					Average daily emissions (lbs/day)				
			PM_{10}	$PM_{2.5}$	NO_x	SO_2	NH_3	PM_{10}	$PM_{2.5}$	NO_x	SO_2	NH_3
Rural Minor Collector	LDGV	2201001190	0.21	0.09	4.67	0.06	0.32	1.1	0.5	25.5	0.3	1.8
	LDGT1	2201020190	0.33	0.16	11.35	0.09	0.39	1.8	0.9	62.0	0.5	2.1
	LDGT2	2201040190	0.17	0.08	5.85	0.05	0.20	0.9	0.5	32.0	0.3	1.1
	HDGV	2201070190	0.06	0.03	2.21	0.01	0.05	0.3	0.2	12.1	0.1	0.3
	MC	2201080190	0.02	0.02	0.59	0.00	0.03	0.1	0.1	3.2	0.0	0.2
	LDDV	2230001190	0.00	0.00	0.04	0.00	0.00	0.0	0.0	0.2	0.0	0.0
	LDDT	2230060190	0.05	0.05	0.83	0.00	0.00	0.3	0.3	4.5	0.0	0.0
	2BHDDV	2230071190	0.02	0.02	0.37	0.00	0.00	0.1	0.1	2.0	0.0	0.0
	LHDDV	2230072190	0.12	0.11	1.96	0.00	0.01	0.7	0.6	10.7	0.0	0.1
	MHDDV	2230073190	0.20	0.17	3.60	0.00	0.01	1.1	0.9	19.7	0.0	0.1
	HHDDV	2230074190	0.61	0.55	12.00	0.01	0.03	3.3	3.0	65.6	0.1	0.2
	BUSES	2230075190	0.05	0.04	0.82	0.00	0.00	0.2	0.2	4.5	0.0	0.0
Rural Local	LDGV	2201001210	2.16	0.97	48.79	0.61	3.36	11.8	5.3	266.6	3.3	18.3
	LDGT1	2201020210	3.49	1.72	118.58	0.96	4.02	19.1	9.4	648.0	5.2	22.0
	LDGT2	2201040210	1.80	0.89	61.09	0.49	2.07	9.8	4.8	333.8	2.7	11.3
	HDGV	2201070210	0.58	0.30	23.07	0.15	0.57	3.2	1.6	126.0	0.8	3.1
	MC	2201080210	0.23	0.20	6.21	0.05	0.31	1.3	1.1	33.9	0.3	1.7
	LDDV	2230001210	0.02	0.02	0.37	0.00	0.00	0.1	0.1	2.0	0.0	0.0
	LDDT	2230060210	0.53	0.49	8.69	0.01	0.05	2.9	2.7	47.5	0.0	0.3
	2BHDDV	2230071210	0.23	0.21	3.87	0.00	0.02	1.2	1.1	21.1	0.0	0.1
	LHDDV	2230072210	1.30	1.19	20.50	0.01	0.12	7.1	6.5	112.0	0.1	0.6
	MHDDV	2230073210	2.06	1.79	37.57	0.03	0.13	11.3	9.8	205.3	0.2	0.7
	HHDDV	2230074210	6.40	5.71	125.39	0.10	0.30	35.0	31.2	685.2	0.5	1.6
	BUSES	2230075210	0.48	0.42	8.59	0.00	0.02	2.6	2.3	46.9	0.0	0.1
Urban Interstate	LDGV	2201001230	35.00	20.31	849.09	10.40	61.12	191.2	111.0	4,639.9	56.8	334.0
	LDGT1	2201020230	63.55	39.72	2,226.82	17.85	79.15	347.3	217.0	12,168.4	97.5	432.5
	LDGT2	2201040230	32.74	20.46	1,147.15	9.19	40.77	178.9	111.8	6,268.6	50.2	222.8
	HDGV	2201070230	14.10	8.04	686.11	4.22	13.33	77.1	43.9	3,749.2	23.1	72.8
	MC	2201080230	4.24	3.71	80.48	0.67	4.37	23.2	20.3	439.8	3.7	23.9
	LDDV	2230001230	0.44	0.39	5.51	0.01	0.04	2.4	2.1	30.1	0.0	0.2
	LDDT	2230060230	9.80	9.05	149.81	0.12	0.95	53.5	49.5	818.7	0.7	5.2
	2BHDDV	2230071230	4.14	3.82	66.53	0.05	0.43	22.6	20.8	363.6	0.3	2.3
	LHDDV	2230072230	23.92	22.14	355.07	0.28	2.24	130.7	121.0	1,940.3	1.5	12.2
	MHDDV	2230073230	87.96	77.50	1,683.69	1.35	5.40	480.7	423.5	9,200.5	7.4	29.5
	HHDDV	2230074230	248.09	222.83	5,074.27	3.98	11.77	1,355.7	1,217.7	27,728.2	21.7	64.3
	BUSES	2230075230	18.74	17.02	362.14	0.20	0.67	102.4	93.0	1,978.9	1.1	3.7
Urban Freeway And Express way	LDGV	2201001250	36.72	21.31	890.85	10.91	64.12	200.6	116.4	4,868.1	59.6	350.4
	LDGT1	2201020250	66.67	41.67	2,336.34	18.72	83.04	364.3	227.7	12,766.9	102.3	453.8
	LDGT2	2201040250	34.35	21.47	1,203.57	9.65	42.78	187.7	117.3	6,576.9	52.7	233.8
	HDGV	2201070250	14.79	8.43	719.85	4.43	13.99	80.8	46.1	3,933.6	24.2	76.4
	MC	2201080250	4.45	3.89	84.44	0.70	4.59	24.3	21.3	461.4	3.8	25.1
	LDDV	2230001250	0.46	0.41	5.78	0.01	0.04	2.5	2.2	31.6	0.0	0.2
	LDDT	2230060250	10.28	9.50	157.18	0.13	1.00	56.2	51.9	858.9	0.7	5.5
	2BHDDV	2230071250	4.34	4.00	69.81	0.06	0.45	23.7	21.9	381.5	0.3	2.4
	LHDDV	2230072250	25.10	23.23	372.53	0.29	2.35	137.1	126.9	2,035.7	1.6	12.8
	MHDDV	2230073250	92.29	81.32	1,766.50	1.41	5.67	504.3	444.3	9,653.0	7.7	31.0
	HHDDV	2230074250	260.29	233.79	5,323.82	4.17	12.35	1,422.3	1,277.6	29,091.9	22.8	67.5
	BUSES	2230075250	19.66	17.86	379.95	0.21	0.70	107.5	97.6	2,076.2	1.1	3.8

Table 5.2–3. Annual and average daily onroad mobile source emissions by facility type and vehicle class in Maricopa County (continued).

Facility Type	Vehicle Class	SCC	Annual emissions (tons/year)					Average daily emissions (lbs/day)				
			PM_{10}	$PM_{2.5}$	NO_x	SO_2	NH_3	PM_{10}	$PM_{2.5}$	NO_x	SO_2	NH_3
Urban Principal Arterial	LDGV	2201001270	116.26	46.54	1,955.75	25.74	127.42	635.3	254.3	10,687.2	140.7	696.3
	LDGT1	2201020270	155.34	63.31	3,649.06	32.11	118.39	848.9	345.9	19,940.2	175.5	646.9
	LDGT2	2201040270	80.03	32.61	1,879.82	16.54	60.99	437.3	178.2	10,272.2	90.4	333.3
	HDGV	2201070270	26.96	10.68	750.02	5.54	17.12	147.3	58.4	4,098.5	30.3	93.6
	MC	2201080270	6.49	5.24	134.88	1.35	6.81	35.4	28.7	737.1	7.4	37.2
	LDDV	2230001270	0.88	0.66	16.58	0.02	0.07	4.8	3.6	90.6	0.1	0.4
	LDDT	2230060270	20.69	18.19	346.70	0.22	1.39	113.0	99.4	1,894.5	1.2	7.6
	2BHDDV	2230071270	8.82	7.73	154.36	0.10	0.62	48.2	42.2	843.5	0.5	3.4
	LHDDV	2230072270	50.62	44.71	821.30	0.51	3.26	276.6	244.3	4,488.0	2.8	17.8
	MHDDV	2230073270	97.03	80.06	1,530.08	1.19	4.11	530.2	437.5	8,361.1	6.5	22.5
	HHDDV	2230074270	278.56	238.17	4,204.75	3.30	8.27	1,522.2	1,301.5	22,976.8	18.0	45.2
	BUSES	2230075270	21.19	18.11	313.11	0.17	0.51	115.8	99.0	1,711.0	0.9	2.8
Urban Minor Arterial	LDGV	2201001290	59.09	23.65	994.10	13.08	64.77	322.9	129.3	5,432.2	71.5	353.9
	LDGT1	2201020290	78.96	32.18	1,854.80	16.32	60.18	431.5	175.8	10,135.5	89.2	328.8
	LDGT2	2201040290	40.68	16.58	955.50	8.41	31.00	222.3	90.6	5,221.3	46.0	169.4
	HDGV	2201070290	13.70	5.43	381.23	2.82	8.70	74.9	29.7	2,083.2	15.4	47.6
	MC	2201080290	3.30	2.67	68.56	0.68	3.46	18.0	14.6	374.6	3.7	18.9
	LDDV	2230001290	0.45	0.34	8.43	0.01	0.04	2.5	1.8	46.1	0.1	0.2
	LDDT	2230060290	10.51	9.25	176.23	0.11	0.71	57.5	50.5	963.0	0.6	3.9
	2BHDDV	2230071290	4.48	3.93	78.46	0.05	0.32	24.5	21.5	428.7	0.3	1.7
	LHDDV	2230072290	25.73	22.72	417.46	0.26	1.65	140.6	124.2	2,281.2	1.4	9.0
	MHDDV	2230073290	49.32	40.70	777.73	0.61	2.09	269.5	222.4	4,249.9	3.3	11.4
	HHDDV	2230074290	141.59	121.06	2,137.26	1.68	4.20	773.7	661.5	11,679.0	9.2	23.0
	BUSES	2230075290	10.77	9.20	159.15	0.09	0.26	58.9	50.3	869.7	0.5	1.4
Urban Collector	LDGV	2201001310	11.54	4.62	194.14	2.56	12.65	63.1	25.2	1,060.9	14.0	69.1
	LDGT1	2201020310	15.42	6.28	362.23	3.19	11.75	84.3	34.3	1,979.4	17.4	64.2
	LDGT2	2201040310	7.94	3.24	186.60	1.64	6.05	43.4	17.7	1,019.7	9.0	33.1
	HDGV	2201070310	2.68	1.06	74.45	0.55	1.70	14.6	5.8	406.8	3.0	9.3
	MC	2201080310	0.64	0.52	13.39	0.13	0.68	3.5	2.8	73.2	0.7	3.7
	LDDV	2230001310	0.09	0.07	1.65	0.00	0.01	0.5	0.4	9.0	0.0	0.0
	LDDT	2230060310	2.05	1.81	34.42	0.02	0.14	11.2	9.9	188.1	0.1	0.8
	2BHDDV	2230071310	0.88	0.77	15.32	0.01	0.06	4.8	4.2	83.7	0.1	0.3
	LHDDV	2230072310	5.02	4.44	81.53	0.05	0.32	27.5	24.2	445.5	0.3	1.8
	MHDDV	2230073310	9.63	7.95	151.89	0.12	0.41	52.6	43.4	830.0	0.6	2.2
	HHDDV	2230074310	27.65	23.64	417.39	0.33	0.82	151.1	129.2	2,280.8	1.8	4.5
	BUSES	2230075310	2.10	1.80	31.08	0.02	0.05	11.5	9.8	169.8	0.1	0.3
Urban Local	LDGV	2201001330	55.71	22.30	937.13	12.33	61.05	304.4	121.8	5,120.9	67.4	333.6
	LDGT1	2201020330	74.44	30.33	1,748.50	15.39	56.73	406.8	165.8	9,554.7	84.1	310.0
	LDGT2	2201040330	38.35	15.63	900.74	7.93	29.22	209.5	85.4	4,922.1	43.3	159.7
	HDGV	2201070330	12.92	5.12	359.38	2.65	8.20	70.6	28.0	1,963.8	14.5	44.8
	MC	2201080330	3.11	2.51	64.63	0.65	3.26	17.0	13.7	353.2	3.5	17.8
	LDDV	2230001330	0.42	0.32	7.95	0.01	0.03	2.3	1.7	43.4	0.1	0.2
	LDDT	2230060330	9.91	8.72	166.13	0.11	0.66	54.2	47.6	907.8	0.6	3.6
	2BHDDV	2230071330	4.23	3.70	73.96	0.05	0.30	23.1	20.2	404.2	0.3	1.6
	LHDDV	2230072330	24.25	21.42	393.54	0.24	1.56	132.5	117.1	2,150.5	1.3	8.5
	MHDDV	2230073330	46.49	38.36	733.16	0.57	1.97	254.1	209.6	4,006.3	3.1	10.8
	HHDDV	2230074330	133.47	114.12	2,014.77	1.58	3.96	729.4	623.6	11,009.7	8.6	21.7
	BUSES	2230075330	10.15	8.68	150.03	0.08	0.25	55.5	47.4	819.8	0.4	1.3

Table 5.2–3. Annual and average daily onroad mobile source emissions by facility type and vehicle class in Maricopa County (continued).

Facility Type	Vehicle Class	SCC	Annual emissions (tons/year)					Average daily emissions (lbs/day)				
			PM_{10}	$PM_{2.5}$	NO_x	SO_2	NH_3	PM_{10}	$PM_{2.5}$	NO_x	SO_2	NH_3
Off-Network	LDGV	2201001000	69.48	63.97	4,520.99	6.27	0.00	379.6	349.6	24,704.9	34.3	0.0
	LDGT1	2201020000	20.26	18.65	1,566.03	1.46	0.00	110.7	101.9	8,557.5	8.0	0.0
	LDGT2	2201040000	10.44	9.61	806.74	0.75	0.00	57.0	52.5	4,408.4	4.1	0.0
	HDGV	2201070000	3.96	3.64	250.31	0.22	0.00	21.6	19.9	1,367.8	1.2	0.0
	MC	2201080000	0.08	0.07	2.30	0.02	0.00	0.4	0.4	12.6	0.1	0.0
	LDDV	2230001000	6.38	6.19	18.86	0.01	0.00	34.9	33.8	103.1	0.0	0.0
	LDDT	2230060000	1.48	1.43	28.15	0.01	0.00	8.1	7.8	153.8	0.0	0.0
	2BHDDV	2230071000	0.53	0.51	12.26	0.00	0.00	2.9	2.8	67.0	0.0	0.0
	LHDDV	2230072000	3.31	3.22	66.42	0.02	0.00	18.1	17.6	363.0	0.1	0.0
	MHDDV	2230073000	2.34	2.27	155.73	0.03	0.00	12.8	12.4	851.0	0.2	0.0
	HHDDV	2230074000	33.61	32.61	2,787.80	0.46	0.00	183.7	178.2	15,233.9	2.5	0.0
	BUSES	2230075000	0.24	0.24	3.99	0.01	0.00	1.3	1.3	21.8	0.0	0.0

5.3 Fugitive dust emissions

While exhaust, tire wear, and brake wear emissions were calculated using the EPA MOVES-2010a model, fugitive dust emissions from paved and unpaved roads were calculated using the equations found in sections 13.2.1 and 13.2.2 of the EPA Compilation of Air Pollutant Emission Factors, AP-42 (EPA, 2006). The new AP-42 equation published by EPA in January 2011 has been applied to estimate the PM_{10} and $PM_{2.5}$ emissions from paved roads. The contact person for the fugitive dust emission estimates is Cathy Arthur (602-254-6300).

5.3.1 Paved road fugitive dust emissions

In the AP-42 equation, paved road emissions are a function of silt loading values and the average weight of vehicles traveling on paved road surfaces. Paved roads have been classified as freeways, high-traffic arterials, and low-traffic arterials to reflect different silt loading assumptions. An arterial carrying a traffic volume of less than 10,000 vehicles per average weekday is classified as low-traffic; all other roads that are not freeways are classified as high-traffic arterials. The silt loading levels, in grams per square meter, are 0.02 for freeways, 0.067 for high-traffic arterials, and 0.23 for low-traffic arterials. The silt loadings were derived from paved road samples collected in Maricopa County by an EPA contractor (US EPA, 1993). The average vehicle weights were derived from July 1, 2010 vehicle registrations for Maricopa County provided by the Arizona Department of Transportation. The fugitive dust emission factors for paved roads were derived by applying the following AP-42 equation:

$$E = k \times sL^{0.91} \times W^{1.02} \times (1 - P/4N)$$

where: E = annual average particulate emission factor (g/mile),
k = particle size multiplier for particle size range (1.0 g/mile for PM_{10} and 0.25 g/mile for $PM_{2.5}$),
sL = road surface silt loading (0.02 g/m^2 for freeways, 0.067 g/m^2 for high-traffic arterials, and 0.23 g/m^2 for low-traffic arterials),
W = average weight of the vehicles traveling on the roads (3.53 tons on freeways and 2.65 tons on arterials),

P = annual number of "wet" days with at least 0.254 mm (0.01 in) of precipitation (39 days[3] in 2008), and
N = annual number of days (366 days in 2008).

The annual average PM_{10} and $PM_{2.5}$ emission factors for paved roads derived from the AP-42 equation are presented in Table 5.3–1.

The 2008 VMTs by silt loading category were used to estimate paved road fugitive dust emissions. Daily VMTs by silt loading category for the PM_{10} NAA and Maricopa County are shown in Table 5.3–2. The VMTs were derived by applying geographic information systems (GIS) to a 2008 traffic assignment output by the MAG travel demand model, TransCAD. The 2008 weekday traffic volumes output by TransCAD were normalized to 2008 HPMS VMTs for the PM_{10} NAA and Maricopa County to produce the VMTs by silt loading category shown in Table 5.3–2.

Table 5.3–1. 2008 fugitive dust emission factors for paved roads.

	Emission factors (g/mile)	
Silt Loading Category	**PM_{10}**	**$PM_{2.5}$**
Freeways	0.10	0.03
High Traffic Arterials	0.22	0.06
Low Traffic Arterials	0.69	0.17

Table 5.3–2. 2008 VMT by silt loading category for paved roads.

	Daily VMT	
Silt Loading Category	**PM_{10} NAA**	**Maricopa County**
Freeways	30,835,329	32,526,693
High Traffic Arterials	42,498,543	43,586,568
Low Traffic Arterials	13,819,127	15,143,740
Totals:	**87,153,000**	**91,257,000**

Applying the emission factors in Table 5.3–1 to the VMTs in Table 5.3–2 and converting to pounds per day produces the 2008 uncontrolled particulate emissions from paved roads for the PM_{10} NAA and Maricopa County, shown in Table 5.3–3. These uncontrolled emissions do not include the 2008 emission reductions attributed to the committed measures in the MAG 2007 Five Percent Plan.

Table 5.3–3. 2008 uncontrolled fugitive dust emissions from paved roads.

	PM_{10} NAA(lbs/day)		Maricopa County (lbs/day)	
Silt Loading Category	**PM_{10}**	**$PM_{2.5}$**	**PM_{10}**	**$PM_{2.5}$**
Freeways	6,798.0	2,039.4	7,170.8	2,151.3
High Traffic Arterials	20,612.3	5,621.5	21,140.0	5,765.5
Low Traffic Arterials	21,021.3	5,179.2	23,036.3	5,675.6
Totals:	**48,431.6**	**12,840.1**	**51,347.1**	**13,592.4**

The MAG 2007 Five Percent Plan contains a number of committed measures that reduce paved road fugitive dust emissions in the PM_{10} NAA. Five committed measures that reduce paved road particulate emissions were quantified in the MAG 2007 Five Percent Plan. Table 5.3–4 shows the emission reductions attributed to these committed measures based on their implementation

[3] Precipitation data for 2008 were obtained from National Oceanic and Atmospheric Administration (NOAA) in the form of local climatological data at Phoenix Sky Harbor Airport.

status in 2008. In addition, Table 5.3–4 includes emission reduction credit for 97 PM_{10}-certified street sweepers purchased by December 31, 2007 with FY 2001–2006 MAG Congestion Mitigation and Air Quality Improvement (CMAQ) funds. Reductions for the sweepers that were purchased with FY 2001–2006 CMAQ funds were also applied to base case uncontrolled paved road emissions in the MAG 2007 Five Percent Plan.

The emission benefits in Table 5.3–4 were subtracted from the uncontrolled PM_{10} emissions in Table 5.3–3. The total 2008 PM_{10} emission reduction of 11,851.1 pounds per day in the PM_{10} NAA represents 24.5 percent of the uncontrolled PM_{10} emissions of 48,431.6 pounds per day. This percent reduction was applied to the uncontrolled $PM_{2.5}$ emissions in the PM_{10} NAA; then the absolute reduction in $PM_{2.5}$ emissions due to the control measures was applied to the uncontrolled $PM_{2.5}$ emissions in Maricopa County. The controlled emissions in tons per year and pounds per day are shown in Table 5.3–5.

Table 5.3–4. 2008 benefits of measures that reduce paved road fugitive dust in the PM10 NAA[4].

	PM_{10} emission reduction	
Committed Measures in the MAG 2007 Five Percent Plan	**Annual (tons/year)**	**Average daily (lbs/day)[5]**
1. Public education and outreach program (Measure 1)[6]	7.7	42.2
2. Reduce trackout onto paved roads (Measures 14/15/17)	579.9	3,169.0
3. Sweep streets with PM_{10}-certified sweepers (Measure 24)	166.9	911.9
4. Pave or stabilize existing unpaved shoulders (Measure 28)	233.3	1,274.6
5. Additional $5M in FY07 MAG TIP for paving roads/shoulders (Measure 43)[7]	8.2	44.8
97 PM_{10}-certified sweepers purchased with FY 2001–2006 CMAQ funds:	1,172.8	6,408.6
Total 2008 PM_{10} emission reductions for paved roads:	**2,168.8**	**11,851.1**

Table 5.3–5. Annual controlled fugitive dust emissions from paved roads.

	Annual emissions (tons/year)		Average daily emissions (lbs/day)	
Geographic Area	**PM_{10}**	**$PM_{2.5}$**	**PM_{10}**	**$PM_{2.5}$**
PM_{10} NAA	6,694.2	1,774.8	36,580.5	9,698.1
Maricopa County	7,227.8	1,912.4	39,496.0	10,450.4

5.3.2 Unpaved road fugitive dust emissions

AP-42 emission factors were applied to unpaved road and alley VMTs to estimate fugitive dust emissions (US EPA, 2006). The unpaved road and alley particulate emission factors were derived from the following AP-42 equation for publicly accessible unpaved roads, assuming a silt content of 11.9%, a soil moisture content of 0.5%, and an average speed of 25 miles per hour on unpaved roads and 10 miles per hour on unpaved alleys:

[4] The 2008 benefits of the committed measures in the Five Percent Plan have been reduced by 61 percent to reflect the new AP-42 equation for paved road dust released by EPA in January 2011.
[5] 366 days were used to convert tons per year to pounds per day in 2008.
[6] Measure benefit reflects a 0.1% reduction in 2008 uncontrolled paved road emissions in the MAG 2007 Five Percent Plan.
[7] Measure benefit includes only the projects that paved unpaved shoulders in 2008.

$$E = \left[\frac{k\left(\frac{s}{12}\right)^{1}\left(\frac{S}{30}\right)^{0.5}}{\left(\frac{M}{0.5}\right)^{0.2}} - C \right]\left(1 - \frac{P}{N}\right)$$

where: E = annual average particulate emission factor extrapolated for natural mitigation (lb/mile),

k = particle size multiplier for particle size range (1.8 lb/mile for PM_{10} and 0.18 lb/mile for $PM_{2.5}$),

s = surface material silt content (11.9%),

S = mean vehicle speed (25 mph for unpaved roads and 10 mph for unpaved alleys),

M = surface material moisture content (0.5%),

C = emission factor for 1980's vehicle fleet exhaust, brake wear and tire wear (0.00047 lb/mile for PM_{10} and 0.00036 lb/mile for $PM_{2.5}$),

P = annual number of "wet" days with at least 0.254 mm (0.01 in) of precipitation (39 days in 2008), and

N = annual number of days (366 days in 2008).

The unpaved road emission factors resulting from the above equation are 1.4554 pounds per mile for PM_{10} and 0.1453 pounds per mile for $PM_{2.5}$. The unpaved alley emission factors are 0.9203 pounds per mile for PM_{10} and 0.0918 pounds per mile for $PM_{2.5}$.

The 2008 daily VMTs on unpaved roads and alleys in the PM_{10} NAA and Maricopa County are shown in Table 5.3–6. The 2008 VMT for unpaved roads in the PM_{10} NAA was derived from the MAG 2009 Unpaved Road Inventory (MAG, 2010). The 2008 VMT for unpaved alleys was derived by multiplying a MAG GIS-derived estimate of 650 miles of dirt alleys by an annual average daily traffic estimate of 9.1 vehicles per day.

The 2008 Maricopa County VMT was obtained by applying a ratio of 1.047 to the PM_{10} NAA VMT in Table 5.3–6. This ratio represents 2008 VMT on all roads in Maricopa County to 2008 VMT on all roads in the PM_{10} NAA, as derived in Table 5.3–7. The VMTs in Table 5.3–7 represent 2008 HPMS data submitted to the Federal Highway Administration by ADOT in August 2009.

Table 5.3–6. 2008 VMT on unpaved roads in the PM10 NAA and Maricopa County.

	2008 Annual Average Daily VMT	
Geographic Area	**Unpaved Roads**	**Unpaved Alleys**
PM_{10} NAA	47,984	5,915
Maricopa County	50,239	6,193

Table 5.3–7. 2008 VMT on all roads in the PM10 NAA and Maricopa County.

Geographic Area	2008 Annual Average Daily VMT (in thousands)	Ratio to 2008 Annual Average Daily VMT in the PM_{10} NAA
PM_{10} NAA	87,153	1.000
Maricopa County	91,257	1.047

Multiplying the unpaved road emission factors by the VMTs in Table 5.3–6 results in the uncontrolled emissions shown in Table 5.3–8. These uncontrolled emissions do not include the 2008 emission reductions attributed to the committed measures in the MAG 2007 Five Percent Plan for PM_{10}.

Table 5.3–8. Daily uncontrolled unpaved road and alley fugitive dust emissions.

	PM_{10} (lbs/day)		$PM_{2.5}$ (lbs/day)	
Geographic Area	Unpaved Roads	Unpaved Alleys	Unpaved Roads	Unpaved Alleys
PM_{10} NAA	69,835.9	5,443.6	6,972.1	543.0
Maricopa County	73,117.8	5,699.4	7,299.7	568.5

The MAG 2007 Five Percent Plan contains a number of committed measures that reduce unpaved road and alley fugitive dust emissions in the PM_{10} NAA (MAG, 2007). Four committed measures that reduce unpaved road and alley PM_{10} emissions were quantified in the MAG 2007 Five Percent Plan. The 2008 emission reductions attributed to these measures are shown in Table 5.3–9.

Table 5.3–9. 2008 benefits of measures that reduce unpaved road and alley fugitive dust in the PM10 NAA.

	PM_{10} emission reductions	
Committed Measures in the MAG 2007 Five Percent Plan	Annual (tons/year)	Average daily (lbs/day)[8]
1. Public education and outreach program (Measure 1)[9]	17.5	95.6
2. Pave or stabilize existing public dirt roads and alleys (Measure 26)	1,488.0	8,131.2
3. Limit speeds to 15 mph on high-traffic dirt roads (Measure 27)	390.4	2,133.4
4. Additional $5M in FY07 MAG TIP for paving roads/shoulders (Measure 43)[10]	169.5	926.2
Total 2008 PM_{10} emission reductions for unpaved roads:	**2,065.4**	**11,286.4**

The reductions in Table 5.3–9 were subtracted from the uncontrolled PM_{10} emissions in Table 5.3–8. The total 2008 PM_{10} emission reduction of 11,286.4 pounds per day represents 15.0 percent of the total uncontrolled unpaved road and alley PM_{10} emissions of 75,279.5 pounds per day in the PM_{10} NAA. This percent reduction was applied to the uncontrolled $PM_{2.5}$ emissions in the PM_{10} NAA; then the absolute reduction in $PM_{2.5}$ emissions due to the control measures was applied to the uncontrolled $PM_{2.5}$ emissions in Maricopa County. The controlled emissions in tons per year and pounds per day are shown in Table 5.3–10.

Table 5.3–10. Annual and average daily controlled fugitive dust emissions from unpaved roads.

	Annual emissions (tons/year)		Average daily emissions (lbs/day)	
Area	PM_{10}	$PM_{2.5}$	PM_{10}	$PM_{2.5}$
PM_{10} NAA	11,710.70	1,169.00	63,993.1	6,387.8
Maricopa County	12,358.20	1,233.60	67,530.9	6,741.0

[8] 366 days were used to convert tons per year to pounds per day in 2008.
[9] Measure benefit reflects a 0.1% reduction in 2008 uncontrolled paved road emissions in the MAG 2007 Five Percent Plan.
[10] Measure benefit includes only the projects that paved unpaved roads in 2008.

5.4 Summary of particulate emissions from onroad mobile sources

Table 5.4–1 summarizes the annual emissions and the average daily emissions for PM_{10}, $PM_{2.5}$, NO_x, SO_2, and NH_3 from all onroad mobile sources in Maricopa County in 2008. Similar data for the PM_{10} NAA are presented in Table 5.4–2.

Table 5.4–1. Annual and average daily emissions from all onroad mobile sources in Maricopa County.

Emission Category	Annual emissions (tons/year)					Average daily emissions (lbs/day)				
	PM_{10}	$PM_{2.5}$	NO_x	SO_2	NH_3	PM_{10}	$PM_{2.5}$	NO_x	SO_2	NH_3
Exhaust, tire wear, and brake wear	3,295.74	2,417.89	75,033.94	314.45	1,294.12	18,009.2	13,212.4	410,021.3	1,718.2	7,072.1
Paved road fugitive dust	7,227.77	1,912.42	—	—	—	39,496.0	10,450.4	—	—	—
Unpaved road and alley fugitive dust	12,358.20	1,233.60	—	—	—	67,530.9	6,741.0	—	—	—
Totals:	**22,881.71**	**5,563.91**	**75,033.94**	**314.45**	**1,294.12**	**125,036.1**	**30,403.8**	**410,021.3**	**1,718.2**	**7,072.1**

Table 5.4–2. Annual and average daily emissions from all onroad mobile sources in the PM10 NAA.

Emission Category	Annual emissions (tons/year)					Average daily emissions (lbs/day)				
	PM_{10}	$PM_{2.5}$	NO_x	SO_2	NH_3	PM_{10}	$PM_{2.5}$	NO_x	SO_2	NH_3
Exhaust, tire wear, and brake wear	3,144.17	2,300.80	71,444.20	300.66	1,235.28	17,181.3	12,572.9	390,405.5	1,643.0	6,750.5
Paved road fugitive dust	6,694.22	1,774.76	—	—	—	36,580.5	9,698.1	—	—	—
Unpaved road and alley fugitive dust	11,710.70	1,169.00	—	—	—	63,993.1	6,387.8	—	—	—
Totals:	**21,549.09**	**5,244.56**	**71,444.20**	**300.66**	**1,235.28**	**117,754.9**	**28,658.8**	**390,405.5**	**1,643.0**	**6,750.5**

5.5 Quality assurance process

5.5.1 VMT estimates

Normal quality assurance procedures, including automated and manual consistency checks, were conducted by MAG in developing the 2008 TransCAD traffic assignment network used to generate the VMT data. The VMT estimates using the MAG travel demand model have been validated against approximately 2,200 traffic counts collected in 2006–2008.

5.5.2 Emission estimates

The quality assurance process performed on the MOVES2010a analyses included accuracy, completeness, and reasonableness checks. For accuracy and completeness, all calculations were checked by an independent reviewer. Any errors found were corrected and the changes were then rechecked by the reviewer.

5.5.3 Draft particulate matter emissions inventory

The draft onroad mobile source portion of the 2008 periodic PM_{10} emissions inventory was reviewed using published EPA quality review guidelines for base year emission inventories (EPA, 1992b). The procedure review (Levels I, II, and III) included checks for completeness, consistency, and the correct use of appropriate procedures.

5.6 References

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US EPA, 2010b. User's Guide for the SMOKE-MOVES Integration Tool, EPA Contract EP-D-07-102 (WA 3-03), July 2010.

US EPA, 2010c. Motor Vehicle Emission Simulator (MOVES) - User Guide for MOVES2010a, EPA-420-B-10-036, August 2010.

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6. Biogenic Sources

6.1 Introduction

Biogenic emissions have been estimated for the 2008 Periodic Emissions Inventory for particulate matter in Maricopa County (9,223 square miles) and the PM_{10} Nonattainment Area (NAA) (2,887 square miles). The Model of Emissions of Gases and Aerosols from Nature (MEGAN) has been used to estimate the biogenic emissions. MEGAN is a state-of-the-art biogenic emissions model developed by the National Center for Atmospheric Research (NCAR). Some important corrections and improvements were made in the latest version of MEGAN2.04 (Guenther, 2007) compared to previous versions (Guenther, 2006, 2006a and 2006b). MEGAN2.04 was applied to compute biogenic emissions in Maricopa County and the PM_{10} NAA. Among the chemical species included in MEGAN, only nitric oxide (NO) is attributable to particulate matter formation. Therefore, only NO_x emissions are included in the inventory. The MEGAN runs were executed by the Maricopa Association of Governments. The contact person for the MEGAN emission estimates is Feng Liu (602-254-6300).

6.2 Modeling domain

As a numerical model, the MEGAN inputs and outputs are given in user-defined two-dimensional grid cells. To develop biogenic emissions for the 2008 Periodic Emission Inventory for particulate matter, the 4-km and 12-km modeling domains developed for the MAG eight-hour ozone plans for the Maricopa Nonattainment Area (MAG, 2007 and 2009), were employed for the PM_{10} NAA and Maricopa County, respectively. The definitions of these two domains in the Universal Transverse Mercator (UTM) coordinate system are presented in Table 6.2–1. Since MEGAN estimates biogenic emissions for entire modeling domains rather than specific areas, additional input files, masking areas covered by the PM_{10} NAA and Maricopa County, were developed by applying Geographic Information Systems (GIS) to calculate emissions for those two target areas. In order to represent the target area, the masking file assigns 1.0 for the grid cells fully covered by the target area, a fractional value for grid cells partially covered by the target area, and 0.0 for grid cells outside the target area. As shown in Figure 6.3–1, biogenic emissions for the PM_{10} NAA and Maricopa County were extracted from MEGAN runs for the masked grid cells in the 4-km and 12-km modeling domains, respectively.

Table 6.2–1. Two modeling domains defined in the UTM coordinate system.

Grid Horizontal Resolution	Grid Size	Domain Range (km)	Target Area
4-km	50 × 29	(297,3652) to (497,3768)	PM_{10} NAA
12-km	111 × 84	(275, 3188) to (1,057,4196)	Maricopa County

6.3 Input data

To calculate biogenic emissions using MEGAN, the following gridded input files for land cover and meteorological data were prepared:

1. EFMAP_LAI file: This file provides emission factors (EF) for 20 MEGAN species including NO, and monthly average leaf index (LAI) for 12 months for each grid cell.

2. PFTF file: This input file gives percentage of four plant function types (PFT) including broadleaf trees (BT), needle leaf trees (NT), grass and crops (HB) and shrubs (SB) for each model domain grid location.

3. METCRO2D file: This file contains meteorological parameters including temperature, short wave radiation, wind speed, humidity and soil moisture for each grid.

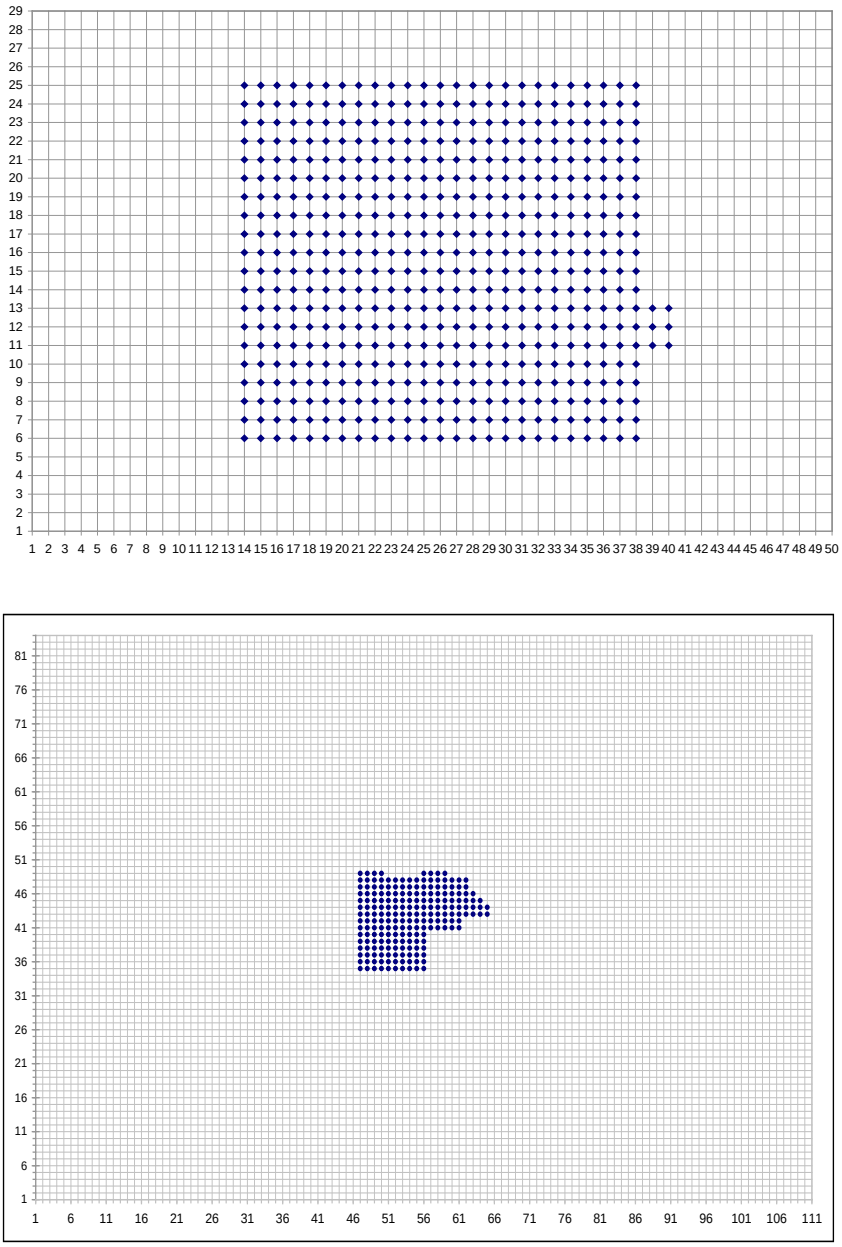

Figure 6.3–1. Mask of the PM_{10} NAA in the 4-km modeling domain (top) and mask of Maricopa County in the 12-km modeling domain (bottom).

6.3.1 Land cover data

The land cover data, including the monthly LAI, PFT, and EF, are provided by the EFMAP_LAI and PFTF files. These input data were derived from the MEGAN land cover database available

at a base resolution of 30 seconds latitude by 30 seconds longitude (~1×km^2) in ArcGIS format (http://acd.ucar.edu/~guenther/MEGAN/MEGAN.htm). For the MEGAN runs, however, the default land cover data during the summer season (June to August) were replaced by local datasets, which were developed by a field study conducted by Dr. Guenther in June 2006 (ENVIRON, 2006). The substitution was made because the default database systematically underestimated the LAIs in Maricopa County.

6.3.2 Weather data

The weather data used by MEGAN are temperature, downward short wave radiation, wind speed, humidity and soil moisture. The Measurement and Instrumentation Data Center (MIDC) collects irradiance and meteorological data from nation-wide stations, one of which is located in northern Phoenix (33.83° N, 112.17° W, denoted by red star in Figure 6.3–2), and is operated by the Phoenix Federal Correction Institution (PFCI). The archived hourly temperature, wind speed, humidity and radiation data from this site are available to the public. Monthly mean diurnal cycles of the weather parameters were calculated based on hourly data for the year 2008, and a netCDF file representing 24-hour data for each month was prepared for MEGAN inputs.

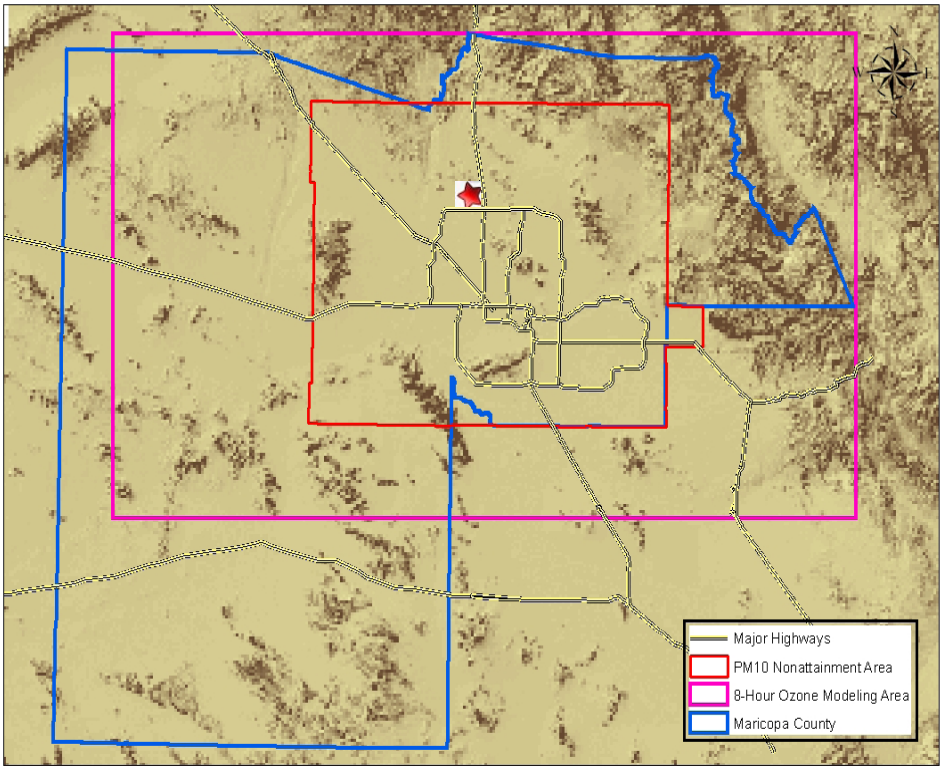

Figure 6.3–2. Boundaries of the PM_{10} NAA (red line), the 4-km eight-hour ozone modeling domain (pink line), Maricopa County (blue line), and the meteorological observation site (red star).

Biogenic NO is mainly emitted from wetted soil. The emission rate is dependent not only upon temperature and downward short wave radiation but also on soil moisture. Due to dry conditions year round in Maricopa County, the NO flux from the surface is very low compared to other states with higher precipitation. Only moisture delivery by Arizona monsoons leads to precipitation during the summer. This precipitation, in turn, increases soil moisture and humidity. According to weather records at the Phoenix Sky Harbor International Airport, the precipitation

in the Phoenix area was 0.0 and 2.15 inches in June and July 2008, respectively. Therefore, maximum monthly NO emissions occurred in July 2008. In general, however, NO emissions in the Maricopa County area are temperature and radiation dominated during the year. Figure 6.3–3 shows annual mean diurnal cycles of temperature and radiation. The peak temperature around 4:00–5:00 pm lags three hours behind the peak radiation. The delay is due to the fact that heating of the air occurs not from the sun's rays, but from heating of the earth and infrared radiation leaving the ground in the form of heat. As a result, maximum hourly emission rates take place in the afternoon because the emission rates are positively related to both temperature and short wave radiation (Guenther, 2006).

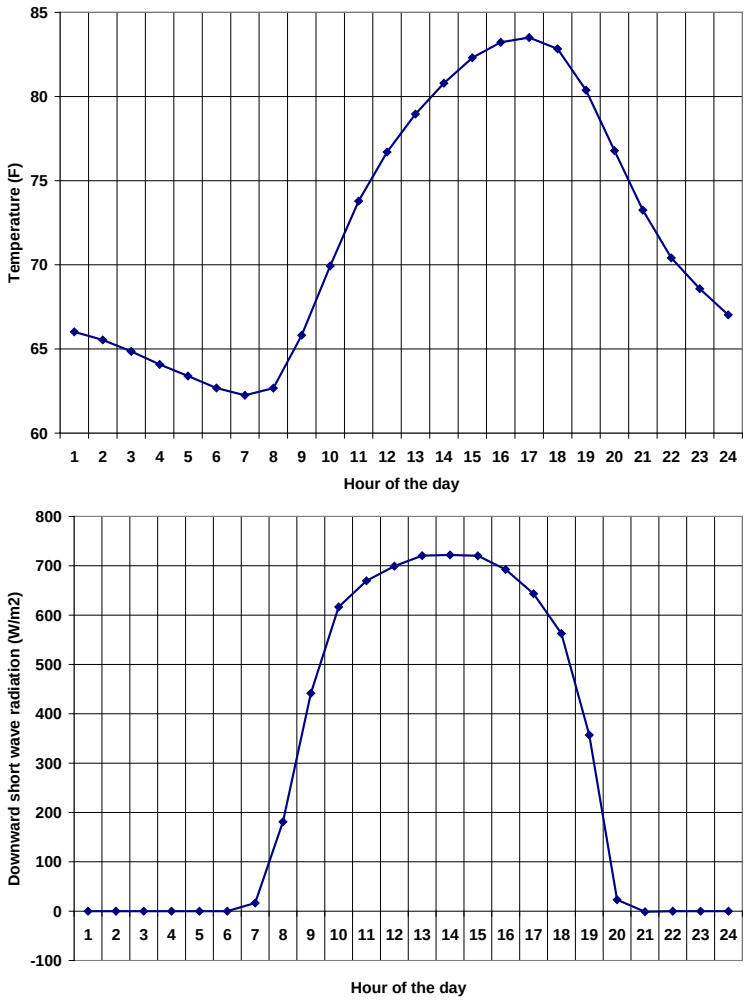

Figure 6.3–3. Annual mean diurnal cycles of measured temperature (top panel) and downward short wave radiation (bottom panel) in 2008.

6.4 Emissions estimation

MEGAN runs for the two modeling domains provide hourly emission outputs for the year 2008. Daily mean emissions for each month in 2008 were derived by using the hourly outputs for each month. In addition, monthly total emissions were obtained by multiplying the daily mean emissions for each month by the number of days in the month. The daily mean emissions for the 12 months of 2008 are shown in Table 6.4–1.

Table 6.4–1. Daily mean biogenic emissions of NO_x in the PM_{10} NAA and Maricopa County, by month.

	PM_{10} NAA		Maricopa County	
Month	**kg/day**	**lbs/day**	**kg/day**	**lbs/day**
January	127.2	280.4	355.2	783.1
February	168.0	370.4	480.9	1,060.2
March	413.3	911.2	1,131.0	2,493.4
April	601.7	1,326.5	1,658.8	3,657.0
May	721.0	1,589.5	1,923.1	4,239.7
June	1,818.8	4,009.8	4,729.4	10,426.5
July	1,878.7	4,141.8	4,930.0	10,868.8
August	1,702.0	3,752.3	4,485.1	9,888.0
September	1,331.9	2,936.3	3,784.7	8,343.8
October	651.1	1,435.4	1,839.9	4,056.3
November	328.5	724.2	910.8	2,008.0
December	138.6	305.6	388.0	855.4

Monthly mean emissions for Maricopa County and the PM_{10} NAA are illustrated in Figure 6.4–1. Monthly emission values are presented in Table 6.4–2. It can be seen that the monthly NO_x emissions reached the highest values in July. This is because biogenic emissions of nitric oxide (NO) are mainly from wetted soil. Thus, the NO emission rate depends not only on temperature and radiation, but also on soil moisture, which is related to precipitation. As discussed in Section 6.3, there were 2.15 inches of precipitation in July, but no precipitation in June, 2008. There is also one more day in July than June; therefore, the total NO_x monthly emissions in July are higher than in June.

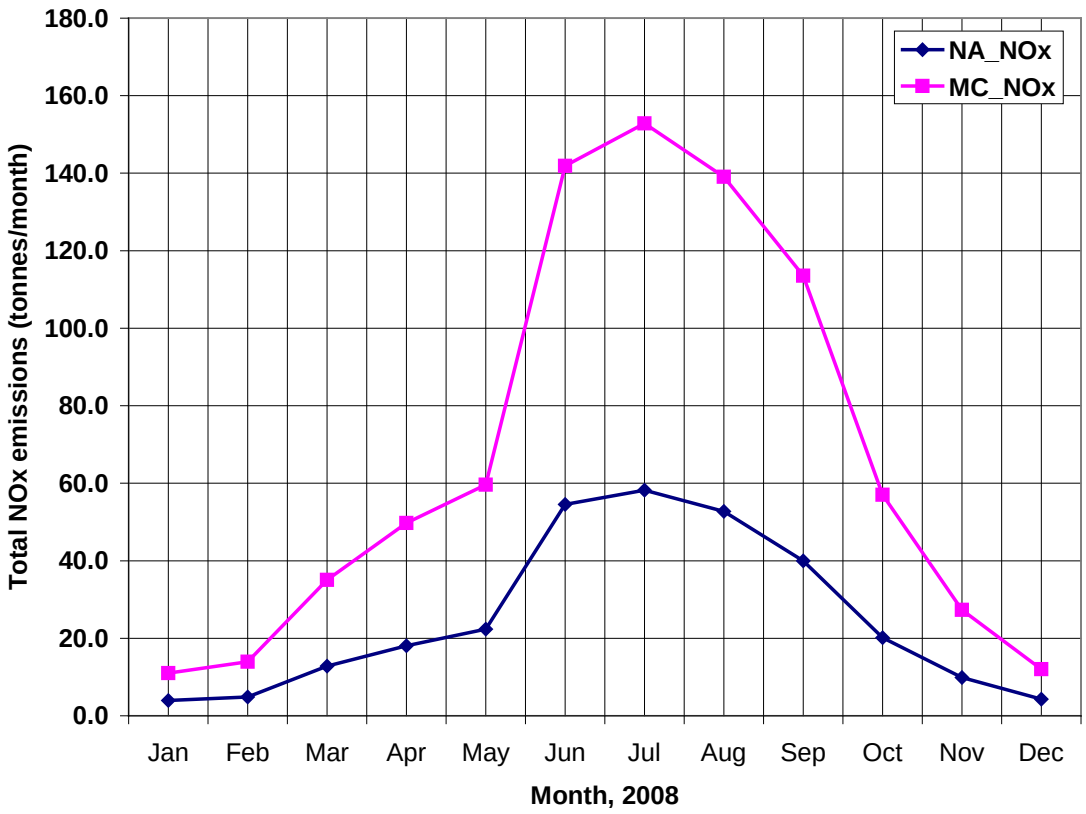

Figure 6.4–1. Monthly emissions of NO_x in Maricopa County (pink solid line, abbreviated as "MC") and the PM_{10} NAA (blue solid line, abbreviated as "NA").

Table 6.4–2. Monthly biogenic emissions of NO_x in the PM_{10} NAA and Maricopa County.

	PM_{10} NAA		Maricopa County	
Month	**Metric tons/mo**	**Tons/mo**	**Metric tons/mo**	**Tons/mo**
January	3.94	4.35	11.01	12.14
February	4.87	5.37	13.95	15.37
March	12.81	14.12	35.06	38.65
April	18.05	19.90	49.76	54.85
May	22.35	24.64	59.62	65.72
June	54.56	60.15	141.88	156.40
July	58.24	64.20	152.83	168.46
August	52.76	58.16	139.04	153.27
September	39.96	44.05	113.54	125.16
October	20.18	22.26	57.04	62.87
November	9.86	10.86	27.32	30.12
December	4.30	4.74	12.03	13.26
Totals:	**301.88**	**332.77**	**813.08**	**896.27**

6.5 Summary of biogenic source emissions

Daily mean and annual total biogenic NO_x emissions for Maricopa County and the PM_{10} NAA in 2008 are summarized in Table 6.5–1. Due to the incorporation of land cover data that are more characteristic of plants located in the desert southwest, as well as improvements to the MEGAN model, the 2008 data shown in Table 6.5–1 represent a substantial improvement over previous biogenic emission estimates for Maricopa County and the PM_{10} NAA.

Table 6.5–1. Daily mean and annual total NO_x emissions from biogenic sources.

	Daily mean		Annual total	
Geographic Area	**kg/day**	**lbs/day**	**Metric tons/yr**	**Tons/yr**
Maricopa County	2,218.1	4,890.0	813.08	896.27
PM_{10} NAA	823.4	1,815.3	301.88	332.77

6.6 References

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MAG, 2009. MAG Eight-Hour Ozone Redesignation Request and Maintenance Plan for the Maricopa Nonattainment Area. Maricopa Association of Governments, Phoenix AZ.

Maricopa County Air Quality Department

NEWS RELEASE

CLEAN AIR MAKE MORE

Public Information Officer
Maricopa County Air Quality
1001 N. Central Avenue
Suite 900
Phoenix, Arizona 85004
(602) 506-6713, desk
(602) 526-7307, cell

April 26, 2010

Contact: Holly Ward: 602-506-6713/desk * 602-526-7307/cell

FOR IMMEDIATE RELEASE

Emissions Inventory Public Review Draft Released

Document details sources of air pollution emissions within Maricopa County; public workshop to be held May 14

The Maricopa County Air Quality Department announced today the release of its draft 2008 Periodic Emissions Inventory for PM_{10} for the Maricopa County PM_{10} Nonattainment Area. The document is now available for an informal 30-day public review period. The PM_{10} emissions inventory includes emissions estimates for PM_{10} and $PM_{2.5}$ as well as three particulate matter precursors: nitrogen oxides (NO_x), sulfur oxides (SO_x) and ammonia (NH_3).

The inventory provides emission estimates from point, area, nonroad mobile, onroad mobile and biogenic sources. The report is divided into six chapters, as follows:

Chapter 1: Introduction
Chapter 2: (Stationary) point sources (large manufacturing facilities, power plants)
Chapter 3: Area (non-point) sources (widespread, similar sources, such as fuel combustion, fires, etc.)
Chapter 4: Nonroad mobile sources (aircraft, locomotives, lawn movers, tractors, etc.)
Chapter 5: Onroad mobile sources (cars, trucks, other vehicles)
Chapter 6: Biogenic sources (crops, indigenous vegetation, landscaping, etc.)

The latter two chapters were prepared by the Maricopa Association of Governments (MAG).

The document is available in electronic format (PDF files) on the department's website at:
http://www.maricopa.gov/aq/divisions/planning_analysis/emissions_inventory/Default.aspx

The Air Quality Department will hold a public workshop to discuss the draft 2008 Periodic Emissions Inventory for PM_{10}. The workshop will be held at 9 AM at the department's offices at 1001 N. Central Ave., Suite 560, on Friday, May 14, 2010.

(continued on next page)

The department is also accepting written comments on the draft inventory through Wednesday, May 26, 2010, 5:00 PM. Comments may be submitted to:

Maricopa County Air Quality Department
Emissions Inventory Unit
1001 N. Central Avenue, Suite 595
Phoenix, AZ 85004
E-mail: EmisInv@mail.maricopa.gov

Questions may be addressed to Bob Downing at bdowning@mail.maricopa.gov.

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About Maricopa County Air Quality Department

The Maricopa County Air Quality Department is a regulatory agency whose goal is to ensure federal clean air standards are achieved and maintained for the residents and visitors of Maricopa County. The department is governed by the Maricopa County Board of Supervisors and follows air quality standards set forth by the federal Clean Air Act.

Maricopa County
Air Quality Department

INSTRUCTIONS

FOR REPORTING 2008

ANNUAL AIR POLLUTION EMISSIONS

January 2009

Emissions Inventory Unit
1001 North Central Avenue, Suite 595
Phoenix, Arizona 85004
(602) 506-6790
(602) 506-6179 (Fax)

Copies of this document, related forms
and other reference materials are available online at our web site:
http://www.maricopa.gov/aq/divisions/planning_analysis/emissions_inventory/Default.aspx

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WHAT'S NEW FOR 2008?

Reporting forms:

- Some **preprinted information** on your report may be different from last year's version. Please review the enclosed forms carefully, and verify all preprinted information.

- Many of our reporting forms **have changed** in past years. 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.

- **Please VERIFY that your reporting forms match the preprinted forms.**

Miscellaneous:

- **If this is the first emissions inventory for your permit and your business did not operate in 2008, you must still submit a completed Business Form and a signed Data Certification Form stating that there were no operations at your facility during 2008.**

- In accordance with Maricopa County Air Pollution Control Rule 280 (Fees), the 2008 annual emission fee for Title V sources only is $38.25/ton. **NOTE:** Only Title V sources (those whose air quality permit numbers have a **"V"** prefix) are subject to this annual emissions fee.

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 2008 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 preprinted 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 number would start with **"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:

MCAQD One Stop Shop
Emissions Inventory Intake
501 N. 44th St. Suite 200
Phoenix AZ 85008-6538

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.)

EPA has re-designated 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. County Rule 100, Section 200.69b states:

"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, not 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 ***or***
(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 VOC.

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 (taken from County Rule 280, Section 305.1).

(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 One Stop Shop 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, mark it with 'DELETE' and 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:
http://www.maricopa.gov/aq/divisions/planning_analysis/emissions_inventory/Default.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:
http://www.maricopa.gov/aq/divisions/planning_analysis/emissions_inventory/Default.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 MCAQD One Stop Shop 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: http://www.maricopa.gov/aq/divisions/planning_analysis/emissions_inventory/Default.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: N33.5276 Long: W112.2626***
2	***V***	***14*** ft	***200*** ^{o}F		***19,186***	***40***			***thermal oxidizer, Bldg. 2 Lat:N33.5259 Long:W112.2611***

* Stack Type Codes: **V** = Vertical unobstructed; **D** = Downward unobstructed; **W** = Obstructed vertical (e.g. weather cap); **H** = Horizontal unobstructed; **G** = Gooseneck

** 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: http://www.maricopa.gov/aq/divisions/planning_analysis/emissions inventory/Default.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 2008. 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 2008.

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 2008

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- [X] 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 **2008**

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: http://www.maricopa.gov/aq/divisions/planning_analysis/emissions_inventory/Default.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 2008. 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.

Evaporative Process Form (continued)

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 preprinted 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 2008

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 parts*

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 preprinted 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* 2008** 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		MEGASOLVE	2258	gl	VOC	6.8	gl	6,741	%		%		8,613
									%		%		

Note: Do NOT change preprinted 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 2008

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 http://www.maricopa.gov/aq/divisions/planning_analysis/emissions_inventory/Default.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.)

2) What was the quantity of this waste stream in 2008? 2,400 *Check one:* ☐ pounds ☒ gallons
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	2008 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	MEGASOLVE	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 2008

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 2008 Annual Emissions:	(1) Totals from Process Forms	(2) + Accidental Releases	(3) = TOTAL 2008 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 to: Maricopa County Air Quality Department, One Stop Shop, Emissions Inventory Intake, 501 N. 44th Street, Suite 200, Phoenix, AZ 85008-6538. 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 **$38.25**, and enter the result on line 8. This is your 2008 emission fee.

EXAMPLE (for Title V sources only)

Data Certification/Fee Calculation Form 2008

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 2008 Annual Emissions:	(1) Totals from Process Forms	(2) + Accidental Releases	(3) = TOTAL 2008 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 **$ 38.25**. This is your **2008 ANNUAL EMISSION FEE**.			$ 688.50

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, One Stop Shop, Emissions Inventory Intake, 501 N. 44th Street, Suite 200, Phoenix, AZ 85008-6538. 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 3. Rule Effectiveness (RE) Studies

3.1 Introduction

Rule effectiveness (RE) studies are designed to assess the success of regulatory rules at controlling their targeted emissions. It is acknowledged that facilities and source categories subject to control techniques and devices mandated by rules do not always achieve 100% compliance with those requirements. Given this reality, the US EPA recommends the use of rule effectiveness studies to improve the quality of emission estimates presented in emission inventories.

Once an RE rate has been calculated, its value is applied to relevant sources at an individual process level, thus adjusting (i.e., increasing) emission estimates to reflect a lower degree of control efficiency. The formulas below illustrate how inclusion of rule effectiveness can significantly affect the resulting emission estimates:

Emissions <u>before</u> the application of rule effectiveness:

Uncontrolled Emissions	×	[1 – (Control Efficiency)]	=	Emissions with Control
100 tons	×	**[1 – (0.90)]**	**=**	**10.0 tons**

Emissions <u>including</u> the application of rule effectiveness:

Uncontrolled Emissions	×	[1 – (Control Efficiency × RE)]	=	Emissions with Control
100 tons	×	**[1 – (0.90 × 0.83)]**	**=**	**25.3 tons**

In general, the RE rate is applied to all processes where a control device or control technique is in use. There are however some limitations to this blanket rule, as expressed in US EPA's most recent guidance:

> *…not all emission estimates involving use of a control device or technique need to be adjusted to account for RE…For example, a state or local agency may conclude that a control device that operates in conjunction with a continuous emissions monitor, or is equipped with an automatic shutdown device, may provide a sufficient level of assurance that intended emission reductions will be achieved, and therefore an adjustment for rule effectiveness is not necessary. Another example would be in instances where a direct determination of emissions, such as via a mass balance calculation, can be made.* (US EPA, 2005)

Another complication in any attempt to apply a blanket RE percentage rate occurs where control device efficiencies are extremely high. Some categories of control devices routinely operate at efficiencies of 99% or greater (e.g., baghouses, thermal oxidizers). For these activities, even small adjustments through the application of RE can cause a dramatic increase in reported emissions. As an example, a process with a control device of 99.9% efficiency may report controlled emissions of 10 tons. If an RE rate of 85% were applied to this process, the adjusted emissions would total 1,508.5 tons (an increase of nearly 15,000%). In these types of instances, the department evaluated the affected processes on a case-by-case basis to determine the appropriateness of applying an RE adjustment.

3.2 Calculating Rule Effectiveness Rates for Rules 310, 310.01, and 316

Rule effectiveness studies adjust the emissions from subject facilities and source categories to account for times of non-compliance and control device equipment failure. Of particular importance to the Maricopa County Air Quality Department (MCAQD) are those rules that control particulate matter release, since parts of the county have been designated as nonattainment areas in regard to US EPA PM_{10} standards. Consequently, the rule effectiveness studies presented here deal with the control of criteria pollutant PM_{10}.

Source-specific rule effectiveness studies were undertaken as part of this project to adjust the emissions from subject facilities and source categories to account for times of non-compliance and control device equipment failure by incorporating applicable compliance history data to ascribe a percentage rate (RE rate) at which the subject rule(s) attains the intended emissions reductions. These source-specific studies use data from inspections conducted from July 2008 through June 2009 to determine the rate of compliance of subject facilities and source categories with Rule 310 (Fugitive Dust from Dust-Generating Operations), Rule 310.01 (Fugitive Dust from Non-Traditional Sources of Fugitive Dust), and Rule 316 (Nonmetallic Mineral Processing) with final RE rates listed in Table A3–1 below. Rule effectiveness rates were calculated separately for agricultural activities (best management practices), Title V, and non-Title V permitted facilities, which are each described in detail in Section 3.3.

Table A3–1. Rule effectiveness rates, listed by rule analyzed.

Rule	Rule Effectiveness (RE) Rate
Rule 310	89.94%
Rule 310.01	95.21%
Rule 316	65.44%

The resulting RE rates shown above have been applied to relevant point and area source inventory categories and are reflected in the emission estimates presented in applicable sections of Chapters 2 and 3.

The US EPA has provided a number of guidance documents that detail the use and formulation of rule effectiveness studies (US EPA, 2005; 1994; 1992). The most recent of these documents states, “First and foremost, an agency responsible for emissions inventory preparation should attempt to obtain facility specific data from as many sources as possible, and use the collected information to make a refined source or source category RE determination” (US EPA, 2005). Given this directive, MCAQD developed a rule effectiveness study methodology that utilizes all available compliance data to produce a RE rate that best reflects the field effectiveness of the rule. By using the entire population of data for the prescribed time period, (July 2008 – June 2009) the statistical validity of the RE rate greatly improves. This approach differs from previous rule effectiveness studies conducted by the department that were based upon a small sample pool of targeted inspections (MCAQD, 2007).

The source-specific RE rates presented here are developed from statistical examination of recorded inspection data. This is the rate at which inspection staff is observing facility and source category compliance in the field. While this provides the most direct measure of rule effectiveness, it can still be an incomplete picture of overall rule effectiveness. In the case of the source-specific studies for those sources directly affected by a county air quality rule (Rules 310, 310.01, and 316) the compliance rate is used as the RE rate. These sources tend to have a focused, homogeneous set of processes. This, combined with the fact that these studies not only

contain the entire population of affected sources but are also very large sample sizes, gives confidence that inconsistencies of individual inspections are already addressed in practice. To further focus the study of these sources each unique permit was classified as "in violation" if any inspection during the allotted time period resulted in an emission based violation or as "in compliance" if no violations were issued or an administrative based violation was issued.

A total of six distinct rule effectiveness rates were calculated for use in this emissions inventory: four source-specific rule effectiveness determinations (Rule 310, Rule 310.01, Rule 316 and agricultural activities) along with two multi-rule determinations (Title V and non-Title V permitted facilities). The following three sections describe in further detail the data and methods used in the development of the Rule 310, Rule 310.01, and Rule 316 RE factors.

3.2.1 Calculating Rule Effectiveness for Sources Subject to Rule 310

Sources subject to the department Rule 310 (Fugitive Dust from Dust-Generating Operations) are most often those construction sites where the disturbance of earth is occurring. The RE rate for Rule 310 sources is developed from the observed compliance rate of permitted sites.

The compliance rate for Rule 310 sources uses inspection data of issued dust permits between July 2008 and June 2009. Only inspections that result in a finding of compliance or non-compliance (i.e., "in violation") are considered in the compliance rate. Inspections conducted solely to confirm the closing of a permit, or inspections where a compliance determination could not be made, were not included in the development of the compliance rate. Using these criteria, a total of 12,325 inspections were conducted on 5,467 issued permits, out of a possible pool of 7,918 issued permits. Dust Control Permits are only valid for 12 months, and expire on the anniversary of their issue date; for instance a permit issued on July 22, 2007 would have a July 22, 2008 expiration date. This permit would therefore only have "operated" 22 days in the inspection period on which this compliance data is based. Some issued permits also experience limited operations, perhaps only a month or two, but in most cases these permits are left open by the permit holder for the entire 12 months. Given these realities, it is not unexpected that 2,451 out of the pool of 7,918 permits received no compliance determination inspection during the 12-month period of July 2008–June 2009. Conversely, over 59% of all issued permits that received a compliance determination inspection were inspected two or more times, with some sites receiving as many as 13 inspections during the 12-month time period of this study.

Of the inspected sources listed above, individual compliance rates are determined on a permit by permit basis. Any permit that received at least one emissions-related violation during any inspection conducted between July 2008 and June 2009 received a compliance rate of 0%. Permitted sites that had no recorded emissions-related violations during the study period received a compliance rate of 100%. Of the permits with violations noted, 550 (80%) were emissions-related (track-out, visible emissions, recordkeeping, silt content, etc.), with the remaining 137 (20%) violating permits being procedural (inadequate dust control plan, late fees, etc.). The permit-specific compliance rates were summed and averaged to produce an overall grouped compliance rate of 89.94%.

3.2.2 Calculating Rule Effectiveness for Sources Subject to Rule 310.01

The majority of sources subject to Rule 310.01 (Fugitive Dust from Non-Traditional Sources of Fugitive Dust) are vacant lots. It is estimated that there are presently more than 100,000 vacant lots in Maricopa County. Rule 310.01 sources generally do not require a permit, unlike Rule 310 and Rule 316 sources. The RE rate for Rule 310.01 sources is calculated based upon vacant lot inspection compliance rates.

During the study period (July 2008 – June 2009), the department inspectors performed a total of 12,370 inspections of vacant lots in Maricopa County. The primary purpose of a Rule 310.01 inspection is to verify whether or not the vacant lot in question has a stabilized surface. If the surface is determined to be stable (through a variety of tests), the lot is deemed to be in compliance. Conversely, if the lot's surface is deemed to be unstable, then a violation of Rule 310.01 has occurred. As with Rule 310, a compliance rate is determined individually for each vacant lot, and then summed and averaged to produce a group compliance rate. The overall compliance rate for Rule 310.01 sites is 95.21%. All 592 violations noted by inspectors were emissions-related violations, as all the violations are for unstable soil conditions.

3.2.3 Calculating Rule Effectiveness for Sources Subject to Rule 316

Facilities subject to Rule 316 (Nonmetallic Mineral Processing) include those involved in the mining of sand and gravel and the production of concrete products. All such "Rule 316 sites" are required to have either a Title V or non-Title V permit issued by the department. At present, all facilities that are subject to Rule 316 have only non-Title V permits. (One class of sources that has long been an exception to this is portable sources that may operate in more than one county during the life of the permit; thus these sources are issued permits by the Arizona Department of Environmental Quality.) The RE rate for Rule 316 sites was determined in a similar fashion as for Rules 310 and 310.01; i.e., calculated on the basis of the actual observed compliance rates of permitted sites.

Inspection data for the period July 2008 through June 2009 reveal that inspections were conducted for 136 issued permits for Rule 316 facilities. All of these facilities were inspected at least once during this study period, with a compliance determination made for each facility. Overall, 525 inspections that resulted in a compliance determination were performed during the study period. As with Rules 310 and 310.01, a compliance rate is computed for each facility, and then summed and averaged for the group, resulting in an overall compliance rate of 65.44%. Of the violating permits noted, 47 (54%) were emissions-related, with the remaining 40 (46%) primarily procedural in nature.

3.3 Calculating Rule Effectiveness Rates for Agricultural Activities, Title V Facilities, and Non-Title V Facilities

The observed compliance rate in some cases, such as multi-source Title V and non-Title V facilities, can be better described as a rate at which inspection staff issue violations. Inspection staff has a range of experience and training which influences their proficiency in issuing appropriate violations. There may be instances when a rule violation goes unnoticed by staff, or

conversely a violation may be issued in error. Even when a compliance rate has a high statistical measure of accuracy, it can fail to reflect a number of programmatic measures that affect overall rule effectiveness; measures like the strength of rule language, departmental enforcement and penalty actions, inspector training programs, educational and public outreach efforts, etc. This reality is reflected in earlier US EPA guidance:

> *A percentage effectiveness rating is not enough to describe the compliance effectiveness of a rule for a source category. An SSCD [Stationary Source Compliance Division] study should attempt to link the rating to a regulatory agency's overall effort. The study should address the factors that affect the percentage effectiveness rating such as the compliance rate of the sources in a category, inspection frequency and thoroughness, the language of the rule (i.e., whether or not it has loopholes), and the reporting and recordkeeping by the regulatory agency. Evaluating these factors will provide a more complete evaluation of the effectiveness of a rule.* (US EPA, 1994)

In order to incorporate all the salient factors described above, a matrix was created to produce a final RE rate. US EPA's latest guidance (2005) provides a listing of factors that can impact rule effectiveness rates (e.g., inspector training, frequency of inspections, media outreach, enforcement policies, recordkeeping requirements, etc.), grouped into major categories such as most important factors, important factors and other factors. The department used these suggested factors as the basis for developing the RE matrices contained in Tables A3–3 through A3–5.

In brief, the compliance rate developed from inspection data accounts for 70% of the overall RE rate, while all other factors account for the remaining 30%. (An exception to these values applies in the case of agricultural activities.) Each factor is scored individually, based upon the department's success in implementing that factor. As an example, the score for the factor "Compliance History" is the compliance rate developed from the study period inspection data, while the score for "Enforcement Penalties" is based upon the department's timely response to, and settlement of, observed violations associated with the subject rule or source category. The complete matrices for each applicable rule or source category for which rule effectiveness was addressed, are contained in Tables A3–3 through A3–5.

The following sections describe in further detail the data and methods used in the development of the remaining RE factors for agricultural activities, Title V, and non-Title V permitted facilities; results are summarized in Table A3–2 below.

Table A3–2. Compliance and rule effectiveness rates, by source category analyzed.

Source Category	Compliance Rate	Rule Effectiveness (RE) Rate
Agricultural Activities	Unknown	55.33%
Title V Facilities	89.14% *	90.94%
Non-Title V Facilities	81.00% *	84.27%

** Compliance rates for both Title V and Non-Title V facilities are based upon 2008-2009 inspection data, and reflect compliance self-monitoring recordkeeping practice, in addition to violation data.*

3.3.1 Calculating Rule Effectiveness for Agricultural Activities

Agricultural activities in most parts of Maricopa County are subject to the Best Management Practices program administered by the Arizona Department of Environmental Quality (ADEQ). This program is largely a self-monitoring program, in which participants indicate which management practices were chosen to be used during various operations (e.g., harvesting, tilling). No compliance rate estimates for this program were noted during the study period. ADEQ does indicate that after a site has been visited, 100% of the sources return to compliance. Since compliance with this program is verified only on a complaint-driven basis, the weight given to compliance history was lowered, from 70% to 25%, in the matrix shown in Table A3–3, indicating an overall RE rate of 55.30% for agricultural activities.

3.3.2 Calculating Rule Effectiveness for Title V and Non-Title V Processes

For the remaining emission processes (not regulated by Rules 310, 310.01 and/or 316) that include a control device or technique that limits particulate matter or ozone formation, separate multi-rule RE rates have been calculated for permitted Title V and non-Title V facilities. Factor-based matrices have been utilized to develop RE rates for Title V and non-Title V facilities. Compliance rates for these sources are based upon two full years of data (2008 through 2009), as compliance information for these sources tends to be more detailed (as reflected in the matrix). The compliance rate for these facilities also includes data on self-monitoring recordkeeping practices in addition to inspection data. The combination of monitoring data and inspection data comprise the 'compliance rate' section of the RE calculation matrix, and still account for 70% of the overall RE rate. The combined compliance rate for Title V facilities is 89.14% and 81.00% for non-Title V facilities, resulting in RE rates of 90.94% and 84.27% for Title V and non-Title V facilities, respectively, as shown in Tables A3–4 and A3–5 below.

3.4 References

MCAQD, 2007. 2005 Periodic Emissions Inventory for PM_{10} for the Maricopa County, Arizona, Nonattainment Area.

US EPA, 1992. Guidelines for Estimating and Applying Rule Effectiveness for Ozone/CO State Implementation Plan Base Year Inventories. EPA Rep. 452/R-92-010, November 1992.

US EPA, 1994. Rule Effectiveness Guidance: Integration of Inventory, Compliance and Assessment Applications. EPA Rep. 452/R-94-001, January 1994.

US EPA, 2005. Emissions Inventory Guidance for Implementation of Ozone and Particulate Matter National Ambient Air Quality Standards (NAAQS) and Regional Haze Regulations. EPA Rep. 454/R-05-001, November 2005.

Table A3–3. Rule Effectiveness Matrix for Agricultural Activities

A. Most important factor (1 criterion, assigned weighting of 25% of total):

Factor	Range		Midpt. value	Description	Weight	Value assigned to MCAQD	Score (= weight × value)
Compliance History	86%	100%	93%	Over 90% of facilities inspected in the source category are in compliance	25%	93%	**23.25%**
	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			
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 inspection of control equipment;			
		< 70%	35%	Inspections generally consist of a records review only;	10%	35%	**3.5%**

B. Other important factors (6 criteria, each assigned weighting of 10% 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;	10%	35%	**3.5%**
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;			
		< 70%	35%	Percent of facilities inspected in the sector in a given year is less than 15%	10%	35%	**3.5%**
Unannounced Inspections	86%	100%	93%	Unannounced inspections are sometimes done;			
	70%	85%	78%	Unannounced inspections are done, but infrequently;			
		< 70%	35%	Unannounced inspections are never done;	10%	35%	**3.5%**
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;			
		< 70%	35%	Agency usually does not take enforcement action against violators;	10%	35%	**3.5%**
Compliance Assistance	86%	100%	93%	A compliance assistance program exists and is adequately staffed, and includes such things as workshops, mailings, web-based tutorials, etc.	10%	93%	**9.3%**
	70%	85%	78%	A compliance assistance program exists and 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):

Factor	Range		Midpt. value	Description	Weight	Value assigned to MCAQD	Score (= weight × value)
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;			
		< 70%	35%	Monitoring requirements do not exist;	5%	35%	**1.75%**
Follow-up Inspections	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 some of the time;			
		< 70%	35%	Follow-up inspections are not routinely done;	5%	35%	**1.75%**
Media Publicity	86%	100%	93%	Media publicity of enforcement actions is routinely conducted.			
	70%	85%	78%	Media publicity of enforcement actions is sometimes done.			
		< 70%	35%	Media publicity of enforcement actions is rarely done.	5%	35%	**1.75%**

Overall rule effectiveness score for agricultural activities: 55.30%

Table A3–4. Rule Effectiveness Matrix for Title V Facilities

A. Most important factors (2 criteria, each assigned weighting of 35% of total):

Factor	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.	35%	90%	**31.5%**
	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.	35%	10 of 19 facilities	**17.9%**
	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.			
	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.		8 of 19 facilities	**12.4%**
		< 70%	35%	High Priority Violator (HPV): the facility is in significant violation of one or more applicable requirement of the CAA.		1 of 19 facilities	**0.6%**
						Sum:	**30.9%**

B. Other important factors (4 criteria, each assigned weighting of 3% 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.	3%	97%	**2.9%**
	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.	3%	90%	**2.7%**
	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.			

Factor	Range		Midpt. value	Description	Weight	Value assigned to MCAQD	Score (= weight × value)
Unannounced Inspections	94%	100%	97%	Routinely conducted.	3%	97%	**2.9%**
	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.	3%	97%	**2.91%**
	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 2% of total):

Compliance Certifications	94%	100%	97%	Source subject to Title V or other type of compliance certification.	2%	97%	**1.94%**
	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.	2%	97%	**1.94%**
	87%	93%	90%	Source(s) are inspected once every 3 years or more frequently.			
	81%	86%	84%	Source(s) are inspected once 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.	2%	97%	**1.94%**
	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.			

Factor	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.	2%	84%	**1.68%**
	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.	2%	97%	**1.94%**
	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.	2%	97%	**1.94%**
	87%	93%	90%	Regulatory workshops are available every 1-2 years, and/or the implementing agency mails regulatory information packages every 1-2 years.			
	81%	86%	84%	Regulatory workshops 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.	2%	90%	**1.80%**
	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.			

Factor	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.	2%	97%	**1.94%**
	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 conducted (90 % of the time or more).	2%	97%	**1.94%**
	87%	93%	90%	Follow-up inspections usually conducted (approximately 75% of the time).			
	81%	86%	84%	Follow-up inspections sometimes conducted (approximately 50% of the time).			
	70%	80%	75%	Follow-up inspections infrequently conducted (approximately 25% of the time).			
		< 70%	35%	Follow-up inspections rarely or never conducted (10% of the time or less)			

Overall rule effectiveness score for Title V facilities: 90.94%

Table A3–5. Rule Effectiveness Matrix for Non-Title V Facilities

A. Most important factors (2 criteria, each assigned weighting of 35% of total):

Factor	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.	35%	75%	**26.3%**
		< 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.	35%	156 of 298 facilities	**17.8%**
	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.		10 of 298 facilities	**1.1%**
	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.		130 of 298 facilities	**11.5%**
		< 70%	35%	High Priority Violator (HPV): the facility is in significant violation of one or more applicable requirement of the CAA.		2 of 298 facilities	**0.1%**
						Sum:	**30.4%**

B. Other important factors (4 criteria, each assigned weighting of 3% 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.	3%	90%	**2.7%**
	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.	3%	90%	**2.7%**
	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.			

Factor	Range		Midpt. value	Description	Weight	Value assigned to MCAQD	Score (= weight × value)
Unannounced Inspections	94%	100%	97%	Routinely conducted.	3%	97%	**2.91%**
	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.	3%	97%	**2.91%**
	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 2% 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.	2%	75%	**1.5%**
		< 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.	2%	97%	**1.94%**
	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.	2%	97%	**1.94%**
	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.			

Factor	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; the 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%	0.8	75%	Control equipment operators receive only on the job training.	2%	75%	**1.5%**
		< 70%	35%	Control equipment operators receive no specific training.			
Media Publicity	94%	100%	97%	Media publicity of enforcement actions.	2%	97%	**1.94%**
	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.	2%	97%	**1.94%**
	87%	93%	90%	Regulatory workshops are available every 1-2 years, and/or the implementing agency mails regulatory information packages every 1-2 years.			
	81%	86%	84%	Regulatory workshops 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. The implementing agency mails regulatory information packages infrequently, if ever.			
Inspector Training	94%	100%	97%	Inspectors must undergo 2 weeks of comprehen-sive 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.	2%	90%	**1.80%**
	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.			

Factor	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.	2%	97%	**1.94%**
	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 conducted (90 % of the time or more).	2%	97%	**1.94%**
	87%	93%	90%	Follow-up inspections usually conducted (approximately 75% of the time).			
	81%	86%	84%	Follow-up inspections sometimes conducted (approximately 50% of the time).			
	70%	80%	75%	Follow-up inspections infrequently conducted (approximately 25% of the time).			
		< 70%	35%	Follow-up inspections rarely or never conducted (10% of the time or less)			

Overall rule effectiveness score for non-Title V facilities: 84.27%

Appendix 4. Windblown Dust Emission Estimation Methodology

Introduction

The production of windblown dust occurs through an intricate process where the force of wind initiates the movement of soil particles. As stated below,

> *This process has the distinct phases of particle entrainment, transport and deposition. It is a complex process because it is affected by many factors which include atmospheric conditions (e.g., wind, precipitation and temperature), soil properties (e.g., soil texture, composition and aggregation), land-surface characteristics (e.g., topography, moisture, aerodynamic roughness length, vegetation and non-erodible elements) and land-use practice (e.g., farming, grazing and mining). During a wind-erosion event, these factors interact with each other and, as erosion progresses, the properties of the eroded surface can be significantly modified.* (Shao, 2008a)

The development of an annual inventory of PM_{10} emissions from windblown dust focuses on quantifying the first phase of windblown dust production: particle entrainment. The phases of transport and deposition are typically explored during modeling exercises of specific windblown dust events and are not discussed here.

An assortment of dust emission schemes have been developed that attempt to quantify the entrainment of windblown dust (e.g., "Open Area Wind Erosion" chapter in *WRAP Fugitive Dust Handbook*, WGA, 2006). These schemes differ greatly depending on the geographic scale (local, regional or global) and theoretical constructs of the scheme (e.g., assessment of threshold wind speeds, the importance of soil properties and land uses, etc.). Published empirical data on windblown dust emissions varies widely as well, with dust emission rates for a given wind speed varying from 10^{-1} to 10^{5} $\mu g\ m^{-2}s^{-1}$ (Shao, 2008b). This suggests that the specific conditions and properties of subject soils greatly modify dust emission rates, and that the accuracy of a dust emission scheme is heavily dependent on the quality of the input data describing each of these controlling factors (e.g., surface roughness lengths, soil texture, moisture content, vegetation, etc.). Often, there is no reliable data available to account for a controlling factor (e.g., soil moisture or surface roughness lengths), forcing dust schemes to use surrogates or broad assumptions in an attempt to incorporate the effects of a controlling factor. Additionally, even when quality data on a relevant factor exists (e.g., soil texture), the role of that factor as it interacts with other factors is uncertain (Alfaro et al., 2004) or could change as atmospheric or soil conditions are altered throughout the year.

The inherent uncertainties involved with any windblown dust emission scheme require that the available input data for the region of interest be scrutinized to help inform the selection of an appropriate scheme. In choosing a dust emission scheme for this inventory, the focus was placed upon a theoretical model that best describes local, observed windblown dust events combined with empirical data from wind tunnel studies performed in the deserts of the southwest U.S.

Supply-Limited Windblown Dust Emission Scheme

The deserts of the southwest U.S., including Maricopa County, are characterized as supply-limited environments (Gillette and Chen, 2001; Zender and Kwon, 2005), where the potential for generating windblown dust is controlled primarily by the amount of surface material available for entrainment. In contrast, traditional dust emission schemes consider soils to be transport-

limited, where windblown dust emissions are controlled solely by the force of wind (Bagnold, 1941; Greeley and Iverson, 1985). Traditional dust emission schemes perform best in areas where contiguous desert land with little vegetation exists (e.g., Sahara Desert). The Sonoran Desert, of which Maricopa County is a part of, contains a wide variety of vegetation, which can be quite dense in some areas, severely limiting the amount of exposed soil to be entrained by wind. Since the bulk of wind erosion research is rooted in the physics of transport-limited soils, most dust emission schemes (Gillette and Passi, 1988; Shao et al., 1993; Marticorena and Bergametti, 1995; Alfaro and Gomes, 2001) do not address many of the physical realities of supply-limited soils.

A major theoretical tenet of transport-limited schemes is that little or no dust emissions occur until wind speeds reach the threshold required for saltation to occur; the process by which the dynamic bombardment of sand particles blasts and breaks down aggregated soils to then be suspended as dust emissions. However, the supply-limited soils of the desert southwest have been shown to emit substantial quantities of dust, even the majority of dust emissions, in the absence of saltation (Macpherson et al., 2008). While the southwest deserts can experience high magnitude wind events where saltation dominates dust production (e.g., haboob), the majority of windblown dust emissions occur during lower intensity, higher frequency events (e.g., synoptic scale fronts, dust devils) (Koch and Renno, 2005; Macpherson et al., 2008). These events often do not reach the threshold wind speeds required for saltation to occur, yet monitoring data consistently record elevated ambient PM_{10} concentrations at these wind speeds (see further discussion in section on Threshold Friction Velocity). This suggests that significant quantities of dust emissions are generated primarily through direct aerodynamic entrainment of available surface material, before saltation occurs. Despite concerns that direct aerodynamic entrainment is limited due to the strong interactive cohesive forces between dust particles (Iverson and White, 1982), several studies have shown the importance of direct aerodynamic entrainment in the production of windblown dust (Loosmore and Hunt, 2000; Roney and White 2004; Kjelgaard et al., 2004; Macpherson et al., 2008; Harris and Davidson 2009). Consequently, the dust scheme chosen for the supply-limited environment of Maricopa County includes the process of direct aerodynamic entrainment as a major contributor to the production of windblown dust.

Another key limitation of transport-limited schemes concerns surface disturbance of soils. Disturbance levels of soils have been shown to be a key factor in controlling the intensity of dust emissions during a wind event (Tegen and Fung, 1995; Belnap and Gilliette, 1998; Gillette and Chen, 2001; Zender and Newman, 2003; Baddock et al., 2011). However, many transport-limited schemes do not have a direct mechanism to incorporate the effects of disturbed soil on dust production. Since dust emissions in a transport-limited scheme are dependent solely on saltation, a disturbed soil is often theoretically assumed to emit at the same rate as a stable soil since the texture, or particle size distribution of the soil is uniform in both disturbed and stable conditions (Alfaro et al., 2004). A common adjustment made to account for disturbance in traditional dust schemes is to assume that disturbed soils have lower threshold friction velocities than stable soils (WGA, 2006). This effect has been shown in relation to saltation (Gillette, 1980), but does not necessarily reflect the threshold friction velocities required for dust emissions, since supply-limited soils can show dust emissions in the absence of saltation on both disturbed and stable soils (Macpherson et al., 2008).

Instead of directly addressing surface disturbance, incorporation of the surface roughness length of the soil (which can provide an approximation for the non-erodible elements of the soil) is usually assumed to be the principal limiter of dust production, beyond friction velocities, in transport-limited schemes (Marticorena et al., 1997; Alfaro et al., 2004). Surface roughness

lengths (the theoretical height at which the mean wind speed is assumed to be zero) are either calculated through direct measurement of wind speeds at varying heights or approximated through equations that estimate the roughness elements (e.g., rocks, vegetation, structures) associated with land cover or land uses. This produces wide variations in the estimation of surface roughness lengths for similar surfaces (MacKinnon et al., 2004). Surface roughness values have also been shown to change dynamically with effects from factors such as atmospheric conditions, past wind events, levels of disturbance and vegetation growth (Greeley et al., 1997). Attempts have been made recently to improve the database of available surface roughness lengths through satellite data, but incorporation of these data has not readily occurred and is largely focused on global scale dust emissions (Prigent et al., 2005). Because of the transient nature of surface roughness lengths and differing methodologies used to measure these lengths, a reliable local database does not exist that can incorporate their effects, especially when dealing with a large time period like an annual inventory (Marticorena et al., 2006).

While surface roughness lengths can eliminate rough surfaces as sources of dust production (i.e., many dust schemes assume no windblown dust emissions occur from surfaces with roughness lengths greater than 0.1 cm; Gillette, 1999) it cannot explain the difference in emissions seen between disturbed and stable soils at similar roughness lengths. In fact, the Owen Effect (Owen, 1964) demonstrates that surface roughness actually *increases* during saltation events. This positive feedback loop has the effect of simultaneously increasing friction velocities and saltation effects, which in turn increase vertical flux emissions (Gillette et al., 1998). Additionally, with supply-limited soils in particular, disturbed soils have been shown to produce orders of magnitude higher dust emissions than similar stable soils, despite having similar surface roughness lengths (Nickling and Gillies, 1989; Macpherson et al., 2008). This is because disturbance of the soil, through breaking of surface crusts and reorientation of surface grains, has the foremost effect of creating larger reservoirs of surface material available to be entrained as compared to stable soils. Since actual surface roughness lengths of subject soils are largely unknown and vary over time; and because surface roughness does not directly address the effects of disturbed soils, another variable is required to approximate disturbance levels. In this scheme, disturbance of soils is determined through use of site-specific inspection data of specific land uses gathered by Maricopa County Air Quality Department (MCAQD) personnel (further detail available in section on Threshold Friction Velocity).

In addition to the conceptual dust scheme associated with supply-limited soils, empirical wind tunnel data gathered in local supply-limited environments is utilized in the development of vertical dust fluxes. Three data sets of wind tunnel tests performed in the southwest U.S. (areas around Barstow, California; Las Vegas, Nevada and southern Arizona) present empirical data on windblown dust emission rates (Nickling and Gillies, 1989; Wacaser et al., 2006; Macpherson et al., 2008). These data confirm the initiation of dust emissions at wind speeds lower than thresholds required for saltation and that disturbed soils produce higher dust emissions than stable soils. These outcomes are expected in supply-limited environments and support the use of a dust scheme modeled around the characteristics of supply-limited environments. Specifically, the wind tunnel tests performed in southern Arizona (Nickling and Gillies, 1989) form the basis of the vertical fluxes (dust emission rates) used to quantify PM_{10} emissions from windblown dust in Maricopa County and the PM_{10} nonattainment area (see section on Vertical Emission Fluxes for further discussion).

As highlighted in the introduction, there are many factors that control the production of windblown dust beyond wind speed velocities and disturbance levels that cannot be directly accounted for in this dust scheme (e.g., soil texture, soil moisture, topography, land use, etc.).

Data for these factors can be limited, nonexistent or unreliable. It is also unknown what degree of importance each of these factors have when they combine in the processes that contribute to the production of windblown dust. In order to account for the role of these missing variables, windblown dust emissions developed here were standardized to match observed PM_{10} monitor concentrations when high winds were present. This sensitivity analysis puts the windblown dust emission estimates in context with other emissions sources and provides a reality check on dust emissions developed using only wind speed velocities and vertical flux equations. The analysis of PM_{10} concentrations under elevated wind speeds estimated that approximately 10% of annual PM_{10} emissions are linked to high wind speeds (see Standardized Windblown Dust Emissions section for more information). As such, windblown dust emissions have been limited to no more than 10% of the total annual inventory for Maricopa County and the PM_{10} nonattainment area.

Threshold Friction Velocity

An essential factor to any windblown dust scheme involves determining the threshold friction velocity (represented as u^*_t); the minimum wind speed at which windblown dust emissions are initiated at ground level. In reality, the threshold friction velocity will change based upon the individual properties of the subject soil during any given wind event. However, for the purposes of development of a windblown dust inventory, it is necessary to identify a minimum wind speed at which dust production can theoretically begin. The threshold friction velocity for this inventory was identified using the theoretical principles of aerodynamic entrainment observed on supply-limited soils (Macpherson et al., 2008) and empirical data from regional wind tunnel tests, local meteorological data, and local PM_{10} monitoring data.

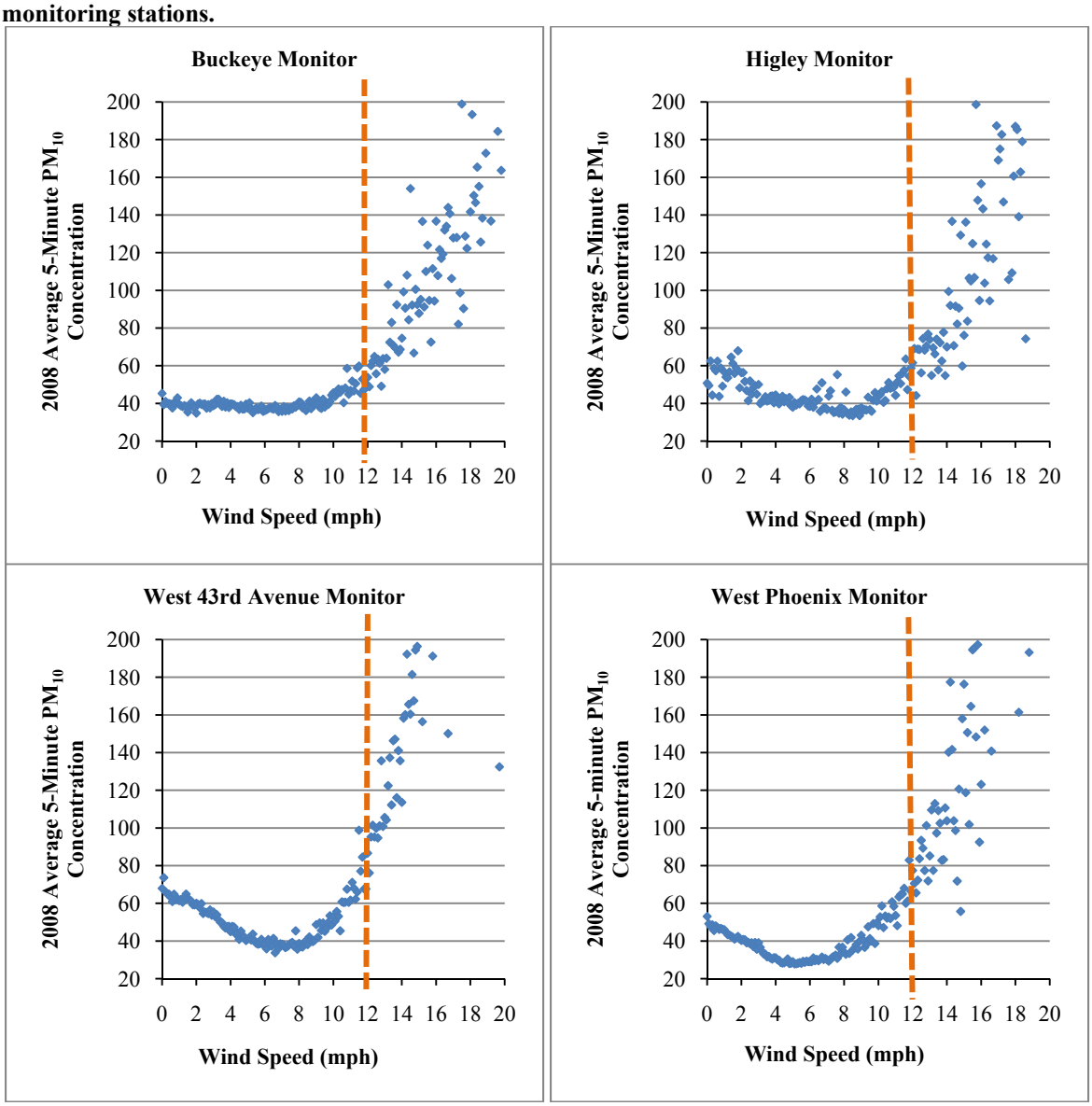
Many dust schemes set separate threshold velocities depending upon a measured or assumed set of soil properties. In the absence of, or augmentation to, local wind tunnel studies, soil texture and soil roughness lengths are common variables used to determine threshold friction velocities. In traditional transport-limited schemes, the physics of saltation dictate that loose, sandy soils will have lower threshold friction velocities than undisturbed clay- or silt-dominated soils (Gillette, 1999). However, the role of soil texture is unclear in the published literature, with recent studies finding that soil texture plays only a secondary role in dust production (Chatenet et al., 1996; Alfaro et al., 2004).

Wind tunnel studies done in the supply-limited deserts of the southwestern U.S. also show little connection between soil texture and threshold friction velocities. Wind tunnel studies in Las Vegas, Nevada (Wacaser et al., 2006) on nine different soil types (including both stable and disturbed soil conditions) found that all soil types emitted dust at the lowest available wind speed of the wind tunnel, approximately 11 mph, suggesting that soil texture plays no distinguishable role in setting threshold friction velocities. Studies in the deserts around Barstow, California found that dust emissions were initiated for three different soil textures (stable and disturbed) at ground-level wind speeds (u*) between 16 to 26 cm/s. Depending on surface roughness values, these ground-level wind speeds translate into 10-meter wind speeds of approximately 10–15 mph. Wind tunnel studies performed in southern Arizona on mostly disturbed, sandy or sandy loam soils found saltation velocities to be between 13 to 30 mph. Roney and White (2004) found that direct aerodynamic entrainment threshold friction velocities are approximately 50 to 75% less than saltation thresholds, suggesting that the dust emission thresholds for southern Arizona could be as low as 7 mph. The measured wind tunnel data, combined with the conceptual ambiguity surrounding the role of soil texture, provide limited empirical rationale to set threshold friction velocities according to soil texture alone.

Large changes in surface roughness lengths have been clearly shown to affect threshold friction velocities of soils (Marticorena et al., 1997). However, there is no reliable data available to estimate surface roughness lengths throughout Maricopa County, especially on lands where frequent human activity is expected (e.g., agriculture, construction sites, urban vacant lots) (Marticorena et al., 2006). As mentioned earlier, these values are not static and change with atmospheric and anthropogenic activities. Surfaces that are known to have uniformly high surface roughness lengths (e.g., built-out urban areas and mountain ranges) have already been eliminated from the underlying land uses that are selected as possible sources of windblown dust. The land uses that remain (e.g., open and vacant areas, agriculture, construction sites) can have varying surface roughness lengths depending on the level of human and natural activity occurring on the soils. As such, tying threshold friction velocities to assumed surface roughness lengths is not a viable option.

Examination of local PM_{10} concentration and meteorological monitoring data in Maricopa County show that when wind speeds reach approximately 12 mph (measured as a 5-minute average), average PM_{10} concentrations are consistently higher than concentrations at lower wind speeds. Also, as wind speeds exceed 12 mph, average PM_{10} concentrations uniformly increase with increasing wind speeds. These monitoring stations are surrounded by a wide variety of land uses and differing surface roughness lengths, yet they all consistently display similar relationships between wind speeds and PM_{10} concentrations. Figure A4–1 displays the annual average relationship between wind speed and PM_{10} concentrations from four distinct monitoring locations which represent a variety of land uses, soil types and geographic conditions within Maricopa County. Although not shown in Figure A4-1, the remaining four monitoring stations that collected 5-minute PM_{10} concentration data in 2008 (Central Phoenix, Durango Complex, Greenwood and South Phoenix) show similar relationships between PM_{10} concentrations and wind speeds. This data, combined with the information developed from the wind tunnel studies performed in the southwest U.S., suggest that 12 mph is a valid approximation of the threshold friction velocity required for the initiation of windblown dust in Maricopa County.

Figure A4–1. 2008 average 5-minute PM_{10} concentration by wind speed at sample Maricopa County monitoring stations.



Vertical Emission Fluxes

The rate at which windblown dust emissions are created and suspended in air is described as a vertical flux. Shao (2008a) describes three processes that contribute to the verical flux: (1) *Aerodynamic Entrainment* where dust particles are directly lifted off the surface; (2) *Saltation Bombardment* as sand grains or aggregates strike the surface and eject dust particles and (3) *Aggregate Disintegration* where dust particles attached to sand grains disintegrate under strong winds. A vertical flux rate can be developed through an equation that represents these processes, or empirically with the use of wind tunnel studies.

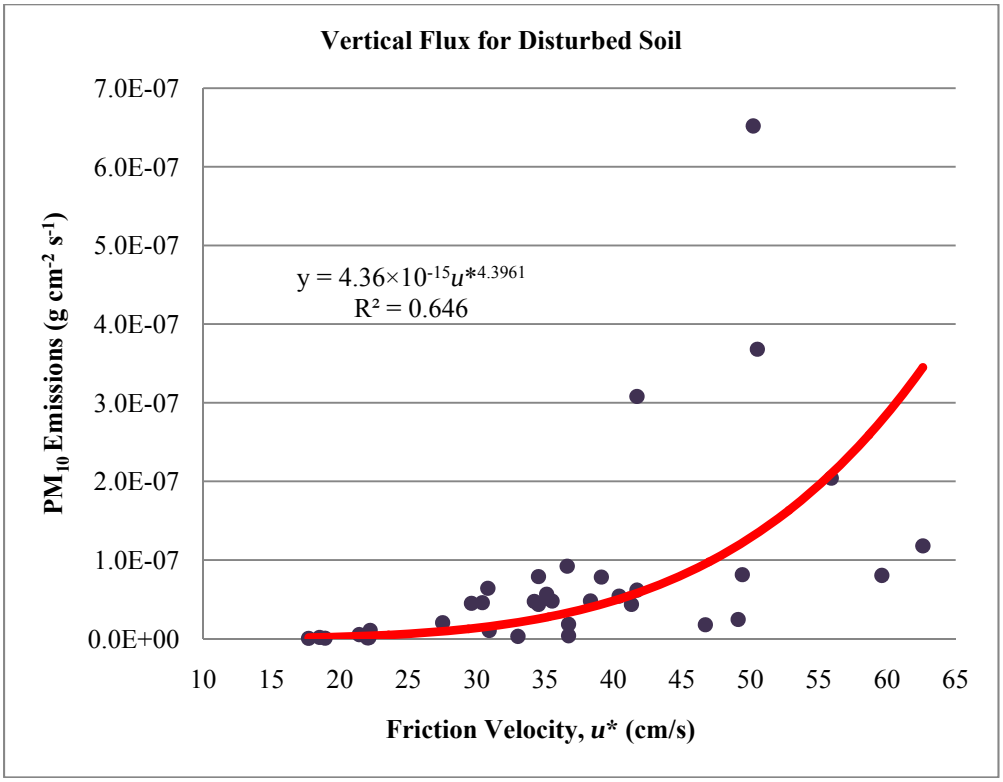
The vertical flux rate developed for this inventory uses wind tunnel studies performed in southern Arizona (Nickling and Gillies, 1989). These studies were performed under a variety of land uses (e.g., native desert, riverbeds, construction sites, agricultural land, mine tailings and dune flats) in soil textures that consisted of either sand or sandy loams. The studies were performed on thirteen sites that are described as disturbed by human activity, or having a strong

potential to be disturbed because of the surface condition of the soil. The authors of the study provide vertical flux rates grouped by land use and by percent clay content. However, these grouping are not useful for this inventory given that recent research (Alfaro et al., 2004) and other wind tunnel studies (Wacaser et al., 2006) have shown that soil texture is not of primary importance in determining vertical fluxes. Fluxes based upon land use groupings provide limited information on soil condition and ignore other essential soil characteristics. Additionally, the wind tunnel studies performed in Barstow, California and Las Vegas, Nevada (Wacaser et al., 2006; Macpherson et al., 2008) show that soil disturbance is the largest factor affecting the vertical flux rate of a soil.

For the above reasons, applicable data from the southern Arizona studies (Nickling and Gillies, 1989) were grouped together to form an overall vertical flux for disturbed soils. Data from seven of the thirteen test sites was grouped together to form the disturbed soil vertical flux. These seven sites include the land uses of construction activities, abandoned agriculture, dry river beds and scrub desert. Six sites were excluded because the land uses or soil properties do not exist in Maricopa County (mine tailings, sand dunes) or because they were conducted on active agricultural fields. Dust emissions from active agricultural fields are calculated using a formula developed by the U.S. Department of Agriculture (see Active Agriculture section). Inactive agricultural land uses that are either fallow, abandoned or some other use (e.g., dairies) are represented by the vertical fluxes developed through the southern Arizona wind tunnel tests, as these land uses do not have active crop cover.

To create the disturbed soil vertical flux, a simple scatter plot of the data (frcition velocity against PM_{10} emissions) was made of the selected southern Arizona wind tunnel data. A power relationship is then developed from the data to produce the best fitting curve of the vertical flux. The assembled data performs reasonably well (R^2 of 0.646) in developing a statistically signifigant vertical flux ($4.36 \times 10^{-15} u^{*4.3961}$ g cm^{-2} s^{-1}) for disturbed soils, given the limited number of test sites and the lack of other variables describing the soil properties. There is significant scatter in the data seen at higher friction velocities. This phenomenon has been documented in other studies, and again highlights the fact that there are many other factors besides friction velocity that determine the vertical flux rates of soils (Houser and Nickling, 2001). Despite this short coming, friction velocity remains the primary variable with which to describe the magnitude of dust emissions; largely because it is one of the easiest variables to verify with quantitative data. The vertical flux developed through the southern Arizona wind tunnel data is in the same order of magnitude, and compares well with, other fluxes measured in similar wind tunnel tests in Barstow, California and Las Vegas, Nevada (Wacaser et al., 2006; Macpherson et al., 2008). Figure A4–2 graphs the data points from the wind tunnel studies used to develop the vertical flux for disturbed soil.

Figure A4–2. Vertical flux for disturbed soil.



Since the southern Arizona wind tunnel tests provided limited information on vertical fluxes from stable soils, a stable soil vertical flux could not be developed directly from the wind tunnel data. As a surrogate, the ratio of stable to disturbed vertical fluxes found in the wind tunnel studies performed in Barstow, California (Macpherson et al., 2008) was used to develop the vertical flux for stable land uses. The Barstow area study contained multiple tests done on stable and disturbed soils at the same test sites. This allows for a direct comparison of the windblown dust emission rates between stable and disturbed soils. Data from all of the Barstow wind tunnel tests were used except for the tests done on salt-crusted soils (dry lake beds), as this type of soil is rare in Maricopa County. The results of the Barstow studies indicate that the stable soil vertical flux was found to produce emissions at a rate of about 12 to 20% of the disturbed soil vertical flux.[1]

Determination of the amount of disturbed land in each land use category is accomplished through use of rule effectiveness rates developed by MCAQD (see Appendix 3 for details on rule effectiveness), since direct measurement of soil disturbance is not feasible (i.e., soil conditions are constantly changing) in an area as large as Maricopa County. Activities on land uses subject to windblown dust are regulated by MCAQD rules that require specific activity-related control measures that stabilize the soil. Compliance and inspection records provide an estimate of how often these measures are being implemented and the frequency of observed violations of the measures. By implied extension, this is also an estimate of how often a regulated land use soil is stabilized. Examination of compliance records for the period of July 2008 through June 2009 produced rule effectiveness rates of 90% for developing land uses (Rule 310), 65% for sand and

[1] For disturbed surfaces a flux of 2.35 x $10^{-12}u^{*2.5604}$ g cm^{-2} s^{-1} was calculated using the Barstow wind tunnel data; likewise for stable surfaces, a flux of 2.96 x $10^{-12}u^{*1.9744}$ g cm^{-2} s^{-1} was calculated. The ratio of these Barstow fluxes applied to the southern Arizona disturbed soil vertical flux (at the mean of each wind speed bin) allows for calculation of a vertical flux that can represent emissions from stable southern Arizona soils.

gravel processing and mining land uses (Rule 316), and 95% for vacant land uses (Rule 310.01). For the purposes of calculating windblown dust, these rule effectiveness percentages are used as surrogates for the percentage of a land use category that is assumed to be disturbed. Thus, the Rule 310 effectiveness rate of 90% serves as a surrogate for developing land uses (i.e., 90% of the land is stable, 10% is disturbed), the Rule 316 rate of 65% serves as a surrogate for sand and gravel processing and mining activities, and the Rule 310.01 rate of 95% serves as a surrogate for all open and vacant lands, landfills, automotive test tracks and inactive agricultural land uses. The rule effectiveness rate developed for agricultural operations (55%) applies only to active agricultural land uses and is incorporated in the equation used to estimate windblown dust from active agricultural fields (see section on Active Agricultural Emissions).

In order to utilize the disturbed soil and stable soil vertical fluxes for generating PM_{10} emission estimates, PM_{10} emission factors based upon these vertical fluxes are created. Initially, the units of the fluxes were converted (from g cm^{-2} s^{-1} to tons $acre^{-1}$ 5-$minute^{-1}$) to match available meteorological data on wind speeds and comparable units of mass with other sections of this inventory. Selection of a 5-minute average for the wind speed value was chosen because it is the shortest duration of wind speed available that is constantly measured. Windblown dust production has been shown to be more closely correlated with gusts than with averaged wind speeds (Cakmur et al., 2004; Engelstaedter and Washington, 2007). However, gusts (usually 1-second maximums) are not constantly measured which does not allow for their use in calculation of emissions in an annual inventory. Thus, the 5-minute average wind speed is selected as the input wind speed in both vertical fluxes (see Wind Speed Data section for more information).

These 5-minute average wind speeds are aggregated into five 10-meter wind speed bins (12-15 mph, 15-20 mph, 20-25 mph, 25-30 mph, and 30-35 mph) in order to develop a disturbed soil and stable soil emission factor per each wind speed bin. The midpoint of each wind speed bin (13.5 mph, 17.5 mph, 22.5 mph, 27.5 mph, and 32.5 mph) is converted via the Prandtl equation[2] to a $u*$ value (surface wind speed) for use in the disturbed soil vertical flux equation, resulting in a disturbed soil emission factor for each wind speed bin. After the disturbed soil emission factors are calculated, the ratio between disturbed and stable soil emissions observed at the Barstow tests is used to develop a stable soil emission factor for each wind speed bin. Table A4–1 shows the resulting stable soil and disturbed soil emission factors for each wind speed bin (by land use category) and the ratio of stable to disturbed soil emissions observed in the Barstow area wind tunnel studies.

[2] The fluid dynamics Prandtl equation: $U = \frac{u^*}{k} ln \frac{z}{z_o}$, allows for the calculation of $u*$ at various 10-meter wind speeds by solving for $u*$: ($u^* = U \frac{k}{ln \frac{z}{z_o}}$), where U is wind speed at 10 meters, k is Von Karman's constant (0.4), z is 10 meters, and z_o is measured surface roughness value. An average value of 0.025cm (as measured during southern Arizona wind tunnel tests) was assumed for z_o Once $u*$ is calculated for each wind speed bin, that value is then inserted into the vertical flux rate to develop the emission factors seen in Table A4-1.

Table A4–1. PM_{10} emission factors for stable and disturbed land uses by wind speed bin.

Land Use Category	% of Land Use Category	PM_{10} Emission Factor (tons/acre-5-minute) by 10-Meter Wind Speed Bin (mph)				
		12-15	15-20	20-25	25-30	30-35
Agriculture (Active)		NA – Calculated Under Different Methodology				
Agriculture (Inactive) – Stable	95%	1.10×10^{-5}	2.93×10^{-5}	7.68×10^{-5}	1.64×10^{-4}	3.10×10^{-4}
Agriculture (Inactive) – Disturbed	5%	5.44×10^{-5}	1.69×10^{-4}	5.14×10^{-4}	1.24×10^{-3}	2.57×10^{-3}
Developing Land – Stable	90%	1.10×10^{-5}	2.93×10^{-5}	7.68×10^{-5}	1.64×10^{-4}	3.10×10^{-4}
Developing Land – Disturbed	10%	5.44×10^{-5}	1.69×10^{-4}	5.14×10^{-4}	1.24×10^{-3}	2.57×10^{-3}
Open Space, River Beds, Vacant, Landfill, Test Tracks – Stable	95%	1.10×10^{-5}	2.93×10^{-5}	7.68×10^{-5}	1.64×10^{-4}	3.10×10^{-4}
Open Space, River Beds, Vacant, Landfill, Test Tracks –Disturbed	5%	5.44×10^{-5}	1.69×10^{-4}	5.14×10^{-4}	1.24×10^{-3}	2.57×10^{-3}
Sand & Gravel, Mining – Stable	65%	1.10×10^{-5}	2.93×10^{-5}	7.68×10^{-5}	1.64×10^{-4}	3.10×10^{-4}
Sand & Gravel, Mining – Disturbed	35%	5.44×10^{-5}	1.69×10^{-4}	5.14×10^{-4}	1.24×10^{-3}	2.57×10^{-3}
Disturbed Soil Vertical Flux:		**Ratio of Barstow Stable to Disturbed Soil Emissions**				
$4.36 \times 10^{-15} u^{*4.3961}$ g cm^{-2} s^{-1}		20.16%	17.33%	14.94%	13.29%	12.06%

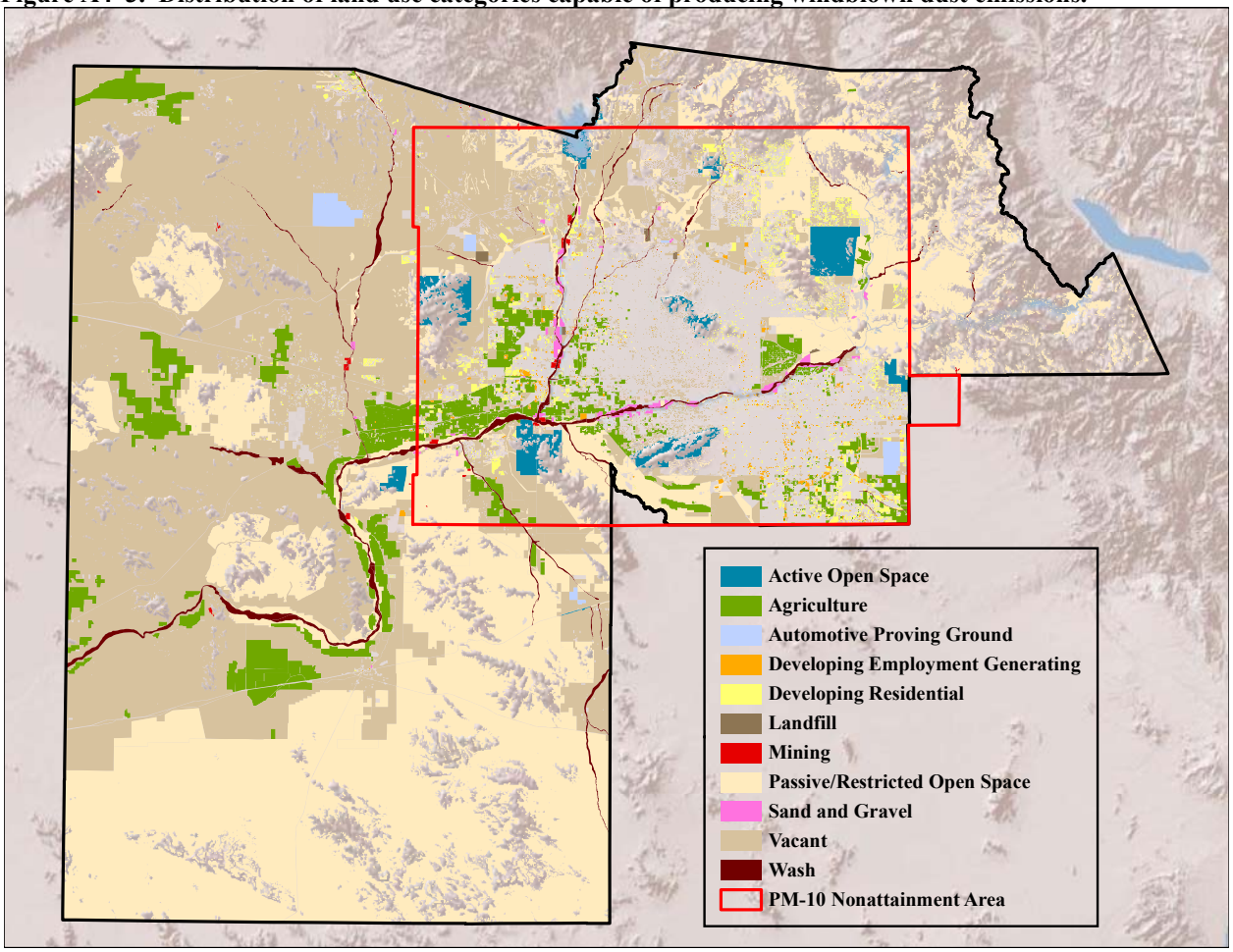
Land Use Data

The Maricopa Association of Governments (MAG) maintains GIS data on land use coverage in Maricopa County. The GIS data compiled by MAG represents land use coverage for the year 2009. A detailed explanation on how MAG assembles and maintains its GIS database is included as Attachment I of this Appendix. In addition to data provided by MAG, the Arizona Cotton Research and Protection Council (ACRPC) provided supplemental GIS information on agricultural field crops in portions of Area A in Maricopa County. Where appropriate, data from the ACRPC was used to update the agricultural land use category maintained by MAG. A total of nine individual land use categories were identified as having potential to emit windblown dust. These categories were selected due to an abundant presence of exposed soils and the possibility of periodic or frequent disturbance. Other land uses not selected may on occasion emit windblown dust, but the presence of structures or vegetated/paved surfaces associated with these land uses limits their ability to emit windblown dust on a consistent basis. Land uses on steeply sloped rocky terrain were also excluded as sources of windblown dust, as the large surface roughness lengths prohibits the production of windblown dust from this type of topography. Table A4–2 lists a description of, and the acreage associated with, the nine land use categories considered as sources of windblown dust. Figure A4–3 shows the extent and distribution of the land use categories determined to have the potential to emit windblown dust.

Table A4–2. Land use categories associated with the production of windblown dust.

MAG Land Use Category	Maricopa County Acreage	PM_{10} NAA Acreage	Description
Active Open Space	59,145	54,835	Natural desert community parks (e.g., White Tanks)
Agriculture	282,793	116,934	Active fields/orchards, dairies & inactive/abandoned
Auto Test Tracks	19,594	6,888	Unpaved automobile proving grounds
Developing	66,341	60,335	Vacant lands converting to built uses
Landfill	2,705	2,705	Community refuse disposal sites
Mining	3,329	2,004	Rock quarries/pits
Passive Open Space/Wash	1,861,493	341066	State/National parks, bombing range, dry rivers/washes
Sand & Gravel	11,112	10,350	Sand & Gravel processing facilities
Vacant	1,930,606	395,902	Developable/unprotected open spaces

Figure A4–3. Distribution of land use categories capable of producing windblown dust emissions.

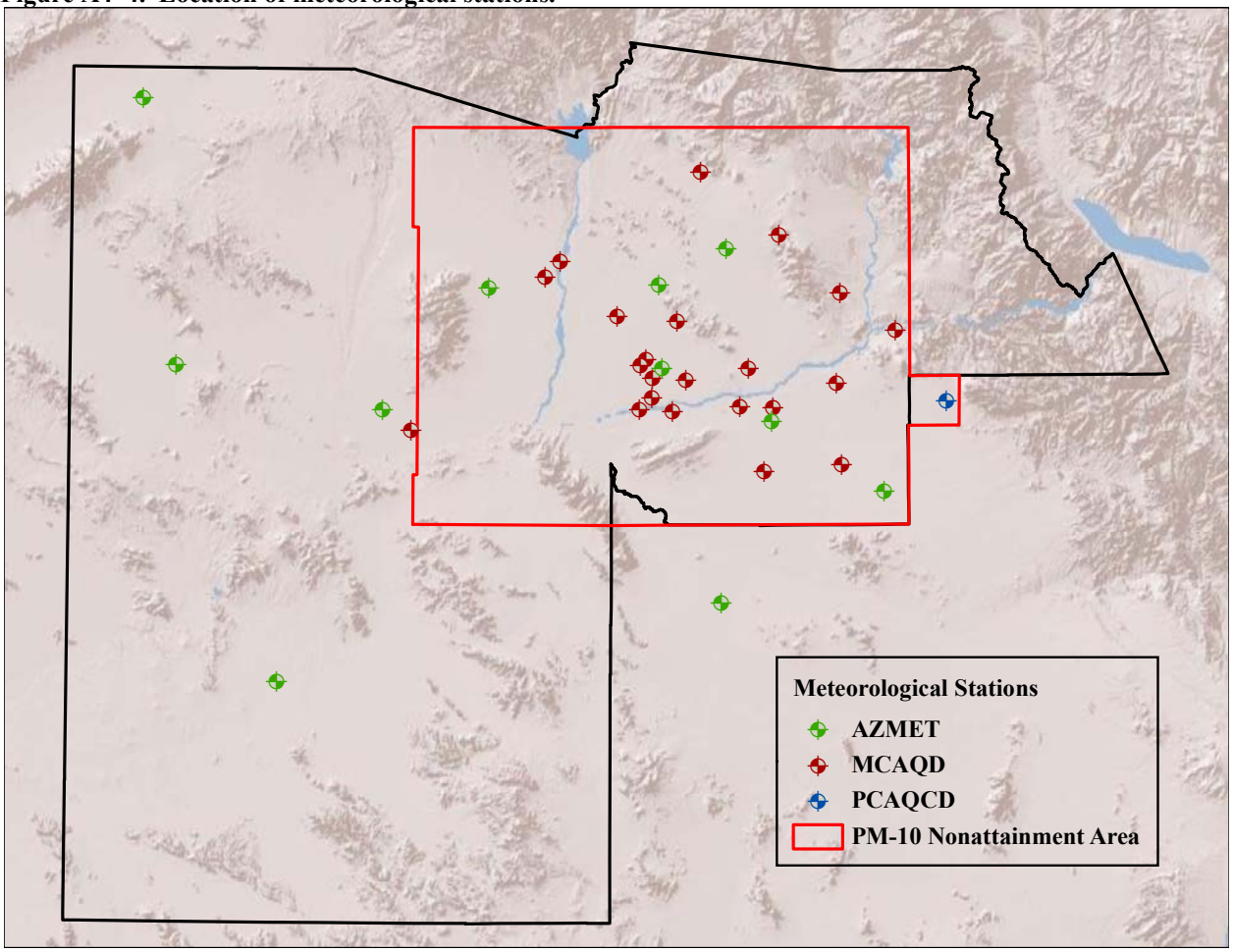


Meteorological Data

Thirty-four meteorological stations were used for source data to compile calendar year 2008 wind speed and precipitation for this inventory of windblown dust. This includes eleven stations operated by the Arizona Meteorological Network (AZMET), twenty-two stations operated by the Maricopa County Air Quality Department (MCAQD), and one station operated by the Pinal County Air Quality Control District (PCAQCD). Stations operated by the National Weather Service (NWS) in and around Maricopa County were not chosen for inclusion in this analysis due to differences in wind speed data collection methods that preclude "apples-to-apples" comparisons with data from the meteorological stations included in this work.[3] Figure A4–4 displays the location of the included meteorological stations.

[3] National Weather Service (NWS) stations report wind speeds in 2-minute averages at the time of posting, while AZMET, MCAQD and PCAQCD all report wind speed in hourly averages at the end of each hour or in 5-minute averages.

Figure A4–4. Location of meteorological stations.



Wind Speed Data

For this analysis, 5-minute average wind speeds form the basis of the wind data used in calculating windblown dust emissions. As mentioned earlier, windblown dust emissions have greater correlation with gusts than with averaged wind speeds (Cakmur et al., 2004; Engelstaedter and Washington, 2007). Data recorded as a 5-minute average provides finer time resolution (versus hourly average wind speeds) that can better capture the effects of gusts while still allowing for emission estimates to be developed. This approach also allows for any 5-minute time period over the threshold friction velocity (12 mph) to be counted and assigned into wind speed bins: 12–15 mph, 15–20 mph, 20–25 mph, 25–30 mph and 30–35 mph. Creating wind speed bins allows for the efficient calculation of emissions while still reflecting the change in magnitude of emissions as wind speeds rise. Outlined below are the steps necessary to prepare the wind speed data for inclusion in windblown dust emission calculations.

As an initial step, wind speed data from the selected meteorological stations were uniformly adjusted to speeds at 10 meters (to account for the difference in anemometer heights) through use of a standard wind profile power-law equation:

$$U_z = U_r(Z/Z_r)^p$$

where U_z is wind speed (in mph) at 10 meters, U_r is wind speed (in mph) at referenced anemometer height, Z is 10 meters, Z_r is the height (in meters) of the reference anemometer, and

p is the power-law exponent. Determination of p was made by comparing wind speeds at neighboring stations with different anemometer heights (e.g., AZMET's Buckeye station at 3 meters compared with MCAQD's Buckeye station at 10 meters) through a simple adaptation of the power-law equation:

$$p = \frac{\ln(U) - \ln(U_r)}{\ln(Z) - \ln(Z_r)}$$

The stations used in comparison were all assumed to have similar surface roughness lengths to each other as the stations were between 1–3 miles apart. Comparison of hourly average wind speeds yielded an average value for p of 0.06 for urban stations and 0.12 for rural stations (only those hours when atmospheric conditions are well mixed were used, as applying the approach described above for hours with calm winds tends to over-inflate the value of p).

In addition to correcting for height, adjustments to wind speed were performed to gap-fill missing data and interpolate 5-minute average values as necessary. All of the meteorological stations report hourly average wind speeds at the end of each hour. In addition, thirteen of the MCAQD stations also report 5-minute average wind speeds, with data completion rates of 75% or better. The data from these stations were: (1) counted and assigned to one of five wind speed bins of 12-15 mph, 15–20 mph, 20–25 mph, 25–30 mph, and 30–35 mph; and (2) "grown" to compensate for missing data, based upon the data completion rate of each station. Thus, a station that reported 124 5-minute periods assigned to a bin with a data completion rate of 90.63%, would result in a "grown" bin value of 137 (124 periods divided by 90.63%). Table A4–3 presents the recorded and grown 5-minute values by wind speed bin for the year 2008, for each of the thirteen MCAQD meteorological stations that were considered.

Table A4–3. Number of recorded and grown 5-minute average wind speeds for 2008, by wind speed bin and meteorological station.

	Recorded 5-Minute Averages						Grown 5-Minute Averages				
MCAQD Station	12-15 mph	15–20 mph	20–25 mph	25–30 mph	30–35 mph	% Data complete	12-15 mph	15–20 mph	20–25 mph	25–30 mph	30–35 mph
Buckeye	3030	1679	296	54	12	99.62%	3042	1685	297	54	12
Coyote Lakes	1846	840	77	1	0	98.71%	1870	851	78	1	0
Durango Complex	1776	618	33	10	1	96.39%	1843	641	34	10	1
Dysart	1782	784	92	6	0	78.16%	2280	1003	118	8	0
Falcon Field	2088	758	95	2	1	76.77%	2720	987	124	3	1
Greenwood	795	124	11	1	0	90.63%	877	137	12	1	0
Higley	1896	766	50	8	1	91.02%	2083	842	55	9	1
North Phoenix	376	80	8	2	0	77.59%	485	103	10	3	0
South Phoenix	696	169	9	0	1	99.19%	702	170	9	0	1
Tempe	54	5	0	0	0	86.38%	63	6	0	0	0
West Chandler	1637	515	42	3	1	99.09%	1652	520	42	3	1
West Forty-Third	2391	1042	83	13	6	98.44%	2429	1059	84	13	6
West Phoenix	892	111	8	1	0	92.47%	965	120	9	1	0

For the stations that do not record 5-minute average wind speeds[4], regression equations were developed (based upon those MCAQD stations that do report 5-minute average wind speeds) to interpolate counts of 5-minute average values. The equations were derived by regressing 5-minute average counts in each wind speed bin (dependent [y]) against a count of an hourly average wind speeds greater than a pre-determined wind speed (independent [x]). Since the

[4] AZMET and PCAQCD stations report average wind speed only on an hourly basis, and another nine MCAQD stations that measure wind speed on a 5-minute average had data completion rates less than 75% for 2008.

majority of wind speed counts exist in the lower wind speed bins (e.g., hourly average wind speeds over 25 mph were recorded only ten unique times in 2008), a count of hourly values greater than 15 mph was chosen as the independent variable (x). All of the regression equations proved to be statistically significant at the 95% confidence level. The results of the regression equations for each wind speed bin are shown in Table A4–4. The resulting 5-minute average wind speeds (by bin) for all meteorological stations in this study are shown in Table A4–5.

Table A4–4. Regression equation, *p*-value, and R^2 for interpolating 5-minute average wind speeds, by bin.

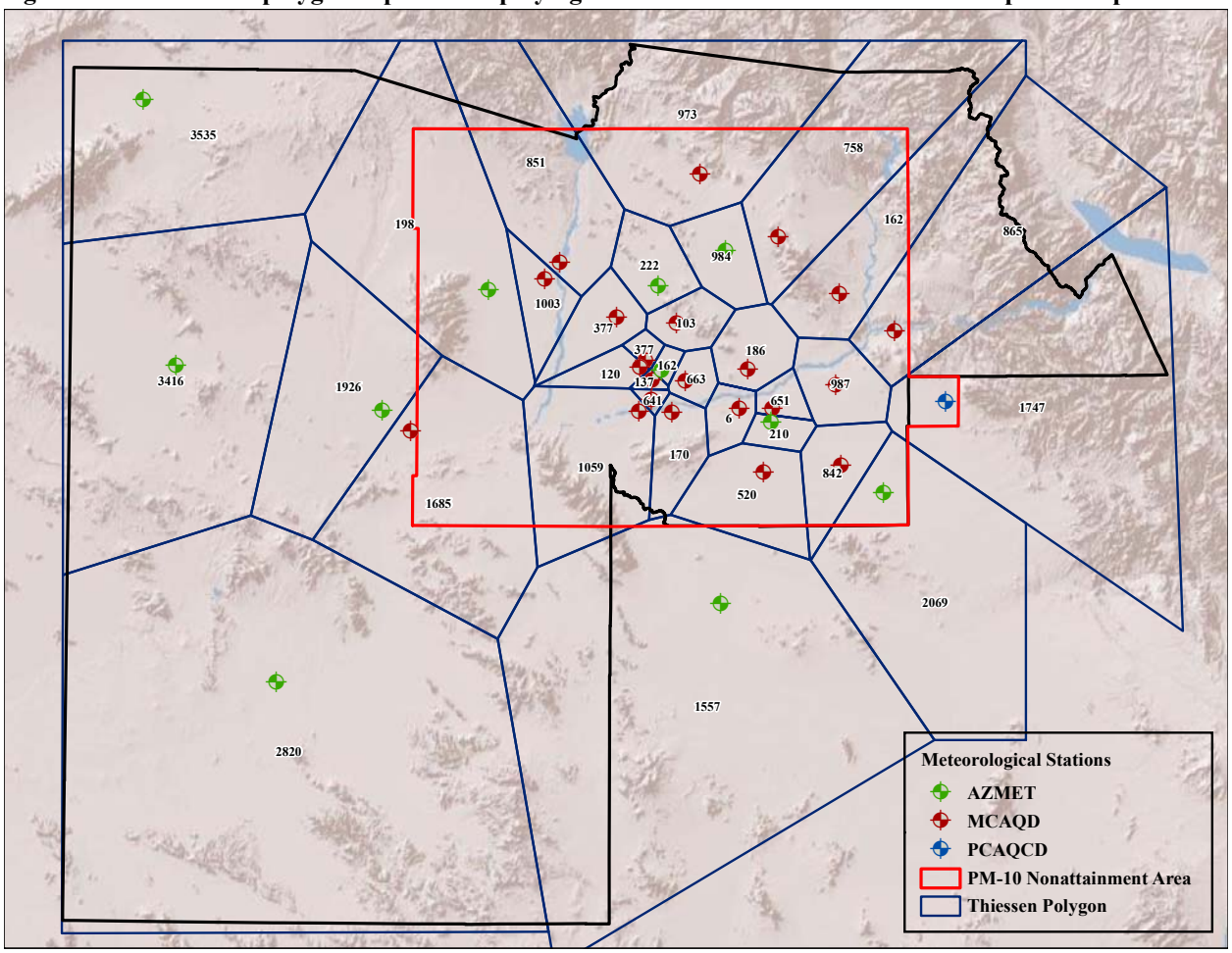
5-minute average wind speed bin	Regression equation	*p*-value (probability)	R^2
12-15 mph	$y = 827.00 + 19.80x$	0.00007056	77.55%
15–20 mph	$y = 150.05 + 11.92x$	0.00000006	93.77%
20–25 mph	$y = –8.34 + 1.39x$	0.00000021	92.09%
25–30 mph	$y = –4.20 + 0.31x$	0.00009300	76.42%
30–35 mph	$y = –0.99 + 0.07x$	0.00047000	68.57%

Table A4–5. Number of interpolated 5-minute average wind speeds, by station and wind speed bin. (Shaded cells denote interpolated values.)

Station Name	Number of hourly average values > 15 mph	Number of 5-minute average values between: 12-15 mph	15–20 mph	20–25 mph	25–30 mph	30–35 mph
AZMET Aguila	284	6450	3535	386	84	19
AZMET Buckeye	149	3777	1926	199	42	9
AZMET Desert Ridge	70	2213	984	89	18	4
AZMET Harquahala	274	6252	3416	373	81	18
AZMET Maricopa	118	3163	1557	156	32	7
AZMET Mesa	5	926	210	0	0	0
AZMET Paloma	224	5262	2820	303	65	15
AZMET Phoenix Encanto	1	847	162	0	0	0
AZMET Phoenix Greenway	6	946	222	0	0	0
AZMET Queen Creek	161	4015	2069	215	46	10
AZMET Waddell	4	906	198	0	0	0
MCAQD Blue Point	60	2015	865	75	14	3
MCAQD Buckeye	146	3042	1685	297	54	12
MCAQD Cave Creek	69	2193	973	88	17	4
MCAQD Central Phoenix	43	1678	663	51	9	2
MCAQD Coyote Lakes	54	1870	851	78	1	0
MCAQD Durango Complex	50	1843	641	34	10	1
MCAQD Dysart	64	2280	1003	118	8	0
MCAQD Falcon Field	58	2720	987	124	3	1
MCAQD Fountain Hills	1	847	162	0	0	0
MCAQD Glendale	19	1203	377	18	2	0
MCAQD Greenwood	1	877	137	12	1	0
MCAQD Higley	42	2083	842	55	9	1
MCAQD Mesa	42	1659	651	50	9	2
MCAQD North Phoenix	4	485	103	10	3	0
MCAQD Pinnacle Peak	51	1837	758	63	12	3
MCAQD South Phoenix	6	702	170	9	0	1
MCAQD South Scottsdale	3	886	186	0	0	0
MCAQD Tempe	0	63	6	0	0	0
MCAQD West Forty-Third	65	2429	1059	84	13	6
MCAQD West Chandler	23	1652	520	42	3	1
MCAQD West Indian School	19	1203	377	18	2	0
MCAQD West Phoenix	5	965	120	9	1	0
PCAQCD Apache Junction	134	3480	1747	178	37	8

Because wind speeds vary dramatically between different meteorological stations in Maricopa County (especially in the transition between rural and urban stations), it is important to represent those variations in space upon the land uses subject to windblown dust. This is accomplished by assigning the wind speed counts in Table A4–5 in GIS (spatial joining) to the land uses nearest each meteorological station through a series of Thiessen polygons[5] (Pulugurtha and James, 2006). This process allows for variations in wind speed counts to be representatively distributed in space across land uses subject to windblown dust, as opposed to "smearing" averaged wind speed counts across all of Maricopa County and the PM_{10} nonattainment area. As an example, Figure A4–5 shows the resulting Thiessen polygons for the 15-20 mph wind speed bin.

Figure A4–5. Thiessen polygon depiction displaying the number of values for the 15–20 mph wind speed bin.



Precipitation Data

During days with precipitation, windblown dust emissions are severely, if not completely, limited. Precipitation also increases overall soil moisture which acts as a control on the production of windblown dust after precipitation has ceased. To account for the role of precipitation, a simple formula used by the U.S. EPA when calculating the controlling role of precipitation on fugitive dust from unpaved roads can be adapted to windblown dust production (US EPA, 2006).

[5] A "Thiessen polygon" depicts an area whose boundaries define the region that is closest to a given point, relative to all other given points.

The adapted equation is represented as:

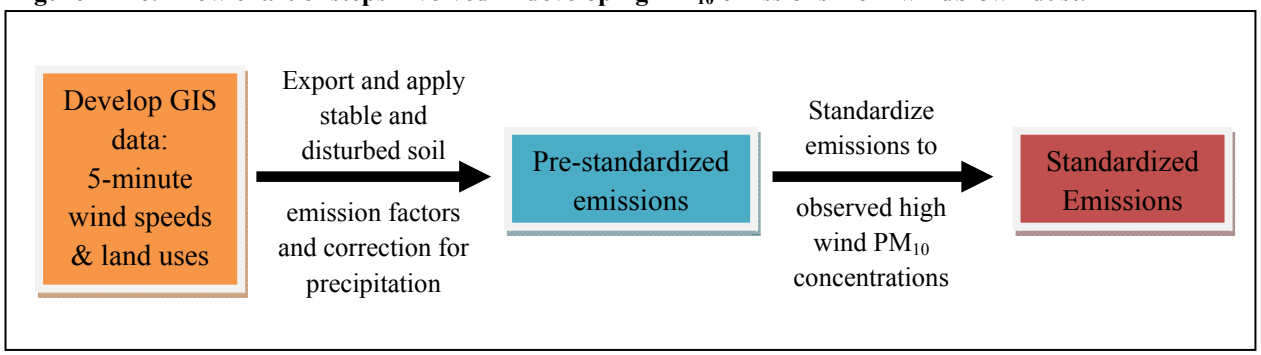
$$E = B \times (1 - P/N)$$

Where E equals emissions, B equals emissions before precipitation, P equals the annual number of "wet" days with at least 0.254 mm (0.01 in) of precipitation (39 days in 2008), and N equals the number of days in the year (366 in 2008). Using this formula equates to applying a 10.66% annual reduction in windblown dust due to precipitation.

Calculation of Windblown Dust Emissions

After developing the input data necessary to calculate windblown dust emissions (e.g., wind speed bin counts, disturbed and stable vertical flux equations, etc.), emission estimates of PM_{10} are calculated for both the PM_{10} nonattainment area and Maricopa County. These emission estimates represent the maximum potential emissions from each land use category since they are a product of only local wind speeds and emission factors developed from soils expected to emit high levels of dust. These emissions will be standardized (adjusted to match observed PM_{10} concentration under high winds) in the next section to account for a range of controlling factors (e.g., surface roughness lengths, soil moisture, vegetation, supply-limitation, etc.) where either adequate quantitative data does not exist or cannot be represented as a unique variable in an emission estimate equation (see section on Standardized Windblown Dust Emissions). Figure A4–6 contains a flow chart showing the steps involved in calculating PM_{10} emissions from windblown dust.

Figure A4–6. Flow chart of steps involved in developing PM_{10} emissions from windblown dust.



Calculation of pre-standardized emission estimates begins through the use of GIS to spatially assign the 5-minute wind speed bin counts to the underlying land use categories (as shown previously in Figure A4–5). These base data are exported from GIS as a spreadsheet, with each row of the spreadsheet representing a spatially unique land use category polygon with associated wind speed bin counts. The land use and wind speed specific emission factors for disturbed and stable soils listed in Table A4–1 are applied to each row of the spreadsheet to produce pre-standardized emissions. Since the specific geographic location of surface disturbance is unknown and varies throughout the year, each land use polygon is assumed to have the same proportion of disturbed and stable soils throughout the year as expressed by the percentages in Table A4–1 (i.e., all vacant parcels are assumed to be 95% stable and 5% disturbed). Base data and emissions from a sample vacant land use polygon are shown in Table A4–6. All pre-standardized emissions from land use categories except active agricultural fields are calculated per the methodology presented in Table A4–6.

Table A4–6. Base data and pre-standardized emissions from a sample vacant land use polygon.

	Polygon Acres	Count of 5-Minute Periods for 12 - 15 mph	Count of 5-Minute Periods for 15 - 20 mph	Count of 5-Minute Periods for 20 - 25 mph	Count of 5-Minute Periods for 25 - 30 mph	Count of 5-Minute Periods for 30 - 35 mph
Vacant Land Use Base Data	22.15	2280	1003	118	8	0
Emission Factors (tons/acre–5-min)		**12 - 15 mph**	**15 - 20 mph**	**20 - 25 mph**	**25 - 30 mph**	**30 - 35 mph**
Stable Soil Emission Factor		1.10×10^{-5}	2.93×10^{-5}	7.68×10^{-5}	1.64×10^{-4}	3.10×10^{-4}
Disturbed Soil Emission Factor		5.44×10^{-5}	1.69×10^{-4}	5.14×10^{-4}	1.24×10^{-3}	2.57×10^{-3}
Annual Emissions	**Acreage**	**12 - 15 mph Emissions (tons)**	**15- 20 mph Emissions (tons)**	**20 - 25 mph Emissions (tons)**	**25 - 30 mph Emissions (tons)**	**30 - 35 mph Emissions (tons)**
Stable Emissions (95% of acreage)[1]	21.04	0.53	0.62	0.19	0.03	0.00
Disturbed Emissions (5% of acreage)[2]	1.11	0.14	0.19	0.07	0.01	0.00
Total Emissions[3]	22.15	0.66	0.81	0.26	0.04	0.00

[1] Stable Emissions = Stable Acreage × Wind Speed Bin Count × Wind Speed Bin Emission Factor
[2] Disturbed Emissions = Disturbed Acreage × Wind Speed Bin Count × Wind Speed Bin Emission Factor
[3] Total (Pre-standardized) Emissions = Stable Emissions + Disturbed Emissions

Windblown Dust Emissions from Active Agricultural Areas

Since crop cover dramatically affects windblown dust production, windblown dust from active agricultural areas (fields or orchards with harvested or planted crops) cannot be calculated using the vertical fluxes developed for the other land use categories. Some crops, like alfalfa, maintain dense vegetative cover all year long and virtually eliminate the possibility of windblown dust from these types of fields. Thus, windblown dust from active agricultural fields is calculated using a soil erodibility formula developed by the U.S. Department of Agriculture (in US EPA, 1974):

$$E_s = a\ I\ C\ K\ L'\ V'$$

where E_s equals suspended PM in tons/acre-year, a is a constant (0.0125) representing the portion of PM as PM_{10}, I is soil erodibility, C is a climatic factor, K is surface roughness, L' is unsheltered field width and V' is vegetative cover.

The number of acres harvested in 2008 serves as a surrogate for the amount of active agricultural areas in Maricopa County. Data on the amount of acres harvested for 2008 is available through the Arizona Agricultural Statistics Bulletin and the U.S. Department of Agriculture National (USDA) Agricultural Statistics Service for 2008 (USDA, 2008; AASS, 2009). Data for the other variables in the equation is taken from the 1999 Serious Area PM-10 Plan (MAG, 2000). Table A4–7 lists the crop-specific values for each variable.

Table A4–7. Active Maricopa County agricultural acreage and default values for USDA equation variables, by crop type.

Crop	2008 Acreage	*a*	*I*	*C*	*K*	*L'*	*V'*	E_s
Cotton	18,800	0.0125	63.6	0.318	0.5	0.74	0.7	0.065
Alfalfa	83,000	0.0125	63.6	0.318	1	0.76	0	0
Other hay	4,500	0.0125	63.6	0.318	0.8	0.83	0	0
Wheat	30,100	0.0125	63.6	0.318	0.6	0.77	0	0
Barley	9,900	0.0125	63.6	0.318	0.6	0.77	0	0
Corn	700	0.0125	63.6	0.318	0.6	0.77	0.44	0.051
Potatoes	1,400	0.0125	63.6	0.318	0.8	0.70	0.6	0.085
Sorghum	2,200	0.0125	63.6	0.318	0.6	0.77	0	0
Other vegetables	16,072	0.0125	63.6	0.318	0.6	0.48	0.77	0.056
Citrus	2,124	0.0125	63.6	0.318	0.6	0.48	0.77	0.056

Application of the formula to develop annual PM_{10} emissions from active agricultural fields is achieved by multiplying crop type E_s by the number of acres in each crop type. In addition to applying the USDA formula, a control factor of 72.28% (1 – 27.72%) was applied to active agricultural emission estimates to reflect the effectiveness of the agricultural BMP program. This control factor is a combination of the rule effectiveness of the BMP program (55.33%; see Appendix 3) and the estimated control effectiveness of the BMP program (50.10%)[6], for an overall effectiveness of 27.72%. Emissions are allocated to the PM_{10} nonattainment area based upon the percentage (41.35%) of agricultural land use acres located with the nonattainment area.

Summary of Pre-standardized Windblown Dust Emission Calculations

To account for precipitation, pre-standardized emission estimates have been reduced by 10.66% (see section on Precipitation for more detail) for all land uses except active agricultural areas, as factor *C* in the USDA formula considers precipitation and the effects of soil moisture content. Annual pre-standardized PM_{10} emissions from active agricultural areas and all other land uses are listed in table A4–8 for Maricopa County and the PM_{10} nonattainment area.

Table A4–8. Annual pre-standardized PM_{10} emissions from windblown dust in Maricopa County and the PM_{10} nonattainment area.

	Annual emissions (tons/yr)	
Land use category	**Maricopa County**	**PM_{10} Nonattainment Area**
Active open space	3,191.63	2,660.86
Agriculture – active	1,739.06	719.10
Agriculture – inactive	16,711.81	3,686.87
Auto test tracks	2,192.92	534.01
Developing	5,897.93	4,863.19
Landfill	78.76	78.76
Mining	723.15	295.40
Passive open space/wash	268,122.10	22,669.38
Sand & gravel	1,511.72	1,341.04
Vacant	283,176.99	23,037.24
Totals:	**582,326.11**	**59,885.85**

[6] Derived from Table 4-2 of the Technical Support Document for Quantification of Agricultural Best Management Practices, prepared for ADEQ by URS and ERG, June 2001.

Standardized Windblown Dust Emissions

Pre-standardized windblown dust emission calculations represent maximum windblown dust emission rates from land uses that have the capability to emit windblown dust. This is largely due to the fact that the vertical fluxes used to calculate pre-standardized emissions are based upon wind tunnel tests done in areas selected *a priori* as areas suspected of generating large quantities of windblown dust (Nickling and Gillies, 1989). These are areas that are mostly free of vegetation, have low surface roughness, and have surfaces that are either disturbed or easily disturbed. Only a small percentage of the land use categories assumed to emit windblown dust have characteristics identical to the wind tunnel test sites. Many areas have much denser vegetation, higher surface roughness values, topography that shelters the wind, higher surface moisture, desert pavement crusts, etc. For those areas disturbed by anthropogenic activities, the role of active controls (e.g., applying water) is not represented in the vertical fluxes. The vertical fluxes also do not take into account the supply-limited nature of desert soils in Maricopa County, because the wind tunnel tests were only performed for a period of 10 to 30 minutes at most (ibid). During a sustained high-wind event, some soils will stop emitting before the wind speeds fall below the threshold friction velocity because the available reservoir of dust particles has been exhausted due to the supply-limitations of the soil. Because these windblown dust-limiting variables are not represented in the wind tunnel tests, they need to be accounted for outside the vertical flux equations. To account for this on an annual basis, a sensitivity analysis was performed by comparing windblown PM_{10} emission estimates against observed PM_{10} concentrations under high wind conditions.

In 2008, there were eight MCAQD PM_{10} monitors that recorded PM_{10} concentrations and associated wind speed in 5-minute averages. A simple test to see the impact of PM_{10} concentrations under high winds is to compare the measured PM_{10} mass associated with wind speeds below 12 mph (threshold friction velocity for windblown dust generation) against the mass associated with wind speeds at 12 mph or greater. While PM_{10} concentrations are not an exact surrogate for emissions since high wind PM_{10} concentrations can be the result of long distance transport from upwind sources in some cases, on an annual basis they are a rough approximation of the sources and magnitude of PM_{10} emissions in the area around the monitoring site. Table A4–9 shows the percentage of PM_{10} mass associated with wind speeds at or above 12 mph for eight MCAQD monitors with 5-minute data.

Table A4–9. Percentage of PM_{10} mass associated with wind speeds at or above 12 mph for eight MCAQD monitors in calendar year 2008.

Monitor	Sum of 5-min PM_{10} mass when 5-min winds ≥ 12mph ($\mu g/m^3$)	Sum of all 5-min PM_{10} mass ($\mu g/m^3$)	Percent PM_{10} mass associated with 5-min winds ≥ 12 mph
Buckeye	646,732	4,596,071	14.07%
Central Phoenix	96,398	2,014,492	4.79%
Durango Complex	361,223	5,023,592	7.19%
Greenwood	140,729	4,175,273	3.37%
Higley	293,153	4,468,163	6.56%
South Phoenix	204,019	4,753,036	4.29%
West Phoenix	133,834	3,698,296	3.62%
West Forty-Third	751,052	5,928,634	12.67%
All Monitors	2,627,139	34,657,557	7.58%

The analysis in Table A4–9 shows that as a weighted average, about 7.6% of annual PM_{10} emissions are associated with wind speeds greater than or equal to 12 mph. The monitors that are surrounded by land uses that are likely to produce windblown dust (e.g., Buckeye, West Forty-Third) have higher mass associated with winds ≥ 12 mph than do more urban monitors (e.g., Greenwood) where land uses have limited opportunity to produce windblown dust. A simple statistical analysis of the eight monitors produces a mean of about 7% and a standard deviation of 4%. Given that the monitors do not capture all emissions associated with high winds and that the limited numbers of monitors covering a large geographic area like Maricopa County do not represent all land use mixes, it is assumed that up to 10% (within one standard deviation of the monitor concentrations) of PM_{10} in an annual inventory of Maricopa County and the PM_{10} nonattainment area is windblown dust.

Annual PM_{10} emissions from sources other than windblown dust total 61,282.27 tons for Maricopa County and 43,333.20 tons for the PM_{10} nonattainment area. If windblown dust emissions are to represent 10% of an annual inventory, than PM_{10} emissions for the nonattainment area and Maricopa County should be standardized to 4,814.80 tons and 6,809.13 tons, respectively.[7]

Initial evaluation of the 10% standardized emission targets raises some questions. Despite the presence of significantly more acreage subject to windblown dust in the areas of Maricopa County outside the PM_{10} nonattainment area than within, the standardized emissions suggest that these areas emit at a lower rate than the PM_{10} nonattainment area. While this may seem counter-intuitive at first, given the disparity between acreages, there are theoretical reasons why these areas would emit less. It is important to point out initially that when high magnitude dust events do occur (wind speeds above saltation thresholds) the areas outside of the nonattainment area are going to be the dominant contributor of windblown dust during the event. This is because as saltation occurs, supply-limitation concerns are less important, and the potential for long-range transport increases. However, these events are rare, occurring only a handful of times in a year; while the majority of windblown dust generated on an annual basis occurs during higher frequency/lower intensity wind speeds where supply-limitations control dust production.

The following reasons therefore help to explain why the areas outside of the nonattainment area have greater supply-limitations (on an annual basis) during the more common lower magnitude/ higher frequency wind events, and thus lower dust emissions rates. First, the rates of soil disturbance are developed largely upon MCAQD inspections done only within the nonattainment area; it is very likely that areas outside the nonattainment area experience significantly fewer disturbances due to their isolation (e.g., Tonto National Forest, Goldwater Bombing Range). Second, vegetation in vacant areas outside the nonattainment area, both on the surface and just below the surface, is likely to be greater than vegetation existing on an area such as an urban vacant lot; this provides extra cohesion for the soil, limiting the reservoir of dust available to be entrained during a high wind event. Third, significantly large mountain ranges exist to the west and east of the nonattainment area, providing topographic protection from high winds and effectively funneling the winds to the valleys of the nonattainment area (Washington et al., 2006). Fourth, a recently installed temporary (March 2010 – February 2011) PM_{10} monitor located near Arlington, Arizona (approximately twelve miles west of the nonattainment border) indicated that approximately 8% of PM_{10} concentration are associated with wind speeds ≥ 12 mph. This is the only PM_{10} monitor that operated any significant distance outside the PM_{10}

[7] 43,333.20 tons ÷ 90% = 48,148.00 tons; 61,282.27 ÷ 90% = 68,091.30 tons. 10% of each represents standardized windblown dust emissions.

nonattainment area.[8] As such, PM_{10} concentrations associated with high winds in other areas of Maricopa County outside the nonattainment area are assumed to be similar to the Arlington monitor given the lack of monitoring data available. Given these observations, it is not unreasonable to assume that on an annual basis, areas outside of the nonattainment area will emit windblown dust at lower rates than areas inside the nonattainment area.

As a final note, it is critical to remember that an emissions inventory of windblown dust does not deal with the processes of transport and deposition. It seeks to quantify the amount of dust produced by the wind within a defined geographic area. Transport and deposition can consider sources of emissions hundreds or even thousands of miles away from the monitors during extreme high wind events (Prospero, 1999; VanCuren and Cahill, 2002). There are clearly sources of windblown dust immediately surrounding Maricopa County that will affect monitor concentrations during these high wind events. The purpose of air quality modeling is to combine all three stages of a dust event, particle entrainment, transport and deposition; while the purpose of this inventory is to quantify particle entrainment from sources within Maricopa County and the PM_{10} nonattainment area.

Functionally, pre-standardized emissions are scaled down to the standardized target emissions in two steps to account for the different emissions rates between Maricopa County and the nonattainment area. The first step simply takes the pre-standardized emissions of the nonattainment area and adjusts them to match the target emissions of 4,814.80 tons. This results in a uniform 91.96% reduction of the emissions in all land use categories. The second step assumes that the balance of emissions between the nonattainment area and the county standardized emission targets, 1,994.33 tons[9], originates in the "donut" area of Maricopa County outside the nonattainment area. Pre-standardized emissions from this "donut" area of the county were calculated using GIS and the methods described in previous sections; then standardized to the target of 1,994.33 tons, a 99.62% reduction of pre-standardized emissions.

Summary of Standardized Windblown Dust Emissions

Using the emission methodologies listed above, annual, standardized PM_{10} emissions for Maricopa County and the PM_{10} nonattainment area are calculated. $PM_{2.5}$ emissions are assumed to be 15% of PM_{10} emissions (WGA, 2006). Daily emissions are obtained by dividing annual emissions by the number of days in calendar year 2008 (366). Annual and daily standardized emissions for Maricopa County and the PM_{10} nonattainment area are shown in Tables A4–10 and A4–11, respectively.

[8] The Buckeye monitor is also located outside the nonattainment area, however at only a distance of 0.75 miles from the western border. In 2008 the Buckeye monitor had 14% of PM_{10} mass associated with wind speeds ≥ 12 mph, suggesting that the rural areas of Maricopa County outside of the nonattainment area may have more of their PM_{10} concentrations associated with high winds. However, when high wind PM_{10} concentrations of the Buckeye monitor are compared to the same time period of the temporary Arlington monitor (March 2010 – February 2011), the high wind percentage is reported to be approximately 7% of the PM_{10} mass, which is similar to the percentage reported by the Arlington monitor (8%).

[9] County standardized emission target of 6,809.13 tons – nonattainment area target of 4,814.80 tons = 1,994.33 tons.

Table A4–10. Standardized, annual and daily PM_{10} and $PM_{2.5}$ emissions from windblown dust in the Maricopa County, by land use category.

	Annual emissions (tons/yr)		Average daily emissions (lbs/day)	
Land use category	**PM_{10}**	**$PM_{2.5}$**	**PM_{10}**	**$PM_{2.5}$**
Active open space	215.94	32.39	1,180.0	177.0
Agriculture – active	61.69	9.25	337.1	50.6
Agriculture – inactive	345.86	51.88	1,890.1	283.5
Auto test tracks	49.23	7.38	269.0	40.4
Developing	394.98	59.25	2,158.4	323.8
Landfill	6.33	0.95	34.6	5.2
Mining	25.37	3.81	138.7	20.8
Passive open space/wash	2,755.11	413.27	15,058.1	2,258.7
Sand & gravel	108.47	16.27	592.7	88.9
Vacant	2,846.15	426.92	15,555.8	2,333.4
Totals:	**6,809.13**	**1,021.37**	**37,214.6**	**5,582.2**

Table A4–11. Standardized, annual and daily PM_{10} and $PM_{2.5}$ emissions from windblown dust in the PM_{10} nonattainment area, by land use category.

	Annual emissions (tons/yr)		Average daily emissions (lbs/day)	
Land use category	**PM_{10}**	**$PM_{2.5}$**	**PM_{10}**	**$PM_{2.5}$**
Active open space	213.93	32.09	1,169.0	175.4
Agriculture – active	57.82	8.67	315.9	47.4
Agriculture – inactive	296.42	44.46	1,619.8	243.0
Auto test tracks	42.93	6.44	234.6	35.2
Developing	391.00	58.65	2,136.6	320.5
Landfill	6.33	0.95	34.6	5.2
Mining	23.75	3.56	129.8	19.5
Passive open space/wash	1,822.61	273.39	9,959.6	1,493.9
Sand & gravel	107.82	16.17	589.2	88.4
Vacant	1,852.19	277.83	10,121.2	1,518.2
Totals:	**4,814.80**	**722.22**	**26,310.4**	**3,946.6**

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Attachment I

MAG 2009 GIS Existing Land Use Database Information

The following attachment exists in draft form, as the land use database is continually updated to reflect new source data and GIS methodologies. The draft as presented here was created on November 16, 2010.

Database Information

Database Name

EXISTING_LAND_USE_2009

Common Names

Existing Land Use, 2009
EXLU, 2009

Description

The Existing Land Use (EXLU) dataset was created as a joint effort of MAG and MAG member agency staff. This dataset serves as a land use inventory and is used for a variety of planning purposes including socioeconomic forecasting and air quality modeling.

This database has three components:

1. **MAG parcels:** Serves as the primary element of the land use inventory. The parcel base integrates Maricopa County Assessor's office (MCA) parcels, Arizona State Land Department (ASLD) land surface ownership and Bureau of Land Management (BLM) designated wilderness areas. Additional supplementary parcels have been created for areas not covered by the other datasets (e.g. within Tribal Lands) based on air photo interpretation and previous EXLU inventories. MCA parcels within the dataset have been modified in some cases to support data requirements for modeling efforts. In particular, groups of related or associated MCA parcels are often aggregated based on a MCA designated Economic Unit or Assessor Subdivision (MCRNUM). However, the majority of parcels retain the original geometry provided by the MCA. All parcels are assigned a detailed MAG land use code and can be related to original MCA parcels via a lookup table.

2. **Land use overlays:** Overrides the parcel base for cases in which the MCA parcels do not adequately distinguish changes in land use. Examples of this include areas encompassing public facilities and institutions, areas adjacent to water courses and major transportation corridors.

3. **Generalized EXLU:** Provides a *generalized* and *contiguous* representation of the land use inventory. Derived by integrating the MAG parcel based with the land use overlays and applying a series of GIS-based generalization procedures. The finest level of categorical detail provided is the MAG ‘Long Display Code’.

Frequency of Update

Updates are made to this dataset on an annual basis.

Format

ArcSDE geodatabase feature classes

Projection

Coordinate System = State Plane
Zone = 3176 (Arizona Central)
Horizontal Datum = NAD83 HARN
Linear units = international feet

Data Sources

1. Maricopa County Assessor Office Parcels, February 2009
2. Maricopa County Assessor's Office Subdivisions, February 2009
3. Maricopa County Assessor's Office Secured Master File, February 2009
4. Maricopa County Assessor's Office Residential Master File, February 2009
5. Maricopa County Assessor's Office Commercial Master File, February 2009
6. Arizona State Land Department Land surface management
7. Arizona State Land Department Arizona Preserve Initiative lands
8. Arizona State Land Department Wilderness areas
9. Salt River Project canals
10. Central Arizona Project canals
11. MAG aerial imagery, 2009 (procured from Aerials Express)
12. MAG Existing Land Use, 2004
13. MAG Employer Database, 2008
14. MAG Residential Completions
15. Maricopa County Elections Department Streets
16. Kammrath property databases

Reference

MAG Land Use Codes

See Appendix A.

Assessor Property Use Codes

See http://www.maricopa.gov/assessor/gis/pdf/puc.pdf.

Database Standards and Structure

Naming Conventions and Update Schedule

The naming convention for the Existing Land Use feature class is as follows:

EXISTING_LAND_USE_20xx

Where xx represents the two digit year

File Location

The final version of this dataset is in an ArcSDE geodatabase. This includes the following feature classes:

- MAG_PARCELS: the detailed MAG parcel base
- EXLU_POLYGONS: the generalized EXLU
- CANALS_ROW: land use overlay for canals and surrounding areas
- PARCEL_ADJUNCTS: used to split or override parcel geometries
- FREEWAYS_ROW: land use overlay for freeways and surrounding areas
- PARKS: land use overlay for areas of significant active open space areas
- RAIL_ROW: land use overlay for railroads and surrounding areas
- WATER_COURSES: land use overlay for significant water areas such as residential lakes and stream beds

Update Schedule

Updates will be performed on this dataset on an annual basis. New secured data are released by the Assessor's Office in September of each year. Following acquisition of this data from the Assessor's Office, an incremental update to the Existing Land Use dataset will be undertaken.

Versioning

The Existing Land Use dataset is actively maintained on the *giswork* instance of ArcSDE. Editors create child versions of the database from the QA/QC version and perform all edits against the child version. Edits are reconciled and posted to the QA/QC version from the editor's child version. Edits are checked for completeness and correctness, and are then posted to the DEFAULT version on *giswork*.

At the end of each quarter, or on an as needed basis, the Existing Land Use data are replicated to the production database, *gismag*. The replicated feature class on the *gismag*

instance is renamed with the naming convention described below. The fourth quarter iteration represents the final iteration for a calendar year.

Topological Relationships

None

Database Structure

Attributes of the generalized EXLU feature class are:

Field	Description	Format	Instance
OBJECTID	ESRI geodatabase unique identifier	ObjectID	giswork
LONG_DISPLAY_CODE	MAG generalized land use class	Text	giswork
ACRES	Area of the polygon	Double	giswork
MPA	MPA the polygon is within	Text	giswork
Shape	ESRI feature geometry	Geometry	giswork

Dependencies

1. Tabular data maintained in the form of the Parcel Information Table, Residential Information Table, and Non-Residential Information Table. These datasets provides input to the AZSMART model. These tables are a modified version of the Secured Master, Residential Master, and Commercial Master files acquired from the Maricopa County Assessor's Office. Work done to the existing land use dataset that modifies the land use also forces an update of the Parcel Information Table, Residential Information Table, and Non-Residential Information Table.
2. A feature class called MAG Parcels was constructed to serve as the basis for an Existing Land Use feature class. A MAG Parcel Number (MPN) was assigned to each feature in the dataset. In most cases the MPA is identical to the APN. In some cases, however, it was necessary to aggregate parcels together based on a shared Economic Unit (this was the case with large shopping centers and some buildings). The MPN, then, was edited to reflect this change. In these cases, the MPN was changed to reflect the Economic Unit value shared by the original parcels.

Database Creation

Summary

- Data are collected from various sources as outlined in this document.
- Assign a MAG Parcel Number (MPN) to each parcel.
- Merge parcels that fall within a single economic unit, as defined by the Maricopa County Assessor's Office. MPN is updated to reflect value of economic unit.
- Assign a property use code to the MAG Parcels by joining with the Secured Master File.
- Assign MAG land use codes based on a lookup table between property use codes and MAG land use codes.
- Locate parcels with null property uses are located and assigned a property use code and MAG land use code.
- Identify single family residential (SFR) land uses. Determine density of SFR parcels and assign a MAG land use code to these parcels.
- Identify parcels associated with airports, proving grounds, and public facilities and reviewed for assignment of correct MAG land use code.
- Compare MAG Parcels to Kammrath property databases.
- Visually inspect MAG Parcels with the aid of contextual datasets such as MAG aerial imagery, MAG employers database, and MAG residential completions database; recoding erroneous land uses.
- Construct Existing Land Use dataset for review by MAG member agencies.
- Incorporate comments from member agencies to Existing Land Use Parcels
- Construct final Existing Land Use dataset.

Ancillary Tables or Databases

MCA_MAG_LU_LOOKUP – a lookup table between Assessor property use codes and MAG land use codes.

APN_MPN_LOOKUP – a lookup table that maps MPN to APN

MAG_LU_CODES – a lookup table that provides additional information about the MAG land use codes and maps detailed land use codes to simple land use codes

Preliminary Steps

Data was collected from the Maricopa County Assessor's Office and the Arizona State Land Department. These datasets were loaded into the Enterprise geodatabase. A separate database for MAG Parcels was created. The purpose of the MAG parcel database was to aggregate parcels with shared economic units, thus aggregating multiple parcels into logical whole units. A MAG Parcel Number (MPN) was then assigned to each parcel remaining. For the majority of parcels, the MPN is the same as the APN. For parcels that were merged based on similar economic units, a new MPN was created. Following this, each parcel and property use file was checked for records with duplicate MPNs. The resulting MPN is the shared economic unit of the merged parcels or the MCR Number of the subdivision depending on if the percent ownership file is less than 100 in the Commercial Master File. The latter case was used in cases where an economic unit did not exist (i.e. condominiums) or where multiple economic units functioned as a logical whole.

Editing Steps

Initial Feature Class Construction

For each parcel and property use file, a field called FILE was added. This field was used calculate to the source of the parcels (e.g. ME for Mesa). The purpose of this was to provide a lineage back to the source file. Following this, all parcel files were merged into a single feature class, retaining the FILE, MPN, and shape fields. A new column, KEY, was added and calculated to the value of FILE + " " + MPN. The KEY field provides a unique identifier for cases in which MPN values exist in multiple files. Parcel property use tables were also merged into a single file, retaining the MPN and PROPERTY_USE fields. A similar KEY field was added to the property use table.

A PROPERTY_USE field was then added to the parcels feature class. The feature class and the property use table were then joined based on the KEY field and the PROPERTY_USE in the feature class was calculated based on the property use value in the joined table.

PROP_USE_COMMENT, REVIEW_PROP_USE, and MAG_LU fields were added to the feature class. PROP_USE_COMMENT was intended to detail problems or other information about property use codes. REVISE_PROP_USE stored changes made to the PROPERTY_USE field. Finally, MAG_LU stored the subsequent MAG land use code based on the MCA_MAG_LU lookup table.

Next, duplicate MPNs (most likely existing at the edges of merged regions) were dropped from the feature class. For parcels to be dropped, the REVISE_PROP_USE was set to -9999 and annotated using the PROP_USE_COMMENT field.

Addressing Null Property Uses

Next, null property uses were located in the feature class. Null property uses arose from one of two reasons: the parcel/MPN did not have a corresponding record in the property use table or the property use was null in the secured master file acquired from the Assessor's Office. This condition most likely arose due to the parcels and secured files being out of sync with one another, the secured files being more current than the parcels. Null values were reconciled by querying the Assessor's Office website. A script was written to scrape property uses from the Assessor's website. Most of the null values were resolved in this way, while the remainders were fixed manually.

Assigning densities to single family uses

When the 'default' MAG land use classes are assigned based on the MCA property use code, all single family residential (SFR) parcels are assigned a single class (e.g. 100). This class needs to be refined to provide additional detail about the density of the SFR parcel. Multiple definitions and approaches may be used to classify the SFR densities. The approach employed here is based on the assumption that (*a.*) MCA subdivisions provide a logical grouping of parcels within which to assess density since the subdivision boundaries likely reflect the original intents of the development and (*b.*) that SFR parcels falling outside of subdivisions may be grouped according to neighboring SFR parcels that are not separated by other land uses. This entails the following:

1. Assign each parcel to the subdivision it falls within:
    a. Obtain centroids for the parcel
    b. Perform a spatial join in which each parcel centroid is assigned to the subdivision it falls within
    c. Perform an attribute join (based on MPN) between the parcel polygons and their corresponding centroids to assign the subdivision to the parcel polygons. For parcel polygons falling outside of a centroid this value will be NULL

2. For SFR parcels falling outside a MCA subdivision, assign a pseudo subdivision based on a contiguous set of SFR parcels it falls within:
    a. Select a subset of SFR parcel polygons with NULL subdivisions
    b. Dissolve these parcels to obtain contiguous blocks: these blocks are pseudo subdivisions
    c. Assign a unique identity to each pseudo subdivision. The identity is assigned by concatenating the character 'b' with the OBJECTID of the pseudo subdivision
    d. Obtain centroids for the parcels identified in 2a.
    e. Perform a spatial join in which each centroid from 2b is assigned to the pseudo subdivision it falls within
    f. Perform an attribute join between the centroids resulting from 2e with the parcel polygons from 2b. Assign each parcel's subdivision field the values of the pseudo subdivision id of its corresponding centroid.

3. Assign a refined SFR land use based on the total number of units and the total number of SFR acres in its subdivision or pseudo subdivision.
    a. If it does not already exist, add a field called ACRES and use the Calculate Geometry tool to assign area in acres for each parcel
    b. Get a subset of SFR parcels
    c. Dissolve parcels on the subdivision field; retain the sum of ACRES field
    d. Join the parcels from 3b with the dissolved attribute table from 3c
    e. Use the following VBA code block to assign a density based SFR land use class to the parcels:

```
d = sumSubdivision Units/ sumSubdivisionAcres
if d <= 0.2 then
  lu = 110
elseif d > 0.2 and d <= 1 then
  lu = 120
elseif d > 1 and d <= 2 then
  lu = 130
elseif d > 2 and d <= 4 then
  lu = 140
elseif d > 4 and d <= 6 then
  lu = 150
elseif d > 6 then
  lu = 160
end if
```

Initial and Automated Land Use Checks

Areas in and around airports were checked. Parcels comprising the regional airports were flagged and recoded to an airport property use and MAG land use code. In most

cases, the parcel configurations closely resembled the actual airport boundaries were kept as-is. However, overlays needed to be created for Sky Harbor, Buckeye, Gila Bend, and Pleasant Valley airports whose boundaries are distinctly different from the parcel boundaries.

Proving ground areas were also examined in detail. These areas typically consist of very large parcels that end up being coded as "industrial." This tends to skew the acreage of industrial land in the county. These large parcels were sought out and recoded. Several landfills were also captured in this process.

Parcels representing large public facilities, prisons and jails, city halls, community centers, and religious institutions were also checked using aerial imagery, Google Street View, employer points, 2004 existing land use, and the values of neighboring parcels.

Kammrath property databases were also used during this process to check correctness of MAG land use code assignment. Property types addressed by this check were apartment complexes, mobile home and RV parks, and industrial parks in which the classification on warehousing versus light industrial use was not clear.

City by City Review

Having resolved a number of issues out of the gate, the next step was to perform a city by city review of the parcels. This was accomplished by the use of a tracking grid based on the PLSS to avoid duplication of effort. MAG GIS staff reviewed each city individually for assumed correctness of land use coding, to recode land uses or flag for exclusion sliver parcels. Parcels in which the land use was in question were primarily reviewed using aerial imagery, however the MAG employer database and MAG residential completions database were also used to provide supplementary information about the types of activities, and hence potential uses, taking place on individual parcels.

Overlay feature classes were also edited during this time. Since the underlying assumption in this editing process was that parcels could not be modified because they had to be tied back to an original parcel base for change tracking, overlays were used to approximate splits. For example, in many cases near water courses, property lines are not coincident with natural land use breaks. A parcel whose primary land use is agricultural may extend into the river bottom. The portion of the parcel in the river bottom is not agricultural, therefore a polygon is added to an overlay feature class representing that portion of the parcel that is in the river bottom and coded as "passive open space." Layers used for this purpose include cultural features, freeway right-of-ways, railroad right-of-ways, parks, canals, and water courses and lakes.

Rules observed during the city by city review were:

1. As a general rule, parcel geometries were not changed. Significant non-road void areas were filled to account for public lands and State Trust not otherwise present in the Assessor's data.
2. Developing residential parcels should be "parcelized" or broken into groups of parcels that look like a residential development. If this is not the case, these are recoded as vacant.
3. Developing residential and commercial parcels were generally recoded as vacant, unless it was demonstrable through review of aerial photos that the parcel in question was indeed developing.

4. Residential parcels that appeared to be connected with another already developed residential parcel were coded to match their associated parcel and flagged as "AZSMART EXCLUDE." The purpose of including this flag was so as not to change the total number of residential parcels.
5. Very small public facilities were excluded.
6. River bottoms and floodways are coded as Passive Open Space unless some other land use was evident. In most cases, this other land use would be sand and gravel operations.
7. For mobile homes or trailers sitting on large lots, as opposed to within mobile home/RV parks, the parcel was coded to match the adjacent residential parcels.
8. Parking lots and parking structures were coded to match adjacent commercial or office parcels if the parking feature was visibly associated with another parcel.

Some edits were made to the underlying parcels during this review. The Assessor's Parcels cover only those areas not occupied by State Trust or Federal public lands, including National Forests, BLM public lands, and Bureau of Reclamation sites. These were added as features to the Existing Land Use Parcels. These are identifiable by their lack of an MPN and being flagged in the comments field as being BLM, Bureau of Reclamation, Forest Service, Military or State Trust.

Once a MAG staff member had completed a review of a city, the MAG GIS Program Manager reviewed the city a second time to ensure consistency among editors and across cities.

Construction of Existing Land Use Feature Classes for Member Agency Review

Following these initial activities, the generalized existing land use for an individual city was constructed. Land use blocks were first generated using a selected subset of parcels (i.e. those parcels not flagged for exclusion). These were clipped to the MPA boundary of the individual city in question. The resulting clipped blocks were joined with a lookup table to assign generalized long display codes. The blocks were then dissolved on the long display code.

Next, land use blocks were integrated with Assessor Subdivisions. The intent in this operation was to identify subdivisions with homogenous residential land use and to remove most of the neighborhood active open space land use. These land uses were problematic because they tend to form long, continuous landscaping parcels that, in many cases, encircle a subdivision. These also include neighborhood parks of all sizes. Some parks were necessary to maintain because of their size, and the geometry of these were copied into the parks overlay.

The integration proceeded by first dividing the contiguous land use blocks into two sets: those contained within subdivisions and those falling outside of subdivisions. This was achieved by performing a union between the subdivisions and the land use blocks and then selected out the results based on the combinations of resulting values (more specifically, the FID values). Next, areas *within* subdivisions were further divided into areas within homogenous subdivisions and those falling within heterogeneous subdivisions. This classification was obtained by grouping the areas by subdivision (via the 'Summarize' tool in ArcGIS) and identifying those subdivisions that had a single long display code value. A minimum area threshold was also specified to eliminate slivers that are artifacts of the union process. Areas within homogenous subdivisions were replaced with a subdivision boundary. Areas within heterogeneous subdivisions were then independently fed into a cost allocation algorithm that assigned that land use at a given location based on the land use it was closest to (here distance was based on

impedance rather than Euclidean distance). Following this, the land use outside of subdivisions, the homogenous subdivision boundaries and the results of the cost allocation algorithms were merged into a single dataset. The resulting dataset was then fed into another cost allocation to fill in the voids for areas falling outside of subdivisions.

The final step in this process was to integrate overlays via successive erases and merges. This began by integrating all the overlays into a single feature class. The overlays were integrated in the following order:

1. Open space
2. Parks
3. Water courses
4. Canal rows
5. Railroad rows
6. Freeways
7. Cultural adjuncts

Finally, the resulting integrated overlay feature class was combined with results of the final cost allocation. This was achieved by erasing the overlay areas from the allocated feature class and then merging the results of the erase with the integrated overlay class.

Database Update

Ancillary Tables or Databases

Parcels and secured master files from the previous year are used as a point of comparison with new data collected from the Assessor's Office.

MCA_MAG_LU_LOOKUP – a lookup table between Assessor property use codes and MAG land use codes

APN_MPN_LOOKUP – a lookup table that maps MPN to APN

MAG_LU_CODES – a lookup table that provides additional information about the MAG land use codes and maps detailed land use codes to simple land use codes

Preliminary Steps

Data is collected from the Maricopa County Assessor's Office and the Arizona State Land Department. These datasets are loaded into the Enterprise geodatabase.

Preparatory Steps

A determination of the extent of changes between data vintages is made. For the Land Department data, the changes will tend to be small. The likely impact of these changes will be removal of State Trust land into private ownership or to another government entity, the end result of either case being that Assessor parcels will be created from the transfer of ownership. For the Assessor data, the change will be more substantial and will include:

1. Parcels that have been retired through splits or merges
2. Parcels that have been added due to splits from a parent parcel or transfer from State or Federal ownership

3. Parcels that have new property uses assigned to them

These changes may be identified by comparing the APNs and property use codes among the parcels in the current year with those in the previous year. This can be handled via SQL queries:

Births

```
select * from dataloader.PARCELS_2010
where APN not in (
   select APN from dataloader.PARCELS_2009
)
```

Retirements/deaths

```
select * from dataloader.PARCELS_2009
where APN not in (
   Select APN from dataloader.PARCELS_2010
)
```

Transitions/changes

```
select a.APN, a.MAG_LU as MAG_LU_2010, b.MAG_LU as MAG_LU_2009
from (
   select a.APN, b.PropertyUseCode, c.MAG_Lucode as MAG_LU
   from dataloader.PARCELS_2010 a
   inner join dataloader.SECURED_MASTER_2010 b
   on a.APN = b.APN
   inner join GISWORK.dataloader.MCA_MAG_LU_LOOKUP c
   on b.PropertyUseCode = c.Property_Use_code
) a
inner join(
   select a.APN, b.PropertyUseCode, c.MAG_Lucode as MAG_LU
   from dataloader.PARCELS_2009 a
   inner join dataloader.SECURED_MASTER_2009 b
   on a.APN = b.APN
   inner join GISWORK.dataloader.MCA_MAG_LU_LOOKUP c
   on b.PropertyUseCode = c.Property_Use_code
) b
on a.APN = b.APN
where a.MAG_LU <> b.MAG_LU
```

MAG Parcels Update Process

1. For all parcels that have not changed, (i.e. they have the same property use code and their APN exists in both years) assign the MAG_LU based on the previous year

2. For parcels that have changed (i.e. their property use codes have changed) assign MAG_LU based on the default value provided in the MCA_MAG_LU_LOOKUP.

3. Re-build MAG Parcels for the parcels that have not changed. Note: this step is only necessary if the parcel geometries have shifted, otherwise the MAG Parcels from the

previous year can be used.

4. For all deaths/retiree parcels identify any MAG Parcels that will also need to be retired. It may also be necessary to identify related parcels that may or may not also be retired (e.g. a single parcel is retired but other parcels in the Economic Unit or subdivision remain unchanged).

5. Identify parcel births that will need to be aggregated to create new Existing Land Use Parcels:

```
select a.APN, count(*) as NUM_IMPROVEMENTS from (
   select APN
   from dataloader.PARCELS_2010
   where APN not in (
      select APN from dataloader.PARCELS_2009
   )
) a
inner join dataloader.COMMERCIAL_MASTER_2010 b
on a.APN = b.APN
where LTRIM(RTRIM(b.PercentOfOwnership)) <> '100'
group by a.APN
order by count(*) desc
```

6. Re-assign single family residential densities for parcel births and surrounding areas.

Generalized Existing Land Use Update Process

Determine if the parcels have shifted across years. If the parcels have shifted, re-build the generalized land use for the entire dataset per the process discussed for the initial construction. If the parcels have not shifted, identify regions surrounding births and transitions. These neighborhoods may simply involve generating minimum bounding rectangles (MBRs) or may be more complicated using something like a Voronoi diagram. Finally, re-build the generalized EXLU for each of the identified change regions.

Reporting

Report the number of changes that will be made to the database. This might include: the number of parcel births, deaths and transitions. Also, report the number of MAG Parcels that will consequently be retired or updated. It may also be worthwhile to report the types of transitions that are occurring, as well as the dominant land uses of the births and deaths.

For example, to report the types of land use transitions occurring:

```
select cast(b.MAG_LU as int) as MAG_LU_2009, cast(a.MAG_LU as
int) as MAG_LU_2010, count(*) as Parcel_Count from (
   select a.APN, b.PropertyUseCode, c.MAG_Lucode as MAG_LU from
   dataloader.PARCELS_2010 a inner join
   dataloader.SECURED_MASTER_2010 b
```

```
   on a.APN = b.APN
   inner join GISWORK.dataloader.MCA_MAG_LU_LOOKUP c
   on b.PropertyUseCode = c.Property_Use_code
) a
inner join (
   select a.APN, b.PropertyUseCode, c.MAG_Lucode as MAG_LU from
   dataloader.PARCELS_2009 a inner join
   dataloader.SECURED_MASTER_2009 b
   on a.APN = b.APN
   inner join GISWORK.dataloader.MCA_MAG_LU_LOOKUP c
   on b.PropertyUseCode = c.Property_Use_code
) b
on a.APN = b.APN
where a.MAG_LU <> b.MAG_LU
group by a.MAG_LU, b.MAG_LU
order by count(*) desc, a.MAG_LU asc, b.MAG_LU asc
```

This will return the following:

2009 land use	2010 land use	Parcel count
910	100	6902
750	910	2567
910	710	1397
910	750	1310
900	910	1194
910	170	980
910	900	523
100	170	468
900	750	404
100	910	376
...	...	...

Review Process

Internal Review

Preliminary Steps

Perform the steps in the previous section. The resulting data should be in a versioned SDE database.

Review Steps

1. Perform QA/QC on births with “problematic” property use codes. For example most single family parcels will be fine, but parcels with a Property Use Code of 9000 will require additional review.

2. Examine problematic land use transitions. For example a transition from 910 (developing residential) to 100 (single family residential) is a reasonable transition. However, a transition, such as from 110 to 552 (public services), likely represents a problem in one of the base datasets and bears further investigation.

3. Generate acreages for all medium-level land use classes and compared against the previous existing land use acreages to determine if an error has occurred. The changes

between vintages should not be significant. Substantial changes in one land use class between vintages will be indicative of a problem in one of the underlying datasets, and will force a review of that land use class in the new data.

4. Perform point-in-polygon analysis between geocoded Kammrath data or other similar dataset and the MAG parcels. Check for parcels that contain points with incompatible uses (e.g. industrial point falling on a retail parcel) and make appropriate corrections as warranted with a secondary examination of aerial imagery for the area of interest.

Reporting

Report changes in acreages across the two years for the detailed MAG land use codes. Generate 'change maps' to highlight spatial trends in the land use transitions. Generate a semi-detailed report and dataset for the Air Quality division and Maricopa County using a course land use classification. The semi-detailed dataset contains parcel boundaries dissolved using the course classification and has overlays integrated but remaining voids are left alone and treated as 'Transportation' uses.

Member Agency Review

Preliminary Steps

The existing land use dataset is sent to members of the MAG POPTAC and GIS professionals who have been identified as key GIS contacts within the member agencies. A tracking database that includes a list of recipients and status of review material delivery and responses should be completed prior to sending any data out for review. It is also preferable to let members of the POPTAC know to expect the review materials within a certain period of time. This is best accomplished at a monthly MAG POPTAC meeting.

Review Steps

Notify members of the POPTAC that the existing land use dataset will be provided to them immediately. Members of the POPTAC will receive the low-detail dataset as a file geodatabase of their or as a paper map of their MPA, a summary table of existing land use classifications within their MPA at the low-detail level, and a lookup table of APN to MAG land use codes at the high-detail level. Data and maps will be mailed to members of the POPTAC. Members of the POPTAC will be instructed that they should provide feedback to MAG within six weeks. Feedback may be provided by individuals receiving paper maps may mark up the maps with any corrections or by individuals receiving geospatial data may provide a polygon feature class of recommended changes.

Comments received from member agencies shall be incorporated into the Existing Land Use as quickly as possible.

Reporting

Notify Members of the POPTAC that a final version of existing land use exists and that they will be provided with the dataset upon request.

Final Output

Metadata Update

Export the metadata from the current version of the Existing Land Use feature class to a local directory. This can then be imported to serve as the new feature class's metadata. Metadata fields that will then need to be updated are the citation name, publication date, and last update fields. Any additional changes to the feature class should be noted in the metadata at this time.

Export for Distribution

Export the current year's Existing Land Use feature classes from the *data* instance to I:\data\distribution\exlu. The frequency of export from ArcSDE is dependent on the frequency of replication from the *work* instance to the *data* instance.

Reporting

Report changes in acreages across the two years for the detailed MAG land use codes. Generate 'change maps' to highlight spatial trends in the land use transitions. It may also be worthwhile to generate ArcGIS server sites to deliver results and support land use queries.

Appendix A

MAG Land Use Codes

LUCODE	Land Use - Detailed	Land Use Description
110	Rural Residential	<= 1/5 du per acre (SF)
120	Estate Residential	1/5 du per acre to 1 du per acre (SF)
130	Large Lot Residential (SF)	1 du per acre to 2 du per acre (SF)
140	Medium Lot Residential (SF)	2-4 du per acre (SF)
150	Small Lot Residential (SF)	4-6 du per acre (SF)
160	Very Small Lot Residential (SF)	>6 du per acre (SF)
161	Very Small Lot Residential (SF-Mobile Homes)	Mobile home parks/RV Parks (>6 du per acre)
170	Medium Density Residential (MF)	5-10 du per acre (MF)
180	High Density Residential (MF)	10-15 du per acre (MF)
190	Very High Density Residential (MF)	15-50 DU/AC Residential (MF)
191	High Rise Residential	>50 DU/AC (MF)
210	Low Density Commercial	Movie Theatres, Skating Rinks, Amusement Facilities
220	Greenhouse Commercial	Nurseries, Greenhouses
230	Specialty Commercial	<=50,000 square feet
240	Neighborhood Commercial	50,000 to 100,000 square feet
250	Community Commercial	100,000 to 500,000 square feet
260	Regional Commercial	500,000 to 1,000,000 square feet
270	Super-Regional Commercial	>= 1,000,000 square feet
310	Storage Facilities	Storage Facilities
320	Warehouse	Warehouse/Distribution Centers
330	Light Industrial	Laboratory/Back Office
340	Heavy Industrial	Manufacturing
410	Office Low Rise	1-4 stories
420	Office Mid Rise	5-12 stories
430	Office High Rise	13 stories or more

510	Motels/Hotels	Motels/Hotels
511	Resorts	Resorts
520	Educational	Educational institutions where no detail available
521	Preschool/Daycare facilities	Preschool/Daycare facilities
522	Schools (K-12 grade)	Schools
523	Post High School Institutions	Including public and private colleges and technical training institutions
524	Arizona State University	ASU Main and Extended Campuses
525	Dormitories	Dormitories associated with educational institutions
530	Institutional	Institutions where no details are available
531	Religious Institutions	Churches/Religious Institutions
532	Medical Offices	Medical Offices
533	Hospitals/Medical Centers	Hospitals/Medical Centers
534	Nursing Homes/Assited Care Facilities	Nursing Homes/Assited Care Facilites (Group Quarter)
540	Cemeteries	Cemeteries, Mausoleums, Crematoriums
551	Public Offices	Includes city halls
552	Public Services	Includes community centers, libraries, police and fire stations, courts and other government services
553	Large Public Facilities	Includes power sub-stations, Work yards, Sewer and Water treatment plants
554	Military	Military Use
555	Prisons	Prisons and jails
560	Special Events	Includes stadiums, sports complexes, and fairgrounds
571	Landfill	Landfill
572	Sand and Gravel	Sand and Gravel
573	Automotive Proving Grounds	Automotive Proving Grounds
574	Mining	Mining

575	Solar Generating Stations	Solar generation stations not associated with other power facilities
610	Transportation	Freeways/Expressways/ Highways/ Major Roads/ Arterials/ ROWs where no detail available
611	Parking Lots	Parking Lots
612	Parking Structures	Parking Structures
613	Park and Ride lots	Park and Ride lots
614	Transit Center	Transit Center
615	Freeways/Expressways/ Highways	Freeways/Expressways/ Highways
616	Major Roads, Arterials	Major Roads, Arterials
617	Neighborhood roads	Neighborhood roads
618	Railroads	Railroads
620	Airports	Public use airports
621	Sky Harbor Airport	Sky Harbor Airport
622	Private airport	Private use airports
710	City/Regional Active Open Space	Includes city/regional parks, playgrounds/fields
711	Local/Neighborhood Active Open Space	Includes Local/Neighborhood common areas, parks, playgrounds
720	Golf courses	Golf Courses
730	Passive Open Space	Includes mountain preserves and washes
731	Restricted Open Space	Restricted Open Space (Including Firing Range)
732	Limited Use Public Facilities	Very small difficult to access parcels
733	Floodplain	Floodplain
740	Water	Reservoirs/Rivers/Lakes
741	Canal	Canal
742	Intermittant Water	Intermittant Water
743	Residential Lake	Residential Lake
750	Agriculture	General Agriculture
810	Business Park	Includes enclosed industrial, office or retail in a planned environment
820	Mixed Use	Jurisdiction defined
821	Mixed Use/Indian Community	Mixed Use/Indian Community
830	Planned Community	Planned Community

900	Vacant (existing land use database only)	Vacant
910	Developing Residential	Residential Under Construction
920	Developing Commercial	Commercial Under Construction
930	Developing Industrial	Industrial Under Construction
940	Developing Office	Office Under Construction
950	Developing Public/Other Employment	Employment Under Construction
960	Developing Transportation	Transportation Under Construction
970	Developing Open Space	Developing Open Space
980	Developing Multiple Use	Multiple Use Under Construction
999	Unknown	Unknown

Appendix 5. MOVES2010a Local Input Data and RunSpecs

In order to calculate the 2008 annual and average day onroad source emissions, MOVES2010a was executed using local input data for each month of the year and each geographical area (Maricopa County and the PM_{10} NAA).

A portion of the MOVES2010a RunSpec Summary, RunSpec, and local input data for Maricopa County are provided in this appendix as an example.

MOVES2010a RunSpec Summary (Maricopa County, July 2008)

Output Database Server Name: [using default]

Output Database Name: 2008_pm10_pei_mc_07_out
Time Spans:
Aggregate By: Hour
Years:
2008

Months:
July
Days:
Weekend
Weekdays
Hours:
Begin Hour: 00:00 - 00:59
End Hour: 23:00 - 23:59

Geographic Bounds:
COUNTY geography
Selection: ARIZONA - Maricopa County

On Road Vehicle Equipment:
Diesel Fuel - Combination Long-haul Truck
Diesel Fuel - Combination Short-haul Truck
Diesel Fuel - Intercity Bus
Diesel Fuel - Light Commercial Truck
Diesel Fuel - Motor Home
Diesel Fuel - Motorcycle
Diesel Fuel - Passenger Car
Diesel Fuel - Passenger Truck
Diesel Fuel - Refuse Truck
Diesel Fuel - School Bus
Diesel Fuel - Single Unit Long-haul Truck
Diesel Fuel - Single Unit Short-haul Truck
Diesel Fuel - Transit Bus
Gasoline - Combination Long-haul Truck
Gasoline - Combination Short-haul Truck
Gasoline - Intercity Bus
Gasoline - Light Commercial Truck
Gasoline - Motor Home
Gasoline - Motorcycle
Gasoline - Passenger Car
Gasoline - Passenger Truck
Gasoline - Refuse Truck
Gasoline - School Bus
Gasoline - Single Unit Long-haul Truck
Gasoline - Single Unit Short-haul Truck
Gasoline - Transit Bus

Road Types:
Off-Network
Rural Restricted Access
Rural Unrestricted Access
Urban Restricted Access
Urban Unrestricted Access

Pollutants And Processes:
Running Exhaust Ammonia (NH3)
Start Exhaust Ammonia (NH3)
Crankcase Running Exhaust Ammonia (NH3)
Crankcase Start Exhaust Ammonia (NH3)
Crankcase Extended Idle Exhaust Ammonia (NH3)
Extended Idle Exhaust Ammonia (NH3)
Running Exhaust Oxides of Nitrogen (NOx)
Start Exhaust Oxides of Nitrogen (NOx)
Crankcase Running Exhaust Oxides of Nitrogen (NOx)
Crankcase Start Exhaust Oxides of Nitrogen (NOx)
Crankcase Extended Idle Exhaust Oxides of Nitrogen (NOx)
Extended Idle Exhaust Oxides of Nitrogen (NOx)
Running Exhaust Primary Exhaust PM10 - Total
Start Exhaust Primary Exhaust PM10 - Total
Crankcase Running Exhaust Primary Exhaust PM10 - Total
Crankcase Start Exhaust Primary Exhaust PM10 - Total
Crankcase Extended Idle Exhaust Primary Exhaust PM10 - Total
Extended Idle Exhaust Primary Exhaust PM10 - Total
Running Exhaust Primary Exhaust PM2.5 - Total
Start Exhaust Primary Exhaust PM2.5 - Total
Crankcase Running Exhaust Primary Exhaust PM2.5 - Total
Crankcase Start Exhaust Primary Exhaust PM2.5 - Total
Crankcase Extended Idle Exhaust Primary Exhaust PM2.5 - Total
Extended Idle Exhaust Primary Exhaust PM2.5 - Total
Brakewear Primary PM10 - Brakewear Particulate
Running Exhaust Primary PM10 - Elemental Carbon
Start Exhaust Primary PM10 - Elemental Carbon
Crankcase Running Exhaust Primary PM10 - Elemental Carbon
Crankcase Start Exhaust Primary PM10 - Elemental Carbon
Crankcase Extended Idle Exhaust Primary PM10 - Elemental Carbon
Extended Idle Exhaust Primary PM10 - Elemental Carbon
Running Exhaust Primary PM10 - Organic Carbon
Start Exhaust Primary PM10 - Organic Carbon
Crankcase Running Exhaust Primary PM10 - Organic Carbon
Crankcase Start Exhaust Primary PM10 - Organic Carbon
Crankcase Extended Idle Exhaust Primary PM10 - Organic Carbon
Extended Idle Exhaust Primary PM10 - Organic Carbon
Running Exhaust Primary PM10 - Sulfate Particulate
Start Exhaust Primary PM10 - Sulfate Particulate
Crankcase Running Exhaust Primary PM10 - Sulfate Particulate
Crankcase Start Exhaust Primary PM10 - Sulfate Particulate
Crankcase Extended Idle Exhaust Primary PM10 - Sulfate
Particulate
Extended Idle Exhaust Primary PM10 - Sulfate Particulate
Tirewear Primary PM10 - Tirewear Particulate
Brakewear Primary PM2.5 - Brakewear Particulate
Running Exhaust Primary PM2.5 - Elemental Carbon
Start Exhaust Primary PM2.5 - Elemental Carbon
Crankcase Running Exhaust Primary PM2.5 - Elemental Carbon
Crankcase Start Exhaust Primary PM2.5 - Elemental Carbon
Crankcase Extended Idle Exhaust Primary PM2.5 - Elemental
Carbon
Extended Idle Exhaust Primary PM2.5 - Elemental Carbon
Running Exhaust Primary PM2.5 - Organic Carbon
Start Exhaust Primary PM2.5 - Organic Carbon
Crankcase Running Exhaust Primary PM2.5 - Organic Carbon
Crankcase Start Exhaust Primary PM2.5 - Organic Carbon
Crankcase Extended Idle Exhaust Primary PM2.5 - Organic Carbon
Extended Idle Exhaust Primary PM2.5 - Organic Carbon
Running Exhaust Primary PM2.5 - Sulfate Particulate
Start Exhaust Primary PM2.5 - Sulfate Particulate
Crankcase Running Exhaust Primary PM2.5 - Sulfate Particulate
Crankcase Start Exhaust Primary PM2.5 - Sulfate Particulate
Crankcase Extended Idle Exhaust Primary PM2.5 - Sulfate
Particulate
Extended Idle Exhaust Primary PM2.5 - Sulfate Particulate
Tirewear Primary PM2.5 - Tirewear Particulate
Running Exhaust Sulfur Dioxide (SO2)
Start Exhaust Sulfur Dioxide (SO2)
Crankcase Running Exhaust Sulfur Dioxide (SO2)
Crankcase Start Exhaust Sulfur Dioxide (SO2)
Crankcase Extended Idle Exhaust Sulfur Dioxide (SO2)
Extended Idle Exhaust Sulfur Dioxide (SO2)
Running Exhaust Total Energy Consumption
Start Exhaust Total Energy Consumption
Extended Idle Exhaust Total Energy Consumption

Rate of Progress:
Rate of Progress calculations are disabled

Manage Input Data Sets:
selection: / stageii_input /

MOVES2010a RunSpec (Maricopa County, July 2008)


```
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- Maricopa County
- inventory mode
- both weekdays and weekend days
- output by SCC
- July 2008]]></description>
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        <modeldomain value="SINGLE"/>
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<pollutantprocessassociation pollutantkey="3" pollutantname="Oxides of Nitrogen (NOx)" processkey="17"
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<pollutantprocessassociation pollutantkey="102" pollutantname="Primary PM10 - Elemental Carbon" processkey="1"
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<pollutantprocessassociation pollutantkey="102" pollutantname="Primary PM10 - Elemental Carbon" processkey="15"
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    processname="Crankcase Start Exhaust"/>
<pollutantprocessassociation pollutantkey="102" pollutantname="Primary PM10 - Elemental Carbon" processkey="17"
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<pollutantprocessassociation pollutantkey="101" pollutantname="Primary PM10 - Organic Carbon" processkey="1"
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<pollutantprocessassociation pollutantkey="105" pollutantname="Primary PM10 - Sulfate Particulate" processkey="1"
    processname="Running Exhaust"/>
<pollutantprocessassociation pollutantkey="105" pollutantname="Primary PM10 - Sulfate Particulate" processkey="2"
    processname="Start Exhaust"/>
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    processname="Crankcase Running Exhaust"/>
<pollutantprocessassociation pollutantkey="105" pollutantname="Primary PM10 - Sulfate Particulate" processkey="16"
    processname="Crankcase Start Exhaust"/>
<pollutantprocessassociation pollutantkey="105" pollutantname="Primary PM10 - Sulfate Particulate" processkey="17"
    processname="Crankcase Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="105" pollutantname="Primary PM10 - Sulfate Particulate" processkey="90"
    processname="Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="107" pollutantname="Primary PM10 - Tirewear Particulate"
    processkey="10" processname="Tirewear"/>
<pollutantprocessassociation pollutantkey="116" pollutantname="Primary PM2.5 - Brakewear Particulate"
    processkey="9" processname="Brakewear"/>
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    processname="Running Exhaust"/>
<pollutantprocessassociation pollutantkey="112" pollutantname="Primary PM2.5 - Elemental Carbon" processkey="2"
    processname="Start Exhaust"/>
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    processname="Crankcase Running Exhaust"/>
<pollutantprocessassociation pollutantkey="112" pollutantname="Primary PM2.5 - Elemental Carbon" processkey="16"
    processname="Crankcase Start Exhaust"/>
<pollutantprocessassociation pollutantkey="112" pollutantname="Primary PM2.5 - Elemental Carbon" processkey="17"
    processname="Crankcase Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="112" pollutantname="Primary PM2.5 - Elemental Carbon" processkey="90"
    processname="Extended Idle Exhaust"/>
<pollutantprocessassociation pollutantkey="111" pollutantname="Primary PM2.5 - Organic Carbon" processkey="1"
    processname="Running Exhaust"/>
<pollutantprocessassociation pollutantkey="111" pollutantname="Primary PM2.5 - Organic Carbon" processkey="2"
    processname="Start Exhaust"/>
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                    <pollutantprocessassociation pollutantkey="111" pollutantname="Primary PM2.5 - Organic Carbon" processkey="15"
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                        processname="Crankcase Start Exhaust"/>
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                        processname="Crankcase Extended Idle Exhaust"/>
                    <pollutantprocessassociation pollutantkey="111" pollutantname="Primary PM2.5 - Organic Carbon" processkey="90"
                        processname="Extended Idle Exhaust"/>
                    <pollutantprocessassociation pollutantkey="115" pollutantname="Primary PM2.5 - Sulfate Particulate" processkey="1"
                        processname="Running Exhaust"/>
                    <pollutantprocessassociation pollutantkey="115" pollutantname="Primary PM2.5 - Sulfate Particulate" processkey="2"
                        processname="Start Exhaust"/>
                    <pollutantprocessassociation pollutantkey="115" pollutantname="Primary PM2.5 - Sulfate Particulate"
                        processkey="15" processname="Crankcase Running Exhaust"/>
                    <pollutantprocessassociation pollutantkey="115" pollutantname="Primary PM2.5 - Sulfate Particulate"
                        processkey="16" processname="Crankcase Start Exhaust"/>
                    <pollutantprocessassociation pollutantkey="115" pollutantname="Primary PM2.5 - Sulfate Particulate"
                        processkey="17" processname="Crankcase Extended Idle Exhaust"/>
                    <pollutantprocessassociation pollutantkey="115" pollutantname="Primary PM2.5 - Sulfate Particulate"
                        processkey="90" processname="Extended Idle Exhaust"/>
                    <pollutantprocessassociation pollutantkey="117" pollutantname="Primary PM2.5 - Tirewear Particulate"
                        processkey="10" processname="Tirewear"/>
                    <pollutantprocessassociation pollutantkey="31" pollutantname="Sulfur Dioxide (SO2)" processkey="1"
                        processname="Running Exhaust"/>
                    <pollutantprocessassociation pollutantkey="31" pollutantname="Sulfur Dioxide (SO2)" processkey="2"
                        processname="Start Exhaust"/>
                    <pollutantprocessassociation pollutantkey="31" pollutantname="Sulfur Dioxide (SO2)" processkey="15"
                        processname="Crankcase Running Exhaust"/>
                    <pollutantprocessassociation pollutantkey="31" pollutantname="Sulfur Dioxide (SO2)" processkey="16"
                        processname="Crankcase Start Exhaust"/>
                    <pollutantprocessassociation pollutantkey="31" pollutantname="Sulfur Dioxide (SO2)" processkey="17"
                        processname="Crankcase Extended Idle Exhaust"/>
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                        processname="Extended Idle Exhaust"/>
                    <pollutantprocessassociation pollutantkey="91" pollutantname="Total Energy Consumption" processkey="1"
                        processname="Running Exhaust"/>
                    <pollutantprocessassociation pollutantkey="91" pollutantname="Total Energy Consumption" processkey="2"
                        processname="Start Exhaust"/>
                    <pollutantprocessassociation pollutantkey="91" pollutantname="Total Energy Consumption" processkey="90"
                        processname="Extended Idle Exhaust"/>
          </pollutantprocessassociations>
          <databaseselections>
                    <databaseselection servername="" databasename="stageii_input" description=""/>
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<internalcontrolstrategy
classname="gov.epa.otaq.moves.master.implementation.ghg.internalcontrolstrategies.rateofprogress.RateOfProgressStrategy"><![CDATA
[
useParameters       No
]]></internalcontrolstrategy>
          </internalcontrolstrategies>
          <inputdatabase servername="" databasename="" description=""/>
          <uncertaintyparameters uncertaintymodeenabled="false" numberofrunspersimulation="0" numberofsimulations="0"/>
          <geographicoutputdetail description="COUNTY"/>
          <outputemissionsbreakdownselection>
                    <modelyear selected="false"/>
                    <fueltype selected="true"/>
                    <emissionprocess selected="false"/>
                    <onroadoffroad selected="true"/>
                    <roadtype selected="false"/>
                    <sourceusetype selected="false"/>
                    <movesvehicletype selected="false"/>
                    <onroadscc selected="true"/>
                    <offroadscc selected="false"/>
                    <estimateuncertainty selected="false" numberOfIterations="2" keepSampledData="false" keepIterations="false"/>
                    <sector selected="false"/>
                    <engtechid selected="false"/>
                    <hpclass selected="false"/>
          </outputemissionsbreakdownselection>
          <outputdatabase servername="" databasename="2008_pm10_pei_mc_07_out" description=""/>
          <outputtimestep value="Hour"/>
          <outputvmtdata value="true"/>
          <outputsho value="false"/>
          <outputsh value="false"/>
          <outputshp value="false"/>
          <outputshidling value="false"/>
          <outputstarts value="false"/>
          <outputpopulation value="true"/>
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          <pmsize value="0"/>
          <outputfactors>
                    <timefactors selected="true" units="Hours"/>
                    <distancefactors selected="true" units="Miles"/>
                    <massfactors selected="true" units="Grams" energyunits="Joules"/>
          </outputfactors>
          <savedata>
          </savedata>

          <donotexecute>
          </donotexecute>

          <generatordatabase shouldsave="false" servername="" databasename="" description=""/>
                    <donotperformfinalaggregation selected="false"/>
          <lookuptableflags scenarioid="" truncateoutput="true" truncateactivity="true"/>
</runspec>
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MOVES2010a Local Input Data (Maricopa County, July 2008)

[FuelFormulation]

Fuel Formulation	Fuel Subtype	RVP	Sulfur Level	ETOH Volume	MTBE Volume	ETBE Volume	TAME Volume	Aromatic Content	Olefin Content	Benzene Content	e200	e300	volToWt PercentOxy	BioDiesel Ester	Cetane Index	PAH Content
10801	12	8.76	35.00	9.5	0	0	0	14.4	4.9	1.0	53.0	91.0	3.4933	0	0	0
10802	12	8.42	23.14	9.2	0	0	0	12.8	3.9	0.9	50.3	91.1	3.4229	0	0	0
10803	12	8.40	49.00	9.2	0	0	0	12.0	4.0	0.8	50.3	92.0	3.4075	0	0	0
10804	14	7.77	23.00	5.6	0	0	0	17.7	6.0	1.0	45.5	88.5	2.0567	0	0	0
10805	14	6.95	26.04	1.3	0	0	0	16.8	7.6	0.8	40.2	88.4	0.5086	0	0	0
10806	11	6.64	25.20	0.0	0	0	0	16.3	7.0	0.7	38.4	86.4	0.0000	0	0	0
10807	14	7.07	18.83	0.7	0	0	0	16.6	7.3	0.8	37.9	89.0	0.3367	0	0	0
10808	14	6.81	28.59	0.4	0	0	0	15.0	7.4	0.8	38.9	89.2	0.1495	0	0	0
10809	11	6.48	34.56	0.0	0	0	0	18.2	10.1	0.9	40.3	88.8	0.0000	0	0	0
10810	13	7.91	24.95	6.8	0	0	0	17.1	8.0	0.9	46.5	89.5	2.5173	0	0	0
10811	12	8.41	15.17	9.5	0	0	0	16.1	5.9	1.1	53.3	90.9	3.5425	0	0	0
10812	13	8.38	29.45	8.8	0	0	0	14.5	5.3	0.9	50.7	90.9	3.2767	0	0	0
30801	20	0	6.18	0	0	0	0	0	0	0	0	0	0	0	0	0
30802	20	0	6.27	0	0	0	0	0	0	0	0	0	0	0	0	0
30803	20	0	6.65	0	0	0	0	0	0	0	0	0	0	0	0	0
30804	20	0	6.60	0	0	0	0	0	0	0	0	0	0	0	0	0
30805	20	0	5.78	0	0	0	0	0	0	0	0	0	0	0	0	0
30806	20	0	5.60	0	0	0	0	0	0	0	0	0	0	0	0	0
30807	20	0	4.20	0	0	0	0	0	0	0	0	0	0	0	0	0
30808	20	0	6.25	0	0	0	0	0	0	0	0	0	0	0	0	0
30809	20	0	6.25	0	0	0	0	0	0	0	0	0	0	0	0	0
30810	20	0	6.49	0	0	0	0	0	0	0	0	0	0	0	0	0
30811	20	0	6.49	0	0	0	0	0	0	0	0	0	0	0	0	0
30812	20	0	6.85	0	0	0	0	0	0	0	0	0	0	0	0	0

[FuelSupply]

countyID	fuelYearID	monthGroupID	fuelFormulationID	marketShare	marketShareCV
4013	2008	1	10801	1	0.5
4013	2008	1	30801	1	0.5
4013	2008	2	10802	1	0.5
4013	2008	2	30802	1	0.5
4013	2008	3	10803	1	0.5
4013	2008	3	30803	1	0.5
4013	2008	4	10804	1	0.5
4013	2008	4	30804	1	0.5
4013	2008	5	10805	1	0.5
4013	2008	5	30805	1	0.5
4013	2008	6	10806	1	0.5
4013	2008	6	30806	1	0.5
4013	2008	7	10807	1	0.5
4013	2008	7	30807	1	0.5
4013	2008	8	10808	1	0.5
4013	2008	8	30808	1	0.5
4013	2008	9	10809	1	0.5
4013	2008	9	30809	1	0.5
4013	2008	10	10810	1	0.5
4013	2008	10	30810	1	0.5
4013	2008	11	10811	1	0.5
4013	2008	11	30811	1	0.5
4013	2008	12	10812	1	0.5
4013	2008	12	30812	1	0.5

[HPMSvTypeYear]

HPMSVtypeID	yearID	VMTGrowthFactor	HPMSBaseYearVMT	baseYearOffNetVMT
10	2008	0	645,186,775	0
20	2008	0	10,853,816,218	0
30	2008	0	18,712,863,968	0
40	2008	0	120,356,976	0
50	2008	0	1,301,102,686	0
60	2008	0	1,675,478,378	0

[SourceTypeYear]

yearID	sourceTypeID	sourceTypePopulation
2008	11	72,411
2008	21	2,056,832
2008	31	474,713
2008	32	183,510
2008	41	1,109
2008	42	680
2008	43	7,115
2008	51	832
2008	52	27,284
2008	53	1,756
2008	54	3,599
2008	61	13,958
2008	62	11,504

[ZoneMonthHour]

monthID	zoneID	HourID	temperature	relHumidity
7	40130	1	90.0	39.0
7	40130	2	89.0	41.0
7	40130	3	88.0	42.0
7	40130	4	88.0	43.0
7	40130	5	87.0	44.0
7	40130	6	86.0	46.0
7	40130	7	87.0	45.0
7	40130	8	89.0	41.0
7	40130	9	92.0	37.0
7	40130	10	94.0	34.0
7	40130	11	96.0	30.0
7	40130	12	99.0	27.0
7	40130	13	100.0	25.0
7	40130	14	102.0	23.0
7	40130	15	103.0	22.0
7	40130	16	104.0	21.0
7	40130	17	103.0	23.0
7	40130	18	103.0	23.0
7	40130	19	101.0	24.0
7	40130	20	99.0	26.0
7	40130	21	97.0	30.0
7	40130	22	95.0	32.0
7	40130	23	93.0	35.0
7	40130	24	91.0	38.0

[SourceTypeAgeDistribution]

Source TypeID	YearID	AgeID	AgeFraction
11	2008	0	0.097639
11	2008	1	0.153685
11	2008	2	0.124466
11	2008	3	0.088073
11	2008	4	0.100239
11	2008	5	0.075075
11	2008	6	0.060726
11	2008	7	0.050223
11	2008	8	0.041801
11	2008	9	0.030675
11	2008	10	0.024748
11	2008	11	0.023188
11	2008	12	0.019341
11	2008	13	0.014557
11	2008	14	0.013518
11	2008	15	0.009462
11	2008	16	0.006967
11	2008	17	0.006863
11	2008	18	0.006447
11	2008	19	0.006239
11	2008	20	0.006551
11	2008	21	0.010190
11	2008	22	0.008734
11	2008	23	0.006239
11	2008	24	0.004456
11	2008	25	0.003183
11	2008	26	0.002274
11	2008	27	0.001624
11	2008	28	0.001160
11	2008	29	0.000829
11	2008	30	0.000829
21	2008	0	0.058600
21	2008	1	0.089800
21	2008	2	0.090900
21	2008	3	0.084700
21	2008	4	0.078600
21	2008	5	0.071000
21	2008	6	0.069000
21	2008	7	0.063900
21	2008	8	0.062800
21	2008	9	0.053900
21	2008	10	0.044000
21	2008	11	0.038300
21	2008	12	0.029700
21	2008	13	0.029400
21	2008	14	0.023000
21	2008	15	0.018700
21	2008	16	0.014700
21	2008	17	0.012900
21	2008	18	0.010600
21	2008	19	0.008800
21	2008	20	0.006600
21	2008	21	0.005600
21	2008	22	0.004300

Source TypeID	YearID	AgeID	AgeFraction
21	2008	23	0.003600
21	2008	24	0.003014
21	2008	25	0.002523
21	2008	26	0.002113
21	2008	27	0.001769
21	2008	28	0.001481
21	2008	29	0.001240
21	2008	30	0.014461
31	2008	0	0.056148
31	2008	1	0.089988
31	2008	2	0.092916
31	2008	3	0.074872
31	2008	4	0.076932
31	2008	5	0.063022
31	2008	6	0.057914
31	2008	7	0.065833
31	2008	8	0.061920
31	2008	9	0.048255
31	2008	10	0.042507
31	2008	11	0.042947
31	2008	12	0.031419
31	2008	13	0.030928
31	2008	14	0.028403
31	2008	15	0.018757
31	2008	16	0.012649
31	2008	17	0.011138
31	2008	18	0.010056
31	2008	19	0.011393
31	2008	20	0.008919
31	2008	21	0.005793
31	2008	22	0.007552
31	2008	23	0.005668
31	2008	24	0.004272
31	2008	25	0.003242
31	2008	26	0.002452
31	2008	27	0.001919
31	2008	28	0.001515
31	2008	29	0.001206
31	2008	30	0.029464
32	2008	0	0.059763
32	2008	1	0.095684
32	2008	2	0.099128
32	2008	3	0.077088
32	2008	4	0.074825
32	2008	5	0.060022
32	2008	6	0.054098
32	2008	7	0.061759
32	2008	8	0.062509
32	2008	9	0.047608
32	2008	10	0.041619
32	2008	11	0.043153
32	2008	12	0.031489
32	2008	13	0.031005
32	2008	14	0.029429

Source TypeID	YearID	AgeID	AgeFraction
32	2008	15	0.019239
32	2008	16	0.011888
32	2008	17	0.010528
32	2008	18	0.009695
32	2008	19	0.011148
32	2008	20	0.008679
32	2008	21	0.005441
32	2008	22	0.007091
32	2008	23	0.005301
32	2008	24	0.004014
32	2008	25	0.003071
32	2008	26	0.002418
32	2008	27	0.001846
32	2008	28	0.001426
32	2008	29	0.001119
32	2008	30	0.027915
41	2008	0	0.054400
41	2008	1	0.127000
41	2008	2	0.137800
41	2008	3	0.114200
41	2008	4	0.062400
41	2008	5	0.042000
41	2008	6	0.031200
41	2008	7	0.041300
41	2008	8	0.057600
41	2008	9	0.053600
41	2008	10	0.030900
41	2008	11	0.029700
41	2008	12	0.030500
41	2008	13	0.029100
41	2008	14	0.054600
41	2008	15	0.014200
41	2008	16	0.008200
41	2008	17	0.007600
41	2008	18	0.014800
41	2008	19	0.023100
41	2008	20	0.017500
41	2008	21	0.004500
41	2008	22	0.003500
41	2008	23	0.002300
41	2008	24	0.001511
41	2008	25	0.000993
41	2008	26	0.000653
41	2008	27	0.000429
41	2008	28	0.000282
41	2008	29	0.000185
41	2008	30	0.003947
42	2008	0	0.054400
42	2008	1	0.127000
42	2008	2	0.137800
42	2008	3	0.114200
42	2008	4	0.062400
42	2008	5	0.042000
42	2008	6	0.031200

Source TypeID	YearID	AgeID	AgeFraction
42	2008	7	0.041300
42	2008	8	0.057600
42	2008	9	0.053600
42	2008	10	0.030900
42	2008	11	0.029700
42	2008	12	0.030500
42	2008	13	0.029100
42	2008	14	0.054600
42	2008	15	0.014200
42	2008	16	0.008200
42	2008	17	0.007600
42	2008	18	0.014800
42	2008	19	0.023100
42	2008	20	0.017500
42	2008	21	0.004500
42	2008	22	0.003500
42	2008	23	0.002300
42	2008	24	0.001511
42	2008	25	0.000993
42	2008	26	0.000653
42	2008	27	0.000429
42	2008	28	0.000282
42	2008	29	0.000185
42	2008	30	0.003947
43	2008	0	0.091684
43	2008	1	0.148636
43	2008	2	0.157944
43	2008	3	0.098690
43	2008	4	0.056752
43	2008	5	0.033430
43	2008	6	0.020118
43	2008	7	0.025423
43	2008	8	0.069363
43	2008	9	0.042739
43	2008	10	0.034531
43	2008	11	0.046342
43	2008	12	0.032930
43	2008	13	0.031173
43	2008	14	0.038212
43	2008	15	0.021940
43	2008	16	0.004822
43	2008	17	0.004813
43	2008	18	0.006470
43	2008	19	0.009141
43	2008	20	0.006922
43	2008	21	0.002448
43	2008	22	0.002714
43	2008	23	0.001715
43	2008	24	0.001077
43	2008	25	0.000681
43	2008	26	0.000430
43	2008	27	0.000290
43	2008	28	0.000183
43	2008	29	0.000115
43	2008	30	0.008269
51	2008	0	0.091611
51	2008	1	0.148519
51	2008	2	0.157820
51	2008	3	0.098612
51	2008	4	0.056707
51	2008	5	0.033404
51	2008	6	0.020103
51	2008	7	0.025403
51	2008	8	0.069309
51	2008	9	0.042705
51	2008	10	0.034504
51	2008	11	0.046306
51	2008	12	0.032904
51	2008	13	0.031602
51	2008	14	0.038601
51	2008	15	0.022601
51	2008	16	0.004899
51	2008	17	0.004900
51	2008	18	0.006499
51	2008	19	0.009099
51	2008	20	0.006797
51	2008	21	0.002400
51	2008	22	0.002700
51	2008	23	0.001700
51	2008	24	0.001070
51	2008	25	0.000674
51	2008	26	0.000424

Source TypeID	YearID	AgeID	AgeFraction
51	2008	27	0.000267
51	2008	28	0.000168
51	2008	29	0.000106
51	2008	30	0.007586
52	2008	0	0.082905
52	2008	1	0.133171
52	2008	2	0.140432
52	2008	3	0.091977
52	2008	4	0.061324
52	2008	5	0.040558
52	2008	6	0.029326
52	2008	7	0.035280
52	2008	8	0.066813
52	2008	9	0.043674
52	2008	10	0.036113
52	2008	11	0.044920
52	2008	12	0.032191
52	2008	13	0.031518
52	2008	14	0.036333
52	2008	15	0.022117
52	2008	16	0.006913
52	2008	17	0.006552
52	2008	18	0.007429
52	2008	19	0.009720
52	2008	20	0.007356
52	2008	21	0.003264
52	2008	22	0.004084
52	2008	23	0.002855
52	2008	24	0.002131
52	2008	25	0.001652
52	2008	26	0.001562
52	2008	27	0.001023
52	2008	28	0.000676
52	2008	29	0.000468
52	2008	30	0.015661
53	2008	0	0.090873
53	2008	1	0.146351
53	2008	2	0.155089
53	2008	3	0.097122
53	2008	4	0.056197
53	2008	5	0.033312
53	2008	6	0.020196
53	2008	7	0.025496
53	2008	8	0.068212
53	2008	9	0.042125
53	2008	10	0.034022
53	2008	11	0.045480
53	2008	12	0.032373
53	2008	13	0.033217
53	2008	14	0.040496
53	2008	15	0.025464
53	2008	16	0.005390
53	2008	17	0.005435
53	2008	18	0.006778
53	2008	19	0.009212
53	2008	20	0.006638
53	2008	21	0.002389
53	2008	22	0.003010
53	2008	23	0.001941
53	2008	24	0.001400
53	2008	25	0.001053
53	2008	26	0.001075
53	2008	27	0.000559
53	2008	28	0.000310
53	2008	29	0.000179
53	2008	30	0.008605
54	2008	0	0.092048
54	2008	1	0.149226
54	2008	2	0.158572
54	2008	3	0.099082
54	2008	4	0.056977
54	2008	5	0.033563
54	2008	6	0.020198
54	2008	7	0.025524
54	2008	8	0.069639
54	2008	9	0.042909
54	2008	10	0.034669
54	2008	11	0.046526
54	2008	12	0.033061
54	2008	13	0.030138
54	2008	14	0.036854
54	2008	15	0.020274

Source TypeID	YearID	AgeID	AgeFraction
54	2008	16	0.004587
54	2008	17	0.004591
54	2008	18	0.006362
54	2008	19	0.009049
54	2008	20	0.007043
54	2008	21	0.002525
54	2008	22	0.002703
54	2008	23	0.001719
54	2008	24	0.001069
54	2008	25	0.000675
54	2008	26	0.000432
54	2008	27	0.000338
54	2008	28	0.000212
54	2008	29	0.000131
54	2008	30	0.009302
61	2008	0	0.092019
61	2008	1	0.149180
61	2008	2	0.158522
61	2008	3	0.099051
61	2008	4	0.056959
61	2008	5	0.033553
61	2008	6	0.020192
61	2008	7	0.025516
61	2008	8	0.069617
61	2008	9	0.042895
61	2008	10	0.034658
61	2008	11	0.046512
61	2008	12	0.033051
61	2008	13	0.031559
61	2008	14	0.037665
61	2008	15	0.022381
61	2008	16	0.004788
61	2008	17	0.004864
61	2008	18	0.006421
61	2008	19	0.008694
61	2008	20	0.006439
61	2008	21	0.002319
61	2008	22	0.002610
61	2008	23	0.001634
61	2008	24	0.001022
61	2008	25	0.000627
61	2008	26	0.000397
61	2008	27	0.000256
61	2008	28	0.000154
61	2008	29	0.000090
61	2008	30	0.006355
62	2008	0	0.091775
62	2008	1	0.148783
62	2008	2	0.158101
62	2008	3	0.098788
62	2008	4	0.056808
62	2008	5	0.033464
62	2008	6	0.020138
62	2008	7	0.025448
62	2008	8	0.069432
62	2008	9	0.042781
62	2008	10	0.034566
62	2008	11	0.046388
62	2008	12	0.032963
62	2008	13	0.031586
62	2008	14	0.038240
62	2008	15	0.022517
62	2008	16	0.004855
62	2008	17	0.004882
62	2008	18	0.006464
62	2008	19	0.008940
62	2008	20	0.006652
62	2008	21	0.002363
62	2008	22	0.002658
62	2008	23	0.001670
62	2008	24	0.001049
62	2008	25	0.000654
62	2008	26	0.000412
62	2008	27	0.000262
62	2008	28	0.000162
62	2008	29	0.000100
62	2008	30	0.007099

[IMCoverage]

polProcess ID	State ID	County ID	yearID	sourceTypeID	fuelTypeID	IMProgramID	Beg ModelYearID	End ModelYearID	inspectFreq	Test StandardsID	useIMyn	Compliance Factor
101	4	4013	2008	21	1	103	1967	1980	1	13	Y	57.62
101	4	4013	2008	21	1	106	1981	1995	2	31	Y	64.12
101	4	4013	2008	21	1	110	1996	2004	2	51	Y	90.04
101	4	4013	2008	31	1	103	1967	1980	1	13	Y	57.62
101	4	4013	2008	31	1	106	1981	1995	2	31	Y	64.12
101	4	4013	2008	31	1	110	1996	2004	2	51	Y	90.04
101	4	4013	2008	32	1	103	1967	1980	1	13	Y	57.62
101	4	4013	2008	32	1	106	1981	1995	2	31	Y	64.12
101	4	4013	2008	32	1	110	1996	2004	2	51	Y	90.04
101	4	4013	2008	52	1	103	1967	2004	1	13	Y	87.20
102	4	4013	2008	21	1	103	1967	1980	1	13	Y	57.62
102	4	4013	2008	21	1	106	1981	1995	2	31	Y	64.12
102	4	4013	2008	21	1	110	1996	2004	2	51	Y	90.04
102	4	4013	2008	31	1	103	1967	1980	1	13	Y	57.62
102	4	4013	2008	31	1	106	1981	1995	2	31	Y	64.12
102	4	4013	2008	31	1	110	1996	2004	2	51	Y	90.04
102	4	4013	2008	32	1	103	1967	1980	1	13	Y	57.62
102	4	4013	2008	32	1	106	1981	1995	2	31	Y	64.12
102	4	4013	2008	32	1	110	1996	2004	2	51	Y	90.04
102	4	4013	2008	52	1	103	1967	2004	1	13	Y	87.20
112	4	4013	2008	21	1	108	1996	2004	2	43	Y	83.81
112	4	4013	2008	21	1	109	1981	1995	2	44	Y	64.12
112	4	4013	2008	31	1	108	1996	2004	2	43	Y	83.81
112	4	4013	2008	31	1	109	1981	1995	2	44	Y	64.12
112	4	4013	2008	32	1	108	1996	2004	2	43	Y	83.81
112	4	4013	2008	32	1	109	1981	1995	2	44	Y	64.12
112	4	4013	2008	52	1	107	1981	2004	1	41	Y	86.29
113	4	4013	2008	21	1	108	1996	2004	2	43	Y	83.81
113	4	4013	2008	21	1	109	1981	1995	2	44	Y	64.12
113	4	4013	2008	31	1	108	1996	2004	2	43	Y	83.81
113	4	4013	2008	31	1	109	1981	1995	2	44	Y	64.12
113	4	4013	2008	32	1	108	1996	2004	2	43	Y	83.81
113	4	4013	2008	32	1	109	1981	1995	2	44	Y	64.12
113	4	4013	2008	52	1	107	1981	2004	1	41	Y	86.29
201	4	4013	2008	21	1	103	1967	1980	1	13	Y	57.62
201	4	4013	2008	21	1	106	1981	1995	2	31	Y	64.12
201	4	4013	2008	21	1	110	1996	2004	2	51	Y	90.04
201	4	4013	2008	31	1	103	1967	1980	1	13	Y	57.62
201	4	4013	2008	31	1	106	1981	1995	2	31	Y	64.12
201	4	4013	2008	31	1	110	1996	2004	2	51	Y	90.04
201	4	4013	2008	32	1	103	1967	1980	1	13	Y	57.62
201	4	4013	2008	32	1	106	1981	1995	2	31	Y	64.12
201	4	4013	2008	32	1	110	1996	2004	2	51	Y	90.04
201	4	4013	2008	52	1	103	1967	2004	1	13	Y	87.20
202	4	4013	2008	21	1	103	1967	1980	1	13	Y	57.62
202	4	4013	2008	21	1	106	1981	1995	2	31	Y	64.12
202	4	4013	2008	21	1	110	1996	2004	2	51	Y	90.04
202	4	4013	2008	31	1	103	1967	1980	1	13	Y	57.62
202	4	4013	2008	31	1	106	1981	1995	2	31	Y	64.12
202	4	4013	2008	31	1	110	1996	2004	2	51	Y	90.04
202	4	4013	2008	32	1	103	1967	1980	1	13	Y	57.62
202	4	4013	2008	32	1	106	1981	1995	2	31	Y	64.12
202	4	4013	2008	32	1	110	1996	2004	2	51	Y	90.04
202	4	4013	2008	52	1	103	1967	2004	1	13	Y	87.20
301	4	4013	2008	21	1	103	1967	1980	1	13	Y	57.62
301	4	4013	2008	21	1	106	1981	1995	2	31	Y	64.12
301	4	4013	2008	21	1	110	1996	2004	2	51	Y	90.04
301	4	4013	2008	31	1	103	1967	1980	1	13	Y	57.62
301	4	4013	2008	31	1	106	1981	1995	2	31	Y	64.12
301	4	4013	2008	31	1	110	1996	2004	2	51	Y	90.04
301	4	4013	2008	32	1	103	1967	1980	1	13	Y	57.62
301	4	4013	2008	32	1	106	1981	1995	2	31	Y	64.12
301	4	4013	2008	32	1	110	1996	2004	2	51	Y	90.04
301	4	4013	2008	52	1	103	1967	2004	1	13	Y	87.20
302	4	4013	2008	21	1	103	1967	1980	1	13	Y	57.62
302	4	4013	2008	21	1	106	1981	1995	2	31	Y	64.12
302	4	4013	2008	21	1	110	1996	2004	2	51	Y	90.04
302	4	4013	2008	31	1	103	1967	1980	1	13	Y	57.62
302	4	4013	2008	31	1	106	1981	1995	2	31	Y	64.12
302	4	4013	2008	31	1	110	1996	2004	2	51	Y	90.04
302	4	4013	2008	32	1	103	1967	1980	1	13	Y	57.62
302	4	4013	2008	32	1	106	1981	1995	2	31	Y	64.12
302	4	4013	2008	32	1	110	1996	2004	2	51	Y	90.04
302	4	4013	2008	52	1	103	1967	2004	1	13	Y	87.20

[RoadType]

roadTypeID	rampFraction
2	0.042906
4	0.083904

[RoadTypeDistribution]

sourceTypeID	roadTypeID	roadTypeVMTFraction
11	1	0.00000
11	2	0.01276
11	3	0.06796
11	4	0.28067
11	5	0.63861
21	1	0.00000
21	2	0.02030
21	3	0.04908
21	4	0.28647
21	5	0.64415
31	1	0.00000
31	2	0.04043
31	3	0.05352
31	4	0.33805
31	5	0.56801
32	1	0.00000
32	2	0.04043
32	3	0.05352
32	4	0.33805
32	5	0.56801
41	1	0.00000
41	2	0.03007
41	3	0.03859
41	4	0.48841
41	5	0.44293
42	1	0.00000
42	2	0.03007
42	3	0.03859
42	4	0.48841
42	5	0.44293
43	1	0.00000
43	2	0.03007
43	3	0.03859
43	4	0.48841
43	5	0.44293
51	1	0.00000
51	2	0.04242
51	3	0.03293
51	4	0.51248
51	5	0.41217
52	1	0.00000
52	2	0.04242
52	3	0.03293
52	4	0.51248
52	5	0.41217
53	1	0.00000
53	2	0.04242
53	3	0.03293
53	4	0.51248
53	5	0.41217
54	1	0.00000
54	2	0.04242
54	3	0.03293
54	4	0.51248
54	5	0.41217
61	1	0.00000
61	2	0.07911
61	3	0.03800
61	4	0.51530
61	5	0.36759
62	1	0.00000
62	2	0.07911
62	3	0.03800
62	4	0.51530
62	5	0.36759

[MonthVMTFraction]

sourceTypeID	isLeapYear	monthID	monthVMTFraction
11	Y	7	0.07881
21	Y	7	0.07881
31	Y	7	0.07881
32	Y	7	0.07881
41	Y	7	0.07881
42	Y	7	0.07881
43	Y	7	0.07881
51	Y	7	0.07881
52	Y	7	0.07881
53	Y	7	0.07881
54	Y	7	0.07881
61	Y	7	0.07881
62	Y	7	0.07881

[DayVMTFraction]

Source TypeID	Month ID	Road TypeID	dayID	Day VMTFraction
11	7	1	5	0.78131
21	7	1	5	0.78131
31	7	1	5	0.78131
32	7	1	5	0.78131
41	7	1	5	0.78131
42	7	1	5	0.78131
43	7	1	5	0.78131
51	7	1	5	0.78131
52	7	1	5	0.78131
53	7	1	5	0.78131
54	7	1	5	0.78131
61	7	1	5	0.78131
62	7	1	5	0.78131
11	7	2	5	0.78337
21	7	2	5	0.78337
31	7	2	5	0.78337
32	7	2	5	0.78337
41	7	2	5	0.78337
42	7	2	5	0.78337
43	7	2	5	0.78337
51	7	2	5	0.78337
52	7	2	5	0.78337
53	7	2	5	0.78337
54	7	2	5	0.78337
61	7	2	5	0.78337
62	7	2	5	0.78337
11	7	3	5	0.77907
21	7	3	5	0.77907
31	7	3	5	0.77907
32	7	3	5	0.77907
41	7	3	5	0.77907
42	7	3	5	0.77907
43	7	3	5	0.77907
51	7	3	5	0.77907
52	7	3	5	0.77907
53	7	3	5	0.77907
54	7	3	5	0.77907
61	7	3	5	0.77907
62	7	3	5	0.77907
11	7	4	5	0.78337
21	7	4	5	0.78337
31	7	4	5	0.78337
32	7	4	5	0.78337
41	7	4	5	0.78337
42	7	4	5	0.78337
43	7	4	5	0.78337
51	7	4	5	0.78337
52	7	4	5	0.78337
53	7	4	5	0.78337
54	7	4	5	0.78337
61	7	4	5	0.78337
62	7	4	5	0.78337
11	7	5	5	0.77907
21	7	5	5	0.77907
31	7	5	5	0.77907
32	7	5	5	0.77907
41	7	5	5	0.77907
42	7	5	5	0.77907
43	7	5	5	0.77907
51	7	5	5	0.77907
52	7	5	5	0.77907
53	7	5	5	0.77907
54	7	5	5	0.77907
61	7	5	5	0.77907
62	7	5	5	0.77907
11	7	1	2	0.21869
21	7	1	2	0.21869
31	7	1	2	0.21869
32	7	1	2	0.21869
41	7	1	2	0.21869
42	7	1	2	0.21869
43	7	1	2	0.21869
51	7	1	2	0.21869
52	7	1	2	0.21869
53	7	1	2	0.21869
54	7	1	2	0.21869
61	7	1	2	0.21869
62	7	1	2	0.21869
11	7	2	2	0.21663
21	7	2	2	0.21663
31	7	2	2	0.21663
32	7	2	2	0.21663
41	7	2	2	0.21663
42	7	2	2	0.21663
43	7	2	2	0.21663
51	7	2	2	0.21663
52	7	2	2	0.21663
53	7	2	2	0.21663
54	7	2	2	0.21663
61	7	2	2	0.21663
62	7	2	2	0.21663
11	7	3	2	0.22093
21	7	3	2	0.22093
31	7	3	2	0.22093
32	7	3	2	0.22093
41	7	3	2	0.22093
42	7	3	2	0.22093
43	7	3	2	0.22093
51	7	3	2	0.22093
52	7	3	2	0.22093
53	7	3	2	0.22093
54	7	3	2	0.22093
61	7	3	2	0.22093
62	7	3	2	0.22093
11	7	4	2	0.21663
21	7	4	2	0.21663
31	7	4	2	0.21663
32	7	4	2	0.21663
41	7	4	2	0.21663
42	7	4	2	0.21663
43	7	4	2	0.21663
51	7	4	2	0.21663
52	7	4	2	0.21663
53	7	4	2	0.21663
54	7	4	2	0.21663
61	7	4	2	0.21663
62	7	4	2	0.21663
11	7	5	2	0.22093
21	7	5	2	0.22093
31	7	5	2	0.22093
32	7	5	2	0.22093
41	7	5	2	0.22093
42	7	5	2	0.22093
43	7	5	2	0.22093
51	7	5	2	0.22093
52	7	5	2	0.22093
53	7	5	2	0.22093
54	7	5	2	0.22093
61	7	5	2	0.22093
62	7	5	2	0.22093

[HourVMTFraction] (SourceTypeID 21: Passenger Car)

Source TypeID	Road TypeID	dayID	hourID	hourVMT Fraction
21	1	5	1	0.00773
21	1	5	2	0.00526
21	1	5	3	0.00489
21	1	5	4	0.00636
21	1	5	5	0.01666
21	1	5	6	0.03683
21	1	5	7	0.05414
21	1	5	8	0.06525
21	1	5	9	0.06070
21	1	5	10	0.05269
21	1	5	11	0.05070
21	1	5	12	0.05410
21	1	5	13	0.05696
21	1	5	14	0.05867
21	1	5	15	0.06421
21	1	5	16	0.06827
21	1	5	17	0.06945
21	1	5	18	0.06952
21	1	5	19	0.05826
21	1	5	20	0.04182
21	1	5	21	0.03361
21	1	5	22	0.02915
21	1	5	23	0.02116
21	1	5	24	0.01360
21	2	5	1	0.00935
21	2	5	2	0.00655
21	2	5	3	0.00634
21	2	5	4	0.00864
21	2	5	5	0.02363
21	2	5	6	0.04783
21	2	5	7	0.05924
21	2	5	8	0.06055
21	2	5	9	0.05818
21	2	5	10	0.05502
21	2	5	11	0.05157
21	2	5	12	0.05326
21	2	5	13	0.05552
21	2	5	14	0.05931
21	2	5	15	0.06444
21	2	5	16	0.06360
21	2	5	17	0.06052
21	2	5	18	0.05806
21	2	5	19	0.05274
21	2	5	20	0.04064
21	2	5	21	0.03340
21	2	5	22	0.03082
21	2	5	23	0.02436
21	2	5	24	0.01644
21	3	5	1	0.00608
21	3	5	2	0.00395
21	3	5	3	0.00341
21	3	5	4	0.00404
21	3	5	5	0.00958
21	3	5	6	0.02566
21	3	5	7	0.04895
21	3	5	8	0.07002
21	3	5	9	0.06326
21	3	5	10	0.05034
21	3	5	11	0.04983
21	3	5	12	0.05497
21	3	5	13	0.05843
21	3	5	14	0.05802
21	3	5	15	0.06398
21	3	5	16	0.07301
21	3	5	17	0.07853
21	3	5	18	0.08117
21	3	5	19	0.06387
21	3	5	20	0.04302
21	3	5	21	0.03383
21	3	5	22	0.02745
21	3	5	23	0.01791
21	3	5	24	0.01071
21	4	5	1	0.00935
21	4	5	2	0.00655
21	4	5	3	0.00634
21	4	5	4	0.00864
21	4	5	5	0.02363
21	4	5	6	0.04783
21	4	5	7	0.05924
21	4	5	8	0.06055
21	4	5	9	0.05818
21	4	5	10	0.05502
21	4	5	11	0.05157
21	4	5	12	0.05326
21	4	5	13	0.05552
21	4	5	14	0.05931
21	4	5	15	0.06444
21	4	5	16	0.06360
21	4	5	17	0.06052
21	4	5	18	0.05806
21	4	5	19	0.05274
21	4	5	20	0.04064
21	4	5	21	0.03340
21	4	5	22	0.03082
21	4	5	23	0.02436
21	4	5	24	0.01644
21	5	5	1	0.00608
21	5	5	2	0.00395
21	5	5	3	0.00341
21	5	5	4	0.00404
21	5	5	5	0.00958
21	5	5	6	0.02566
21	5	5	7	0.04895
21	5	5	8	0.07002
21	5	5	9	0.06326
21	5	5	10	0.05034
21	5	5	11	0.04983
21	5	5	12	0.05497
21	5	5	13	0.05843
21	5	5	14	0.05802
21	5	5	15	0.06398
21	5	5	16	0.07301
21	5	5	17	0.07853
21	5	5	18	0.08117
21	5	5	19	0.06387
21	5	5	20	0.04302
21	5	5	21	0.03383
21	5	5	22	0.02745
21	5	5	23	0.01791
21	5	5	24	0.01071
21	1	2	1	0.02131
21	1	2	2	0.01510
21	1	2	3	0.01346
21	1	2	4	0.01033
21	1	2	5	0.01242
21	1	2	6	0.01988
21	1	2	7	0.02807
21	1	2	8	0.03490
21	1	2	9	0.04138
21	1	2	10	0.04933
21	1	2	11	0.05577
21	1	2	12	0.05977
21	1	2	13	0.06401
21	1	2	14	0.06459
21	1	2	15	0.06369
21	1	2	16	0.06339
21	1	2	17	0.06375
21	1	2	18	0.06265
21	1	2	19	0.05921
21	1	2	20	0.05076
21	1	2	21	0.04447
21	1	2	22	0.04097
21	1	2	23	0.03542
21	1	2	24	0.02536
21	2	2	1	0.02131
21	2	2	2	0.01510
21	2	2	3	0.01346
21	2	2	4	0.01033
21	2	2	5	0.01242
21	2	2	6	0.01988
21	2	2	7	0.02807
21	2	2	8	0.03490
21	2	2	9	0.04138
21	2	2	10	0.04933
21	2	2	11	0.05577
21	2	2	12	0.05977
21	2	2	13	0.06401
21	2	2	14	0.06459
21	2	2	15	0.06369
21	2	2	16	0.06339
21	2	2	17	0.06375
21	2	2	18	0.06265
21	2	2	19	0.05921
21	2	2	20	0.05076
21	2	2	21	0.04447
21	2	2	22	0.04097
21	2	2	23	0.03542
21	2	2	24	0.02536
21	3	2	1	0.02131
21	3	2	2	0.01510
21	3	2	3	0.01346
21	3	2	4	0.01033
21	3	2	5	0.01242
21	3	2	6	0.01988
21	3	2	7	0.02807
21	3	2	8	0.03490
21	3	2	9	0.04138
21	3	2	10	0.04933
21	3	2	11	0.05577
21	3	2	12	0.05977
21	3	2	13	0.06401
21	3	2	14	0.06459
21	3	2	15	0.06369
21	3	2	16	0.06339
21	3	2	17	0.06375
21	3	2	18	0.06265
21	3	2	19	0.05921
21	3	2	20	0.05076
21	3	2	21	0.04447
21	3	2	22	0.04097
21	3	2	23	0.03542
21	3	2	24	0.02536
21	4	2	1	0.02131
21	4	2	2	0.01510
21	4	2	3	0.01346
21	4	2	4	0.01033
21	4	2	5	0.01242
21	4	2	6	0.01988
21	4	2	7	0.02807
21	4	2	8	0.03490
21	4	2	9	0.04138
21	4	2	10	0.04933
21	4	2	11	0.05577
21	4	2	12	0.05977
21	4	2	13	0.06401
21	4	2	14	0.06459
21	4	2	15	0.06369
21	4	2	16	0.06339
21	4	2	17	0.06375
21	4	2	18	0.06265
21	4	2	19	0.05921
21	4	2	20	0.05076
21	4	2	21	0.04447
21	4	2	22	0.04097
21	4	2	23	0.03542
21	4	2	24	0.02536
21	5	2	1	0.02131
21	5	2	2	0.01510
21	5	2	3	0.01346
21	5	2	4	0.01033
21	5	2	5	0.01242
21	5	2	6	0.01988
21	5	2	7	0.02807
21	5	2	8	0.03490
21	5	2	9	0.04138
21	5	2	10	0.04933
21	5	2	11	0.05577
21	5	2	12	0.05977
21	5	2	13	0.06401
21	5	2	14	0.06459
21	5	2	15	0.06369
21	5	2	16	0.06339
21	5	2	17	0.06375
21	5	2	18	0.06265
21	5	2	19	0.05921
21	5	2	20	0.05076
21	5	2	21	0.04447
21	5	2	22	0.04097
21	5	2	23	0.03542
21	5	2	24	0.02536

[AvgSpeedDistribution] (SourceTypeID 21: Passenger Car and RoadTypeID 2: Rural Restricted Access)

Source TypeID	Road TypeID	Hour DayID	avgSpeed BinID	avgSpeed Fraction
21	2	15	1	0.00000
21	2	15	2	0.00000
21	2	15	3	0.00000
21	2	15	4	0.00000
21	2	15	5	0.00000
21	2	15	6	0.00000
21	2	15	7	0.00360
21	2	15	8	0.00000
21	2	15	9	0.00000
21	2	15	10	0.06574
21	2	15	11	0.00073
21	2	15	12	0.01326
21	2	15	13	0.12481
21	2	15	14	0.35321
21	2	15	15	0.19430
21	2	15	16	0.24435
21	2	25	1	0.00000
21	2	25	2	0.00000
21	2	25	3	0.00000
21	2	25	4	0.00000
21	2	25	5	0.00000
21	2	25	6	0.00000
21	2	25	7	0.00360
21	2	25	8	0.00000
21	2	25	9	0.00000
21	2	25	10	0.06574
21	2	25	11	0.00073
21	2	25	12	0.01326
21	2	25	13	0.12481
21	2	25	14	0.35321
21	2	25	15	0.19430
21	2	25	16	0.24435
21	2	35	1	0.00000
21	2	35	2	0.00000
21	2	35	3	0.00000
21	2	35	4	0.00000
21	2	35	5	0.00000
21	2	35	6	0.00000
21	2	35	7	0.00360
21	2	35	8	0.00000
21	2	35	9	0.00000
21	2	35	10	0.06574
21	2	35	11	0.00073
21	2	35	12	0.01326
21	2	35	13	0.12481
21	2	35	14	0.35321
21	2	35	15	0.19430
21	2	35	16	0.24435
21	2	45	1	0.00000
21	2	45	2	0.00000
21	2	45	3	0.00000
21	2	45	4	0.00000
21	2	45	5	0.00000
21	2	45	6	0.00000
21	2	45	7	0.00360
21	2	45	8	0.00000
21	2	45	9	0.00000
21	2	45	10	0.06574
21	2	45	11	0.00073
21	2	45	12	0.01326
21	2	45	13	0.12481
21	2	45	14	0.35321
21	2	45	15	0.19430
21	2	45	16	0.24435
21	2	55	1	0.00000
21	2	55	2	0.00000
21	2	55	3	0.00000
21	2	55	4	0.00000
21	2	55	5	0.00000
21	2	55	6	0.00000
21	2	55	7	0.00360
21	2	55	8	0.00000
21	2	55	9	0.00000
21	2	55	10	0.06574
21	2	55	11	0.00073
21	2	55	12	0.01326
21	2	55	13	0.12481
21	2	55	14	0.35321
21	2	55	15	0.19430
21	2	55	16	0.24435

Source TypeID	Road TypeID	Hour DayID	avgSpeed BinID	avgSpeed Fraction
21	2	65	1	0.00000
21	2	65	2	0.00000
21	2	65	3	0.00000
21	2	65	4	0.00000
21	2	65	5	0.00000
21	2	65	6	0.00000
21	2	65	7	0.00360
21	2	65	8	0.00000
21	2	65	9	0.00000
21	2	65	10	0.06574
21	2	65	11	0.00073
21	2	65	12	0.01326
21	2	65	13	0.12481
21	2	65	14	0.35321
21	2	65	15	0.19430
21	2	65	16	0.24435
21	2	75	1	0.00000
21	2	75	2	0.00000
21	2	75	3	0.00000
21	2	75	4	0.00038
21	2	75	5	0.00000
21	2	75	6	0.00790
21	2	75	7	0.00338
21	2	75	8	0.02171
21	2	75	9	0.03200
21	2	75	10	0.15639
21	2	75	11	0.13785
21	2	75	12	0.23232
21	2	75	13	0.12192
21	2	75	14	0.06243
21	2	75	15	0.09575
21	2	75	16	0.12797
21	2	85	1	0.00000
21	2	85	2	0.00000
21	2	85	3	0.00000
21	2	85	4	0.00038
21	2	85	5	0.00000
21	2	85	6	0.00790
21	2	85	7	0.00338
21	2	85	8	0.02171
21	2	85	9	0.03200
21	2	85	10	0.15639
21	2	85	11	0.13785
21	2	85	12	0.23232
21	2	85	13	0.12192
21	2	85	14	0.06243
21	2	85	15	0.09575
21	2	85	16	0.12797
21	2	95	1	0.00000
21	2	95	2	0.00000
21	2	95	3	0.00000
21	2	95	4	0.00038
21	2	95	5	0.00000
21	2	95	6	0.00790
21	2	95	7	0.00338
21	2	95	8	0.02171
21	2	95	9	0.03200
21	2	95	10	0.15639
21	2	95	11	0.13785
21	2	95	12	0.23232
21	2	95	13	0.12192
21	2	95	14	0.06243
21	2	95	15	0.09575
21	2	95	16	0.12797
21	2	105	1	0.00000
21	2	105	2	0.00000
21	2	105	3	0.00000
21	2	105	4	0.00000
21	2	105	5	0.00000
21	2	105	6	0.00010
21	2	105	7	0.00307
21	2	105	8	0.00000
21	2	105	9	0.07782
21	2	105	10	0.20747
21	2	105	11	0.22000
21	2	105	12	0.12630
21	2	105	13	0.07248
21	2	105	14	0.09291
21	2	105	15	0.07367
21	2	105	16	0.12618

Source TypeID	Road TypeID	Hour DayID	avgSpeed BinID	avgSpeed Fraction
21	2	115	1	0.00000
21	2	115	2	0.00000
21	2	115	3	0.00000
21	2	115	4	0.00000
21	2	115	5	0.00000
21	2	115	6	0.00010
21	2	115	7	0.00307
21	2	115	8	0.00000
21	2	115	9	0.07782
21	2	115	10	0.20747
21	2	115	11	0.22000
21	2	115	12	0.12630
21	2	115	13	0.07248
21	2	115	14	0.09291
21	2	115	15	0.07367
21	2	115	16	0.12618
21	2	125	1	0.00000
21	2	125	2	0.00000
21	2	125	3	0.00000
21	2	125	4	0.00000
21	2	125	5	0.00000
21	2	125	6	0.00010
21	2	125	7	0.00307
21	2	125	8	0.00000
21	2	125	9	0.07782
21	2	125	10	0.20747
21	2	125	11	0.22000
21	2	125	12	0.12630
21	2	125	13	0.07248
21	2	125	14	0.09291
21	2	125	15	0.07367
21	2	125	16	0.12618
21	2	135	1	0.00000
21	2	135	2	0.00000
21	2	135	3	0.00000
21	2	135	4	0.00000
21	2	135	5	0.00000
21	2	135	6	0.00010
21	2	135	7	0.00307
21	2	135	8	0.00000
21	2	135	9	0.07782
21	2	135	10	0.20747
21	2	135	11	0.22000
21	2	135	12	0.12630
21	2	135	13	0.07248
21	2	135	14	0.09291
21	2	135	15	0.07367
21	2	135	16	0.12618
21	2	145	1	0.00000
21	2	145	2	0.00000
21	2	145	3	0.00000
21	2	145	4	0.00000
21	2	145	5	0.00000
21	2	145	6	0.00010
21	2	145	7	0.00307
21	2	145	8	0.00000
21	2	145	9	0.07782
21	2	145	10	0.20747
21	2	145	11	0.22000
21	2	145	12	0.12630
21	2	145	13	0.07248
21	2	145	14	0.09291
21	2	145	15	0.07367
21	2	145	16	0.12618
21	2	155	1	0.00000
21	2	155	2	0.00000
21	2	155	3	0.00000
21	2	155	4	0.00000
21	2	155	5	0.00000
21	2	155	6	0.00010
21	2	155	7	0.00307
21	2	155	8	0.00000
21	2	155	9	0.07782
21	2	155	10	0.20747
21	2	155	11	0.22000
21	2	155	12	0.12630
21	2	155	13	0.07248
21	2	155	14	0.09291
21	2	155	15	0.07367
21	2	155	16	0.12618

Source TypeID	Road TypeID	Hour DayID	avgSpeed BinID	avgSpeed Fraction
21	2	165	1	0.00000
21	2	165	2	0.00000
21	2	165	3	0.00000
21	2	165	4	0.00000
21	2	165	5	0.00000
21	2	165	6	0.00708
21	2	165	7	0.04834
21	2	165	8	0.06439
21	2	165	9	0.17359
21	2	165	10	0.34525
21	2	165	11	0.05809
21	2	165	12	0.04723
21	2	165	13	0.05493
21	2	165	14	0.07183
21	2	165	15	0.04109
21	2	165	16	0.08819
21	2	175	1	0.00000
21	2	175	2	0.00000
21	2	175	3	0.00000
21	2	175	4	0.00000
21	2	175	5	0.00000
21	2	175	6	0.00708
21	2	175	7	0.04834
21	2	175	8	0.06439
21	2	175	9	0.17359
21	2	175	10	0.34525
21	2	175	11	0.05809
21	2	175	12	0.04723
21	2	175	13	0.05493
21	2	175	14	0.07183
21	2	175	15	0.04109
21	2	175	16	0.08819
21	2	185	1	0.00000
21	2	185	2	0.00000
21	2	185	3	0.00000
21	2	185	4	0.00000
21	2	185	5	0.00000
21	2	185	6	0.00708
21	2	185	7	0.04834
21	2	185	8	0.06439
21	2	185	9	0.17359
21	2	185	10	0.34525
21	2	185	11	0.05809
21	2	185	12	0.04723
21	2	185	13	0.05493
21	2	185	14	0.07183
21	2	185	15	0.04109
21	2	185	16	0.08819
21	2	195	1	0.00000
21	2	195	2	0.00000
21	2	195	3	0.00000
21	2	195	4	0.00000
21	2	195	5	0.00000
21	2	195	6	0.00000
21	2	195	7	0.00360
21	2	195	8	0.00000
21	2	195	9	0.00000
21	2	195	10	0.06574
21	2	195	11	0.00073
21	2	195	12	0.01326
21	2	195	13	0.12481
21	2	195	14	0.35321
21	2	195	15	0.19430
21	2	195	16	0.24435
21	2	205	1	0.00000
21	2	205	2	0.00000
21	2	205	3	0.00000
21	2	205	4	0.00000
21	2	205	5	0.00000
21	2	205	6	0.00000
21	2	205	7	0.00360
21	2	205	8	0.00000
21	2	205	9	0.00000
21	2	205	10	0.06574
21	2	205	11	0.00073
21	2	205	12	0.01326
21	2	205	13	0.12481
21	2	205	14	0.35321
21	2	205	15	0.19430
21	2	205	16	0.24435
21	2	215	1	0.00000
21	2	215	2	0.00000

Source TypeID	Road TypeID	Hour DayID	avgSpeed BinID	avgSpeed Fraction
21	2	215	3	0.00000
21	2	215	4	0.00000
21	2	215	5	0.00000
21	2	215	6	0.00000
21	2	215	7	0.00360
21	2	215	8	0.00000
21	2	215	9	0.00000
21	2	215	10	0.06574
21	2	215	11	0.00073
21	2	215	12	0.01326
21	2	215	13	0.12481
21	2	215	14	0.35321
21	2	215	15	0.19430
21	2	215	16	0.24435
21	2	225	1	0.00000
21	2	225	2	0.00000
21	2	225	3	0.00000
21	2	225	4	0.00000
21	2	225	5	0.00000
21	2	225	6	0.00000
21	2	225	7	0.00360
21	2	225	8	0.00000
21	2	225	9	0.00000
21	2	225	10	0.06574
21	2	225	11	0.00073
21	2	225	12	0.01326
21	2	225	13	0.12481
21	2	225	14	0.35321
21	2	225	15	0.19430
21	2	225	16	0.24435
21	2	235	1	0.00000
21	2	235	2	0.00000
21	2	235	3	0.00000
21	2	235	4	0.00000
21	2	235	5	0.00000
21	2	235	6	0.00000
21	2	235	7	0.00360
21	2	235	8	0.00000
21	2	235	9	0.00000
21	2	235	10	0.06574
21	2	235	11	0.00073
21	2	235	12	0.01326
21	2	235	13	0.12481
21	2	235	14	0.35321
21	2	235	15	0.19430
21	2	235	16	0.24435
21	2	245	1	0.00000
21	2	245	2	0.00000
21	2	245	3	0.00000
21	2	245	4	0.00000
21	2	245	5	0.00000
21	2	245	6	0.00000
21	2	245	7	0.00360
21	2	245	8	0.00000
21	2	245	9	0.00000
21	2	245	10	0.06574
21	2	245	11	0.00073
21	2	245	12	0.01326
21	2	245	13	0.12481
21	2	245	14	0.35321
21	2	245	15	0.19430
21	2	245	16	0.24435
21	2	12	1	0.00000
21	2	12	2	0.00000
21	2	12	3	0.00000
21	2	12	4	0.00000
21	2	12	5	0.00000
21	2	12	6	0.00000
21	2	12	7	0.00360
21	2	12	8	0.00000
21	2	12	9	0.00000
21	2	12	10	0.06574
21	2	12	11	0.00073
21	2	12	12	0.01326
21	2	12	13	0.12481
21	2	12	14	0.35321
21	2	12	15	0.19430
21	2	12	16	0.24435
21	2	22	1	0.00000
21	2	22	2	0.00000
21	2	22	3	0.00000
21	2	22	4	0.00000

Source TypeID	Road TypeID	Hour DayID	avgSpeed BinID	avgSpeed Fraction
21	2	22	5	0.00000
21	2	22	6	0.00000
21	2	22	7	0.00360
21	2	22	8	0.00000
21	2	22	9	0.00000
21	2	22	10	0.06574
21	2	22	11	0.00073
21	2	22	12	0.01326
21	2	22	13	0.12481
21	2	22	14	0.35321
21	2	22	15	0.19430
21	2	22	16	0.24435
21	2	32	1	0.00000
21	2	32	2	0.00000
21	2	32	3	0.00000
21	2	32	4	0.00000
21	2	32	5	0.00000
21	2	32	6	0.00000
21	2	32	7	0.00360
21	2	32	8	0.00000
21	2	32	9	0.00000
21	2	32	10	0.06574
21	2	32	11	0.00073
21	2	32	12	0.01326
21	2	32	13	0.12481
21	2	32	14	0.35321
21	2	32	15	0.19430
21	2	32	16	0.24435
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21	2	42	3	0.00000
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21	2	42	6	0.00000
21	2	42	7	0.00360
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21	2	42	9	0.00000
21	2	42	10	0.06574
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21	2	42	12	0.01326
21	2	42	13	0.12481
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21	2	52	7	0.00360
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21	2	52	12	0.01326
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21	2	52	14	0.35321
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21	2	62	5	0.00000
21	2	62	6	0.00000
21	2	62	7	0.00360
21	2	62	8	0.00000
21	2	62	9	0.00000
21	2	62	10	0.06574
21	2	62	11	0.00073
21	2	62	12	0.01326
21	2	62	13	0.12481
21	2	62	14	0.35321
21	2	62	15	0.19430
21	2	62	16	0.24435
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21	2	72	3	0.00000
21	2	72	4	0.00038
21	2	72	5	0.00000
21	2	72	6	0.00790

Source TypeID	Road TypeID	Hour DayID	avgSpeed BinID	avgSpeed Fraction
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21	2	72	8	0.02171
21	2	72	9	0.03200
21	2	72	10	0.15639
21	2	72	11	0.13785
21	2	72	12	0.23232
21	2	72	13	0.12192
21	2	72	14	0.06243
21	2	72	15	0.09575
21	2	72	16	0.12797
21	2	82	1	0.00000
21	2	82	2	0.00000
21	2	82	3	0.00000
21	2	82	4	0.00038
21	2	82	5	0.00000
21	2	82	6	0.00790
21	2	82	7	0.00338
21	2	82	8	0.02171
21	2	82	9	0.03200
21	2	82	10	0.15639
21	2	82	11	0.13785
21	2	82	12	0.23232
21	2	82	13	0.12192
21	2	82	14	0.06243
21	2	82	15	0.09575
21	2	82	16	0.12797
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21	2	92	2	0.00000
21	2	92	3	0.00000
21	2	92	4	0.00038
21	2	92	5	0.00000
21	2	92	6	0.00790
21	2	92	7	0.00338
21	2	92	8	0.02171
21	2	92	9	0.03200
21	2	92	10	0.15639
21	2	92	11	0.13785
21	2	92	12	0.23232
21	2	92	13	0.12192
21	2	92	14	0.06243
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21	2	102	4	0.00000
21	2	102	5	0.00000
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21	2	102	7	0.00307
21	2	102	8	0.00000
21	2	102	9	0.07782
21	2	102	10	0.20747
21	2	102	11	0.22000
21	2	102	12	0.12630
21	2	102	13	0.07248
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21	2	102	16	0.12618
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21	2	112	6	0.00010
21	2	112	7	0.00307
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21	2	112	9	0.07782
21	2	112	10	0.20747
21	2	112	11	0.22000
21	2	112	12	0.12630
21	2	112	13	0.07248
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21	2	112	16	0.12618
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21	2	122	3	0.00000
21	2	122	4	0.00000
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21	2	122	6	0.00010
21	2	122	7	0.00307
21	2	122	8	0.00000

Source TypeID	Road TypeID	Hour DayID	avgSpeed BinID	avgSpeed Fraction
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21	2	122	10	0.20747
21	2	122	11	0.22000
21	2	122	12	0.12630
21	2	122	13	0.07248
21	2	122	14	0.09291
21	2	122	15	0.07367
21	2	122	16	0.12618
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21	2	132	3	0.00000
21	2	132	4	0.00000
21	2	132	5	0.00000
21	2	132	6	0.00010
21	2	132	7	0.00307
21	2	132	8	0.00000
21	2	132	9	0.07782
21	2	132	10	0.20747
21	2	132	11	0.22000
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21	2	132	13	0.07248
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21	2	142	5	0.00000
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21	2	142	7	0.00307
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21	2	152	3	0.00000
21	2	152	4	0.00000
21	2	152	5	0.00000
21	2	152	6	0.00010
21	2	152	7	0.00307
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21	2	162	5	0.00000
21	2	162	6	0.00708
21	2	162	7	0.04834
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21	2	162	9	0.17359
21	2	162	10	0.34525
21	2	162	11	0.05809
21	2	162	12	0.04723
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21	2	172	5	0.00000
21	2	172	6	0.00708
21	2	172	7	0.04834
21	2	172	8	0.06439
21	2	172	9	0.17359
21	2	172	10	0.34525

Source TypeID	Road TypeID	Hour DayID	avgSpeed BinID	avgSpeed Fraction
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21	2	172	12	0.04723
21	2	172	13	0.05493
21	2	172	14	0.07183
21	2	172	15	0.04109
21	2	172	16	0.08819
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21	2	182	2	0.00000
21	2	182	3	0.00000
21	2	182	4	0.00000
21	2	182	5	0.00000
21	2	182	6	0.00708
21	2	182	7	0.04834
21	2	182	8	0.06439
21	2	182	9	0.17359
21	2	182	10	0.34525
21	2	182	11	0.05809
21	2	182	12	0.04723
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21	2	182	14	0.07183
21	2	182	15	0.04109
21	2	182	16	0.08819
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21	2	192	7	0.00360
21	2	192	8	0.00000
21	2	192	9	0.00000
21	2	192	10	0.06574
21	2	192	11	0.00073
21	2	192	12	0.01326
21	2	192	13	0.12481
21	2	192	14	0.35321
21	2	192	15	0.19430
21	2	192	16	0.24435
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21	2	202	3	0.00000
21	2	202	4	0.00000
21	2	202	5	0.00000
21	2	202	6	0.00000
21	2	202	7	0.00360
21	2	202	8	0.00000
21	2	202	9	0.00000
21	2	202	10	0.06574
21	2	202	11	0.00073
21	2	202	12	0.01326
21	2	202	13	0.12481
21	2	202	14	0.35321
21	2	202	15	0.19430
21	2	202	16	0.24435
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21	2	212	3	0.00000
21	2	212	4	0.00000
21	2	212	5	0.00000
21	2	212	6	0.00000
21	2	212	7	0.00360
21	2	212	8	0.00000
21	2	212	9	0.00000
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21	2	212	11	0.00073
21	2	212	12	0.01326
21	2	212	13	0.12481
21	2	212	14	0.35321
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21	2	222	5	0.00000
21	2	222	6	0.00000
21	2	222	7	0.00360
21	2	222	8	0.00000
21	2	222	9	0.00000
21	2	222	10	0.06574
21	2	222	11	0.00073
21	2	222	12	0.01326

Source TypeID	Road TypeID	Hour DayID	avgSpeed BinID	avgSpeed Fraction
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21	2	222	14	0.35321
21	2	222	15	0.19430
21	2	222	16	0.24435
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21	2	232	4	0.00000
21	2	232	5	0.00000
21	2	232	6	0.00000
21	2	232	7	0.00360
21	2	232	8	0.00000

Source TypeID	Road TypeID	Hour DayID	avgSpeed BinID	avgSpeed Fraction
21	2	232	9	0.00000
21	2	232	10	0.06574
21	2	232	11	0.00073
21	2	232	12	0.01326
21	2	232	13	0.12481
21	2	232	14	0.35321
21	2	232	15	0.19430
21	2	232	16	0.24435
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21	2	242	2	0.00000
21	2	242	3	0.00000
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Source TypeID	Road TypeID	Hour DayID	avgSpeed BinID	avgSpeed Fraction
21	2	242	5	0.00000
21	2	242	6	0.00000
21	2	242	7	0.00360
21	2	242	8	0.00000
21	2	242	9	0.00000
21	2	242	10	0.06574
21	2	242	11	0.00073
21	2	242	12	0.01326
21	2	242	13	0.12481
21	2	242	14	0.35321
21	2	242	15	0.19430
21	2	242	16	0.24435

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MAG 2012 FIVE PERCENT PLAN FOR PM-10 FOR THE MARICOPA COUNTY NONATTAINMENT AREA

APPENDICES

VOLUME TWO

MARCH 2012

MARICOPA ASSOCIATION of GOVERNMENTS

MAG 2012 FIVE PERCENT PLAN FOR PM-10 FOR THE MARICOPA COUNTY NONATTAINMENT AREA

APPENDICES

MARCH 2012

MARICOPA ASSOCIATION of GOVERNMENTS

MAG 2012 FIVE PERCENT PLAN FOR PM-10 FOR THE MARICOPA COUNTY NONATTAINMENT AREA

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APPENDIX B

Exhibit 1: Technical Document in Support of the MAG 2012 Five Percent Plan for PM-10 for the Maricopa County Nonattainment Area. Maricopa Association of Governments.

Exhibit 2: Calculation of Benefits from PM-10 Certified Street Sweepers Purchased with CMAQ Funds in 2001-2009.

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Exhibit 1: Arizona Revised Statutes Listed in Table 4-1.

Exhibit 2: Maricopa County Resolution to Evaluate Measures in the MAG 2012 Five Percent Plan for PM-10 for the Maricopa County Nonattainment Area.

Exhibit 3: Arizona Department of Environmental Quality Dust Action General Permit.

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Exhibit 1: Agricultural Best Management Practices Program.

APPENDIX E

Exhibit 1: Public Hearing Process Documentation.

Exhibit 2: Certification of Adoption.

APPENDIX B

APPENDIX B

EXHIBIT 1:

Technical Document in Support of the MAG 2012 Five Percent Plan for PM-10 for the Maricopa County Nonattainment Area. Maricopa Association of Governments

TECHNICAL DOCUMENT

IN SUPPORT OF THE

MAG 2012 FIVE PERCENT PLAN FOR PM-10
FOR THE MARICOPA COUNTY NONATTAINMENT AREA

February 2012

Maricopa Association of Governments
302 North 1st Avenue, Suite 300
Phoenix, Arizona 85003

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I. INTRODUCTION

The Technical Document in Support of the MAG 2012 Five Percent Plan for PM-10 for the Maricopa County Nonattainment Area (TSD) describes the base case emission inventories, quantification of measures used to meet the five percent and contingency requirements, and the modeling that demonstrates attainment in the PM-10 nonattainment area.

The U.S. Environmental Protection Agency (EPA) published a final notice on June 6, 2007 that the Maricopa County PM-10 Nonattainment Area had failed to attain the 24-hour PM-10 standard by December 31, 2006. Section 189(d) of the Clean Air Act requires Serious nonattainment areas that do not meet the applicable attainment date to prepare a plan that reduces PM-10 emissions by at least five percent per year until the standard is attained at all monitors. The Clean Air Act specifies that the plan must be based on the most recent emissions inventory for the area, meet contingency requirements, and include a modeling demonstration of attainment.

The 2008 PM-10 Periodic Emission Inventory for the Maricopa County, Arizona, Nonattainment Area, revised in June 2011 (PEI), is the most recent emissions inventory for the area (Appendix A, Exhibit 1). This inventory has been used as the basis for the five percent and contingency reductions and the attainment modeling required by the Clean Air Act. Chapter II of the TSD describes the development of the 2007-2012 base case emission inventories that were derived from the 2008 PEI.

Chapter III discusses the methods used to quantify rule effectiveness for Maricopa County Rules 310, 310.01 and 316. As described in the Plan, the increases in rule effectiveness between 2007 and 2012 are sufficient to meet the annual five percent reduction requirements (Chapter Five) and demonstrate modeled attainment (Chapter Six).

Chapter IV describes the technical assumptions used to meet contingency requirements of the Clean Air Act. The requirement is met by quantifying the PM-10 emission reductions due to numerous projects completed in the nonattainment area in 2008-2011. These projects include PM-10 certified street sweeping; paving and stabilizing unpaved roads, alleys and shoulders; reducing speed limits on unpaved roads and alleys, and overlaying payment with rubberized asphalt. As discussed in Chapter Six of the Plan, cumulatively, these reductions are sufficient to meet EPA's contingency guideline of one year of reasonable further progress (RFP).

Chapter V documents the technical assumptions underlying the rollback modeling used to demonstrate attainment by 2012. As discussed in Chapter Six of the Plan, the modeling concludes that the PM-10 standard will be attained on high wind days at the West 43rd Avenue monitor and throughout the PM-10 nonattainment area by December 31, 2012.

II. BASE CASE PM-10 EMISSIONS

Section 189(d) of the Clean Air Act requires that the plan provide an annual reduction in PM-10 emissions of not less than five percent of the emissions in the most recent inventory prepared for the area. The MAG 2012 Five Percent Plan for PM-10 provides reductions of five percent per year from the 2007 base year until the attainment year of 2012. This chapter describes the development of the base case emissions for 2007 through 2012. "Base case" emissions do not include reductions due to measures quantified in either the MAG 2007 Five Percent Plan or the MAG 2012 Five Percent Plan.

In June 2011, the Maricopa County Air Quality Department finalized the latest version of the 2008 PM-10 Periodic Emissions Inventory (PEI). The 2007-2012 base case emissions are derived from the 2008 PEI (Appendix A, Exhibit 1). Growth factors have been applied to the 2008 PEI emissions to estimate 2007 and 2009-2012 base case emissions. For most source categories, the growth factors are derived from projections for the Phoenix-Mesa metropolitan area released in August 2011 by Marshall Vest of the University of Arizona, Economic and Business Research Center. These projections are based on the 2010 U.S. Census and the latest economic forecasts for the Phoenix metropolitan area. Since the economic outlook for the United States and Arizona remains extremely volatile, the actual population and employment levels in 2011 and 2012 may differ from the projections. However, the University of Arizona growth factors represent the most reliable data currently available. Table II-1 summarizes the annual projection factors, relative to 2008, for population, construction employment and manufacturing employment.

The remainder of this chapter documents the derivation of the 2007-2012 base case emissions in Table II-2. The discussion is organized by major source category, i.e., point, area, nonroad mobile and onroad mobile. The order of the subcategories is consistent with the source category sequence in Table II-2. All tonnage estimates referred to below represent annual PM-10 emissions in the Maricopa County PM-10 nonattainment area.

POINT SOURCES

Point sources of PM-10 emissions are those permitted sources that emit more than five tons per year of PM-10. The 2008 PEI estimate of 149.84 tons from point sources is back-cast to 2007 and projected to 2009-2012 using the manufacturing employment growth factors shown in Table II-1.

AREA SOURCES

Area sources of PM-10 emissions include fuel combustion, wildfires, agriculture, construction, travel on unpaved parking lots, off-road recreational vehicles, leaf blowers, windblown dust, and industrial processes that are not large enough to qualify as point sources. The derivation of 2007-2012 base case emissions for each of these area sources is discussed below. As noted previously, the source subcategories are organized in the same sequence as Table II-2.

Table II-1
Growth Factors for the PM-10 Nonattainment Area

	Factors Relative to 2008					
	2007	**2008**	**2009**	**2010**	**2011**	**2012**
Population	0.981	1.000	1.005	1.008	1.012	1.021
Construction Employment	1.216	1.000	0.689	0.588	0.569	0.578
Manufacturing Employment	1.058	1.000	0.886	0.849	0.852	0.898

Note: The growth factors above are based on the 3rd Quarter 2011 baseline projections for the Phoenix-Mesa metropolitan area published by Marshall Vest, Economic and Business Research Center, University of Arizona. The Phoenix-Mesa metropolitan area includes all of Maricopa and Pinal Counties. The table below shows the Marshall Vest annual projections and percentage changes relative to each previous year, beginning in 2009. For 2007, the percent change is shown relative to 2008, since 2008 is the year for the latest PM-10 emissions inventory (Appendix A, Exhibit 1).

Year	Population	%	Construction Employment	%	Manufacturing Employment	%
2007	4,087,390	-1.9%	169,392	21.6%	137,242	5.8%
2008	4,167,019		139,358		129,683	
2009	4,186,131	0.5%	96,008	-31.1%	114,883	-11.4%
2010	4,200,427	0.3%	82,021	-14.6%	110,047	-4.2%
2011	4,215,500	0.4%	79,283	-3.3%	110,444	0.4%
2012	4,251,802	0.9%	80,580	1.6%	116,448	5.4%

Table II-2
2007-2012 Base Case Emissions in the PM-10 Nonattainment Area

	tons/year					
Source Category	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
POINT	158.53	149.84	132.76	127.18	127.69	134.59
AREA						
Fuel combustion	1,275.94	1,300.65	1,307.15	1,311.07	1,316.32	1,328.17
Commercial cooking	974.17	993.04	998.01	1,001.00	1,005.00	1,014.05
Construction (includes windblown dust)	16,671.97	13,811.01	9,691.77	8,359.38	8,102.20	8,222.78
Tilling, harvesting and cotton ginning	936.27	893.20	893.20	893.20	893.20	893.20
Travel on unpaved farm roads	768.69	731.03	731.03	731.03	731.03	731.03
Livestock	260.95	260.95	260.95	260.95	260.95	260.95
Travel on unpaved parking lots	2,375.50	2,421.51	2,433.62	2,440.92	2,450.68	2,472.74
Offroad recreational vehicles	2,138.74	2,180.16	2,191.06	2,197.63	2,206.42	2,226.28
Leaf blowers	877.98	894.98	899.45	902.15	905.76	913.91
Windblown agriculture	447.85	447.85	447.85	447.85	447.85	447.85
Other windblown sources	5,430.01	5,430.01	5,430.01	5,430.01	5,430.01	5,430.01
Fires	496.71	496.71	496.71	496.71	496.71	496.71
Mining/quarrying (includes windblown dust)	752.18	721.38	660.84	641.08	642.89	667.32
Travel on industrial paved/unpaved roads	770.71	728.46	645.41	618.31	620.78	654.30
Other industrial sources	1,032.62	976.01	864.74	828.43	831.74	876.65
NONROAD						
Aircraft	193.54	183.80	151.52	141.54	143.44	145.50
Airport ground support equipment	28.64	26.99	23.32	20.94	20.11	19.90
Locomotives	34.16	34.16	34.16	34.16	34.16	34.16
Other nonroad equipment	1,709.76	1,682.91	1,660.64	1,640.88	1,595.22	1,513.25
ONROAD						
Exhaust	2,943.36	2,835.65	2,647.20	2,371.05	1,843.23	1,407.06
Tire wear	245.80	255.82	256.50	257.23	257.94	261.41
Brake wear	727.66	758.17	767.49	770.58	772.79	787.25
Paved roads	7,749.01	8,154.57	8,213.92	8,289.47	8,322.90	8,421.72
Unpaved roads and alleys	10,217.66	10,312.22	10,284.04	10,284.04	10,284.04	10,312.22
TOTALS	**59,218.38**	**56,681.08**	**52,123.36**	**50,496.80**	**49,743.06**	**49,673.01**

Fuel Combustion

This category includes residential, commercial and industrial gas, wood and oil burning. The 2008 PEI estimate of 1,300.65 tons from fuel combustion is back-cast to 2007 and projected to 2009-2012 using the population growth factors shown in Table II-1.

Commercial Cooking

This category includes restaurant cooking with five types of equipment: chain-driven charbroilers, under-fired charbroilers, deep-fat fryers, flat griddles and clamshell griddles. The 2008 PEI estimate of 993.04 tons for commercial cooking is back-cast to 2007 and projected to 2009-2012 using the population growth factors in Table II-1.

Construction

The 2008 PEI estimates of annual PM-10 emissions from construction are 1,692.38 tons for residential construction, 4,057.29 tons for commercial construction, 2,051.78 tons for road construction, and 162.41 tons for other land clearing. The other land clearing category includes site preparation, weed control and trenching.

Rule Effectiveness (RE) rates for earth-moving activities permitted under Maricopa County Rule 310 have been calculated by the Maricopa County Air Quality Department using actual earthmoving inspection data for the years 2007-2010. The methodology used in calculating the RE rates was developed in consultation with the Environmental Protection Agency. The RE rate for Rule 310 in 2007 was 76 percent and in 2008, 90 percent. This major increase in rule effectiveness is attributable to strengthened and increased enforcement of Rule 310.

The 2008 PEI estimate of 7,963.86 tons for construction emissions was adjusted to account for the decrease in RE from 90 percent to 76 percent, resulting in non-windblown construction emissions of 13,245.15 tons. These 2008 emissions were back-cast to 2007 and projected to 2009-2012 using the construction employment growth factors in Table II-1. The addition of the windblown construction emissions of 565.86 tons, discussed in the Windblown Dust section below, produced the total 2008 base case construction emissions of 13,811.01 tons shown in Table II-2.

Agriculture

The 2008 PEI estimates of PM-10 emissions from agriculture include tilling and harvesting (888.34 tons), travel on unpaved farm roads (731.03 tons), cotton ginning (4.86 tons), and livestock (260.95 tons). The factor to back-cast agricultural activity from 2008 to 2007 was derived from the trends in Arizona Agricultural Statistics Bulletins for Maricopa County between 2000 and 2004. (Complete data on crop acreage in Maricopa County was not available after 2004). Based on these trends, tilling and harvesting acreage was expected to decline by 4.6 percent between 2007 and 2008. This 4.6 percent decline between 2007

and 2008 translates into a 4.8 percent increase between 2008 and 2007. The agricultural emissions for 2009-2012 are held constant at 2008 PEI levels, due to reductions in agricultural product demand associated with the economic recession that began in 2008.

Travel on Unpaved Parking Lots

The 2008 PEI estimate of 2,365.07 tons of PM-10 emissions generated by vehicles traveling on unpaved parking lots was back-cast to 2007 and projected to 2009-2012 based on the population growth factors in Table II-1.

Off-Road Recreational Vehicles

The PEI estimate of 2,014.17 tons of PM-10 generated off-road recreational vehicles was back-cast to 2007 and projected to 2009-2012 based on the population growth factors in Table II-1.

Leaf Blower Fugitive Dust

The PEI estimate of 894.98 tons of PM-10 produced by leaf blowers was back-cast to 2007 and projected to 2009-2012 based on the population growth factors in Table II-1.

Windblown Dust

The 2008 PEI estimate for windblown dust from all sources is 4,814.80 tons. This includes windblown dust from construction (391.00 tons), mining/quarrying (131.57 tons), agriculture (354.24 tons) and vacant land and other sources (3,937.99 tons) including open space, landfills and test tracks. Details concerning the methodology and data used to estimate the 2008 windblown dust emissions are provided in Appendix 4 of the 2008 PEI.

To obtain base case emissions for windblown sources, the rule effectiveness (RE) rates for each category in 2008 have been adjusted to the appropriate 2007 RE. Between 2007 and 2008, RE rates for construction increased from 76 to 90 percent; mining/quarrying increased from 40 to 65 percent; and vacant land increased from 85 to 95 percent. Adjusting the 2008 PEI emissions to these 2007 RE rates results in 565.86 tons for windblown construction, 190.36 tons for mining/quarrying, 5,430.01 tons for vacant land and other sources, and 447.85 tons for agriculture. In the case of windblown agricultural, the non-cropland portions of windblown agriculture emissions are assumed to have the same RE rates as vacant lands in the 2008 PEI and are thus affected by changes in RE rates from 2007 to 2008. The cropland portion of windblown agricultural emissions are calculated using a separate methodology in the 2008 PEI and are held constant between 2008 and 2007.

The 2007 base case emissions for all windblown categories are held constant from 2008 through 2012. Windblown construction and mining/quarrying emissions are added to the corresponding non-windblown categories in Table II-1, while windblown agriculture and

other windblown sources are shown as separate categories.

Fires

This category include wildfires, prescribed fires, structure fires and vehicle fires. The 2008 PEI estimate for this category is 469.03 tons. This 2008 estimate is held constant in 2007 and 2009-2012 because the biggest contributor to this category is wildfires (90 percent), which are not possible to predict or control.

Non-Metallic Mineral Processing and Mining/Quarrying

Non-metallic mineral processing includes concrete batch plants, ceramic clay and tile manufacturing, brick manufacturing and gypsum mining. The Mining/Quarrying category includes sand and gravel operations and other types of mining. The 2008 PEI estimates are 187.73 tons for non-metallic mineral processing and 156.60 tons for mining/quarrying.

Rule Effectiveness (RE) rates for non-metallic mineral processing and sand and gravel operations permitted under Maricopa County Rule 316 have been calculated by the Maricopa County Air Quality Department using actual inspection data for the years 2007-2010. The methodology used in calculating the RE rates was developed in consultation with the Environmental Protection Agency. The RE rate for Rule 316 was 40 percent in 2007 and 65 percent in 2008. This major increase in rule effectiveness is attributable to strengthened enforcement and increased compliance with Rule 316.

The 2008 PEI emissions for non-metallic mineral processing and mining/quarrying were adjusted to account for the decrease in RE from 65 percent to 40 percent, resulting in total non-windblown emissions of 531.01 tons. These 2008 emissions were back-cast to 2007 and projected to 2009-2012 based on the manufacturing employment growth factors in Table II-1. The addition of the windblown mining/quarrying emissions of 190.36 tons, discussed in the Windblown Dust section above, produced base case non-metallic mineral processing and mining/quarrying emissions of 721.38 tons. These two categories are combined and denoted as “mining/quarrying” in Table II-2.

Travel on Industrial Roads

Travel on Industrial Roads includes emissions from motor vehicles traveling on paved and unpaved roads within the boundaries of a facility that is permitted by Maricopa County. The 2008 PEI emissions for this category are 472.36 tons. The 2008 PEI estimate was adjusted to account for the decrease in rule effectiveness for Rule 316, as discussed in the previous section. Decreasing the RE from 65 percent to 40 percent produced 2008 base case emissions for travel on industrial roads of 728.46 tons. The base case 2008 emissions were back-cast to 2007 and projected to 2009-2012 based on the manufacturing employment growth factors in Table II-1.

Other Industrial Sources

This category includes manufacturing and other industrial activities that do not individually produce enough emissions to qualify as point sources and are not addressed in any of the other Area Source categories above. The 2008 PEI estimate of PM-10 emitted by these other industrial sources is 976.01 tons. The other industrial source emissions were back-cast to 2007 and projected to 2009-2012 using the manufacturing employment growth factors in Table II-1.

NONROAD MOBILE SOURCES

Nonroad mobile sources are those that move or are movable within a 12-month period and are not licensed or certified as highway vehicles. This category includes exhaust emissions from equipment used in agriculture, construction, mining, landscaping, commerce, industry and recreation. The category also includes aircraft, airport equipment and locomotives. The growth factors vary by equipment type.

The 2008 PEI estimate of PM-10 emissions from all nonroad mobile sources is 1,927.89 tons per year for the PM-10 nonattainment area. The major source categories and emission estimates for 2007-2012 are discussed in the sections that follow.

Aircraft and Airport Ground Support Equipment

The 2008 PEI estimate of PM-10 emissions from aircraft is 183.80 tons, while airport ground support equipment (GSE) emissions, which include emissions from auxiliary power units (APUs), are 26.99 tons. These 2008 estimates were back-cast to 2007 and grown to 2009-2012 based on the growth factors shown in Table II-3. The aircraft growth factors were derived from estimates of landings and takeoffs (LTO) obtained from the Federal Aviation Administration (FAA). The growth factors for GSE were estimated using the FAA Emissions Dispersion Modeling System (EDMS), version 5.1.3.

Locomotive Emissions

The 2008 PEI PM-10 emissions estimate of 34.16 tons for locomotives was derived from surveys of the three railroad companies that have operations in Maricopa County (Burlington Northern Santa Fe, Union Pacific and Amtrak). The 2008 locomotive emissions are held constant in 2007-2012.

Other Nonroad Mobile Source Equipment

The 2008 PEI estimate for other nonroad sources besides aircraft, airport GSE and locomotives is 1,682.94 tons. MAG ran the EPA NONROAD2008 model to estimate 2007-2012 PM-10 emissions by source type using the same inputs assumed in the 2008 PEI (Appendix A, Exhibit 1). The 2007-2012 emissions by source type for other nonroad mobile source equipment and the corresponding growth factors are shown in Table II-4. The

Table II-3
Growth Factors for Aircraft and Ground Support Equipment

PM-10 Annual Emissions from Aviation Sources in PM-10 NAA (metric tons)							Growth Factors Relative to 2008					
Source Type	**2007 [1]**	**2008**	**2009 [2]**	**2010**	**2011**	**2012**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Aircraft [3]	254.80	241.98	199.49	186.34	188.84	191.56	1.053	1.000	0.824	0.770	0.780	0.792
GSE+APUs[4]	30.74	28.97	25.03	22.48	21.59	21.36	1.061	1.000	0.864	0.776	0.745	0.737
Total	285.54	270.95	224.52	208.82	210.43	212.92	1.054	1.000	0.829	0.771	0.777	0.786

[1]Landings and takeoffs (LTOs) for the years 2007, 2008, and 2009 are extracted from the FAA website (http://aspm.faa.gov/opsnet/sys/Airport.asp); LTOs for years 2010-2013 are extracted from the FAA Terminal Area Forecast (TAF) (http://aspm.faa.gov/main/taf.asp).
[2]LTOs for military aircraft in all airports, except Luke Air Force Base, are assumed to remain constant from 2009 -2012.
[3]PM-10 emissions from aircrafts are calculated by using emission factors from EPA's guidance, *Documentation for the NONROAD Model Criteria Air Pollutant Component of the National Emissions Inventory (NEI) for Base Years 1970–2001.* Report prepared by E.H. Pechan & Associates for U.S. EPA Office of Air Quality Planning and Standards, Sept. 2003.
[4]PM-10 emissions from Ground Support Equipment (GSE) and Auxiliary Power Units (APUs) are calculated using EDMS 5.1.3.

Table II-4
Growth Factors for Other Nonroad Mobile Sources

NONROAD2008 Annual PM-10 Emissions by Source Type for Maricopa County							Growth Factors Relative to 2008					
Source Type	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Agricultural Equipment	35.86	34.27	32.74	31.25	29.44	27.28	1.047	1.000	0.955	0.912	0.859	0.796
Commercial Equipment	118.35	117.97	117.32	116.26	114.80	111.38	1.003	1.000	0.995	0.985	0.973	0.944
Construction and Mining Equipment	1,286.45	1,260.98	1,240.09	1,222.25	1,178.71	1,105.11	1.020	1.000	0.983	0.969	0.935	0.876
Industrial Equipment	105.13	102.60	100.81	99.24	97.06	90.98	1.025	1.000	0.983	0.967	0.946	0.887
Lawn and Garden Equipment	179.69	182.19	184.91	187.72	190.75	192.37	0.986	1.000	1.015	1.030	1.047	1.056
Logging Equipment	0.00	0.00	0.00	0.00	0.00	0.00	1.000	1.000	1.000	1.000	1.000	1.000
Pleasure Craft	9.79	9.19	8.61	7.81	7.06	6.37	1.066	1.000	0.937	0.850	0.768	0.693
Railroad Equipment	1.15	1.13	1.10	1.07	1.03	0.99	1.023	1.000	0.976	0.950	0.917	0.877
Recreational Equipment	45.44	45.58	45.12	44.49	43.65	42.59	0.997	1.000	0.990	0.976	0.958	0.934
Total (tons/year)	**1,781.87**	**1,753.90**	**1,730.69**	**1,710.09**	**1,662.50**	**1,577.08**	**1.016**	**1.000**	**0.987**	**0.975**	**0.948**	**0.899**

growth factors for total other nonroad mobile source equipment shown at the bottom of the table were used to back-cast 2008 emissions to 2007 and project 2008 emissions to 2009-2012.

ONROAD MOBILE SOURCES

There are three categories of PM-10 emissions from onroad mobile sources: exhaust, tire wear and brake wear; reentrained dust from paved roads; and travel on unpaved roads and alleys. Each of these categories is discussed in a separate section below.

Exhaust, Tire Wear and Brake Wear Emissions

The 2008 PEI estimate of PM-10 emissions from exhaust, tire wear and brake wear is 3,144.17 tons. The 2008 PEI emissions were estimated by MAG using the new EPA MOVES2010a model. The MOVES input assumptions are detailed in Chapter Five of the 2008 PEI (Appendix A, Exhibit 1).

MAG re-estimated onroad mobile source emissions using the MOVES2010a model and the latest planning assumptions available in August 2011. The latest planning assumptions included July 1, 2011 vehicle registration data provided by the Arizona Department of Transportation. Due to the recession, the 2011 vehicle registrations contain a larger proportion of older vehicles than the 2010 vehicle registrations used in estimating mobile source emissions for the 2008 PEI. In addition, the vehicle miles of travel (VMT) and link-level speeds were based on the latest MAG transportation models, which incorporate a new truck model and updated volume/delay functions. The traffic assignments produced by the MAG transportation models in August 2011 had also been validated against the most recent (2008-2010) traffic counts. Due to these changes in vehicle registrations and transportation modeling and the use of updated factors to convert from weekday to annual average daily traffic, the exhaust, tire wear and brake wear emissions estimated with MOVES2010a for the 2008 base case PM-10 emissions are 3,849.64 tons, which is 22.4 percent higher than the 2008 PEI.

The emission rates produced by MOVES for 2007-2012 were applied to VMT estimates for the PM-10 nonattainment area. For 2008, the MOVES emission rates were applied to VMTs produced by the 2008 MAG traffic assignment. The 2007 VMT was derived from the 2008 VMT, using historical, pre-recession trends in VMT growth produced by MAG traffic assignments. The traffic counts MAG has conducted since 2008 indicate that traffic volumes have not increased at their historical rate. Therefore, for 2009-2012, the MOVES emission rates were applied to VMT estimates based on the population growth factors in Table II-1, rather than VMTs output by the MAG traffic assignments. The population projections shown in Table II-1 take into account the 2010 U.S. Census, as well as the economic downturn after 2007. In contrast, the MAG traffic assignments utilize the official population projections adopted by the MAG Regional Council in May 2007. The adopted projections, which are based on the 2005 Special Census for Maricopa County, significantly overstate the socioeconomic growth in the area since 2008. MAG is working on new

population and employment projections by traffic analysis zone that are consistent with the 2010 U.S. Census, but these will not be available to use as input to the transportation models until early 2013. In the meantime, the VMT estimates during the recession years of 2009-2012 are based on the best available population projections for the area shown in Table II-1. The base case exhaust, tire wear and brake wear emissions for 2007-2012 and the growth factors, relative to 2008, are shown in Table II-5.

Reentrained Dust from Paved Roads

The 2008 PEI estimate of PM-10 emissions from dust reentrained by vehicles traveling on paved roads is 6,694.22 tons. The estimate is based on the new AP-42 equation for paved roads that was revised by EPA in January 2011. The PEI emissions include a reduction of 1,172.8 tons for 97 PM-10 certified street sweepers purchased by December 31, 2006 with Congestion Mitigation and Air Quality Improvement (CMAQ) funds. The PEI estimate also includes reductions of 996.0 tons for five measures in the MAG 2007 Five Percent Plan that were implemented in 2008.

The 2008 base case PM-10 emissions for the MAG 2012 Five Percent Plan were developed using the assumptions in the 2008 PEI, with one exception; the average vehicle weights for freeways and arterials have been re-estimated using July 1, 2011 vehicle registrations and the EPA default vehicle weight of 3.18 tons, while the 2008 PEI used July 1, 2010 vehicle registrations and an average vehicle weight of 3 tons. The new vehicle weights for freeways (3.91 tons) and arterials (2.73 tons) were derived from July 1, 2011 vehicle registrations and a 2008 traffic assignment. When weighted by VMT, these freeway and arterial weights average 3.18 tons.

Other AP-42 input assumptions used in calculating paved road emissions are consistent with the 2008 PEI. The silt loadings in grams per square meter are 0.02 for freeways, 0.067 for high traffic arterials ($\geq$10,000 average daily traffic (ADT)), and 0.23 for low traffic arterials (<10,000 ADT). The number of “wet” days per year is 39, while the annual number of days in the leap year of 2008 was 366.

Applying these inputs to the AP-42 equation produces paved road emission rates of 0.11 grams per VMT for freeways, 0.23 grams per VMT for high traffic arterials, and 0.71 grams per VMT for low traffic arterials. These emission rates are multiplied by the 2008 annual average daily VMTs used in the PEI, which are 30,835,329 for freeways, 42,498,543 for high traffic arterials, and 13,819,127 for low traffic arterials. The resultant uncontrolled paved road emissions for 2008 are 9,270.34 tons, which is five percent higher than the 2008 PEI estimate without benefits for street sweepers and the five other measures in the 2007 Plan.

The uncontrolled paved road emissions do not include credit for PM-10 certified street sweepers that were purchased in 2001 through 2006. During this six year period, MAG member agencies purchased 94 PM-10 certified street sweepers to replace conventional (non-certified) sweepers, increase the frequency of sweeping, and expand the area swept

Table II-5
2007-2012 PM-10 Emissions from Exhaust, Tire Wear and Brake Wear

	PM-10 Emissions (tons/year)						Growth Factors Relative to 2008					
	2007	2008	2009	2010	2011	2012	2007	2008	2009	2010	2011	2012
Exhaust	2,943.36	2,835.65	2,647.20	2,371.05	1,843.23	1,407.06	1.038	1.000	0.934	0.836	0.650	0.496
Tire Wear	245.80	255.82	256.50	257.23	257.94	261.41	0.961	1.000	1.003	1.005	1.008	1.022
Brake Wear	727.66	758.17	767.49	770.58	772.79	787.25	0.960	1.000	1.012	1.016	1.019	1.038
Total	3,916.81	3,849.64	3,671.19	3,398.86	2,873.96	2,455.72	1.017	1.000	0.954	0.883	0.747	0.638

in the PM-10 nonattainment area. The agencies purchased the sweepers with Congestion Mitigation and Air Quality Improvement (CMAQ) funds and paid a minimum local match of 5.7 percent of the cost of each sweeper. As part of the funding request, the agencies provided MAG with data on the lane miles to be swept, the traffic volume per lane swept and the sweeping cycle length. These data have been used to quantify the PM-10 emission reductions attributable to the PM-10 certified sweepers purchased with CMAQ funds in 2001-2006.

There were 94 PM-10 certified sweepers purchased with CMAQ funds between January 1, 2001 and December 31, 2006. An ADOT street sweeper inventory dated April 2, 2010 indicated that only 59 of these sweepers were still in service as of December 31, 2009. To be conservative in estimating the emissions reduced by PM-10 certified sweepers, the benefits of the sweepers that were not in service as of December 31, 2009 have been removed. In addition, no credit is taken for the one sweeper purchased to replace an older PM-10 certified sweeper during this period.

The equations used to quantify the benefit of the PM-10 certified sweepers are documented in the CMAQ Methodologies (MAG, 2011). The average unswept emission factors used in calculating the sweeper benefits for non-freeways is 0.35 grams per vehicle mile of travel (VMT). This represents a 2008 VMT-weighted average of 0.71 grams per VMT for low traffic arterials and 0.23 grams per VMT for high traffic arterials. Table II-6 shows the emission rates for sweeping freeways, non-freeways and streets in the Salt River Area with PM-10 certified and conventional sweepers for sweeping cycle lengths of one to thirty days.

In converting from daily to annual reductions, it was assumed that a new PM-10 certified unit would sweep 95 percent of the days during the first year, with the remainder of the time devoted to routine maintenance and holiday downtime. It was also assumed that the rate of utilization (and attendant emission reductions) would decline according to the usage factors shown in Table II-7 due to the need for increased maintenance as the equipment ages. The usage factors are based on maintenance data provided by agencies requesting CMAQ funding for a new PM-10 certified sweeper to replace an older PM-10 certified sweeper.

The total PM-10 emissions reduction attributable to PM-10 certified street sweepers purchased in 2001 through 2006 and still in service as of December 31, 2009 is 1,115.77 tons in 2008. The uncontrolled paved road emissions estimate of 9,270.34 tons is reduced by the benefit of the CMAQ-funded street sweepers, resulting in 2008 base case paved road emissions of 8,154.57 tons.

For 2007, 2009, and 2010, the reductions due to the sweepers purchased in 2001-2006 vary slightly, because the aging of the sweepers and increased downtime reduces the benefits over time. As a result, the reduction in 2007 is slightly higher than 2008: 1,153.93 tons, while the reductions in 2009 and 2010 are slightly lower: 1,077.32 tons and 1,029.63 tons, respectively. The 2008 uncontrolled base case paved road emissions are back-cast to 2007 based on the vehicle miles of travel (VMT) estimated by the MAG transportation

Table II-6
PM-10 Emission Rates for PM-10 Certified and Conventional Sweepers

Cycle Length (days)	Composite Emission Rates (g/VMT) - PM-10 Certified Sweeper			Composite Emission Rates (g/VMT) - Conventional Sweeper		
	Freeway	Non-Freeway	Salt River	Freeway	Non-Freeway	Salt River
1	0.031	0.098	0.364	0.065	0.208	0.778
2	0.037	0.118	0.441	0.070	0.223	0.832
3	0.043	0.137	0.510	0.074	0.237	0.884
4	0.048	0.154	0.574	0.079	0.250	0.934
5	0.053	0.170	0.634	0.083	0.263	0.983
6	0.058	0.185	0.692	0.087	0.276	1.029
7	0.063	0.200	0.746	0.090	0.286	1.069
8	0.067	0.214	0.799	0.092	0.294	1.099
9	0.072	0.228	0.850	0.094	0.300	1.122
10	0.075	0.240	0.895	0.096	0.305	1.141
11	0.079	0.250	0.933	0.097	0.309	1.156
12	0.081	0.258	0.964	0.098	0.313	1.168
13	0.083	0.265	0.990	0.099	0.316	1.179
14	0.085	0.271	1.013	0.100	0.318	1.188
15	0.087	0.277	1.033	0.101	0.320	1.196
16	0.088	0.281	1.050	0.101	0.322	1.203
17	0.090	0.285	1.065	0.102	0.324	1.209
18	0.091	0.289	1.078	0.102	0.325	1.215
19	0.092	0.292	1.091	0.103	0.327	1.220
20	0.093	0.295	1.101	0.103	0.328	1.224
21	0.094	0.298	1.111	0.103	0.329	1.228
22	0.094	0.300	1.120	0.104	0.330	1.231
23	0.095	0.302	1.128	0.104	0.331	1.235
24	0.096	0.304	1.136	0.104	0.331	1.238
25	0.096	0.306	1.143	0.104	0.332	1.241
26	0.097	0.308	1.149	0.105	0.333	1.243
27	0.097	0.309	1.155	0.105	0.333	1.245
28	0.098	0.311	1.160	0.105	0.334	1.248
29	0.098	0.312	1.165	0.105	0.335	1.250
30	0.098	0.313	1.170	0.105	0.335	1.252

Table II-7
Usage Factors for PM-10 Certified Street Sweepers

Usage Factor Table	
Year of Use	**Usage Factor**
1st	0.950
2nd	0.919
3rd	0.888
4th	0.857
5th	0.826
6th	0.795
7th	0.764
8th	0.734
9th	0.703
10th+	0

models for 2008 versus 2007. The reduction for sweepers purchased in 2001-2006 (1,153.93 tons) is then subtracted to derive 2007 base case paved road emissions. To account for the economic recession, the 2008 uncontrolled base case paved road emissions are projected to 2009 and 2010 using the Marshall Vest population projections in Table II-1. The reductions for sweepers purchased in 2001-2006 (1,077.32 tons in 2009 and 1,029.63 tons in 2010) are then applied to estimate 2009 and 2010 base case paved road emissions. The 2010 base case paved road emissions with street sweeper reductions are projected to 2011-2012 based on the population growth factors in Table II-1.

Travel on Unpaved Roads and Alleys

The 2008 PEI estimate of PM-10 emissions from vehicles traveling on unpaved roads and alleys is 11,710.70 tons. This estimate is based on the EPA AP-42 equation for unpaved roads (assuming a speed of 25 mph) and unpaved alleys (assuming a speed of 10 mph). The PEI estimate included a reduction of 2,065.4 tons for four measures in the MAG 2007 Five Percent Plan that were implemented in 2008. Assumptions for calculating base case unpaved road and alley emissions for the MAG 2012 Five Percent Plan are consistent with the 2008 PEI, with the exception of the average daily traffic (ADT) on unpaved alleys and the ADT, speeds, and miles of private unpaved roads.

MAG conducted traffic counts on a statistically significant sample of unpaved alleys and private unpaved roads in the PM-10 nonattainment area in February 2011. The survey indicated that the ADT on unpaved alleys should be 4, rather than 10, and the ADT on private unpaved roads should be 26, rather than 28.

In August-September 2011, MAG conducted a private unpaved road inventory. The MAG contractor drove most of the private unpaved roads identified in the MAG 2009 Unpaved Road Inventory (URI) and collected data on the location, length, condition and function of each road. The 2009 URI estimate of 1,270.6 miles of private unpaved roads was based on a GIS analysis of aerial photographs, rather than actual field data. The 2011 field inventory concluded that there are 927.3 miles of private unpaved roads, which is 343.3 miles lower than estimated by the 2009 URI. The principal reason for this difference was the mis-classification of driveways, trails, utility and canal roads, barricaded routes, and inaccessible rights-of-way as private unpaved roads. The contractor also reported that the maximum speed that could be driven on the private unpaved roads was 15 to 20 miles per hour, rather than the 25 miles per hour assumed in the 2008 PEI. Unlike public unpaved roads, which typically carry higher traffic volumes and are better-maintained, private unpaved roads have rough surfaces and poor alignments, which reduces vehicle speeds. To be conservative, the speed used in quantifying the private unpaved road emissions for the MAG 2012 Five Percent Plan was assumed to be 20 mph, which is the higher end of the range.

Other inputs to the AP-42 equation for paved roads are consistent with the 2008 PEI. These include a silt content of 11.9 percent, a soil moisture content of 0.5 percent, and average speeds of 25 mph on public unpaved roads and 10 mph on unpaved alleys. The average

number of “wet” days in 2008 was 36, with the annual number of days in 2008, a leap year, of 366. The resultant emission factors for 2008 are 660.16 grams per VMT for public unpaved roads, 590.45 grams per VMT for private unpaved roads, and 417.45 grams per VMT for unpaved alleys. These factors are applied to annual average daily 2008 VMT estimates of 19,956 for public unpaved roads, 22,255 for private unpaved roads, and 2,600 for unpaved alleys in the PM-10 nonattainment area. Converting to annual emissions results in total 2008 base case emissions from public unpaved roads, private unpaved roads and unpaved alleys of10,312.22 tons.

Base case public unpaved road and alley emissions are held constant between 2008 and 2007. The 2008 private unpaved road emissions are back-cast to 2007 assuming a growth rate of 1.46 percent between 2007 and 2008. This growth rate is based on a longitudinal analysis of historical lot split data conducted by MAG that showed an average annual increase in private unpaved road mileage, prior to the recession, of 1.46 percent. Due to the economic downturn in 2008, base case emissions for public and private unpaved roads and alleys are held constant in 2008 through 2012.

SUMMARY OF BASE CASE EMISSIONS

Table II-2 summarizes the 2007-2012 base case PM-10 emissions by source category that were developed using the methods and assumptions described in this chapter. The base case emissions include no reduction credit for measures quantified in the MAG 2012 Five Percent Plan. Credit for rule effectiveness rates in 2007 has been applied to the base case emissions for construction, other windblown sources, mining/quarrying, and travel on industrial roads. In addition, reduction credit for PM-10 certified street sweepers purchased with CMAQ funds in 2001 through 2006 and still in service on December 31, 2009 was applied to the base case paved road emissions. The benefits quantified for increases in rule effectiveness and contingency projects in the MAG 2012 Five Percent Plan are discussed in the next two chapters of the TSD.

The total 2012 base case emissions are 49,673.01 tons, which is 9,545.37 tons (16.1 percent) lower than the 2007 emissions. Most of this decrease is due to reductions in construction activity between 2007 and 2012. The sources contributing the largest share of base case PM-10 emissions in 2012 are unpaved roads and alleys, paved roads, construction and other windblown sources (vacant lots).

The next chapter discusses the methods and assumptions used to quantify the increases in rule effectiveness for Maricopa County Rules 310, 310.01 and 316. These increases are sufficient to demonstrate annual five percent reductions in PM-10 emissions between the base year of 2007 and the attainment year of 2012. Credit for the increases in rule effectiveness is applied to the base case emissions in Table II-2 to meet the annual five percent reduction requirement of Clean Air Act Section 189(d).

REFERENCES

MAG, 2011. *Methodologies for Evaluating Congestion Mitigation and Air Quality Improvement Projects*. Maricopa Association of Governments. September 30, 2011.

III. EVALUATION OF RULE EFFECTIVENESS

This chapter describes the increases in rule effectiveness that have been quantified to meet the annual five percent reduction requirement in Section 189(d) of the Clean Air Act. The PM-10 emission reductions due to increased rule effectiveness are also used in demonstrating attainment, as discussed in Chapter V of the TSD.

Increases in rule effectiveness have been achieved due to strengthened enforcement and increased compliance with Maricopa County Rules 310, 310.01 and 316 in 2008-2010. Rule effectiveness rates are held constant from 2010 forward except for a 1% increase in 2012 on Rule 310.01 windblown dust sources due to the new Dust Action General Permit measure.

In 2009 EPA approved Rule 316, which controls emissions from permitted sources of non-metallic mineral processing and mining and quarrying operations, as part of the State Implementation Plan for the Maricopa County PM-10 Nonattainment Area (SIP) (EPA, 2009). In 2010 EPA approved Rule 310, which controls emissions from permitted earthmoving sources, and Rule 310.01, which controls sources such as vacant lots and public unpaved roads, as part of the SIP (EPA, 2010).

The benefit of increased compliance with these rules has been quantified, using actual inspection data and a methodology developed by the Maricopa County Air Quality Department, in consultation with EPA. The methodology for quantifying rule effectiveness (RE) is described in the 2008 PEI (Appendix A, Exhibit 1). The RE rates calculated for 2007 through 2010 using this EPA-approved methodology are shown in Table III-1.

Table III-1 also includes base case emissions (with 2007 RE rates), controlled emissions (with increased RE rates), and emission reductions (obtained by subtracting controlled emissions from base case emissions) for each subcategory. The derivation of the base case emissions is discussed in Chapter II of the TSD. For all years, the base case emissions assume the 2007 RE rates of 76 percent for Rule 310, 85 percent for Rule 310.01, and 40 percent for Rule 316, while the controlled emissions incorporate the actual RE rate calculated for each year (2008-2010). The RE rates used in calculating controlled emissions are held constant after 2010.

As shown in Table III-1, the rule effectiveness (RE) rates increased dramatically between 2007 and 2008. Since 2008, the RE rates have continued to increase on an annual basis. Between 2007 and 2010, Rule 310 RE increased from 76 to 94 percent; Rule 310.01 RE increased from 85 to 96 percent; and Rule 316 RE increased from 40 to 73 percent.

In addition to the increases in rule effectiveness discussed above, the 2012 Plan takes credit for one new measure, the Dust Action General Permit, which were passed by the Arizona Legislature in April 2011. This new measure is expected to increase rule effectiveness for Rule 310.01 by one percent during high wind hours, resulting in the 2012 RE rate of 97 percent for windblown vacant land, open space, landfills and test tracks, as

Table III-1
Impact of Increased Rule Effectiveness on 2008-2012 PM-10 Emissions

Categories Affected by Rule Effectiveness	Base Case Emissions (tons/year) 2007	2008	2009	2010	2011	2012	Rule Effectiveness Rates 2007	2008	2009	2010 -2011	2012
Residential Construction	3,423	2,815	1,939	1,656	1,602	1,627	76%	90%	92%	94%	94%
Commercial Construction	8,205	6,748	4,649	3,971	3,839	3,901	76%	90%	92%	94%	94%
Road Construction	4,150	3,412	2,351	2,008	1,942	1,973	76%	90%	92%	94%	94%
All Other Earthmoving	328	270	186	159	154	156	76%	90%	92%	94%	94%
Non-metallic mineral mining	306	290	257	246	247	260	40%	65%	69%	73%	73%
Mining & Quarrying	256	242	214	205	206	217	40%	65%	69%	73%	73%
Industrial paved/unpaved road travel	771	728	645	618	621	654	40%	65%	69%	73%	73%
Windblown Agriculture	448	448	448	448	448	448	n/a	n/a	n/a	n/a	n/a
Windblown Construction	566	566	566	566	566	566	76%	90%	92%	94%	94%
Windblown Vacant, Open, Landfill, Test Tracks	5,430	5,430	5,430	5,430	5,430	5,430	85%	95%	96%	96%	97%
Windblown Sand & Gravel, Mining	190	190	190	190	190	190	40%	65%	69%	73%	73%
TOTALS:	24,073	21,139	16,876	15,497	15,244	15,422					

Categories Affected by Rule Effectivenss	Controlled Emissions (tons/year) 2007	2008	2009	2010	2011	2012	Benefits from RE Increases (tons/year) 2008	2009	2010	2011	2012
Residential Construction	3,423	1,692	1,056	807	780	793	1,122	884	849	821	834
Commercial Construction	8,205	4,057	2,531	1,935	1,871	1,901	2,691	2,119	2,036	1,968	2,000
Road Construction	4,150	2,052	1,280	979	946	961	1,361	1,071	1,029	995	1,011
All Other Earthmoving	328	162	101	77	75	76	108	85	81	79	80
Non-metallic mineral mining	306	188	152	132	132	139	102	105	114	114	121
Mining & Quarrying	256	157	127	110	110	116	85	87	95	96	101
Industrial paved/unpaved road travel	771	472	382	331	333	351	256	263	287	288	304
Windblown Agriculture	448	448	448	448	448	448	0	0	0	0	0
Windblown Construction	566	391	366	341	341	341	175	200	225	225	225
Windblown Vacant, Open, Landfill, Test Tracks	5,430	3,938	3,788	3,788	3,788	3,639	1,492	1,642	1,642	1,642	1,791
Windblown Sand & Gravel, Mining	190	132	123	113	113	113	58	68	77	77	77
TOTALS:	24,073	13,689	10,353	9,062	8,939	8,879	7,450	6,523	6,435	6,305	6,543

shown in Table III-1.

EPA allows an emission reduction to be taken for the new Dust Action General Permit, as an emerging measure (EPA, 2004). According to EPA guidance, emerging measures do not have the same high level of certainty as traditional measures for quantification purposes in a State Implementation Plan. The PM-10 emission reduction increment necessary to demonstrate attainment in 2012, (i.e., total 2012 base case emissions in Table II-2 of 49,673 tons minus total 2012 emissions with increased rule effectiveness in Table III-2 of 43,130 tons), is 6,543 tons. EPA allows up to six percent of this increment, in this case, a maximum of 393 tons, to be credited to emerging and voluntary measures in the SIP. The one percent increase in RE for Rule 310.01 during high wind hours will reduce PM-10 emissions by 149.27 tons in 2012. Since this reduction is less than 393 tons, benefit for this new measure may be used in meeting the annual five percent reduction requirement and demonstrating attainment in this Plan.

As required by EPA's emerging and voluntary measure guidance, Maricopa County has made a commitment to retrospectively assess the performance of the Dust Action General Permit. MCAQD will evaluate the effectiveness of Rules 310, 310.01 and 316 to ensure that this measure achieves at least a 149 ton reduction during calendar year 2012. The County's commitment and the method to be used in calculating rule effectiveness are described in Chapter Four and Appendix C, Exhibit 2.

As discussed above, increases in Rule Effectiveness (RE) for Rules 310, 310.01 and 316 have been quantified to meet the annual five percent reductions required in Section 189(d) of the Clean Air Act. The annual five percent reduction target was calculated by multiplying the total 2007 PM-10 emissions in Table II-2 (59,218.38 tons) by five percent, which results in 2,960.92 tons. To meet the 189(d) requirement, the 2008 emissions with increased rule effectiveness must be at least 2,961 tons less than the 2007 base case emissions. Each year after 2008 imposes yet another 2,961 ton reduction requirement. Thus, the cumulative reduction requirements (relative to 2007 base case emissions) are at least 5,922 tons in 2009, 8,883 tons in 2010, 11,844 tons in 2011, and 14,805 tons in 2012.

Table III-2 shows the impact of the increases in rule effectiveness on PM-10 emissions in 2008 through 2012. A comparison of the five percent reduction requirements with reductions actually achieved by increased rule effectiveness is provided at the bottom of the table. The actual reductions represent the difference between the total 2007 base case emissions in Table II-2 minus the total emissions with increased rule effectiveness in Table III-2 for 2008-2012. The total reduction in PM-10 emission between 2007 and 2012 with the increases in RE is 16,088.55 tons, which represents a 27.2 percent reduction in 2007 base case emissions.

Table III-3 confirms that the annual five percent reduction targets are met in 2008-2012 and there is a surplus margin of benefit in each year. The total surplus in 2012 is 1,284 tons. This surplus is needed to model attainment at all monitors in the PM-10 nonattainment area. The rollback modeling that demonstrates attainment with the

Table III-2
2008-2012 PM-10 Emissions with Increased Rule Effectiveness

Source Category	2008	2009	2010	2011	2012
	(tons/year)				
POINT	149.84	132.76	127.18	127.69	134.59
AREA					
Fuel combustion	1,300.65	1,307.15	1,311.07	1,316.32	1,328.17
Commercial cooking	993.04	998.01	1,001.00	1,005.00	1,014.05
Construction (includes windblown dust)	8,354.86	5,333.29	4,139.15	4,013.81	4,072.58
Tilling, harvesting and cotton ginning	893.20	893.20	893.20	893.20	893.20
Travel on unpaved farm roads	731.03	731.03	731.03	731.03	731.03
Livestock	260.95	260.95	260.95	260.95	260.95
Travel on unpaved parking lots	2,421.51	2,433.62	2,440.92	2,450.68	2,472.74
Offroad recreational vehicles	2,180.16	2,191.06	2,197.63	2,206.42	2,226.28
Leaf blowers	894.98	899.45	902.15	905.76	913.91
Windblown agriculture	447.85	447.85	447.85	447.85	447.85
Other windblown sources	3,937.57	3,788.33	3,788.33	3,788.33	3,639.06
Fires	496.71	496.71	496.71	496.71	496.71
Mining/quarrying (includes windblown dust)	476.33	401.27	354.88	355.85	368.94
Travel on industrial paved/unpaved roads	472.36	382.21	331.37	332.70	350.67
Other industrial sources	976.01	864.74	828.43	831.74	876.65
NONROAD					
Aircraft	183.80	151.52	141.54	143.44	145.50
Airport ground support equipment	26.99	23.32	20.94	20.11	19.90
Locomotives	34.16	34.16	34.16	34.16	34.16
Other nonroad equipment	1,682.91	1,660.64	1,640.88	1,595.22	1,513.25
ONROAD					
Exhaust	2,835.65	2,647.20	2,371.05	1,843.23	1,407.06
Tire wear	255.82	256.50	257.23	257.94	261.41
Brake wear	758.17	767.49	770.58	772.79	787.25
Paved roads	8,154.57	8,213.92	8,289.47	8,322.90	8,421.72
Unpaved roads and alleys	10,312.22	10,284.04	10,284.04	10,284.04	10,312.22
Totals	**49,231.34**	**45,600.42**	**44,061.75**	**43,437.87**	**43,129.84**
5% Reduction Targets (tons/year)	**2,961.00**	**5,922.00**	**8,883.00**	**11,844.00**	**14,805.00**
Actual Plan Reductions (tons/year)	**9,987.05**	**13,617.97**	**15,156.64**	**15,780.51**	**16,088.55**

Table III-3
PM-10 Emission Reductions and Five Percent Reduction Requirements

Year	5% Reduction Requirement (tons/year)	Total PM-10 Emission Reductions due to Increases in Rule Effectiveness (tons/year)	Excess Benefit = Total PM-10 Emission Reductions minus 5% Reduction Requirement (tons/year)	(%)
2008	2,961	9,987	7,026	237%
2009	5,922	13,618	7,696	130%
2010	8,883	15,157	6,274	71%
2011	11,844	15,781	3,937	33%
2012	14,805	16,089	1,284	9%

increased rule effectiveness quantified in this chapter is described in Chapter V.

The annual incremental reductions that demonstrate reasonable further progress (RFP) between 2007 and 2012 are graphed in Figure III-1. After 2007, the RFP line represents total emissions in the PM-10 nonattainment area after credit is applied for the increases in rule effectiveness quantified in this chapter. The RFP requirement is met by showing incremental emission reductions sufficient to maintain linear progress towards attainment. The annual emissions in Figure III-1 show a downward linear trend. The slope of the line becomes less steep after 2008, because most of the measures in the MAG 2007 Five Percent Plan that increased compliance with Rules 310, 310.01 and 316 were implemented in 2008. Figure III-1 demonstrates that RFP will be achieved between 2007 and the attainment date of 2012.

This chapter has quantified the increases in rule effectiveness between 2008 and 2012 in order to meet the five percent reduction and reasonable further progress requirements of the Clean Air Act. Chapter V shows how these increases in rule effectiveness are also sufficient to demonstrate attainment by 2012 through rollback modeling. The next chapter discusses the quantification of additional PM-10 emission reductions needed to meet the contingency requirements of the Clean Air Act.

Figure III-1
Demonstration of Reasonable Further Progress

REFERENCES

EPA, 2004. *Incorporating Emerging and Voluntary Measures in a State Implementation Plan.* EPA Office of Air Quality Standards. September 2004.

IV. EVALUATION OF CONTINGENCY PROJECTS

The increases in rule effectiveness due to measures in the MAG 2007 Five Percent Plan were quantified in Chapter III to demonstrate annual five percent reductions and reasonable further progress (RFP). The PM-10 emission reductions attributable to increased rule effectiveness are also used to model attainment, as discussed in Chapter V. This chapter discusses emission reductions above and beyond the increases in rule effectiveness that meet the contingency requirements of the Clean Air Act.

Section 172(c)(9) of the Clean Air Act requires that nonattainment plans contain contingency measures. Such measures are to be undertaken without further action by the State or the EPA Administrator if the area fails to make reasonable further progress or meet the standard by the attainment date.

The contingency measures must achieve emission reductions above and beyond those relied upon for progress (five percent reductions, milestones, and reasonable further progress) and the modeled attainment demonstration. The benefits of the contingency measures must not be required to show attainment and can not hasten attainment. Although there is no mandated emissions reduction level, EPA has recommended that contingency measures provide the emissions reduction equivalent of one year's average increment of RFP. EPA encourages early implementation of contingency measures, so that emissions are reduced as expeditiously as practicable (EPA, 1993). The contingency requirement is met in the MAG 2012 Five Percent Plan by quantifying the benefits of PM-10 reduction projects that were implemented in 2008-2011.

A large number of PM-10 reduction projects have been implemented in the nonattainment area since the MAG 2007 Five Percent Plan was submitted to EPA in December 2007. As required for contingency measures, the emission reductions attributable to these projects are above and beyond the credit taken for the measures in Chapter Five. In the Fall of 2011, MAG updated the inventory of PM-10 reduction projects in the nonattainment area that were completed in 2008-2011 by the cities, towns, Maricopa County, Pinal County, the Arizona Department of Transportation (ADOT) and the Indian communities. These projects included paving and stabilizing unpaved roads, alleys and shoulders; reducing speed limits on unpaved roads and alleys; and overlaying state highways with rubberized asphalt. In addition, MAG quantified the benefit for the freeways being swept by an ADOT contractor with PM-10 certified street sweepers and the arterials being swept by local jurisdictions with PM-10 certified street sweepers purchased with Congestion Mitigation and Air Quality Improvement (CMAQ) funds between January 1, 2007 and December 31, 2009.

The RFP graph shown in Figure III-1 indicates that total PM-10 emissions, after reductions due to increased rule effectiveness in 2008-2012, are 43,129.84 tons in 2012. Subtracting these 2012 emissions from the total 2007 emissions of 59,218.38 tons and dividing by five years produces a contingency target of 3,218 tons. Therefore, completed projects that reduce total PM-10 emissions by at least 3,218 tons in 2012 must be quantified to meet the contingency requirement.

The emission reductions for all projects quantified to meet the contingency requirement are summarized in Table IV-1. This table includes the benefits of PM-10 certified street sweeping on freeways and arterials and PM-10 reduction projects completed in 2008-2011 that paved and stabilized unpaved roads, alleys and shoulders; reduced speed limits; and overlaid highways with rubberized asphalt.

These projects were implemented in the PM-10 nonattainment area by twenty-one cities and towns, Maricopa County, Pinal County, ADOT and the Gila River Indian Community. All of the projects for which credit was taken were open to traffic between January 1, 2008 and September 30, 2011. The assumptions used in quantifying the PM-10 reductions needed to meet the contingency target are discussed below for each of the five project categories shown in Table IV-1.

PM-10 CERTIFIED STREET SWEEPING

PM-10 certified street sweepers meet the certification criteria specified in South Coast Air Quality Management District Rule 1186. PM-10 certified street sweepers reduce the silt loadings on paved roads, relative to the use of conventional sweepers. The reentrainment of dust by vehicles traveling on the roads is reduced, which, in turn, decreases emissions and ambient concentrations of PM-10.

ADOT Contracted Sweeping

A new contract awarded by the Arizona Department of Transportation (ADOT), effective February 20, 2010, requires freeways, ramps and frontage roads in the PM-10 nonattainment area to be swept with PM-10 certified street sweepers. The ADOT contract also requires sweeping frequencies of every seven days for freeways and every fourteen days for ramps and frontage roads.

A map of the specific highways being swept with PM-10 certified units by the ADOT contractor is provided in Figure IV-1. The emission reduction calculations are shown in Table IV-2.

The vehicle miles of travel (VMT) for freeways and ramps/frontage roads being swept in 2010 was estimated by summing the traffic volumes and link lengths from a 2010 traffic assignment for the routes identified in Figure IV-1. In 2010, the freeways being swept with PM-10 certified sweepers by the ADOT contractor carry nearly 30 million VMT per day, which is 86 percent of the total daily freeway VMT in the PM-10 nonattainment area. All of the freeways and ramps/frontage roads being swept by the ADOT contractor carry about 35 percent of the total daily VMT in the nonattainment area.

The PM-10 emission reductions were derived by subtracting the emission rate for PM-10 certified sweepers from the emission rate for conventional (non-certified) sweepers and

Table IV-1
2008-2012 PM-10 Emission Reductions for Contingency Projects

Completed Projects	Implementing Entities	2008	2009	2010	2011	2012
		(tons/year)				
Sweep streets with PM-10 certified sweepers Contracted sweeping of freeways, ramps and frontage roads-100% compliant, effective 2/20/10 27 PM-10 certified sweepers purchased with CMAQ funds: 1/1/07-12/31/09	ADOT	0	0	293.59	341.57	344.24
	Cities, towns	59.04	115.60	153.20	153.82	155.22
	Total for Street Sweeping	**59.04**	**115.60**	**446.79**	**495.39**	**499.46**
Pave or stabilize existing public dirt roads and alleys Paving/stabilization projects completed in 2008-2011	Cities, towns, Maricopa and Pinal County Gila River Indian Community	461.30	1,351.81	2,124.38	2,662.09	2,625.41
	Total for Road/Alley Paving/Stabilization	**461.30**	**1,351.81**	**2,124.38**	**2,662.09**	**2,625.41**
Lower speed limits on dirt roads and alleys Speed limits lowered in 2008-2011	Cities, towns, Maricopa County	3.61	78.42	160.97	160.97	161.41
	Total for Lower Speed Limits	**3.61**	**78.42**	**160.97**	**160.97**	**161.41**
Pave or stabilize unpaved shoulders Paving/stabilization projects completed in 2008-2011	Cities, towns, Maricopa County	173.31	241.75	264.70	293.34	150.01
	Total for Shoulder Paving/Stabilizing	**173.31**	**241.75**	**264.70**	**293.34**	**150.01**
Repave or overlay paved roads with rubberized asphalt Rubberized asphalt overlays completed in 2008-2011	ADOT	0	2.61	2.61	2.61	2.61
	Total for Overlays	**0**	**2.61**	**2.61**	**2.61**	**2.61**
	Total for Completed Projects	**697.25**	**1,790.19**	**2,999.45**	**3,614.40**	**3,438.90**

Figure IV-1
Map of Highways in the PM-10 Nonattainment Area Swept by ADOT

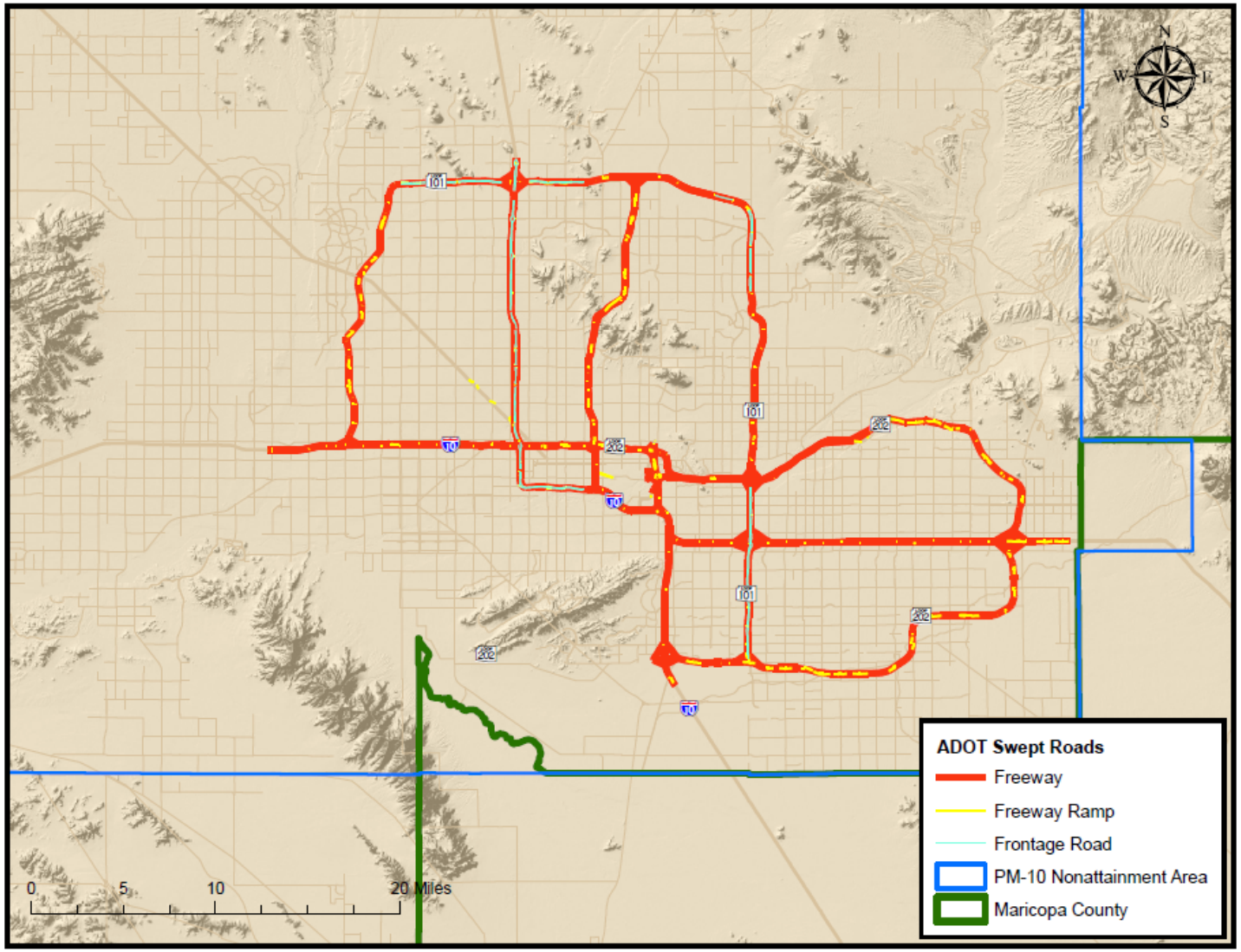


Table IV-2
PM-10 Emission Reductions for ADOT Sweeping

Facilities Swept in the PM-10Nonattainment Area	VMT Swept in 2010	PM-10 reduction in tons/year				
		2008	2009	2010*	2011**	2012**
Freeways	29,964,835	0.00	0.00	282.58	328.76	331.33
Ramps/Frontage Roads	2,153,217	0.00	0.00	11.01	12.81	12.91
Total	32,118,052	0.00	0.00	293.59	341.57	344.24

*2010 reductions are multiplied by 0.863 to reflect the start date of the new ADOT contract - 2/20/10
**2011-2012 emission reductions are grown from 2010, based on 3rd quarter 2011 population projections published by Marshall vest, University of Arizona, for the Phoenix-Mesa metro area (See Table II-1)

Contract Requires Sweeping Cycle of 7 Days			
PM-10 EFs (g/mi)	**Non PM-10**	**PM-10**	**Difference in g/mi**
Freeways	0.090	0.063	0.027
Contract Requires Sweeping Cycle of 14 Days			
PM-10 EFs (g/mi)	**Non PM-10**	**PM-10**	**Difference in g/mi**
Ramps/Frontage Roads	0.100	0.085	0.015

multiplying this difference by the VMT (i.e., for freeways or ramps/frontage roads). The emission rates for sweeping cycle lengths of one to thirty days on freeways, non-freeways, and all roads in the Salt River Area are shown in Table II-6. The unswept emission factor based on the new EPA AP-42 emissions equation for paved roads is 0.11 grams per VMT for freeways and 0.35 grams per VMT for ramps/frontage roads. Other assumptions used in developing the street sweeping emission rates in Table IV-2 are detailed in the Methodologies for Evaluating Congestion Mitigation and Air Quality Improvement Projects (MAG, 2011).

PM-10 Certified Street Sweepers Purchased with CMAQ Funds

PM-10 certified street sweepers reduce PM-10 emissions generated by vehicles traveling on paved roads. Therefore, purchase of these sweepers is eligible for federal Congestion Mitigation and Air Quality Improvement (CMAQ) funding. Since 2001, more than 150 PM-10 certified sweepers have been purchased with CMAQ funds by MAG member agencies. When purchasing a sweeper with CMAQ funds, the agency must provide a local match of at least 5.7 percent of the cost of the sweeper.

PM-10 certified sweepers are eligible for MAG CMAQ funds if they replace a conventional sweeper, replace a PM-10 certified unit that is at least eight years old, increase the sweeping frequency, expand the area that is swept, or a combination of these functions. The equations used to calculate the benefits of the CMAQ-funded sweepers are described in the CMAQ Methodologies (MAG, 2011).

Data on sweeping frequency, lane miles swept and average weekday traffic per lane mile swept is provided to MAG by the agency requesting funds to purchase the sweeper. The agency also identifies the functions to be performed by the new sweeper. If the sweeping frequency or area is to be increased, the agency provides the frequencies or lane miles to be swept before and after deployment of the new sweeper.

Data provided by the requesting agencies is applied to calculate the PM-10 emission reductions associated with each purchased sweeper. The detailed assumptions used to calculate the emission reductions for the sweepers purchased between January 1, 2001 and December 31, 2006 are discussed in Chapter II under Reentrained Dust from Paved Roads. These reductions were applied to the 2007-2012 base case emissions.

Contingency reduction credit is taken for 27 PM-10 certified sweepers purchased with CMAQ funds between January 1, 2007 and December 31, 2009. There were 29 sweepers purchased during this period, but no credit is taken for the two sweepers that replaced older PM-10 certified units. The methods used to calculate the benefit of these sweepers is consistent with those described in Chapter II. The sweeper-specific assumptions are shown in Appendix B, Exhibit 2. The total emission reductions attributable to these 27 sweepers is 153.20 tons in 2010. The 2010 credit is projected to 2011 and 2012 based on the population growth factors in Table II-1.

PAVING AND STABILIZING UNPAVED ROADS AND ALLEYS

In September 2011, MAG contacted its member agencies to request detailed information on paving and stabilization of unpaved road and alley projects that had been implemented in January 2008- September 2011. The information collected included the location of the projects, the year of completion, the length in miles, average daily traffic before paving, whether the unpaved surface was stabilized prior to paving, and the funding source. This section describes the paving and stabilization projects that were completed and open to traffic in 2008 through 2011 and the associated PM-10 emission reductions. The assumptions used in calculating the emission rates for unpaved roads and alleys are consistent with those described under Travel on Unpaved Roads and Alleys in Chapter II. A map showing the location of the road and alley paving projects completed between January 2008- September 2011 is presented in Figure IV-2.

The benefits of paving a public unpaved road is 660.16 minus 1.47 grams per VMT or 658.69 grams per VMT paved. The benefits of paving an unpaved alley is 417.45 minus 1.47 grams per VMT or 415.98 grams per VMT paved. The 1.47 grams per VMT represents the average emission rate for a paved road or alley without paved shoulders or curb and gutter. These emission rates are multiplied by the estimated VMT on each road before it is paved. If the unpaved road was stabilized prior to paving, the reduction credit is reduced by 50 percent. Credit for paving projects is only taken in the years after the project was completed. For example, credit for a paving project completed in 2009 is taken in 2010 through 2012; no credit is taken in 2009.

The benefit of projects that stabilize unpaved roads and alleys is calculated using the same paving factors, but the benefit is reduced by 50 percent. Credit for stabilization projects is only taken in the year the single year that the project was completed. For example, credit for a stabilization project completed in 2009 is taken only in 2009.

Table IV-3 shows the miles and PM-10 benefits of paving and stabilizing unpaved roads and alleys in the PM-10 nonattainment area by jurisdiction. A summary of the paving and stabilization project mileage and PM-10 reductions is shown at the bottom of the table. Twenty cities and towns, Maricopa and Pinal Counties, and the Gila River Indian Community reported information on paving and stabilization projects completed in January 2008-September 2011. During this period, 83.21 miles of unpaved roads and 133.69 miles of unpaved alleys were paved. Another 144.75 miles of unpaved roads and 500.66 miles of unpaved alleys were stabilized. The total PM-10 emissions reduced by the paving and stabilization of unpaved roads and alleys is 2,625.41 tons in 2012.

It is important to note that no credit is taken for stabilization projects in 2012, because these projects have not yet been implemented. It is clear, however, based on the stabilization projects that were implemented in 2008-2011, that some jurisdictions will be stabilizing unpaved roads and alleys in 2012 and therefore, the reduction credit calculated for paving unpaved roads and alleys in 2012 is conservative.

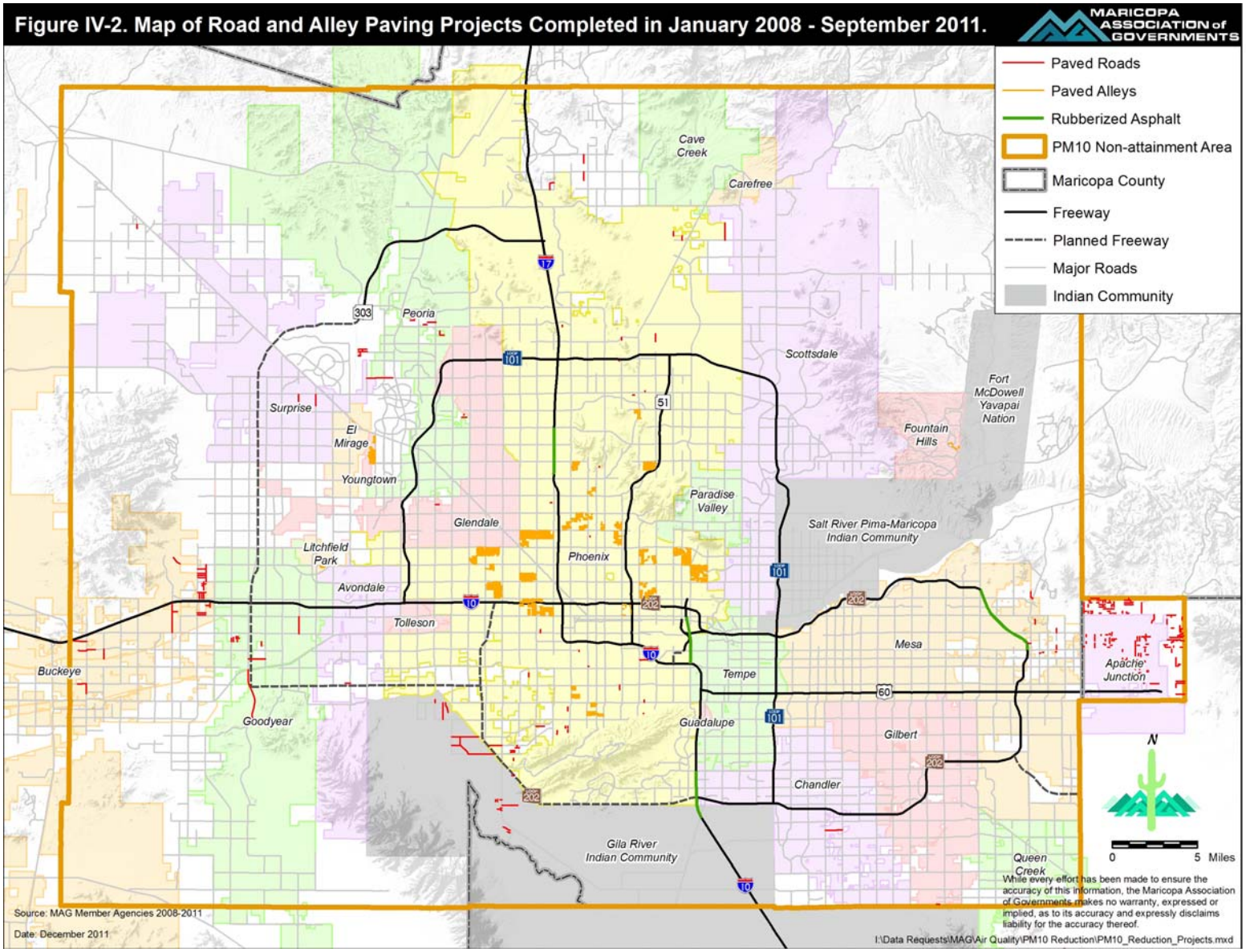


Figure IV-2. Map of Road and Alley Paving Projects Completed in January 2008 - September 2011.
MARICOPA ASSOCIATION of GOVERNMENTS
Paved Roads
Paved Alleys
Rubberized Asphalt
PM10 Non-attainment Area
Maricopa County
Freeway
Planned Freeway
Major Roads
Indian Community
Cave Creek
Carefree
Peoria
Scottsdale
Fort McDowell Yavapai Nation
Fountain Hills
Surprise
El Mirage
Youngtown
Paradise Valley
Glendale
Salt River Pima-Maricopa Indian Community
Litchfield Park
Phoenix
Avondale
Tolleson
Mesa
Buckeye
Tempe
Apache Junction
Goodyear
Guadalupe
Gilbert
Chandler
Gila River Indian Community
Queen Creek
N
0
5 Miles
While every effort has been made to ensure the accuracy of this information, the Maricopa Association of Governments makes no warranty, expressed or implied, as to its accuracy and expressly disclaims liability for the accuracy thereof.
Source: MAG Member Agencies 2008-2011
Date: December 2011
I:\Data Requests\MAG\Air Quality\PM10 Reduction\PM10_Reduction_Projects.mxd

Table IV-3
PM-10 Reductions for Paving and Stabilizing Unpaved Roads/Alleys

Jurisdiction	2008	2009	2010	2011	2012	Total Miles Paved/Stabilized
Apache Junction						
Miles of roads paved	8.72	2.00	0.77			11.49
Miles of roads stabilized	0.25					0.25
Miles of alleys stabilized	4.00	0.04				4.04
Total miles of paved/stabilized	12.97	2.04	0.77	0.00	0.00	15.78
PM-10 reductions (tons/year)	1.94	41.61	50.23	53.90	54.05	
Avondale						
Miles of roads stabilized			0.22			0.22
Miles of alleys stabilized		5.50		2.79		8.29
Total miles of paved/stabilized	0.00	5.50	0.22	2.79	0.00	8.51
PM-10 reductions (tons/year)	0.00	1.84	1.05	4.45	0.00	
Buckeye						
Miles of roads paved	2.50	1.66	1.30	0.30		5.76
Miles of roads stabilized	0.63					0.63
Miles of alleys paved		0.07				0.07
Miles of alleys stabilized	0.86					0.86
Total miles of paved/stabilized	3.99	1.73	1.30	0.30	0.00	7.32
PM-10 reductions (tons/year)	3.30	283.57	407.10	425.06	427.66	
Cave Creek						
Miles of roads stabilized	10.00	10.00	10.00	10.80		40.80
Miles of alleys stabilized	2.00	2.00	2.00	2.00		8.00
Total miles of paved/stabilized	12.00	12.00	12.00	12.80	0.00	48.80
PM-10 reductions (tons/year)	48.51	48.37	48.37	52.19	0.00	
Chandler						
Miles of roads paved	1.00					1.00
Miles of alleys stabilized	10.64	15.80	13.40			39.84
Total miles of paved/stabilized	11.64	15.80	13.40	0.00	0.00	40.84
PM-10 reductions (tons/year)	3.57	29.67	28.87	24.38	24.45	
El Mirage						
Miles of roads stabilized	3.40					3.40
Miles of alleys paved	0.50					0.50
Miles of alleys stabilized	0.50					0.50
Total miles of paved/stabilized	4.40					4.40
PM-10 reductions (tons/year)	15.53	0.33	0.33	0.33	0.34	
Fountain Hills						
Miles of alleys paved	0.19	0.25	0.45			0.89
PM-10 reductions (tons/year)	0.00	0.59	4.40	15.06	15.10	
Gilbert						

Jurisdiction	2008	2009	2010	2011	2012	Total Miles Paved/Stabilized
Miles of roads stabilized	3.62	3.62	3.62	0.75		11.61
Miles of alleys stabilized		3.00				3.00
Total miles of paved/stabilized	3.62	6.62	3.62	0.75	0.00	14.61
PM-10 reductions (tons/year)	17.32	18.27	17.27	3.58	0.00	
Glendale						
Miles of alleys stabilized	0.25					0.25
PM-10 reductions (tons/year)	0.08	0.00	0.00	0.00	0.00	
Goodyear						
Miles of roads paved	3.40	1.25				4.65
PM-10 reductions (tons/year)	0.00	184.13	214.61	214.61	215.20	
Gila River Indian Community						
Miles of roads paved	3.40	5.00	1.00			9.40
PM-10 reductions (tons/year)	0.00	156.63	278.53	302.91	303.74	
Litchfield Park						
Miles of alleys paved	1.60					1.60
PM-10 reductions (tons/year)	0.00	0.54	0.54	0.54	0.54	
Maricopa County						
Miles of roads paved	1.05	4.38	2.00	10.68		18.11
Miles of roads stabilized				0.86		0.86
Total miles of paved/stabilized	1.05	4.38	2.00	11.54	0.00	18.97
PM-10 reductions (tons/year)	0.00	38.13	155.98	238.79	461.56	
Mesa						
Miles of alleys stabilized	1.50	0.26	0.20			1.96
PM-10 reductions (tons/year)	0.50	0.09	0.07	0.00	0.00	
Peoria						
Miles of roads stabilized	1.00	1.00	1.00	6.10		9.10
PM-10 reductions (tons/year)	4.78	4.77	4.77	29.10	0.00	
Phoenix						
Miles of roads paved	5.70	1.54		3.16		10.40
Miles of alleys stabilized	66.81	40.30	25.70	13.25		146.06
Miles of alleys paved	60.53			63.30		123.83
Total miles of paved/stabilized	133.04	41.84	25.70	79.71	0.00	280.29
PM-10 reductions (tons/year)	22.36	106.88	116.28	112.13	198.09	
Pinal County						
Miles of roads paved	15.22	2.30	1.53	1.95		21.00
PM-10 reductions (tons/year)	0.00	100.02	129.84	143.04	172.91	
Queen Creek						

Jurisdiction	2008	2009	2010	2011	2012	Total Miles Paved/Stabilized
Miles of roads stabilized		1.00				1.00
PM-10 reductions (tons/year)	0.00	2.34	0.00	0.00	0.00	
Scottsdale						
Miles of roads stabilized	16.68	16.80	17.36	12.02		62.86
Miles of alleys stabilized	36.00	16.00	80.00	85.00		217.00
Total miles of paved/stabilized	52.68	32.80	97.36	97.02		279.86
PM-10 reductions (tons/year)	297.99	285.85	316.62	291.26	0.00	
Surprise						
Miles of roads paved		0.30	1.10			1.40
Miles of roads stabilized	3.49	6.30	4.00			13.79
Miles of alleys stabilized		3.69				3.69
Total miles of paved/stabilized	3.49	10.29	5.10	0.00	0.00	18.88
PM-10 reductions (tons/year)	16.69	30.05	337.46	738.60	740.63	
Tempe						
Miles of roads stabilized	0.15					0.15
Miles of alleys stabilized	34.20	19.02	2.80	3.10		59.12
Total miles of paved/stabilized	34.35	19.02	2.80	3.10		59.27
PM-10 reductions (tons/year)	12.20	6.37	0.94	1.04	0.00	
Tolleson						
Miles of alleys stabilized	0.50	0.75				1.25
PM-10 reductions (tons/year)	0.17	0.25	0.00	0.00	0.00	
Youngtown						
Miles of roads stabilized		0.08				0.08
Miles of alleys paved	3.10	3.70				6.80
Miles of alleys stabilized	6.80					6.80
Total miles of paved/stabilized	9.90	3.78	0.00	0.00	0.00	13.68
PM-10 reductions (tons/year)	16.35	11.50	11.12	11.12	11.15	

Total Miles	2008	2009	2010	2011	2008-2011
Miles of dirt roads paved	40.99	18.43	7.70	16.09	83.21
Miles of dirt roads stabilized	39.22	38.80	36.20	30.53	144.75
Miles of dirt alleys paved	65.92	4.02	0.45	63.30	133.69
Miles of dirt alleys stabilized	164.06	106.36	124.10	106.14	500.66
Total miles paved/stabilized	310.19	167.61	168.45	216.06	862.31

Total PM-10 Emissions Reduced (Tons/Year)					
	2008	2009	2010	2011	2012
Projects that paved or stabilized public dirt roads and alleys	461.30	1,351.81	2,124.38	2,662.09	2,625.41

PAVING AND STABILIZING UNPAVED SHOULDERS

In September 2011, MAG contacted its member agencies to request detailed information on paving and stabilization of unpaved shoulder projects that had been implemented in 2008- September 2011. The information collected included the location of the projects, the year of completion, the length in curb miles, average daily traffic on the adjacent road, whether the unpaved surface was stabilized prior to paving, whether curb and gutter was also constructed and the funding source. This section describes the shoulder paving and stabilization projects that were completed in 2008 through 2011 and the associated PM-10 emission reductions. The emission rates for unpaved shoulders are described in the CMAQ Methodologies (MAG, 2011).

The emission reductions associated with paving an unpaved shoulder without curb and gutter are 0.29 grams per VMT on low traffic arterials, 0.20 grams per VMT on high traffic arterials and 0.49 grams per VMT in the Salt River Area. If adding curb and gutter, the emission rates are 0.38 grams per VMT for low traffic arterials, 0.27 grams per VMT for high traffic arterials, and 0.66 grams per VMT in the Salt River Area. These emission rates are multiplied by the estimated VMT on the road adjacent to the paving or stabilization project. If the shoulders were stabilized prior to paving, the benefit is reduced by 50 percent. Credit for paving shoulders is taken in the years after the project was completed.

The benefit of projects that stabilize unpaved shoulders is calculated using the paving emission factors, but the benefit is reduced by 50 percent. Credit for stabilization projects is taken only in the year the project was completed.

Table IV-4 shows the curb miles and PM-10 benefits of paving and stabilizing unpaved shoulders in the PM-10 nonattainment area by jurisdiction. A summary of the paving and stabilization project mileage and PM-10 reductions is shown at the bottom of the table. Seventeen cities and towns, Maricopa County and ADOT reported information on paving and stabilization projects completed in 2008-September 2011. During this period, 232.73 miles of unpaved shoulders and 19.26 miles of curb and gutter were paved. Another 906.32 miles of unpaved shoulders were stabilized. The total PM-10 emissions reduced by the paving and stabilization of unpaved shoulders is 150.01 tons in 2012.

It is important to note that no credit is taken for shoulder stabilization projects in 2012, because these projects have not yet been implemented. It is clear, however, based on the projects implemented in 2008-2011, that some jurisdictions will be stabilizing unpaved shoulders in 2012 and therefore, the reduction credit calculated for paving unpaved shoulders in 2012 is conservative.

REDUCED SPEED LIMITS ON UNPAVED ROADS AND ALLEYS

In September 2011, MAG contacted its member agencies to request detailed information on reduced speed limits on unpaved roads and alleys that had been implemented in 2008-September 2011. The information collected included the location of the projects, the year

Table IV-4
PM-10 Reductions for Paving and Stabilizing Unpaved Shoulders

Jurisdiction	2008	2009	2010	2011	2012	Total Curb Miles Paved/Stabilized
ADOT						
Curb miles of shoulders paved	49.47	77.00				126.47
Curb miles of curb and gutter paved	19.26					19.26
Total miles paved & stabilized	68.73	77.00				145.73
PM-10 reductions (tons/year)	0.00	21.03	49.84	49.84	49.98	
Apache Junction						
Curb miles of shoulders stabilized	6.26	6.26	1.50			14.02
PM-10 reductions (tons/year)	0.77	0.77	0.14	0.00	0.00	
Avondale						
Curb miles of shoulders stabilized		6.05	6.05			12.10
PM-10 reductions (tons/year)	0.00	1.31	1.31	0.00	0.00	
Buckeye						
Curb miles of shoulders paved	4.65	1.16	9.30			15.11
Curb miles of shoulders stabilized			8.10			8.10
Total miles paved & stabilized	4.65	1.16	17.40			23.21
PM-10 reductions (tons/year)	0.00	0.77	2.14	3.36	3.37	
Chandler						
Curb miles of shoulders paved			3.30			3.30
Curb miles of shoulders stabilized	7.30	2.00				9.30
Total miles paved & stabilized	7.30	2.00	3.30	0.00	0.00	12.60
PM-10 reductions (tons/year)	8.22	2.25	0.00	7.41	7.43	
El Mirage						
Curb miles of shoulders paved			1.62			1.62
Curb miles of shoulders stabilized	16.00	0.25				16.25
Total miles paved & stabilized	16.00	0.25	1.62			17.87
PM-10 reductions (tons/year)	5.52	0.03	0.00	0.63	0.63	
Gilbert						
Curb miles of shoulders stabilized	15.88	15.88	15.88	15.88		63.52
PM-10 reductions (tons/year)	6.25	6.23	6.23	6.23	0.00	
Glendale						
Curb miles of shoulders paved	2.46					2.46
Curb miles of shoulders stabilized			6.40	6.61		13.01
Total miles paved & stabilized	2.46	0.00	6.40	6.61	0.00	15.48
PM-10 reductions (tons/year)	0.00	3.35	5.13	6.65	3.36	
Guadalupe						
Curb miles of shoulders paved	1.60	1.60	1.60	0.50		5.30
PM-10 reductions (tons/year)	0.00	0.45	0.91	1.36	1.51	

Jurisdiction	2008	2009	2010	2011	2012	Total Curb Miles Paved/Stabilized
Maricopa County						
Curb miles of shoulders paved			13.17			13.17
PM-10 reductions (tons/year)	0.00	0.00	0.00	14.89	14.93	
Mesa						
Curb miles of shoulders paved	5.31	23.70	12.11			41.12
Curb miles of shoulders stabilized			0.75			0.75
Total miles paved & stabilized	5.31	23.70	12.86	0.00	0.00	41.87
PM-10 reductions (tons/year)	0.00	41.01	41.35	41.01	41.12	
Peoria						
Curb miles of shoulders stabilized	43.13	43.13	43.13	43.13		172.52
PM-10 reductions (tons/year)	8.96	8.94	8.94	8.94	0.00	
Phoenix						
Curb miles of shoulders paved	3.85	3.56	1.29	3.90		12.60
PM-10 reductions (tons/year)	0.00	0.97	1.99	2.35	3.21	
Queen Creek						
Curb miles of shoulders paved	1.85					1.85
Curb miles of shoulders stabilized	9.03	25.02	26.94			60.99
Total miles paved & stabilized	10.88	25.02	26.94	0.00	0.00	62.84
PM-10 reductions (tons/year)	6.48	18.44	17.32	0.53	0.53	
Scottsdale						
Curb miles of shoulders paved			4.00	2.00		6.00
Curb miles of shoulders stabilized	131.60	132.20	123.80	134.60		522.20
Total miles paved & stabilized	131.60	132.20	127.80	136.60	0.00	528.20
PM-10 reductions (tons/year)	136.47	135.48	128.65	147.83	21.64	
Surprise						
Curb miles of shoulders paved			2.67			2.67
Curb miles of shoulders stabilized	2.82	2.74	3.50			9.06
Total miles paved & stabilized	2.82	2.74	6.17	0.00	0.00	11.73
PM-10 reductions (tons/year)	0.36	0.28	0.52	2.08	2.09	
Tempe						
Curb miles of shoulders paved		0.06				0.06
Curb miles of shoulders stabilized	0.50					0.50
Total miles paved & stabilized	0.50	0.06	0.00	0.00	0.00	0.56
PM-10 reductions (tons/year)	0.06	0.00	0.01	0.01	0.01	
Tolleson						
Curb miles of shoulders paved	1.00					1.00
PM-10 reductions (tons/year)	0.00	0.22	0.22	0.22	0.22	

Jurisdiction	2008	2009	2010	2011	2012	Total Curb Miles Paved/Stabilized
Youngtown						
Curb miles of shoulders stabilized	2.00	2.00				4.00
PM-10 reductions (tons/year)	0.22	0.22	0.00	0.00	0.00	
Total Curb Miles		**2008**	**2009**	**2010**	**2011**	**2008-2011**
Curb miles of dirt shoulders paved		70.19	107.08	49.06	6.40	232.73
Curb miles of curb and gutter paved		19.26	0.00	0.00	0.00	19.26
Curb miles of dirt shoulders stabilized		234.52	235.53	236.06	200.22	906.32
Total curb miles paved & stabilized		323.97	342.61	285.11	206.62	1,158.31
Total PM-10 Emissions Reduced (Tons/Year)						
		2008	**2009**	**2010**	**2011**	**2012**
Pave or stabilize unpaved shoulders		173.31	241.75	264.70	293.34	150.01

of completion, the length of the roads impacted by the reduced speed limits, and the average daily traffic on the unpaved road or alley. This section describes the reduced speed limit projects that were completed in 2008 through 2011 and the associated PM-10 emission reductions. Table IV-5 provides the miles of roads and alleys for which speed limits were reduced and the associated PM-10 reductions by jurisdiction.

Two towns and Maricopa County posted lower speed limits on unpaved roads and alleys in 2008-2009. Buckeye posted 15 mph signs on 5.4 miles of unpaved roads; the average speed prior to posting was assumed to be 25 mph, which is the ADOT Department of Motor Vehicles speed limit if there are no signs posted. Youngtown posted 10 mph speed limits on 6.8 miles of unpaved alleys; it was assumed that the average speed prior to posting was 15 mph. Maricopa County posted 15 mph speed limits on 6.42 miles and 25 mph speed limits on 1.74 miles of unpaved roads. It was assumed that the speeds on these County roads decreased by 10 mph as a result of the lower speed limits. It was also assumed that compliance with all of these new speed limits would be 70 percent. The unpaved road and alley emission rates used in calculating credit for these lower speed limits are consistent with those used in the 2008 PEI.

OVERLAYS WITH RUBBERIZED ASPHALT

In September 2011, MAG contacted the Arizona Department of Transportation (ADOT) to request detailed information on the state highways that had been overlaid with rubberized asphalt in 2008-September 2011. The information collected included the year of completion, route names, the start and end points, the number of lanes, and the average traffic volume per lane. Table IV-6 shows the assumptions used to calculate the PM-10 reductions in tire wear emissions for the highways that were overlaid with rubberized asphalt in 2008 by ADOT. The total PM-10 emission reductions associated with this project are 2.61 tons in 2009-2012.

DEMONSTRATION THAT THE PM-10 REDUCTION PROJECTS IMPLEMENTED IN 2008-2011 MEET CONTINGENCY REQUIREMENTS

As shown in Table IV-1, the total PM-10 emissions reduction in 2012 due to implementation of the projects described above is 3,439 tons. This reduction exceeds the contingency target of 3,218 tons by 221 tons. Therefore, the emission reductions from the projects described in this chapter meet the contingency requirements of the Clean Air Act.

As discussed previously, no credit has been taken for unpaved road, alley and shoulder stabilization projects in 2012, because these projects have not yet been implemented. It is clear, however, based on the projects implemented in 2008-2011, that some jurisdictions will be stabilizing unpaved roads, alleys and shoulders in 2012 and therefore, the contingency reduction credit calculated for 2012 is conservative.

The projects that have been quantified for contingency credit are not required to meet the five percent requirement, model attainment, or demonstrate reasonable further progress.

Table IV-5
PM-10 Reductions for Reduced Speed Limits on Unpaved Roads and Alleys

Jurisdiction	2008	2009	2010	2011	2012	Total Miles
Buckeye						
Miles of roads with lower speeds		2.50	2.90			5.40
PM-10 reductions (tons/year)	0.00	78.42	155.06	155.06	155.48	
Maricopa County						
Miles of roads with lower speeds		8.16				8.16
PM-10 reductions (tons/year)	0.00	0.00	5.91	5.91	5.93	
Youngtown						
Miles of alleys with lower speeds	6.80					6.80
PM-10 reductions (tons/year)	3.61	0.00	0.00	0.00	0.00	
Total Miles Impacted	**2008**	**2009**	**2010**	**2011**	**2008-2011**	
Miles of roads/alleys with lower speed limits	6.80	10.66	2.90	0.00		20.36
Total PM-10 Emissions Reduced (tons/year)	**2008**	**2009**	**2010**	**2011**	**2012**	
Lower speed limits on unpaved roads/alleys	3.61	78.42	160.97	160.97	161.41	

Table IV-6
PM-10 Reductions for ADOT Overlays with Rubberized Asphalt

Route	Start	End	Miles	Avg # of Lanes	Avg Vehicles Per Lane	Reduction* (tons/lanemile/ year)	PM-10 reduction (tons/year)				
							2008	2009	2010	2011	2012
Interstate 10	Ray Road	Wildhorse Pass	2.84	6.68	15,065	0.0301		0.57	0.57	0.57	0.57
Interstate 17	Arizona Canal	Thunderbird Rd	2.75	8.00	25,837	0.0517		1.14	1.14	1.14	1.14
State Route 143	Interstate 10	Van Buren St	2.80	5.73	18,443	0.0369		0.59	0.59	0.59	0.59
State Route 202L, Red Mtn Freeway	Power Road	University Dr	4.64	6.23	5,363	0.0107		0.31	0.31	0.31	0.31
Totals			**13.03**				**0.00**	**2.61**	**2.61**	**2.61**	**2.61**

*ADOT indicated in the MAG 2007 Five Percent Plan that an average of 17,000 vehicles per lane result in a PM-10 emission reduction of 0.034 tons/lanemile/year for rubberized asphalt overlays

In addition, these projects will not hasten attainment. As discussed in Chapter V, the earliest attainment date that can be demonstrated via modeling is December 31, 2012. This chapter demonstrates that PM-10 emissions will be reduced by 3,439 tons more than the reductions achieved by measures used to show progress and model attainment. The contingency projects implemented in 2008-2011 are assisting in producing the three years of clean data necessary to attain the standard at all monitors by December 31, 2012.

PM-10 EMISSION REDUCTIONS DUE TO ALL MEASURES AND PROJECTS IN THE FIVE PERCENT PLAN

Table IV-7 shows the PM-10 emissions for 2008-2012 by source category after increased rule effectiveness and contingency reductions are applied. The total reduction attributable to the rule effectiveness increases and contingency projects in the MAG 2012 Five Percent is 9,982 tons in 2012. This represents a 17 percent reduction, relative to 2007 emissions. Total PM-10 emissions with all measures and contingency projects are reduced by 19,527 tons or 33 percent between 2007 and 2012.

Table IV-7
2008-2012 PM-10 Emissions with All Plan Measures and Contingency Projects

Source Category	2008	2009	2010	2011	2012
POINT	150	133	127	128	135
AREA					
Fuel combustion	1,301	1,307	1,311	1,316	1,328
Commercial cooking	993	998	1,001	1,005	1,014
Construction (includes windblown dust)	8,355	5,333	4,139	4,014	4,073
Tilling, harvesting and cotton ginning	893	893	893	893	893
Travel on unpaved farm roads	731	731	731	731	731
Livestock	261	261	261	261	261
Travel on unpaved parking lots	2,422	2,434	2,441	2,451	2,473
Offroad recreational vehicles	2,180	2,191	2,198	2,206	2,226
Leaf blowers	895	899	902	906	914
Windblown agriculture	448	448	448	448	448
Other windblown sources	3,938	3,788	3,788	3,788	3,639
Fires	497	497	497	497	497
Mining/quarrying (includes windblown dust)	476	401	355	356	369
Travel on industrial paved/unpaved roads	472	382	331	333	351
Other industrial sources	976	865	828	832	877
NONROAD					
Aircraft	184	152	142	143	146
Airport ground support equipment	27	23	21	20	20
Locomotives	34	34	34	34	34
Other nonroad equipment	1,683	1,661	1,641	1,595	1,513
ONROAD					
Exhaust	2,836	2,647	2,371	1,843	1,407
Tire wear	256	254	255	255	259
Brake wear	758	767	771	773	787
Paved roads	7,922	7,857	7,578	7,534	7,772
Unpaved roads and alleys	9,847	8,854	7,999	7,461	7,525
Totals	**48,534**	**43,810**	**41,062**	**39,823**	**39,691**
Total PM-10 Emissions Reduction 2007-2012:				**19,527 tons, 33.0%**	

REFERENCES

EPA, 1993. *Early Implementation of Contingency Measures for Ozone and Carbon Monoxide (CO) Nonattainment Areas.* August 1993.

MAG, 2011. *Methodologies for Evaluating Congestion Mitigation and Air Quality Improvement Projects*. Maricopa Association of Governments. September 30, 2011.

V. ATTAINMENT MODELING

INTRODUCTION

In order to show attainment with the 24-hour PM-10 National Ambient Air Quality Standard for the Maricopa County PM-10 nonattainment area under high wind conditions, modeling was performed for both the PM-10 nonattainment area and a subset of the nonattainment area known as the Salt River area. The sections in this chapter of the TSD provide a detailed discussion of the elements necessary to perform the attainment modeling and demonstrate that attainment is met in 2012; specifically including:

- The reasons for choosing distance-weighted rollback as a conceptual model for the attainment demonstration;
- An analysis of the insights gained through operation of a short-term PM-10 temporary monitor saturation study;
- The application of a PM-10 emissions source weighting factor based upon distance from the exceeding monitor;
- An analysis of the non-anthropogenic low and high wind background PM-10 concentrations in the Maricopa County nonattainment area;
- The process for selecting design days;
- The development of low and high wind modeling domains;
- The creation of model-ready low and high wind emissions inventories;
- Application of the benefits of the control measures; and
- A demonstration of attainment in 2012.

An overview of the attainment modeling can be found in Chapter Five of the main plan document.

CONCEPTUAL MODEL

In December 2007, the Maricopa Association of Governments (MAG) submitted the "MAG Five Percent Plan for PM-10 for the Maricopa County Nonattainment Area" (Five Percent Plan) to the U.S. Environmental Protection Agency (EPA) in fulfillment of federal Clean Air Act requirements after a failure to attain the 24-hour PM-10 ambient air quality standard (standard) by the statutory deadline of December 31, 2006. The MAG 2007 Five Percent Plan for PM-10 included fifty-three control measures that demonstrated PM-10 emissions reductions of five percent per year and attainment of the PM-10 standard in 2010.

In 2008, there were a number of exceedances of the 24-hour PM-10 standard due to high winds in the Maricopa County nonattainment area. EPA indicated that it did not concur with four high wind exceptional events at the West 43rd Avenue monitor, which constituted a violation. The region then did not have the three years of clean data needed for attainment. In September 2010, EPA published a notice to propose a partial approval and disapproval of the MAG 2007 Five Percent Plan for PM-10. The two major reasons for the proposed disapproval were inaccuracies in the 2005 baseline emissions inventory and EPA's nonconcurrence with the four high wind exceptional events.

In January 2011, the Arizona Department of Environmental Quality (ADEQ) withdrew the MAG 2007 Five Percent Plan for PM-10 to address the technical approvability issues identified by EPA, and to include new information such as the new EPA equation for paved road dust emissions. EPA has indicated that the revised plan needs to show how high wind emissions will be adequately mitigated.

Presented below is a review of the issues considered in assessing available modeling concepts and the steps leading to the selection of distance-weighted rollback as the conceptual model.

Modeling Domain

Due to the uniform pattern and direction of wind flows upwind of the Salt River monitors during high wind events in the Spring, the use of modeling domains extending along wind back-trajectories from these monitors focuses the areal extent of these modeling domains to the areas of significant emission contribution. Past analyses of back-trajectories related to exceptional event evaluations in the Spring have shown that many are from the west/southwest and lie along the Salt River channel due to prevailing synoptic wind fields and the topographic influence of the Estrella Mountains lying directly south and running parallel to the river channel. Furthermore, past modeling analyses indicate that the lands significantly contributing to elevated PM-10 concentrations recorded at a monitoring site lie generally within a mile of either side of the back-trajectory path upwind of the monitor.

Since the areal extent impacting monitors is largely a function of wind speed, it necessary to divide selected design days into low and high wind hours. High wind hours need to represent sources located along back trajectories and low wind hours need to represent

sources within a modeling domain surrounding the selected monitoring site. A significant amount of work was devoted to developing the Salt River area modeling domain in the withdrawn Five Percent Plan which is employed to assess emissions impacting Salt River monitors during low wind hours. As part of a regional demonstration of attainment, other low wind modeling domains that represent similar distributions of land use around modeled monitors are developed as necessary. The basis for distinguishing between low and high wind hours is the 12 mph aerodynamic entrainment threshold (i.e., five-minute average) established in the 2008 PM-10 Periodic Emissions Inventory (Appendix A, Exhibit 1). Both, five-minute and hourly wind measurements at selected monitoring sites are available and can screen to determine which hours are "high wind" hours. The remaining hours are assumed to be "low wind" hours.

Modeling Inventory Development

The withdrawn Five Percent Plan expended considerable resources in collecting source-specific activity data (e.g., traffic counts, aggregate facility operating records, silt measurements, etc.) within the modeling domain to provide an accurate representation of emissions on the days selected for modeling. The focus of that effort, however, was on characterizing emissions under low wind stagnant conditions. While emission estimates were also prepared for a high wind day, the model performance resulting from that inventory was considerably poorer than for the inventories developed for days with stagnant conditions. Given that experience, it suggests a different emissions inventory methodology is needed (i.e., one along the lines of quantifying upwind emissions along a back trajectory during high wind hours and low wind emissions within a modeling domain surrounding the selected monitoring site). Due to the limited contribution of low wind hours to the 24-average values recorded on high wind days it is suggested that design-day specific low wind inventories are not necessary to characterize low wind hour emissions within the Salt River modeling domain and the PM-10 nonattainment area as a whole. Instead, it is planned that existing annual emission estimates be employed through allocation of those emissions to the land uses within each of the modeling domains.

For high wind hours, the methodology employed in the windblown dust emissions inventory developed for the 2008 PM-10 Periodic Emissions Inventory is used to quantify fugitive dust emissions at upwind sources located along back-trajectory domains from each of the modeled monitors. One question that had not been previously researched, was how far back along a back-trajectory line the modeling domain should extend. Insight into this question is provided in the discussion below of data collected at a temporary monitor upwind of the West 43rd Ave. monitoring site.

Temporary Monitoring Insights

An analysis of matched pair measurements between the West 43rd Ave. long-term monitor and 43rd Ave. & Broadway temporary monitor (a distance of 0.42 miles) was prepared for the period between April 2010 and March 2011. The data were organized into five-degree increments so concentration differences could be computed as a function of wind direction

and wind speed. Measurements were organized into three categories of wind speed: 2-6 mph, 6-12 mph, and >12 mph (both monitors had to have wind speeds falling into these categories to be included in the analysis). Tabulations of the results for these monitors and other temporary monitors are presented in the subsequent section entitled Temporary Monitoring Insights. The results for these monitors show that at 240°, the angular direction traveling southwest from the West 43rd Ave. monitor to the West 43rd Ave. & Broadway temporary monitor, average concentrations at the West 43rd monitor are consistently higher than at the temporary site:

- At 2-6 mph, the difference (West 43rd - West 43rd & Broadway/West 43rd) is 13.5% (6.38 μg/m^3);
- At 6-12 mph, the difference is 9% (3.2 μg/m^3); and
- At >12 mph, the difference is 37.3% (39.78 μg/m^3)

The >12 mph differences increase as the angular direction increases from 240° - 290°, suggesting that fugitive dust from land located between those sites disproportionately impacted concentrations at the West 43rd Ave. monitoring site (particularly since emissions impacting the monitor at that hour are coming from a minimum distance of 12 miles and the distance between the monitors is 0.42 miles). This finding suggests that that any modeling analysis prepared to support an attainment demonstration needs to account for the distance between the location where fugitive dust is emitted and the monitoring site impacted during high wind conditions (either through dispersion/deposition or some weighting function).

Available Modeling Concepts

Simple Rollback – Simple rollback analysis provides the least rigorous approach to determining the levels of emission control needed to reduce ambient PM-10 concentrations. A fundamental assumption underlying this method is that pollutant concentrations are directly proportional to total emissions over the area of interest. This assumption acquires some validity if emissions from significant source categories are uniformly distributed throughout the modeling domain, and if control measures will reduce emissions equally from each parcel in a particular source category. The benefits of using simple rollback include a quick turnaround in computing emission reductions necessary to meet a desired air quality improvement goal and the need for very limited emission inventory data to complete the calculation. The drawbacks of using this approach include the loss of accuracy in forecasting air quality improvements if sources are not uniformly distributed and if control measures produce varying benefits on a parcel-by-parcel basis. Simple rollback can be used with some success in modeling over microscale domains, but loses accuracy as the modeling domain grows because of the effects of particle dispersion and deposition over longer travel distances. Additionally, the microscale inventories surrounding each PM-10 monitoring site are different, and one microscale inventory cannot be used to assess inventory/air quality relationships at another site. Demonstrating that a control strategy is

effective at all sites recording exceedances requires the development of separate micro-inventories for each monitoring site. This approach would also suffer accuracy losses if the modeling domains extended more than about one-half mile from the monitoring site.

Weighted Rollback – A weighted rollback approach applies a distance reduction factor to emissions of each source in the modeling domain. The reduction factor is calculated on the basis of the distance between each source and the impacted monitoring site. This method requires the separate analysis of distance reduction factors in addition to the development of modeling domain emission inventories upwind of each impacted monitoring site. The selection of a mathematical form for the calculation of distance reduction factors, ranging from 1/distance to involved equation forms based on hourly meteorological data, requires testing to refine. Coordinates of the centroid of each parcel of land within each back-trajectory swath would need to be extracted from land use GIS files to facilitate the calculation of parcel-specific weighting factors. The benefits of using this method also include a relatively quick turnaround in computing emission reductions and, hence, air quality improvements after inventory data are compiled and distance reduction factors are computed. This approach also takes advantage of the limited-term saturation monitoring data collected in 2010 and early 2011 to inform the calculation of distance reduction factors at this site.

Principle Component Analysis – Principle Component Analysis (PCA) is a multivariate statistical technique that uses eigenvectors to represent varied inter-relationships present in datasets. The latent root regression form extracts relationships among variables that include a dependent variable (here, PM-10) and its predictors (e.g., wind speed, wind direction, soil moisture levels, emissions). PCA is an attractive alternative to photochemical and dispersion modeling when performance is poor due to problems with secondary chemistry and/or meteorological modeling. PCA also provides a framework for assessing the probability of attainment by contrasting meteorological conditions on design day(s) relative to an extended historical record. The downside of the methodology is that it requires assembly of relevant metrics for a long-term, multi-year meteorological record and preparation of an emissions inventory over multiple years so that vectors representing the bulk of the variance in the assembled dataset can be extracted.

AERMOD – The use of dispersion models like AERMOD to quantify the relationship between emissions and air quality can increase the accuracy of the reported results. Because of the complexities of the mathematical algorithms coded into the models to quantify a number of dispersion components, the output of dispersion models like AERMOD shows less linearity between emission strength and ambient pollutant concentration than is inherent in rollback models. These complexities require detailed assessments of the combinations of control measures converging to a solution that attains air quality targets and minimizes instabilities in the economies of regulated sources. Some sophisticated dispersion models, like ISCST3, contain particle deposition algorithms that can be toggled to simulate this ambient removal mechanism. AERMOD does not contain this capability, which is important in the modeling of windblown PM-10 emissions. An additional concern is that AERMOD provides no carryover of entrained emissions from one

hour to the next, which can lead to underestimates of concentrations under both stagnant and high wind conditions.

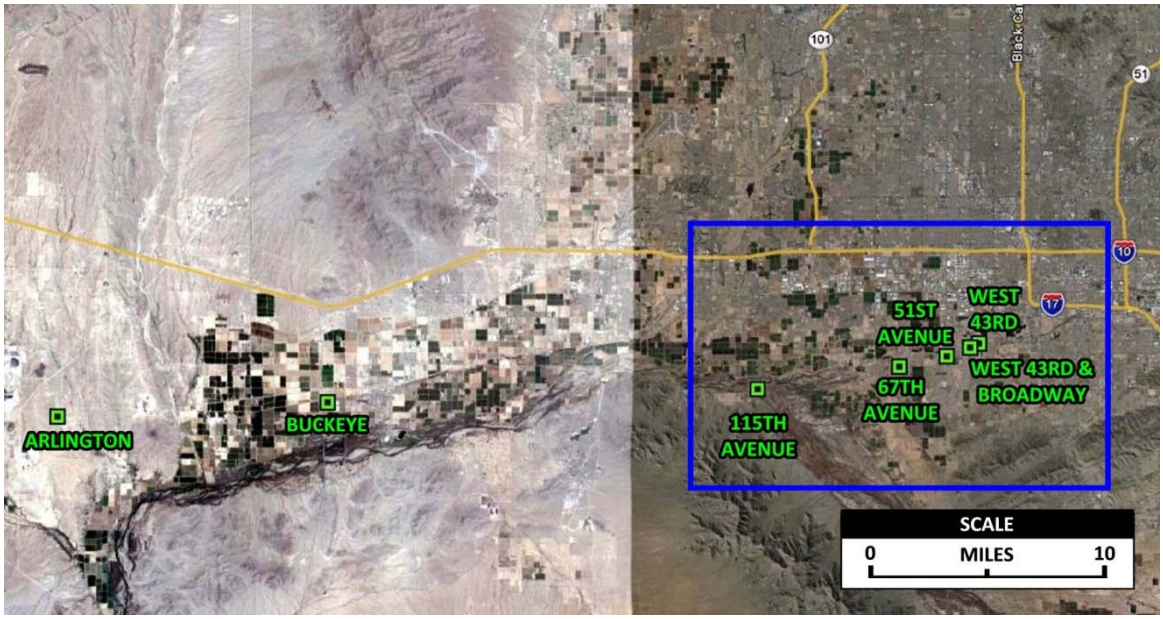
Conclusion

Since high wind AERMOD model performance was poor in the withdrawn Five Percent Plan, a weighted rollback approach was chosen to quantify the benefits of adopted controls on individual low and high wind hour concentrations for both the Salt River area domain and the regional nonattainment area demonstration. The 12 mph five-minute wind speed threshold was chosen to distinguish between low and high wind hours on selected design day(s). High wind hour emissions along the back trajectories are initially calculated based upon land use type at 2007 base levels and then calculated again with the benefits of the control measures through 2012 as identified in the new Five Percent Plan. The difference in high wind emissions will provide the expected reduction benefit of the controls included in the new Five Percent Plan. The aggregate weighted benefit computed for each high wind hour should be applied to the corresponding high wind hour recorded concentration. Since there have been no stagnation exceedances of the PM-10 standard since 2007, it is assumed that control measures implemented since 2007 have been successful in eliminating exceedances during stagnant conditions. The successful elimination of stagnation exceedances dictate that new low wind microscale, design day-specific inventories are not needed. As such, existing annual low wind emissions are allocated by land use in each of the low wind modeling domains as necessary. The 24-hour average of benefit-adjusted low and high wind concentrations in 2012 are lastly contrasted with the ambient 24-hour PM-10 standard to demonstrate attainment.

TEMPORARY MONITOR INSIGHTS

In an effort to better understand source contributions impacting the West 43rd Ave monitoring site during high wind events, Maricopa County, with support from the Arizona Department of Environmental Quality (ADEQ) and the Maricopa Association of Governments (MAG) deployed a series of temporary PM-10 monitors along the dominant upwind trajectory in the spring of 2010. A total of five temporary monitors were deployed at the following sites: Arlington, 115th Avenue, 67th Avenue, 51st Avenue, and West 43rd & Broadway. The locations of the five temporary monitors and two nearby long-term monitors, Buckeye and West 43rd Ave., are displayed in Figure V-1.

Figure V-1
Location of Temporary and Long-Term PM-10 Monitoring Sites



Monitor Placement

The location of each of the temporary monitors is identified below, along with a brief description of the insight that it was expected to provide.

West 43rd Avenue and Broadway (Temp #1) – The objective was to obtain measurements at the western-most edge of the industrialized area located between the West 43rd Ave. monitor and the river bed (roughly 0.4 miles west of the monitor). Differences between monitored values at this location and the West 43rd Ave monitor will provide a basis to assess contributions coming from nearby sources when the wind is from the west/southwest.

51st Avenue and W. Roeser Road (Temp #2) – The goal was to locate monitors on the eastern side of 51st Ave. Differences between measurements at this site and Temp #1 would provide insight into contributions from aggregate facilities located between 51st Ave. and 43rd Ave (a distance of roughly 1 mile).

67th Avenue and Southern Avenue (Temp #3) – The goal was to locate monitors on the eastern side of 67th Ave. between the river bed and Southern Ave. Differences between measurements at this site and Temp #2 would provide insight into emissions from facilities located within the 2 mile area located between 67th Ave. and 51st Ave.

115th Avenue – South side of PIR Bridge (Temp #4) – The purpose of this site was to obtain information on particulate mass being transported by drainage flow down the Agua Fria River during morning commutes. Concern had been expressed that drainage mass accumulates on the river bed and surrounding area over time and is subsequently reentrained under high wind conditions and impacting the West 43rd Ave. monitor. This location also has the advantage of providing a rough mid-point measurement of PM-10 concentrations between the Buckeye and West 43rd Ave. monitors (it is located roughly 10 miles southwest of the West 43rd Ave. monitor).

Arlington School (Temp #5) – The 5% Plan relied on measurements collected at Organ Pipe National Monument to obtain estimates of background concentrations being transported off the desert. The goal was to place a monitor beyond the western boundary of agricultural fields located to the west of the Buckeye monitor to gain a true measurement of background concentrations being transported off the desert into the Salt River area. Initially, it was thought that ADEQ could utilize the former monitoring site at Palo Verde; subsequent investigation, however, determined this site was not available.

Analysis

Presented below are comparisons of pairs of measurements collected between the fixed and temporary sites moving west from the West 43rd Ave. monitor, highlighted in the box displayed in Figure V-1. Comparisons between the Arlington and Buckeye sites are presented in a separate section addressing Background Conditions. To aid the comparison of site measurements, the data were organized into five-degree increments so concentration differences could be computed as a function of wind direction and wind speed. Comparisons between site measurements were adjusted to account for time it takes air mass to travel between the two sites. This was done by lagging the upwind measurement from the downwind measurement by the appropriate number of five-minute intervals (the increment in which the data were collected) needed to account for the time required for air mass to traverse the distance between the two sites along the angular increment between the two sites. Thus, if the angle between the two sites is 260 degrees, the average wind speed computed for that increment was used to adjust all of the angular increments between 180 and 360 degrees. The reason is that the most accurate comparison is along that angle connecting the two sites. Comparisons at other increments reflect the impact of sources not located directly along the line/angle between

the two sites. As the difference between the angular increment and the angle between the two sites grows, the effects of these sources and dispersion become greater. Similarly, as the distance between the two sites grows, the effects of nonaligned sources, dispersion, and deposition continue to grow and the comparisons provide less insight. Fortunately, the sites are located to the southwest of the West 43rd Avenue monitor, which is the dominant direction for high winds impacting that site. Comparisons along the arc between 230 to 290 degrees generally have the largest measurement count and provide the most relevant insight for the analysis. To simplify the presentation, comparisons of winds coming from the east (i.e., 0 to 175 degree increments) are not included for any of the lagged data sets for each site pair and wind speed category. All tables are presented at the end of this section for ease of review.

West 43rd Avenue versus West 43rd Avenue & Broadway (Temp #1) – An analysis of matched pair measurements between the West 43rd Ave. long-term monitor and 43rd Ave. & Broadway temporary monitor was prepared for the period between April 2010 and March 2011. The data were organized into five-degree increments so concentration differences could be computed as a function of wind direction and wind speed. Since the distance between the two sites is 0.4 miles, no lags were introduced into the data comparisons. With the comparisons all on a consistent time basis, results are presented for winds coming from all directions not just the west.

Measurements were organized into three categories of wind speed: 2-6 mph (Tables V-5 & V-6), 6-12 mph (Tables V-3 & V-4), and >12 mph (Tables V-1 & V-2). To ensure matched pair comparisons, both monitors had to have wind speeds falling into these categories to be included in the analysis. The results show that at 240 degrees, the angular direction traveling southwest from the West 43rd Ave. monitor to the West 43rd Ave. & Broadway temporary monitor, average concentrations at the West 43rd monitor are consistently higher than at the temporary site:

- At 2-6 mph, the difference (West 43rd - West 43rd & Broadway/West 43rd) is 13.5% (6.38 $\mu g/m^3$);
- At 6-12 mph, the difference is 9% (3.2 $\mu g/m^3$); and
- At >12 mph, the difference is 37.3% (39.78 $\mu g/m^3$).

The >12 mph differences increase as the angular direction increases from 240 – 290 degrees, suggesting that fugitive dust from land located between those sites disproportionately impacted concentrations at the West 43rd Ave. monitoring site (particularly since emissions impacting the monitor at that hour are coming from a minimum distance of 12 miles and the distance between the monitors is 0.4 miles). This finding suggests that any modeling analysis prepared to support an attainment demonstration needs to account for distance between the location where fugitive dust is emitted and the monitoring site impacted during high wind conditions (either through dispersion/deposition or some weighting function).

West 43rd Avenue & Broadway (Temp #1) versus 51st Avenue & W. Roeser Road (Temp #2) – An analysis of matched pair measurements between these sites was also prepared for the period between April 2010 and March 2011. Only the high wind category (>12 mph), was analyzed from this pair to get the insights of the emissions between these two monitors. Low wind conditions (< 12 mph) were excluded because of the relatively long distances of the sources to the West 43rd monitor and the great wind variability during low wind conditions. To account for the time it takes wind to travel the 1-mile distance between the two sites, the Temp #2 site measurement was lagged by five minutes relative to the Temp 1 measurement (for winds coming from the west). Tabulations of the high wind results are presented in Table V-7. The results show that at 250 degrees, the angular direction when wind is traveling from the southwest from Temp #2 to Temp #1, average concentrations at Temp #1 were consistently higher than at Temp #2:

- At >12 mph, 250 degrees, the difference is 33.8% (28.5 $\mu g/m^3$).

A similar relationship was observed between the two sites when the wind was coming from a broader arc from southwest (200 to 270 degrees), average concentrations at Temp #1 were consistently higher than they were at Temp #2. Wind directions between 270 and 300 degrees produced the opposite relationship, with Temp #2 concentrations consistently higher than Temp #1. This indicates that when the wind is coming from the southwest, fugitive dust from disturbed land located between the two monitors is contributing to elevated concentrations at West 43rd & Broadway and therefore impacting concentrations recorded at the West 43rd Avenue monitoring site. It also suggests that there is considerably less disturbed land located in the 270 and 300 degree arc between the two sites.

51st Avenue & W. Roeser Road (Temp #2) versus 67th Avenue & Southern Avenue (Temp #3) – Similar to the previous analysis, comparisons between the April 2010 and March 2011 data set were prepared only for high wind conditions. The data were lagged by ten minutes to account for the time required for air mass to transit the 2-mile distance between the two sites (i.e., Temp #3 measurements were lagged 10 minutes relative to Temp #2 measurements). A summary of the comparisons for winds coming from the west is presented in Table V-8.

The results show that at 255 degrees, the angular direction traveling southwest from the Temp 2 to Temp 3 monitor, average concentrations at the 51st Ave. monitor are lower than at the 67th Ave monitor:

- At >12 mph, 255 degrees, the difference is -7.4% (-4.6 $\mu g/m^3$).

This pattern of higher upwind values is seen consistently in an arc ranging from 240 to 300 degrees. It is also opposite of the patterns seen in the previous site comparisons. This suggests that upwind sources impacting the 67th Ave. monitor had a significantly greater impact than sources located between the two sites had on the 51st Ave monitor. Another factor to consider is that the greater distance between these sites also allows more

time/distance for dispersion and deposition relative to the previous site comparisons. Given the limitations of the data, it is not possible to know which effect is stronger (i.e., the influence of nearby upwind sources at both sites versus dispersion/deposition). Nevertheless, it suggests some form of distance weighting should be incorporated into the modeling because the greatest impacts at the West 43rd Avenue monitor appear to be coming from nearby upwind land.

67th Avenue & Southern (Temp#3) versus 115th Avenue (Temp #4) – Similar to the previous analysis, comparisons between the April 2010 and March 2011 data set were only prepared for high wind conditions. The data were lagged by 25 minutes to account for the time required for air mass to transit the 6-mile distance between the two sites (i.e., Temp #4 measurements were lagged 25 minutes relative to Temp #3 measurements). A summary of the comparisons for winds coming from the west is presented in Table V-9.

The results show that at 255 degrees, the angular direction traveling southwest from the Temp 2 to Temp 3 monitor, average concentrations at the 51st Ave. monitor are consistently lower than at the 67th Ave monitor:

- At >12 mph, 255 degrees, the difference is -48.0% (-33.1 $\mu g/m^3$).

This pattern is consistent with that observed in the previous comparison between Temp #2 and #3, but inconsistent with the pattern seen in the sites closer to the West 43rd Avenue monitor. The differences observed at 255 degrees between Temp #3 and #4, however, are not generally seen over the broader arc between 230 to 290 degrees. Generally, the pattern is the opposite—higher values are recorded at the 67th Avenue monitor, suggesting land located between the two sites, but not directly along the angle between them, is contributing to emissions impacting that site.

115th Avenue (Temp #4) versus Buckeye – Due to the 18-mile distance between the sites, no comparisons were prepared.

Summary

Analysis of data collected along a line of fixed and temporary PM-10 monitors located on a southwest trajectory from the West 43rd Avenue monitor between April 2010 and March 2011 shows a pattern of elevated impacts from nearby lands. Similar impacts were observed in comparisons between concentrations recorded at the next set of upwind sites. Subsequent site comparisons produced inconsistent and contradictory results, indicating a lessening impact of lands located between the monitored pairs. These findings suggest that lands with the greatest impacts on concentrations recorded at the West 43rd Avenue site are nearby and diminish with distance. The trajectory modeling used to estimate concentrations during high wind hours should incorporate a form of distance weighting or dispersion to account for this effect.

Table V-1
Angular Comparison of Matched Five-Minute PM-10 Concentrations Collected at West 43rd Ave/Broadway and West 43rd Monitors When Winds Exceeded 12 mph (0 - 175 degrees)

WD Sector (Degree)	Measurement Count	43rd & Broadway (μg/m^3)	West 43rd (μg/m^3)	Difference (μg/m^3)	Difference (Percent)
0	21	116.39	113.54	-2.85	-2.5%
5	40	80.27	89.04	8.77	9.8%
10	36	75.15	86.64	11.49	13.3%
15	38	52.07	41.29	-10.78	-26.1%
20	38	43.94	29.64	-14.31	-48.3%
25	38	58.74	27.68	-31.07	-112.3%
30	28	128.18	70.54	-57.64	-81.7%
35	11	167.49	72.14	-95.35	-132.2%
40	11	96.82	45.57	-51.25	-112.4%
45	8	122.26	50.31	-71.95	-143.0%
50	8	66.86	31.31	-35.55	-113.5%
55	1	94.40	47.90	-46.50	-97.1%
60	7	58.56	68.64	10.09	14.7%
65	8	52.56	40.15	-12.41	-30.9%
70	14	50.38	44.15	-6.23	-14.1%
75	27	50.50	46.56	-3.94	-8.5%
80	27	64.63	63.34	-1.29	-2.0%
85	25	56.80	50.55	-6.25	-12.4%
90	19	68.35	62.76	-5.58	-8.9%
95	22	49.96	50.95	0.98	1.9%
100	53	79.18	67.96	-11.22	-16.5%
105	35	141.95	101.19	-40.77	-40.3%
110	21	150.54	104.44	-46.10	-44.1%
115	12	22.78	40.67	17.89	44.0%
120	13	248.30	153.05	-95.25	-62.2%
125	15	166.12	87.01	-79.11	-90.9%
130	23	296.25	139.17	-157.07	-112.9%
135	15	418.20	318.69	-99.51	-31.2%
140	14	177.39	148.76	-28.62	-19.2%
145	12	123.76	118.34	-5.42	-4.6%
150	8	234.20	173.84	-60.36	-34.7%
155	6	796.67	1013.33	216.67	21.4%
160	8	529.34	601.58	72.24	12.0%
165	13	764.37	365.05	-399.32	-109.4%
170	4	273.75	398.73	124.98	31.3%
175	16	630.31	305.08	-325.24	-106.6%

Table V-2
Angular Comparison of Matched Five-Minute PM-10 Concentrations Collected at West 43rd Ave/Broadway and West 43rd Monitors When Winds Exceeded 12 mph (180 - 360 degrees)

WD Sector (Degree)	Measurement Count	43rd & Broadway (µg/m^3)	West 43rd (µg/m^3)	Difference (µg/m^3)	Difference (Percent)
180	15	720.92	320.11	-400.81	-125.2%
185	3	310.43	156.47	-153.97	-98.4%
190	3	46.30	38.80	-7.50	-19.3%
195	2	105.20	94.25	-10.95	-11.6%
200	5	147.90	152.32	4.42	2.9%
205	3	646.00	774.00	128.00	16.5%
210	14	144.09	266.19	122.10	45.9%
215	16	373.00	419.85	46.85	11.2%
220	34	130.21	150.99	20.79	13.8%
225	32	66.88	109.71	42.82	39.0%
230	57	69.08	103.92	34.84	33.5%
235	104	63.30	102.79	39.50	38.4%
240	**130**	**66.92**	**106.70**	**39.78**	**37.3%**
245	158	88.30	132.58	44.29	33.4%
250	153	78.77	134.13	55.36	41.3%
255	182	68.66	129.96	61.30	47.2%
260	246	68.12	130.17	62.05	47.7%
265	271	48.46	91.98	43.53	47.3%
270	205	51.11	110.52	59.40	53.7%
275	141	64.33	124.81	60.48	48.5%
280	94	62.54	150.43	87.89	58.4%
285	51	62.39	124.07	61.68	49.7%
290	20	85.40	195.19	109.79	56.2%
295	24	51.48	74.85	23.37	31.2%
300	7	87.66	164.27	76.61	46.6%
305	8	45.71	46.89	1.18	2.5%
310	12	53.38	64.98	11.61	17.9%
315	15	52.79	53.25	0.45	0.9%
320	13	67.18	84.66	17.48	20.6%
325	8	62.76	56.28	-6.49	-11.5%
330	14	32.36	24.97	-7.39	-29.6%
335	23	57.46	49.74	-7.72	-15.5%
340	41	81.66	79.40	-2.26	-2.8%
345	49	49.45	43.17	-6.28	-14.6%
350	20	141.52	142.74	1.22	0.9%
355	30	126.71	105.82	-20.89	-19.7%
360	3	20.53	25.37	4.83	19.1%

Table V-3
Angular Comparison of Matched Five-Minute PM-10 Concentrations Collected at West 43rd Ave/Broadway and West 43rd Monitors When Winds Are Between 6-12 mph (0 - 175 degrees)

WD Sector (Degree)	Measurement Count	43rd & Broadway (µg/m^3)	West 43rd (µg/m^3)	Difference (µg/m^3)	Difference (Percent)
0	61	20.32	16.66	-3.66	-22.0%
5	47	27.47	22.41	-5.06	-22.6%
10	45	31.10	26.73	-4.37	-16.3%
15	53	24.12	20.18	-3.94	-19.5%
20	55	20.65	20.55	-0.10	-0.5%
25	49	25.99	20.67	-5.33	-25.8%
30	41	29.32	22.95	-6.37	-27.8%
35	46	30.43	22.58	-7.85	-34.8%
40	57	27.96	20.81	-7.15	-34.3%
45	59	29.15	21.02	-8.13	-38.7%
50	66	28.94	21.84	-7.09	-32.5%
55	104	29.37	25.18	-4.19	-16.7%
60	141	36.94	29.59	-7.35	-24.8%
65	157	35.87	29.32	-6.55	-22.3%
70	264	37.52	59.90	22.38	37.4%
75	330	35.36	86.99	51.63	59.4%
80	279	36.85	64.04	27.18	42.5%
85	256	34.53	47.96	13.43	28.0%
90	319	30.11	31.37	1.26	4.0%
95	301	30.76	43.93	13.17	30.0%
100	275	32.54	34.14	1.59	4.7%
105	221	33.60	51.44	17.84	34.7%
110	206	26.63	24.19	-2.45	-10.1%
115	189	29.78	27.39	-2.39	-8.7%
120	156	30.39	26.72	-3.68	-13.8%
125	129	51.33	46.01	-5.33	-11.6%
130	125	30.62	24.80	-5.82	-23.5%
135	117	40.18	35.45	-4.73	-13.3%
140	110	39.70	39.48	-0.23	-0.6%
145	94	52.01	37.78	-14.24	-37.7%
150	109	56.90	59.36	2.47	4.2%
155	115	62.44	68.93	6.50	9.4%
160	105	49.32	41.58	-7.74	-18.6%
165	116	67.84	66.32	-1.53	-2.3%
170	82	50.22	66.74	16.52	24.8%
175	74	43.92	49.20	5.28	10.7%

Table V-4
Angular Comparison of Matched Five-Minute PM-10 Concentrations Collected at West 43rd Ave/Broadway and West 43rd Monitors When Winds are Between 6-12 mph (180 - 360 degrees)

WD Sector (Degree)	Measurement Count	43rd & Broadway ($\mu g/m^3$)	West 43rd ($\mu g/m^3$)	Difference ($\mu g/m^3$)	Difference (Percent)
180	63	35.47	51.12	15.65	30.6%
185	57	26.91	27.85	0.95	3.4%
190	50	26.95	25.52	-1.43	-5.6%
195	74	28.78	38.80	10.02	25.8%
200	54	26.78	28.81	2.03	7.1%
205	65	28.55	30.41	1.86	6.1%
210	78	29.71	32.21	2.50	7.8%
215	93	25.50	36.73	11.23	30.6%
220	133	29.03	33.54	4.51	13.4%
225	219	32.26	34.84	2.58	7.4%
230	375	30.65	33.38	2.73	8.2%
235	389	30.89	34.32	3.43	10.0%
240	**429**	**32.38**	**35.58**	**3.20**	**9.0%**
245	514	33.45	42.23	8.78	20.8%
250	478	33.18	42.14	8.96	21.3%
255	629	35.81	41.11	5.30	12.9%
260	880	33.41	38.89	5.48	14.1%
265	951	32.05	37.10	5.05	13.6%
270	838	32.56	36.81	4.25	11.6%
275	763	32.53	37.56	5.03	13.4%
280	651	30.68	35.33	4.65	13.1%
285	509	27.87	30.98	3.11	10.0%
290	390	27.76	28.06	0.29	1.0%
295	228	27.45	29.60	2.15	7.3%
300	149	27.40	24.79	-2.62	-10.6%
305	96	32.92	27.19	-5.73	-21.1%
310	70	22.01	19.45	-2.56	-13.2%
315	60	35.80	26.73	-9.07	-33.9%
320	60	26.63	22.79	-3.84	-16.8%
325	58	23.16	22.42	-0.74	-3.3%
330	64	23.18	22.59	-0.58	-2.6%
335	50	23.22	16.96	-6.26	-36.9%
340	45	22.04	15.34	-6.70	-43.7%
345	55	25.49	15.47	-10.02	-64.8%
350	70	18.35	14.71	-3.64	-24.8%
355	64	20.18	19.90	-0.28	-1.4%
360	7	20.13	17.17	-2.96	-17.2%

Table V-5
Angular Comparison of Matched Five-Minute PM-10 Concentrations Collected at West 43rd Ave/Broadway and West 43rd Monitors When Winds are Greater Than 2 mph, but do not Exceed 6 mph
(0 - 175 degrees)

WD Sector (Degree)	Measurement Count	43rd & Broadway ($\mu g/m^3$)	West 43rd ($\mu g/m^3$)	Difference* ($\mu g/m^3$)	Difference (Percent)
0	518	46.53	40.66	-5.86	-14.4%
5	536	45.97	45.20	-0.77	-1.7%
10	601	52.61	50.22	-2.39	-4.8%
15	609	52.82	45.26	-7.56	-16.7%
20	638	47.23	43.22	-4.01	-9.3%
25	639	49.91	43.46	-6.45	-14.8%
30	636	51.64	42.89	-8.75	-20.4%
35	723	50.86	45.73	-5.13	-11.2%
40	708	48.95	41.29	-7.66	-18.6%
45	803	48.89	41.39	-7.50	-18.1%
50	859	46.98	41.00	-5.98	-14.6%
55	961	46.18	43.81	-2.38	-5.4%
60	1,113	47.28	43.02	-4.26	-9.9%
65	1,159	46.63	45.47	-1.16	-2.6%
70	1,373	44.75	50.10	5.35	10.7%
75	1,424	43.21	54.39	11.18	20.6%
80	1,316	43.92	49.60	5.68	11.5%
85	1,264	42.95	47.16	4.21	8.9%
90	1,341	40.62	42.41	1.78	4.2%
95	1,361	40.10	46.95	6.85	14.6%
100	1,340	41.59	40.95	-0.64	-1.6%
105	1,240	44.05	45.02	0.96	2.1%
110	1,078	43.69	40.22	-3.47	-8.6%
115	1,014	41.27	39.82	-1.45	-3.6%
120	978	45.21	42.08	-3.12	-7.4%
125	982	50.38	45.33	-5.04	-11.1%
130	958	52.45	48.14	-4.31	-8.9%
135	819	56.34	47.72	-8.63	-18.1%
140	874	54.13	47.03	-7.10	-15.1%
145	825	53.75	46.78	-6.97	-14.9%
150	796	55.61	48.67	-6.94	-14.3%
155	833	59.45	56.67	-2.78	-4.9%
160	790	57.46	52.65	-4.81	-9.1%
165	828	67.32	55.33	-11.99	-21.7%
170	841	52.88	51.87	-1.01	-1.9%
175	870	63.00	52.76	-10.24	-19.4%

Table V-6
Angular Comparison of Matched Five-Minute PM-10 Concentrations Collected at West 43rd Ave/Broadway and West 43rd Monitors When Winds are Greater Than 2 mph, but do not Exceed 6 mph (180 - 360 degrees)

WD Sector (Degree)	Measurement Count	43rd & Broadway ($\mu g/m^3$)	West 43rd ($\mu g/m^3$)	Difference ($\mu g/m^3$)	Difference (Percent)
180	913	63.96	53.33	-10.64	-19.9%
185	952	52.75	48.40	-4.35	-9.0%
190	954	50.78	50.93	0.15	0.3%
195	1,014	54.49	56.53	2.04	3.6%
200	1,007	52.77	58.15	5.38	9.3%
205	1,035	48.48	50.77	2.28	4.5%
210	1,080	47.35	51.14	3.79	7.4%
215	1,043	49.25	57.43	8.18	14.3%
220	1,126	43.43	47.65	4.23	8.9%
225	1,234	40.96	46.57	5.62	12.1%
230	1,479	38.28	45.15	6.87	15.2%
235	1,564	39.60	46.77	7.17	15.3%
240	**1,733**	**40.90**	**47.28**	**6.38**	**13.5%**
245	2,115	42.33	51.05	8.72	17.1%
250	2,154	43.65	56.51	12.86	22.8%
255	2,514	43.70	48.68	4.99	10.2%
260	2,795	44.17	51.20	7.04	13.7%
265	2,907	41.10	49.44	8.33	16.9%
270	2,755	41.13	45.52	4.39	9.7%
275	2,646	41.49	45.26	3.76	8.3%
280	2,515	39.15	42.85	3.70	8.6%
285	2,360	37.96	43.91	5.94	13.5%
290	1,964	37.29	35.66	-1.63	-4.6%
295	1,542	37.81	41.53	3.72	9.0%
300	1,243	39.00	41.53	2.53	6.1%
305	1,012	39.05	35.26	-3.79	-10.7%
310	929	40.86	36.68	-4.18	-11.4%
315	823	42.02	36.28	-5.74	-15.8%
320	769	39.93	38.25	-1.68	-4.4%
325	726	41.51	36.75	-4.76	-13.0%
330	639	43.14	38.31	-4.83	-12.6%
335	644	45.94	37.05	-8.89	-24.0%
340	587	45.38	40.66	-4.73	-11.6%
345	626	43.47	39.32	-4.15	-10.6%
350	624	47.85	40.69	-7.17	-17.6%
355	617	46.02	41.83	-4.19	-10.0%
360	52	37.66	41.61	3.95	9.5

Table V-7
Angular Comparison of Matched Five-Minute PM-10 Concentrations Collected at 51st Avenue and West 43rd Ave/Broadway (lagged 5-minutes) Monitors When Winds Exceeded 12 mph (180 - 355 degrees)

WD Sector (Degree)	Measurement Count	51st Avenue (µg/m^3)	43rd & Broadway (µg/m^3)	Difference (µg/m^3)	Difference (Percent)
180	9	274.6	839.6	565.0	67.3%
185	14	171.2	442.3	271.1	61.3%
190	3	27.4	83.1	55.7	67.0%
195	2	38.2	102.5	64.3	62.8%
200	NA	NA	NA	NA	NA
205	1	32.3	82.3	50.0	60.8%
210	4	34.3	154.3	120.0	77.8%
215	6	59.6	294.4	234.9	79.8%
220	8	182.0	278.3	96.4	34.6%
225	8	197.8	428.8	231.0	53.9%
230	14	219.7	298.2	78.5	26.3%
235	11	135.9	132.7	-3.3	-2.5%
240	18	38.8	78.8	39.9	50.7%
245	24	48.3	64.7	16.5	25.4%
250	**34**	**55.7**	**84.2**	**28.5**	**33.8%**
255	45	60.0	85.0	25.0	29.4%
260	52	37.7	57.5	19.8	34.4%
265	68	61.8	72.8	10.9	15.0%
270	76	49.4	62.2	12.8	20.5%
275	95	51.8	52.0	0.2	0.4%
280	90	43.9	39.8	-4.1	-10.3%
285	62	49.9	36.6	-13.4	-36.6%
290	35	47.0	29.7	-17.3	-58.2%
295	12	35.6	26.7	-8.8	-33.1%
300	6	49.8	46.8	-3.1	-6.6%
305	4	47.4	58.7	11.4	19.3%
310	5	37.5	51.7	14.2	27.5%
315	10	36.5	40.2	3.7	9.2%
320	13	60.9	73.3	12.4	16.9%
325	11	88.7	91.9	3.3	3.6%
330	4	21.0	21.8	0.8	3.6%
335	9	186.6	118.6	-68.0	-57.3%
340	40	50.2	55.9	5.7	10.2%
345	32	73.9	55.1	-18.8	-34.2%
350	15	111.3	86.0	-25.3	-29.4%
355	18	286.0	231.6	-54.4	-23.5%

Table V-8
Angular Comparison of Matched Five-Minute PM-10 Concentrations Collected at 67th Avenue and 51st Avenue (lagged 10-minutes) Monitors When Winds Exceeded 12 mph (180 - 355 degrees)

WD Sector (Degree)	Measurement Count	67th Avenue (µg/m^3)	51st Avenue (µg/m^3)	Difference (µg/m^3)	Difference (Percent)
180	10	517.4	181.8	-335.5	-184.5%
185	15	402.3	132.5	-269.8	-203.6%
190	6	64.5	71.0	6.5	9.2%
195	3	29.0	38.8	9.9	25.4%
200	NA	NA	NA	NA	NA
205	1	93.4	15.7	-77.7	-494.9%
210	1	221.5	320.7	99.2	30.9%
215	4	59.0	144.7	85.7	59.2%
220	8	106.2	164.9	58.7	35.6%
225	7	124.4	131.8	7.4	5.6%
230	13	154.1	226.6	72.5	32.0%
235	9	102.3	191.1	88.8	46.5%
240	25	55.7	37.9	-17.8	-46.9%
245	24	99.1	68.1	-31.1	-45.7%
250	37	88.3	53.5	-34.8	-65.1%
255	**52**	**66.6**	**62.0**	**-4.6**	**-7.4%**
260	63	60.3	45.2	-15.0	-33.2%
265	88	80.8	62.7	-18.2	-29.0%
270	93	72.3	55.0	-17.3	-31.4%
275	106	62.1	55.9	-6.2	-11.0%
280	102	53.6	62.1	8.5	13.7%
285	84	62.9	44.9	-18.0	-40.0%
290	58	148.4	73.2	-75.2	-102.7%
295	18	184.1	95.7	-88.5	-92.5%
300	13	114.0	51.8	-62.2	-120.0%
305	9	69.6	40.4	-29.2	-72.2%
310	18	70.9	71.7	0.8	1.1%
315	23	34.3	17.8	-16.4	-92.0%
320	16	97.7	49.3	-48.4	-98.3%
325	12	164.6	74.9	-89.8	-119.9%
330	3	27.6	20.9	-6.7	-32.3%
335	11	109.9	92.8	-17.1	-18.4%
340	36	47.5	40.7	-6.8	-16.7%
345	28	50.0	70.7	20.7	29.3%
350	16	85.3	84.4	-1.0	-1.1%
355	12	114.2	208.8	94.6	45.3%

Table V-9
Angular Comparison of Five-Minute PM-10 Concentrations Collected at 115th Avenue and 67th Avenue (lagged 25-minutes) Monitors When Winds Exceeded 12 mph (180 - 355 degrees)

WD Sector (Degree)	Measurement Count	Avondale (µg/m^3)	67th Avenue (µg/m^3)	Difference (µg/m^3)	Difference (Percent)
180	NA	NA	NA	NA	NA
185	NA	NA	NA	NA	NA
190	2	59.7	499.5	439.9	88.1%
195	3	45.2	140.4	95.2	67.8%
200	3	27.7	303.8	276.1	90.9%
205	6	16.1	28.3	12.2	43.1%
210	11	56.3	58.4	2.1	3.6%
215	4	55.8	42.2	-13.6	-32.2%
220	11	125.2	164.7	39.5	24.0%
225	16	71.9	55.4	-16.5	-29.8%
230	22	68.5	158.7	90.2	56.8%
235	19	38.3	81.3	43.0	52.9%
240	33	50.8	56.5	5.8	10.2%
245	47	37.5	80.2	42.7	53.2%
250	84	42.4	113.7	71.3	62.7%
255	72	36.2	74.5	38.3	51.4%
260	**87**	**102.3**	**69.1**	**-33.1**	**-48.0%**
265	61	75.7	63.2	-12.5	-19.8%
270	86	38.2	44.2	5.9	13.4%
275	58	51.2	68.9	17.7	25.6%
280	56	50.5	88.3	37.8	42.8%
285	39	83.7	130.9	47.2	36.1%
290	30	112.5	177.6	65.1	36.7%
295	8	26.4	45.7	19.3	42.2%
300	4	25.9	81.5	55.7	68.3%
305	6	38.3	75.5	37.2	49.3%
310	2	25.4	66.0	40.7	61.6%
315	8	52.2	80.5	28.4	35.2%
320	25	36.8	66.3	29.5	44.5%
325	27	60.4	95.9	35.5	37.0%
330	5	140.7	35.9	-104.8	-291.8%
335	3	100.0	25.2	-74.8	-297.2%
340	19	25.9	37.6	11.7	31.1%
345	16	63.3	40.3	-23.0	-57.1%
350	9	173.8	79.1	-94.7	-119.6%
355	NA	NA	NA	NA	NA

SOURCE WEIGHTING ANALYSIS

A modified rollback analysis is used to assess the benefits of controls to reduce windblown dust emissions on disturbed soil areas. Although these benefits can be quantified in terms of emissions, the corresponding reductions in ambient PM-10 concentrations at fixed monitoring sites cannot be determined without additional analysis of the relationships between emissions reductions and reductions in downwind concentrations. This relationship is typically quantified through use of dispersion modeling, and dispersion modeling is used in a screening mode here to inform modifications to the basic rollback process.

Rollback analysis basically assumes a linear relationship between levels of pollutant emissions and levels of resulting pollutant concentrations in downwind ambient air. Under this approach, a fractional reduction in emissions is assumed to produce an equivalent reduction in downwind ambient concentrations after backing out the contribution of background air quality. In the case of entrained PM-10 generated by high wind events, however, we know that two primary factors invalidate this principle of linearity: (1) the settling and deposition from the airstream of entrained particulate with increasing time and distance from the point of entrainment, and (2) the dispersion of particulate both laterally and vertically within the airstream due to increased boundary layer turbulence at higher wind speeds. Both of these phenomena cause PM-10 concentrations to drop dramatically as air parcels holding these concentrations continue moving downwind from the soils generating windblown dust during high wind events.

Fortunately, quantitative estimates of the impacts of these two phenomena can be derived from the use of steady state, Gaussian-dispersion models configured to site-specific conditions found in the Salt River area. One of these models, AERMOD, was used to quantify source-receptor relationships in the previous version of the Maricopa Area Five Percent Plan. For this reason, AERMOD was used to generate PM-10 concentrations downwind of a hypothetical disturbed soil parcel producing windblown dust to assess the rate at which the combination of particle deposition and dispersion reduced concentrations at varying distances downwind of the source.

The hypothetical disturbed soil parcel was configured to represent such parcels typically found in the windblown dust corridor straddling the Salt River. The area of the parcel was specified to be 40 acres, representative of larger cultivated parcels in the area. The parcel was assumed to be square with sides oriented north-south and east-west and measuring 401.54 meters each. The plume release height was set at 0.5 meters, the ambient temperature at 297.9 °K (76.6 °F), and Monin-Obukhov lengths—relating to atmospheric stability—were set at -304.2 meters. These ambient conditions were the same as those that occurred at the W. 43rd monitoring station on the high wind hour of February 15, 2006, the single high wind day evaluated in the Technical Support Document to the initial Five Percent Plan. The urban dispersion toggle was set to represent albedo from a population center of 1.5 million. Both source and receptor elevations were set to zero to generally represent the topographical gradient along the Salt River. The surface

roughness was set at 0.04 meters based on Nickling and Gillies 1986 wind tunnel testing in the Salt River area. The particle size ranges of loose soil particles entrained by high wind conditions from this parcel were assumed to be the same as the size distribution used in the initial Five Percent Plan modeling of high wind conditions. This distribution, as adapted from ambient air monitoring conducted by T&B Systems in the Salt River area in 2006, is shown in Table V-10.

Table V-10
Particle Characteristics

Diameter (micron)	1.229	3.263	4.949	6.802	8.724
Mass Fraction	0.189	0.27	0.231	0.206	0.105
Density (g/cm^3)	2.5	2.5	2.5	2.5	2.5

The emission rate for the 40-acre parcel was set at 1,000 pounds of PM-10 per hour, or 7.815×10^{-4} g/sec-m^2, which is consistent with emission rates published in the 2008 Periodic Emissions Inventory for PM-10 (Appendix A, Exhibit 1).

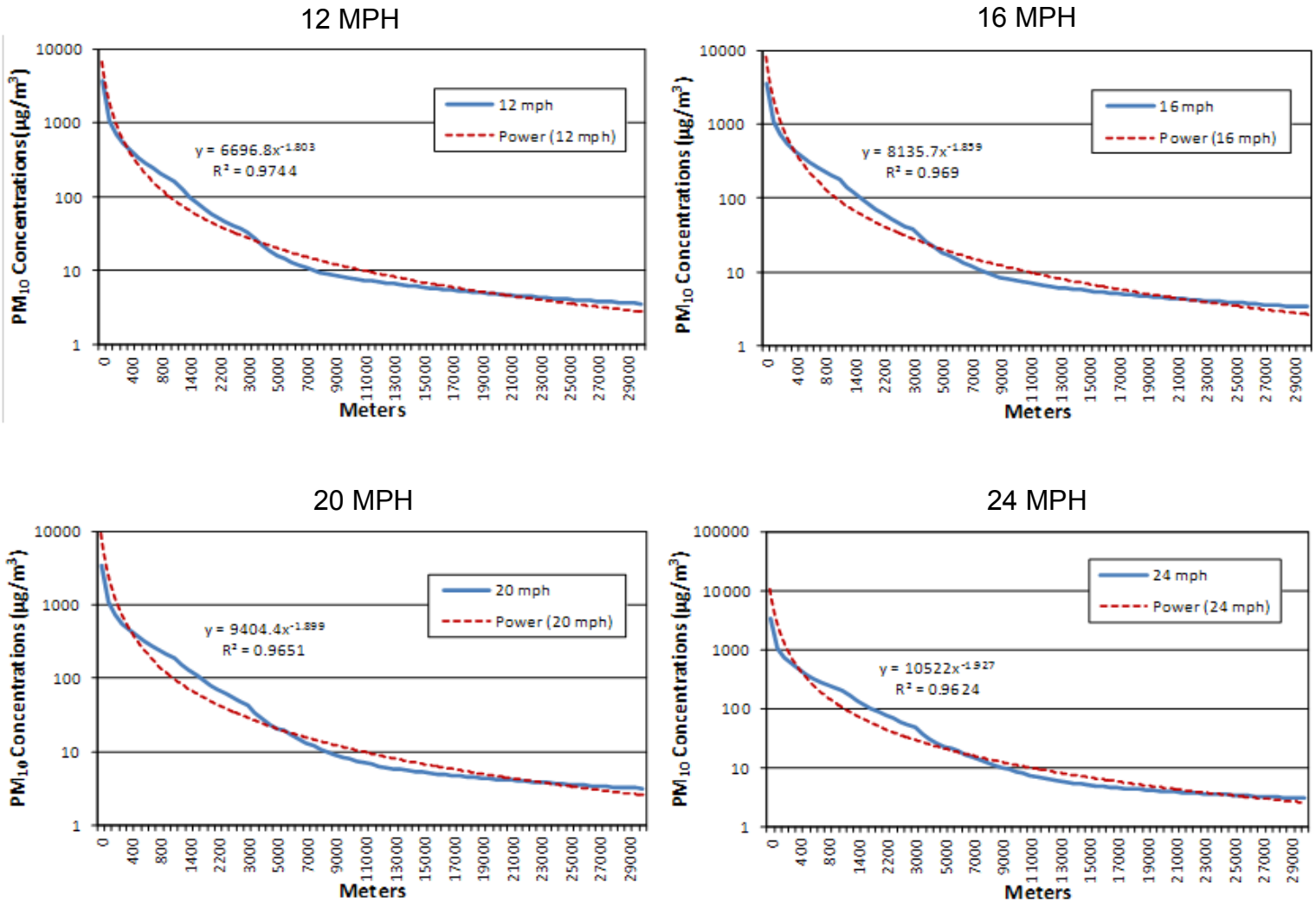
Receptor sites were located at regular intervals downwind of the trailing edge of the area source. Receptor spacing was set at 100 meters between 0 and 1,000 meters; at 200 meters between 1,000 and 3,000 meters; and then at 500 meters between 3,000 and 30,000 meters. All receptors were configured to lie on a radius pointing due east from the source.

Meteorological conditions for this screening run included winds blowing from due west at a series of elevated wind speeds. Hourly average wind velocities ranged from 12 to 24 mph in 1-mph increments.

The resulting hourly-average PM-10 concentrations reported by the AERMOD screening run are shown in Appendix A. These results show concentrations varying by three orders of magnitude over the downwind distance span of 0 to 30,000 meters. At the threshold of high wind conditions, 12 mph, concentrations drop by a factor of 10 between 0 and 500 meters, between 500 and 2,800 meters, and between 2,800 and 30,000 meters. In other words, emissions from sources proximate to or within 500 meters upwind of a monitoring station will overwhelm the emission contributions of sources more than 500 meters upwind.

The trends of modeling results were analyzed using the curve-fitting functions of Excel. In the first analytical series, plots of PM-10 concentrations vs. downwind distance were mapped for the wind speeds of 12, 16, 20, and 24 mph. These plots are shown in Figure V-2.

Figure V-2
Relationship Between PM-10 Concentration and Source Distance at Different Wind Speeds



This progression of plots includes the best fit curve statistics for each AERMOD wind speed. Because of the rapidity at which concentrations decline with increasing downwind distance, a power curve was found to provide the best equation fit to these data. From observation, the correlation coefficients (r^2) of these plots are very high—exceeding 0.96 in all cases. Similarly, the exponent of x in each best fit power curve hovers near -1.9, suggesting that concentrations roughly decline with downwind distances on a $1/x^2$ basis.

Further analysis of the modeling data, however, suggests a somewhat different picture. In each of the plots in Figure V-2, modeling results straddle the best fit curve in a sinusoidal fashion. The first plot in Figure V-2, that of the 12 mph modeling results, was disaggregated into separate sinusoid cycles to determine whether the power equation exponent remained constant over each block of downwind receptors contained within a cycle. The sinusoid cycles were chosen to encompass the receptor intervals of 0 to 1,000 meters; 1,000 to 3,000 meters; 3,000 to 15,000 meters; and 15,000 to 30,000 meters. The resulting plots of PM-10 concentration vs. distance are presented in Figure V-3.

The plots in Figure V-3 show similarly high r^2 values, but the power exponents vary substantially from -0.2 to -1.2. Also, the trend in power exponents is somewhat linear, starting at the high end of -1.233 for receptors in the 0 to 1,000 meter range, and steadily decreasing to -0.173 in the 15,000 to 30,000 meter range. These results point dramatically to a concentration-distance relationship much closer to 1/x than $1/x^2$, especially in the critical zone of nearest receptors, from 0 to 1,000 meters, in which source impacts significantly overwhelm the contributions of sources farther upwind of a receptor.

A similar, but less dramatic, result is seen when the modeling data are evaluated over different portions of the right tail (i.e., toward increasing distances) of these plots in Figure V-2. This analysis was conducted to determine the effect of removing the highest—and most dominant—concentrations reported for near-downwind receptors from the analysis in order to study that portion of the curve with the flatter gradient. In this analysis, power equation curves were fitted to the distributions of PM-10 concentrations (1) over the full range of receptors, (2) over the range of receptors equal to or greater than 500 meters downwind of the source, (3) equal to or greater than 1,000 meters downwind, (4) equal to or greater than 2,000 meters downwind, and (5) equal to or greater than 4,000 meters downwind. The plots of these ranges are shown in Figure V-4.

The power curve statistics of plots in Figure V-4, like those in Figure V-3, show a declining trend in negative power curve exponents with increasing distance, but also stable and very high values of r^2 with increasing distance. Over the full range of receptors, the power curve exponent is -1.803, again suggesting a roughly $1/x^2$ relationship of PM-10 concentration with increasing downwind distance. Excluding the receptors within 500 meters of the source, however, causes the exponent to decline to -1.391. Removing receptors within 1,000 meters, 2,000 meters, and 4,000 meters of the source causes the power curve exponent to drop to -1.098, -0.825, and -0.504, respectively. These exponents conversely suggest rough relationships between PM_{10} concentration and distance of 1/x to $1/\sqrt{x}$.

Figure V-3
Relationship between PM-10 Concentration and Source Distance Increments at 12 mph Wind Speed

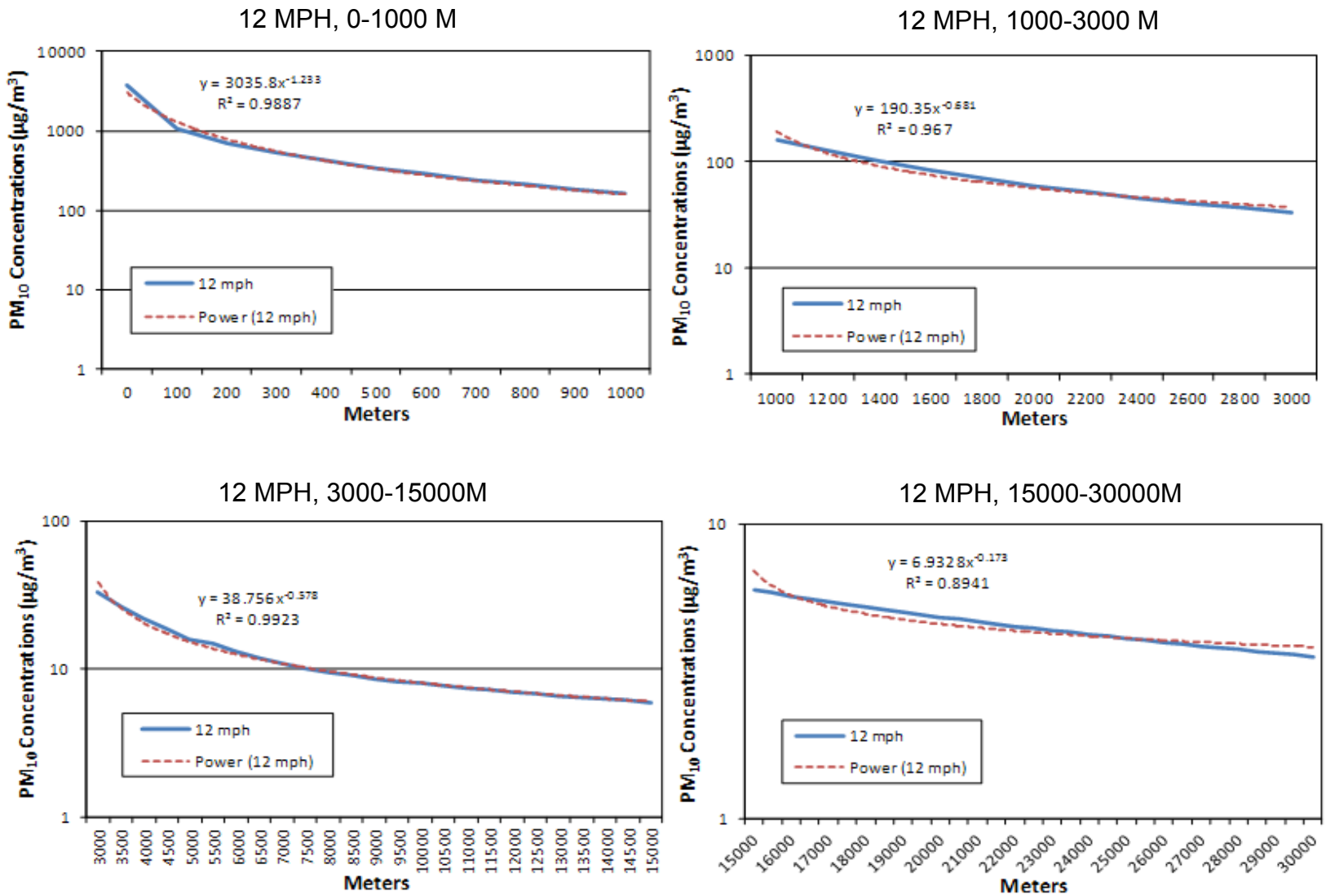
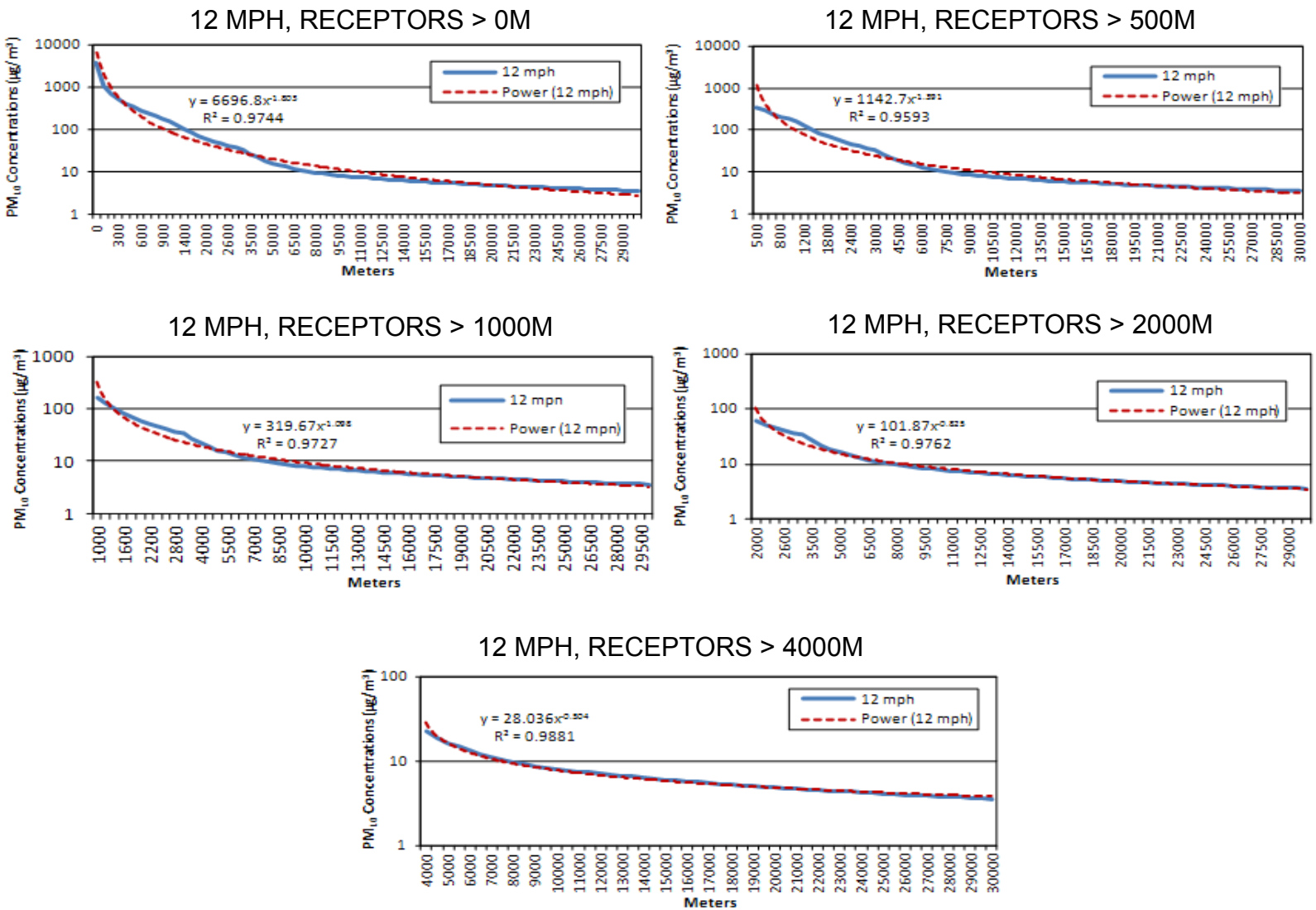


Figure V-4
Relationship between PM-10 Concentration and Increasing Source Distances at 12 mph Wind Speed

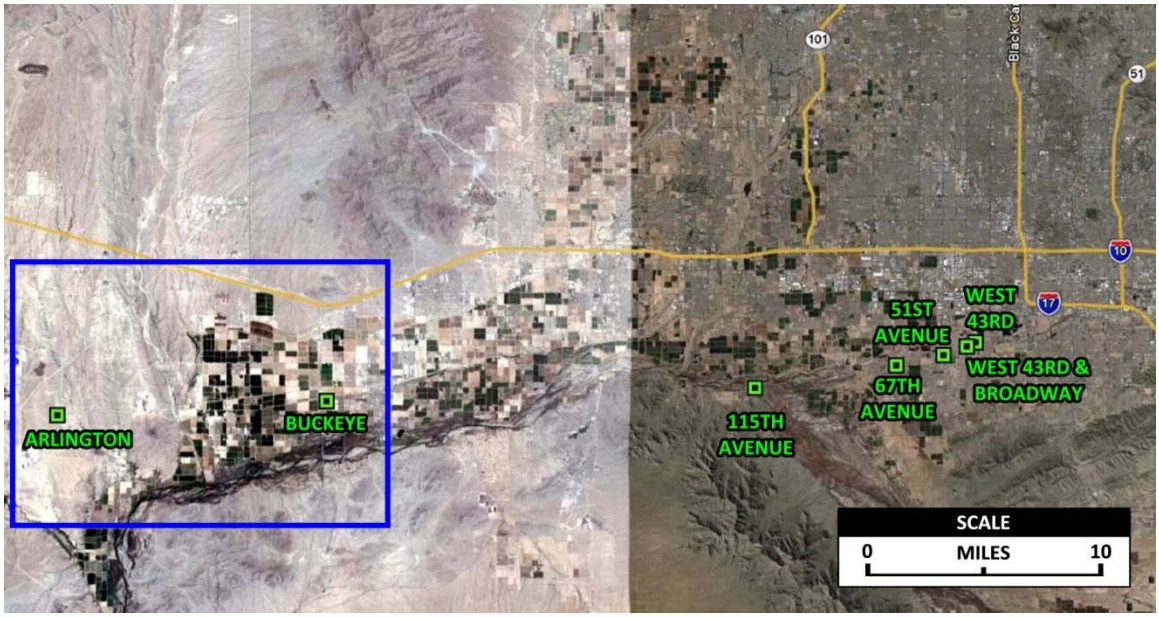


Without question, receptors close to an upwind source will be much more dramatically impacted by emissions from that source—emission rates being equal—than by similar sources at increasing distances upwind of receptors. As a result, the power curve exponents produced by the modeling of impacts in the near downwind field (0 to 1,000 meters) from this modeling analysis must be given greatest weight because of the exponentially smaller impacts at receptors at greater downwind distances. The first curve in Figure V-3 represents this receptor interval, and reports a power curve exponent of -1.233. Because the remainder of the plots report exponents straddling this value, this exponent represents the best singular value for the adjustment of downwind concentrations with increasing distance. Also, because of the range of exponents reported in these plots, an exponent of -1.0—equivalent to 1/x—is reasonably equivalent and should be used to adjust windblown dust emission impacts with increasing downwind distance in any modified rollback analysis in the Salt River area.

BACKGROUND CONDITIONS

As discussed in the section addressing Temporary Monitoring Insights, Maricopa County, with support from the Arizona Department of Environmental Quality (ADEQ) and the Maricopa Association of Governments (MAG), deployed a series of temporary PM-10 monitors along the dominant upwind trajectory in the spring of 2010. A total of five temporary monitors were deployed at the following sites: Arlington, 115th Avenue, 67th Avenue, 51st Avenue, and West 43rd & Broadway. The locations of the five temporary monitors and two nearby long-term monitors, Buckeye and West 43rd Avenue, are displayed in Figure V-5.

Figure V-5
Location of Temporary and Long-Term PM-10 Monitoring Sites



The Arlington monitor is located west of Buckeye, beyond the edge of active agricultural/irrigation land, both are highlighted in Figure 1. Data collected at the Arlington site are intended to provide insight into non-anthropogenic concentrations coming in from the desert. Despite its remote location, there are a number of sources located to the west of the site that impact monitored concentrations—examples include the Palo Verde Nuclear Generating Station, located three miles to the west/northwest; and the Mesquite Power Plant, located three miles to the southwest. All of the remaining monitors are directly impacted by emissions from upwind anthropogenic sources. Buckeye, located 11 miles east of Arlington, is the nearest monitor and is surrounded by agricultural lands.

Temporal Variations

Figures V-6 and V-7 compare wind speed, wind direction, and concentrations recorded at the Arlington, Buckeye, and West 43rd Ave. monitoring sites for two separate episodes that occurred on April 28-29, 2010, and May 22-23, 2010, respectively.

Because wind speed and wind direction were not recorded at the Arlington site, wind speed and wind direction data from the Buckeye and West 43rd monitors were used instead. Both low and high wind speeds were observed during these high wind events. During low winds, the wind direction showed considerable variation, coming from all directions; however, during high winds (wind speed > 12mph), constant west and southwest wind flow was observed. These wind flows represent the frontal winds coming from the west, the dominant direction for high wind events. During the high wind periods, PM-10 spikes were observed at all three sites, with much higher PM_{10} concentrations usually observed at the Buckeye and West 43rd monitors than at Arlington. Clearly, the lower values recorded at Arlington are more representative of PM-10 background concentrations transported by frontal winds coming in off the desert. Those values, however, may be impacted by upwind anthropogenic sources—additional analysis of concentrations as a function of wind direction is needed to assess their impacts.

Data Analysis

Differences between matched pair measurements from Arlington and Buckeye were calculated to provide insight into which upwind sources could be impacting Arlington concentrations. The data were organized into five-degree increments so the concentration differences could be computed as a function of wind direction and wind speed. Only measurements with wind speeds greater than 12 mph were used to represent the high wind events. The five-degree angular values for measurement count and average PM-10 and related standard deviations are presented in Table V-11. The angular direction traveling from the Arlington monitor to the Buckeye monitor is about 265°. The results show that average PM-10 concentrations at the Arlington monitor are consistently lower than the Buckeye monitor within an arc between 230° and 290°. This indicates that fugitive dust emissions east of Arlington are impacting the Buckeye monitor.

Figure V-6
Comparison of WD, WSPD and PM-10 Observations at Arlington, Buckeye and West 43rd Monitoring Sites During 4/28/2010 - 4/29/2010 High Winds Events

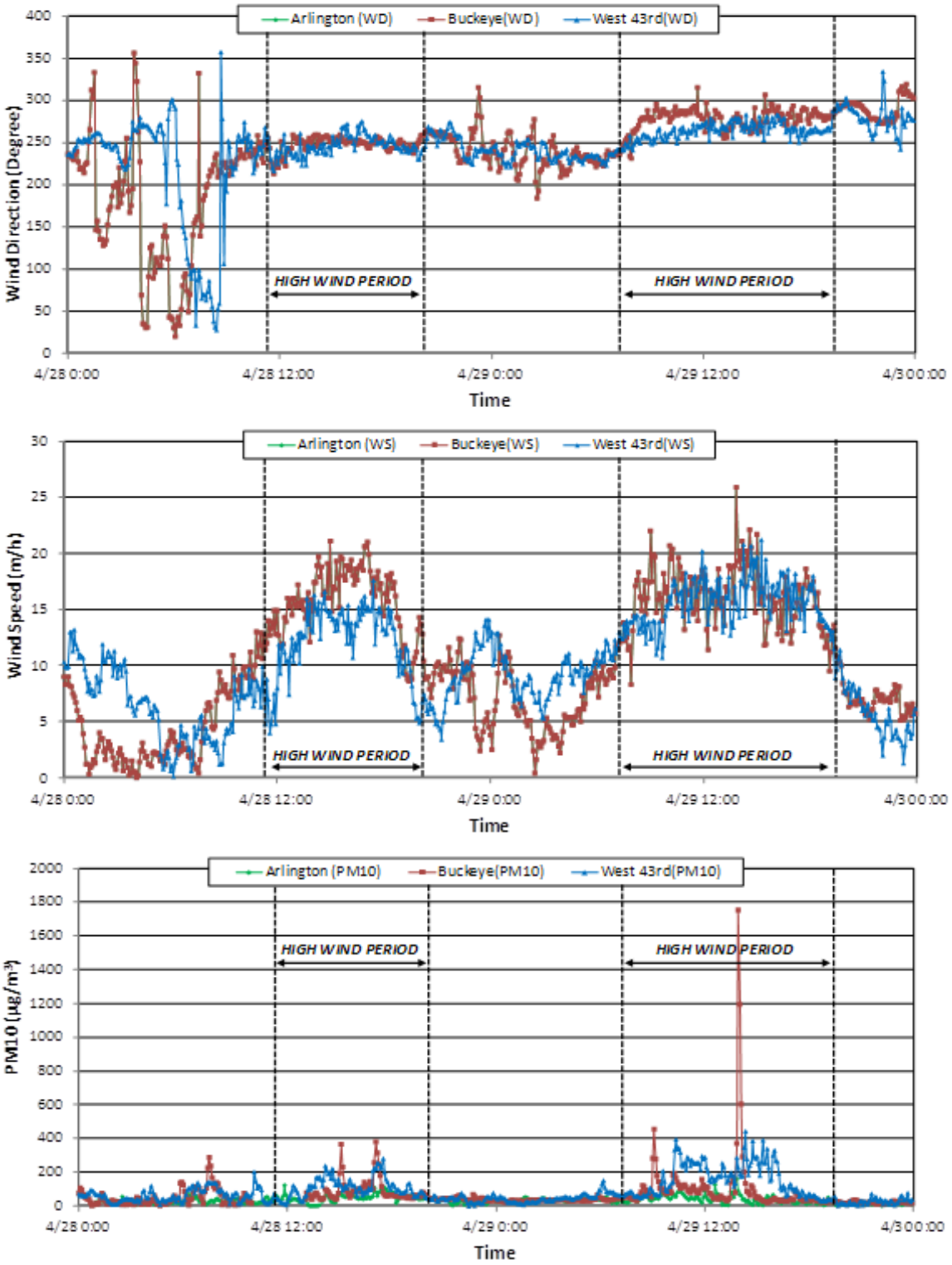
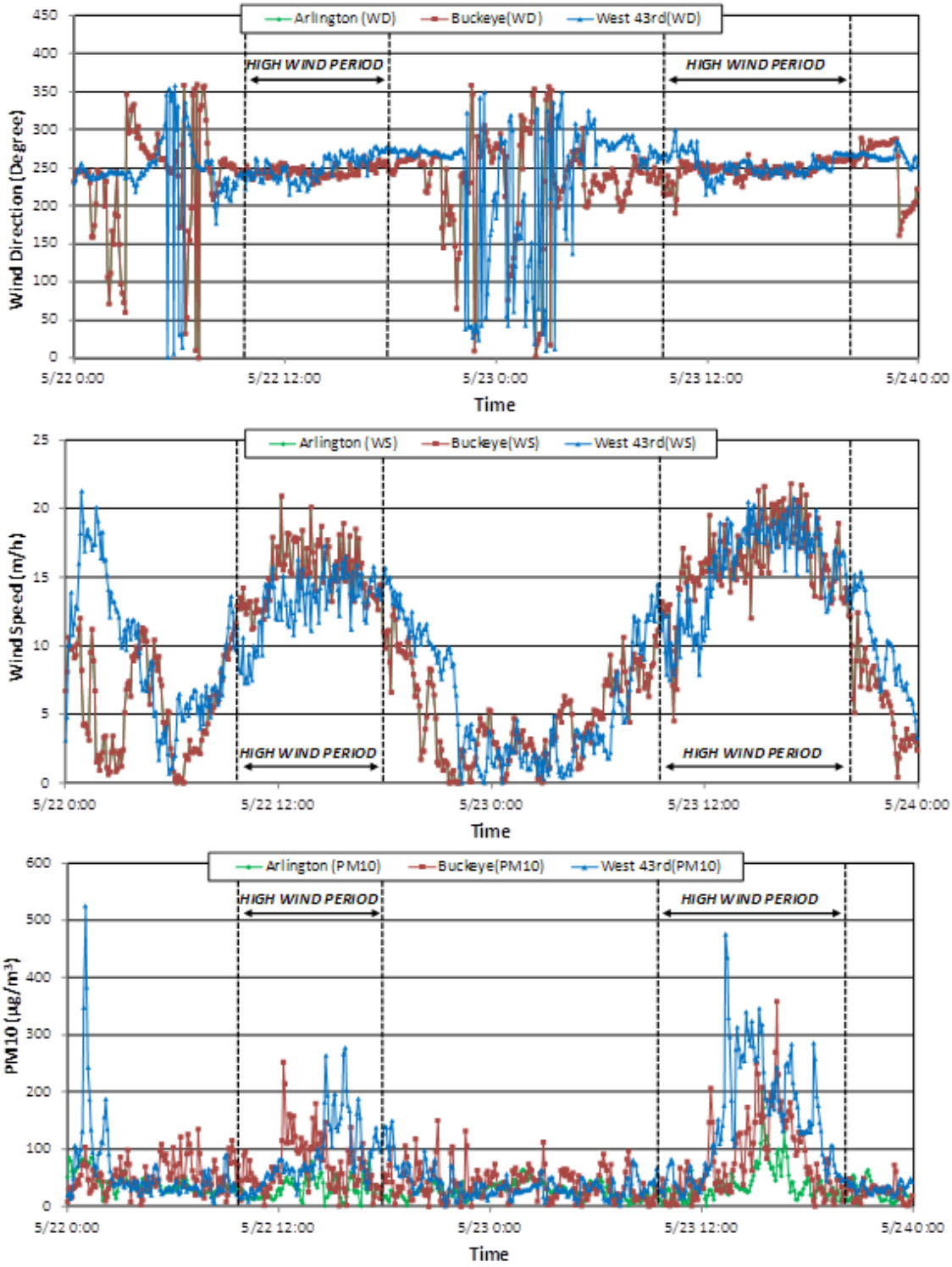


Figure V-7
Comparison of WD, WSPD and PM-10 Observations at Arlington, Buckeye and West 43rd Monitoring Sites During 5/22/2010 - 5/23/2010 High Winds Events



If a monitor is overwhelmed by emissions from nearby sources during high wind events, the variability of PM-10 over the shortest averaging periods (the five-minute data) should be greater (due to the equivalent variability of soil emissions forced by ground-level turbulence) than the corresponding variability computed at a station that is impacted by more distant sources (whose emissions disperse axially along the plume centerline, in addition to vertically and horizontally, thus reducing significant variations). Data for PM-10 at each five-degree angular direction (Table V-11) show that when the wind comes from Arlington to Buckeye (230° to 290°), the standard deviations for the Arlington monitor are usually, but not always, lower than the Buckeye monitor values.

Table V-11
Angular Comparison of Matched Five-Minute PM-10 Concentrations Collected at Arlington and Buckeye Monitors When Winds Are Greater Than 12 mph

WD Sector (Degree)	Measurement Count	Arlington (μg/m^3)	Buckeye (μg/m^3)	Difference (μg/m^3)	Standard Deviation (Arlington)	Standard Deviation (Buckeye)
0	2	233.7	314.1	80.4	31.3	427.6
10	1	18	19.9	1.9	N/A	N/A
20	2	41.6	30.4	-11.3	35.2	12
25	5	25.4	27.1	1.8	12.8	9.2
30	23	21.3	24	2.7	20.2	9
35	24	17.1	39.4	22.3	9.1	19.5
40	29	17.3	29.6	12.3	9.6	7.7
45	21	19.1	26.9	7.8	8.7	7.5
50	11	21.3	29.9	8.7	10.6	4
55	3	28.8	40.3	11.6	22.4	18.6
75	2	33.4	36.5	3.1	17.5	15.5
80	3	32.3	33.5	1.3	17.8	19.5
85	1	36.6	20.8	-15.8	N/A	N/A
90	1	19.9	29.5	9.6	N/A	N/A
140	1	88.1	107	18.9	N/A	N/A
155	1	122.8	563.2	440.4	N/A	N/A
185	7	40.4	27.7	-12.7	19	13.1
190	4	45.7	50.1	4.4	12.4	31.9
195	6	65.3	60.9	-4.5	74.2	61.9
200	16	55.4	118.6	63.2	67.5	178.5
205	24	55.4	85.4	30	79	136.7
210	26	33.6	80.4	46.8	28.6	190.7
215	36	42.8	60.8	17.9	71.1	54.8
220	36	68.8	84.4	15.7	119.5	67.5
225	32	49.2	44.3	-4.8	80.8	47.9
230	30	34.7	64.2	29.5	36.7	59.3
235	66	44.9	74	29.2	43.7	46.3
240	119	37.5	79.6	42.2	43.8	50.3
245	136	46.4	84.7	38.3	81.9	64.2

WD Sector (Degree)	Measurement Count	Arlington (µg/m^3)	Buckeye (µg/m^3)	Difference (µg/m^3)	Standard Deviation (Arlington)	Standard Deviation (Buckeye)
250	122	38.9	71.5	32.5	38.4	55.5
255	110	28.7	51	22.3	25.5	38.1
260	48	35.2	85.5	50.3	48.3	196.4
265	66	36.7	83.6	46.9	52.6	196.7
270	58	37.5	62.2	24.7	46	96.4
275	43	127.9	141.2	13.4	375.5	224.9
280	54	78.2	136.9	58.8	146.4	288.1
285	55	94.2	169	74.8	155.8	243.4
290	45	107.2	157.3	50.1	199.8	195.8
295	19	110.7	105.8	-4.9	174.5	151.2
300	8	298	191.2	-106.8	406.6	293.6
305	4	414.4	234.6	-179.8	321.5	193.4
310	5	217	240.8	23.8	286.5	319.5
315	14	347.7	270.6	-77.1	523.8	406.2
320	18	369.7	188.6	-181.1	653.1	288.7
325	27	473.6	184.1	-289.5	974.7	225
330	27	78.1	50.3	-27.8	180.2	95.8
335	16	26.8	35	8.1	21.5	30.5
340	20	24.6	54.6	30	30.6	131.1
345	11	30.4	36.5	6	21.7	36.8
350	1	16.6	25.1	8.5	N/A	N/A
355	4	149.4	67.9	-81.6	132.9	101.8

Calculation of High Wind Background Concentrations

As shown by the measurement count data in Table V-11, the most common direction of high winds was from the west and southwest (from 200° to 300°). Much lower PM-10 concentrations were observed at both sites when the wind came from the southwest (200° to 270°), whereas the opposite is true when the wind came from the northwest (270° to 300°). For Arlington, the Palo Verde Nuclear Generating Station, located to the northwest (270° to 325°), appears to be the source of elevated concentrations. Similarly, the Mesquite Power Plant located to the southwest (245° to 250°) appears to be the cause of the higher PM-10 standard deviation at the Arlington monitor relative to Buckeye.

Another consideration is that the distance from the Arlington site to the Buckeye site is roughly 11 miles. Any comparison between the two sites should be offset to account for the time it takes for the wind to travel between the two sites. The values presented in Table V-11 did not address this offset. Still another consideration is the magnitude of the concentrations recorded at the two sites. Given the differences in sources surrounding the two sites, the concentrations located at Arlington should always be lower than those recorded at Buckeye for individual matched/offset five-minute pairs since the wind should be picking up anthropogenic emission located between the two sites.

In light of these considerations, the following steps and criteria were used to select the data used to quantify high wind background concentrations:

- Wind speed greater than 12 mph at both the Arlington and Buckeye monitors;

- Consistent with the methodology employed in the temporary monitoring analysis, measurements at Arlington were lagged 45 minutes to account for the time it takes for air mass to travel the 11 miles to Buckeye along the 260 degree angle between the two sites (it takes 45 minutes to travel that distance with a wind speed of 15.2 mph, the value computed for winds in excess of 12 mph along that angle);

- 230° < WD < 245°, and 250°<WD<270° (Figure V-9) at the Arlington monitor and at the one-hour-lagged Buckeye monitor; and

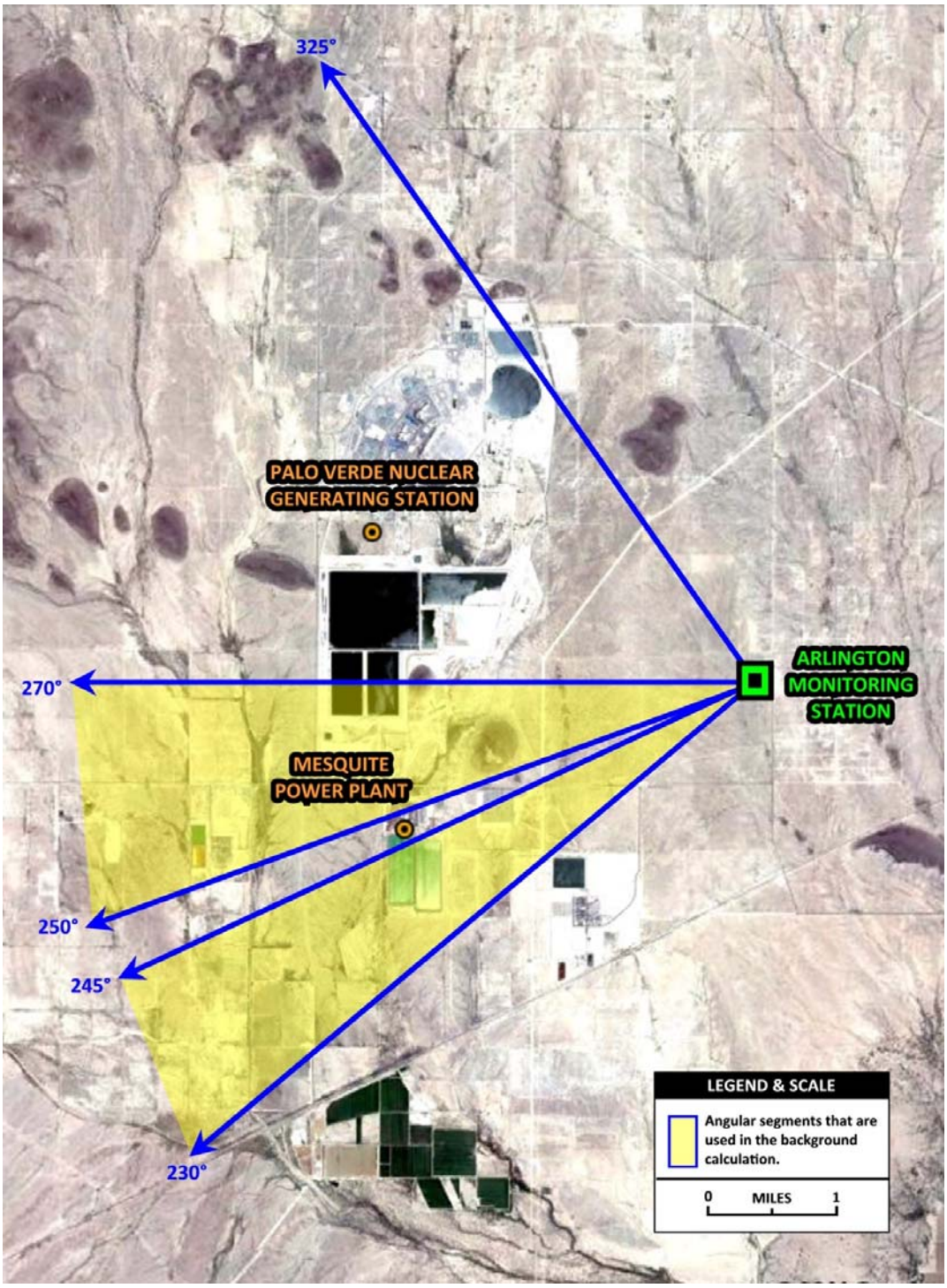
- Exclusions of data points where the concentration at Arlington was greater than that at the Buckeye monitor.

These criteria selected a total of 400 pairs of offset (i.e., lagged) five-minute data at the Arlington and Buckeye monitoring sites. The average concentration computed from the selected Arlington data was 27.8 $\mu g/m^3$; the median concentration was 21.9 $\mu g/m^3$. The difference between these values indicates that the distribution of concentrations (and related wind speeds) is not uniform above 12 mph. Since a higher proportion of the data is based on lower wind speeds which produce lower concentrations, the median value is considered to be a more representative measure of non-anthropogenic high wind background PM-10 concentrations impacting the MAG nonattainment area. A summary of the selected five-minute pairs at the two sites is presented in Table V-12. When contrasted with the values in Table V-11, it shows that the above criteria reduced both the counts of available data and the concentrations recorded at the Arlington site. Figure V-8 presents a plot of the angular segments included and excluded from the datasets included in Table V-12.

Table V-12
Data Used to Calculate High Wind PM-10 Background Concentrations

WD Sector (Degree)	Measurement Count	Arlington (µg/m^3)	Buckeye (µg/m^3)	Difference (µg/m^3)	Standard Deviation (Arlington)	Standard Deviation (Buckeye)
230	22	27.1	73.5	46.4	20.5	62.4
235	46	27.4	66.6	39.2	18.8	38.2
240	97	31.1	79.6	48.4	28.2	48.5
245	0	N/A	N/A	N/A	N/A	N/A
250	88	31.1	72.7	41.5	31.6	59.2
255	80	25.7	61.5	35.8	21.9	42.8
260	29	19.5	47.4	27.9	22.3	38.5
265	33	23.7	51.2	27.5	20.3	55.8
270	5	17.9	32.9	15.0	15.3	20.1
Total/Average	400	27.8	67.4	39.6	25.5	50.4
Median	N/A	21.9	55.6	33.7	N/A	N/A

Figure V-8
Close-In View of Arlington Temporary Monitor and Angular Segments Included and Excluded from the Background Calculations



Calculation of Low Wind Background Concentrations

The Arlington monitoring data can also be used to quantify non-anthropogenic concentrations coming in from the desert during low wind conditions. Table V-13 lists the five-degree angular values for measurement count, average PM-10, and related standard deviations for low wind conditions (wind speed <=12mph) at the Arlington and Buckeye monitoring sites. It shows that Arlington concentrations are consistently lower than Buckeye at any given five degree segment. The lowest Arlington values occur when wind is coming from the west and southwest (from 200° to 325°). As noted earlier, the upwind sources from this wind direction are mostly non-anthropogenic, except for the Palo Verde Nuclear Generating Station and the Mesquite Power Plant. Impacts from these facilities are much less evident in the data as there is no significant concentration increase; the same is true for standard deviations, with a few notable exceptions (e.g., 290º). It is also more difficult to relate the data at Arlington to Buckeye because the wind direction shifts more frequently, and it takes longer for air parcels to travel from Arlington to Buckeye at lower wind speeds. For this reason it was determined that the selection of Arlington values should not be conditioned on Buckeye measurements.

- Given these considerations, the following steps and criteria were used to select the data used to quantify low wind background concentrations:

- Wind speed less than or equal to 12 mph at Arlington monitor; and 230° < WD < 245°, and 250°<WD<270° (Figure V-8) at the Arlington monitor (to be consistent with high wind background calculation).

These criteria selected a total of 17,381 values at Arlington. The average concentration computed from the data was 18.2 $\mu g/m^3$; the median concentration was 14.9 $\mu g/m^3$. The difference between these values indicates that the distribution of concentrations is not uniform at wind speeds below 12 mph. Similar to the high wind analysis, the median value is considered to be a more representative measure of non-anthropogenic low wind background PM-10 concentrations impacting the MAG nonattainment area. A summary of the selected five-minute values is presented in Table V-14.

Table V-13
Angular Comparison of Matched Five-Minute PM-10 Concentrations Collected at Arlington and Buckeye Monitors When Winds Are Less Than 12 mph

WD Sector (Degree)	Measurement Count	Arlington (µg/m^3)	Buckeye (µg/m^3)	Difference (µg/m3)	Standard Deviation (Arlington)	Standard Deviation (Buckeye)
0	871	24.6	49.3	24.7	39.0	78.2
5	929	23.5	48.2	24.8	27.9	102.5
10	956	25.1	44.4	19.4	21.7	48.7
15	941	27.3	44.8	17.5	59.7	67.1
20	961	26.0	45.4	19.3	37.0	46.5
25	861	23.2	40.6	17.4	18.9	44.1
30	950	25.3	37.7	12.3	84.2	37.6
35	1035	25.5	40.7	15.2	29.9	60.2
40	1154	26.1	39.0	12.9	50.2	54.2
45	1366	27.6	40.5	12.9	113.2	57.0
50	1592	30.8	37.7	6.9	220.0	51.1
55	1924	33.1	36.3	3.2	152.4	44.7
60	2333	32.8	36.6	3.8	89.4	38.1
65	2423	32.1	36.7	4.6	118.1	36.9
70	2716	31.7	38.0	6.3	76.8	45.2
75	3066	31.5	40.4	9.0	67.5	36.4
80	3027	32.6	40.1	7.5	102.7	32.6
85	2433	30.5	42.2	11.8	26.5	39.0
90	1929	29.5	41.1	11.6	27.2	39.6
95	1682	29.5	42.1	12.6	26.0	45.3
100	1400	28.9	39.4	10.5	29.0	34.9
105	1158	32.9	40.0	7.1	125.3	30.8
110	950	26.7	40.5	13.8	22.1	34.2
115	739	24.5	40.8	16.3	20.4	42.4
120	587	25.4	39.8	14.3	20.8	32.2
125	553	25.7	42.5	16.8	19.7	38.7
130	475	28.0	42.9	14.9	83.9	81.5
135	480	22.6	37.2	14.6	17.5	35.9
140	475	22.3	36.3	14.1	19.5	34.4
145	480	23.2	38.5	15.3	20.8	36.6
150	473	21.5	41.9	20.4	15.9	81.1
155	520	22.0	42.2	20.1	19.4	52.8
160	475	21.8	39.1	17.3	29.2	62.3
165	458	20.5	36.2	15.7	16.8	36.1
170	466	21.3	36.0	14.7	15.0	32.0
175	470	20.8	33.5	12.7	19.7	34.8
180	465	21.1	34.6	13.5	15.9	32.3
185	508	32.3	33.8	1.5	222.4	31.8
190	507	20.2	32.8	12.7	14.9	37.3

WD Sector (Degree)	Measurement Count	Arlington (µg/m^3)	Buckeye (µg/m^3)	Difference (µg/m3)	Standard Deviation (Arlington)	Standard Deviation (Buckeye)
195	630	20.8	31.3	10.5	17.9	36.8
200	687	20.9	34.3	13.4	16.4	54.3
205	774	19.5	33.1	13.6	13.5	44.4
210	832	20.0	31.6	11.6	17.4	33.0
215	994	19.4	30.7	11.3	16.9	32.5
220	1249	18.1	29.0	10.9	14.2	28.3
225	1331	19.2	30.2	11.0	18.3	28.4
230	1539	18.8	33.9	15.0	22.6	32.3
235	2073	17.4	35.2	17.8	12.2	32.2
240	2434	19.1	36.7	17.7	33.4	37.7
245	2347	17.7	36.4	18.6	16.7	37.6
250	2547	18.3	37.6	19.3	24.4	46.4
255	2688	18.0	34.6	16.6	45.7	34.1
260	2489	17.7	32.2	14.4	20.2	33.3
265	1939	18.0	32.2	14.2	20.2	34.6
270	1672	18.3	32.5	14.2	17.5	32.3
275	1723	18.1	34.2	16.1	14.2	36.8
280	1543	18.8	32.3	13.5	17.1	28.7
285	1544	18.4	32.2	13.8	16.1	27.3
290	1405	21.6	35.2	13.6	100.7	61.7
295	1258	18.2	35.9	17.7	14.4	56.8
300	1132	19.6	34.7	15.1	25.9	35.7
305	1134	19.1	35.7	16.6	19.5	35.1
310	1138	19.1	40.1	21.0	15.8	49.7
315	1182	19.0	39.7	20.7	13.5	49.7
320	1291	18.4	37.0	18.5	14.3	41.1
325	1184	20.1	37.6	17.5	17.6	38.6
330	1268	19.9	40.4	20.5	16.2	71.8
335	1228	20.7	39.7	19.0	17.0	52.9
340	1216	20.2	42.9	22.7	14.9	67.3
345	1091	22.2	43.2	21.0	25.6	71.2
350	1037	21.7	43.9	22.3	20.2	51.1
355	868	21.6	42.1	20.5	18.3	48.6

Table V-14
Data Used to Calculate Low Wind PM-10 Background Concentrations

WD Sector (Degree)	Measurement Count	Arlington ($\mu g/m^3$)	Standard Deviation (Arlington)
230	1539	18.8	22.6
235	2073	17.4	12.2
240	2434	19.1	33.4
245	0	N/A	N/A
250	2547	18.3	24.4
255	2688	18	45.7
260	2489	17.7	20.2
265	1939	18	20.2
270	1672	18.3	17.5
Total /Average	17381	18.2	27.6
Median	N/A	14.9	N/A

DESIGN DAY SELECTION

This section describes the process used to select design days for the PM-10 attainment demonstration in the Maricopa nonattainment area. It identifies three wind speed regimes that are responsible for PM-10 exceedances in 2007, the year just prior to implementation of new control measures under the 2007 Five Percent Plan. Since exceedances under low wind or stagnant conditions have been curtailed by existing controls, the design day selection is only focused on high wind days. The analysis first eliminates exceedance days that do not qualify for consideration, then weights the remaining days according to 24-hour average PM-10 concentration, exceedance location, and the number of stations exceeding on each day. The end result is that June 6, 2007, is recommended as the design day for the Maricopa PM-10 nonattainment area, and May 4, 2007, is recommended as the design day for the Salt River modeling domain.

Introduction

An attainment demonstration requires a baseline, or design day, starting point. Selecting one or more design days for a PM-10 attainment demonstration in the Maricopa area is a non-trivial exercise, given the existence of high wind days— when some of the highest PM-10 concentrations are recorded—that may qualify for exceptional event status under EPA guidelines. This analysis examines all exceedances that were recorded in the Maricopa area in 2007 and evaluates which of these are best qualified for a high wind design day selection.

Exceedance Days

The selection of PM-10 design days was limited to exceedance days recorded in 2007. This year was selected because it was the last full year prior to the implementation of control measures under the MAG 2007 Five Percent Plan, which was adopted in December 2007. During 2007, exceedances of the 24-hour federal PM-10 ambient air quality standard were recorded at six monitoring sites in the Maricopa PM-10 nonattainment area. These sites included Coyote Lakes, Central Phoenix, Durango, Higley, South Phoenix, and West 43rd Avenue. The Buckeye station also exceeded the standard on two days in 2007, but this monitor is outside the nonattainment area and therefore was not modeled in this plan. A listing of exceedance days by monitoring site, together with 24-hour average concentrations and the general meteorological conditions, is presented in Table V-15.

Table V-15
24-Hour Average NAAQS Exceedance Dates, Measured Concentrations and Associated Meteorological Conditions in 2007

Monitor	Date	PM-10 Conc. (µg/m^3)	Meteorological Conditions
Buckeye	July 19	195.0	Low Winds
	November 15	166.2	Irregular Winds
Coyote Lakes	July 19	273.4	Thunderstorm Outflow
	October 21	312.9	Frontal System High Winds
Central Phoenix	July 19	267.8	Thunderstorm Outflow
Durango Complex	November 15	155.7	Irregular Winds
Higley	***June 6***	***181.0***	***Frontal System High Winds***
	July 19	199.5	Thunderstorm Outflow
	August 16	195.6	Thunderstorm Outflow
	August 23	230.4	Thunderstorm Outflow
	October 24	174.8	Frontal System High Winds
South Phoenix	April 12	171.1	Frontal System High Winds
	August 13	159.5	Thunderstorm Outflow
West 43rd Avenue	March 27	227.9	Frontal System High Winds
	April 12	202.7	Frontal System High Winds
	May 4	***197.3***	***Frontal System High Winds***
	June 6	***225.7***	***Frontal System High Winds***
	July 19	178.0	Thunderstorm Outflow
	August 16	215.1	Thunderstorm Outflow

Note: The selected design days are highlighted in bold italics and gray shading. The Buckeye monitor is located outside the PM-10 nonattainment area and is not part of this design day analysis. The Coyote Lakes monitor was a special purpose monitor that no longer operates and has since been replaced by the Zuni Hills monitor in late 2009. As such, the Coyote Lakes monitor is not a good candidate for the development of a design day.

Wind Regimes

All of the exceedances but one occurred on high wind days. The single exception was July 19, 2007, at the Buckeye station. A high wind day is defined as any day in which five-minute average wind speeds exceed 12 mph. This cut-point is based upon the work done in developing the windblown dust emissions inventory in the 2008 Periodic Emissions Inventory (Appenidx A, Exhibit 1) which shows that generation of windblown dust emissions on average (throughout the nonattainment area) occurs when five-minute wind speeds exceed 12 mph. Since not all of the monitoring stations have access to five minute data, days in which the hourly average wind speed is above 12 mph are thus qualified as high wind days, as a conservative metric. High wind conditions generally occur in the Maricopa area under one of two different meteorological regimes: frontal system passage and thunderstorm outflow. Frontal systems passing over the Maricopa area produce high winds because of the pressure differences across the front. Air masses move from areas of high pressure to areas of low pressure, generating winds whose strengths are

dependent on the differences in pressure. Because the leading edges of frontal systems extend for hundreds of miles, the movements of frontal systems produce high winds over large areas. In the Maricopa area, this phenomenon is characterized by rapid increases in wind speeds almost simultaneously at many monitoring stations, followed by elevated wind speeds for several hours afterward as fronts move slowly over the urban area. Depending on the strength of the winds associated with a frontal passage, such an event may overcome the capability of BACM to protect soil surfaces from dust entrainment. When this happens, the event may qualify as an exceptional event under EPA guidance.

Thunderstorm outflows, or monsoon winds, produce high velocity winds that are shorter lived and less geographically expansive than those produced by the passage of frontal systems. Thunderstorm outflows result from the strong downflows that occur when a thunderhead collapses. The downflows have sufficient velocity to cause sand saltation and dust entrainment in areas at the bases of thunderstorms and along the paths of travel as the downflows expend energy. Both undisturbed desert soils and disturbed soils controlled by BACM generate significant quantities of PM-10 emissions during these events. As a result, high PM-10 concentrations resulting from thunderstorm outflows may qualify for exceptional event status under EPA guidelines.

The July 19, 2007 exceedance at the Buckeye monitor occurred during a period of relatively low wind conditions at this site. The low hourly average wind speeds and peak gust velocities that occurred in the early morning hours of this day at Buckeye suggest that mechanical disturbance—such as by nighttime plowing of fields—was responsible for elevated PM-10 concentrations from midnight to 7:00 am, when the highest concentrations of the day were recorded. Meteorological conditions on days such as July 19, 2007, do not qualify as exceptional events but rather are candidates for design days at stations within the nonattainment area. Because the Buckeye station is outside the nonattainment area, July 19, 2007, is not a design day candidate.

The November 15, 2007 exceedance at the Buckeye and Durango monitors occurred under a mix of low and high wind speeds. Concentrations were elevated throughout the nonattainment area on this day, suggesting a mix of regional and local sources contributed to the exceedances. The exceedance at Buckeye is not a candidate for a design day as it is outside the nonattainment area. The exceedance at Durango barely exceeded the standard (155.7 $\mu g/m^3$), making it a poor candidate for a design day as even the slightest control measure would result in attainment of the standard. Given the rare mix of both low and high wind elevated concentrations, a day like this is unlikely to recur, and indeed has not been replicated since.

<u>Monsoon Days</u>

The days on which monsoon, or thunderstorm outflow, winds occurred are possible candidates for exceptional event status and not good candidates for design day status. These days are distinguished from frontal events that usually occur in spring or fall as a transport of dust from source regions outside the nonattainment area is clearly associated

with monsoon events. On these days, exceptionally high gust velocities occurred for brief durations— typically only an hour or two—that entrained dust from all types of exposed soils, including undisturbed desert soils. Additionally, the source area of the thunderstorm outflows on these days originated in the natural desert areas outside of the PM-10 nonattainment area, transporting large to massive amounts of dust into the PM-10 nonattainment area. The days on which these conditions occurred were July 19 and August 13, 16, and 23, 2007. On July 19 and August 16, 2007, peak gust velocities exceeded 40 mph for one or two hours and caused hourly PM-10 concentrations to rise to levels in the range of 1,700 to 4,000 µg/m^3 at the stations with meteorological towers that recorded exceedances (Central Phoenix, Higley, and West 43rd Avenue). Although these sharp rises in concentration occurred only for an hour or two, the magnitudes were sufficient to cause the 24-hour average on that day to exceed the standard. These days, at these stations, would not have been exceedances but for the contributions generated by thunderstorm outflow winds.

Peak gust velocities were lower on August 23, 2007, at the Higley monitor, but hourly PM-10 concentrations still rose and fell with the arrival of the dust front associated with a thunderstorm outflow that had begun to lose strength once encountering the urban edge of the nonattainment area.. The peak gust velocity ranged between 17 and 28 mph from 8:00 pm to 11:00 pm, as hourly PM-10 concentrations hovered between 900 and 1,800 µg/m^3. The pattern of average wind speed, peak gust velocity, and PM-10 concentration during these three hours strongly suggests the contribution of transported particulate to the monitor from outside the immediate area. These trends are displayed in Table V-16.

Table V-16
Hourly PM-10 Concentrations and Wind Speeds at the Higley Monitor at 8:00 – 11:00 PM on August 23, 2007

Hour	Hourly PM-10 µg/m^3	Avg. Hourly Wind Speed, mph	Peak Gust Speed, mph
7:00 PM	73.7	4.8	27.2
8:00 PM	1865.1	9.2	28.7
9:00 PM	916.9	2.2	9.9
10:00 PM	1065.8	4.3	17.1
11:00 PM	595.2	6.1	13.8

In the hour between 7:00 and 8:00 pm, wind gust speeds rose dramatically near the end of the hour, causing the peak to reach 27.2 mph while the hourly average wind speed remained relatively low at 4.8 mph. In the following hour, gust velocities remained elevated while the average wind speed climbed to 9.2 mph and the hourly PM-10 concentration climbed to 1,865 µg/m^3. Then, in the next hour, both gust speeds and the average hourly wind speed dropped dramatically while the hourly PM-10 concentration remained at a relatively high 920 µg/m^3. Between 10:00 and 11:00 pm, wind speeds rose again, doubling in magnitude, but the hourly PM-10 concentration rose by only 16%. In

the subsequent hour, the PM-10 concentration drops by 44% while the average hourly wind speed increases by 42%. This pattern is typical of thunderstorm outflows that dissipate in strength when reaching the increased surface roughness of the urban boundaries of the nonattainment area where the wind speeds and gust are typically low to moderate, but the associated transported dust remains in the air and can take several hours to deposit out of the atmosphere.

A similar, but shorter, episode occurred on August 13, 2007, at the South Phoenix monitor. On this day, the peak gust velocity rose to 24.9 mph between 11:00 pm and midnight, while the hourly PM-10 concentration rose to 2,600 $\mu g/m^3$. During the remainder of the day, PM-10 concentrations and wind speeds were typical of a light wind day. The contribution of this last hour of the day caused the 24-hour average PM-10 concentration to rise to 159.5 $\mu g/m^3$, resulting in an exceedance. The hourly PM-10 concentrations and wind speeds for this day are shown in Table V-17.

During the last hour of this day, the peak gust velocity exceeded the second highest value of the day by 40%, but the hourly average wind speed was greater than the second highest value in this column by only 4%. At the same time, the hourly PM-10 concentration was 2,639% higher than the second highest value of the day. Similar to the August 23rd event, the implication of these data is that the thunderstorm outflow that reached the South Phoenix monitor just before midnight transported significant PM-10 from upwind sources south of the monitor, which includes a limited fetch of urban area and a significant swath of undisturbed desert soils, even as the thunderstorm outflow itself had lost energy on arrival at the South Phoenix monitor.

The significant contribution of transported PM-10 on August 13 and 23, 2007, leads to the same result: further control of sources near this monitor will not eliminate this type of exceedance, and these episodes should be designated exceptional events under EPA guidance.

Table V-17
Hourly PM-10 Concentrations and Wind Speeds
at the South Phoenix Monitor on August 13, 2007

Hour	Hourly PM-10, µg/m^3	Avg. Hourly Wind Speed, mph	Peak Gust Speed, mph
0:00 AM	31.2	0.4	3.3
1:00 AM	32.9	1.2	4.4
2:00 AM	23.9	1.0	4.1
3:00 AM	30.9	0.4	1.9
4:00 AM	35.9	1.6	4.5
5:00 AM	46.9	1.3	3.5
6:00 AM	75.9	2.4	7.7
7:00 AM	64.8	6.1	12.2
8:00 AM	53.4	5.0	10.5
9:00 AM	47.9	5.1	12.3
10:00 AM	40.9	2.4	11.2
11:00 AM	42.1	3.0	12.2
12:00 PM	52.1	7.0	15.1
1:00 PM	98.5	6.5	16.4
2:00 PM	97.2	5.2	15.5
3:00 PM	87.5	5.0	15.2
4:00 PM	69.0	7.1	16.4
5:00 PM	51.3	6.6	15.4
6:00 PM	43.1	6.7	13.5
7:00 PM	51.4	4.9	12.0
8:00 PM	38.9	3.2	9.8
9:00 PM	41.6	4.4	10.8
10:00 PM	71.9	5.8	17.8
11:00 PM	2599.2	7.4	24.9

Frontal Wind Days

On frontal wind days, peak hourly PM-10 concentrations are lower than those occurring on monsoon days, high winds occur for longer durations, and peak gust speeds range a little lower than those recorded on monsoon days. Frontal wind days produced significantly more hours during 2007 in which PM-10 concentrations exceeded the level of the 24-hour standard than are produced on monsoon days. Table V-18 compares some of the totals in 2007 for PM-10 exceedance days and high wind hours as grouped by wind regime. A listing of the frontal wind days on which the 24-hour standard was exceeded in 2007 within the Maricopa nonattainment area is presented in Table V-19.

Table V-18
Comparison of PM-10 Concentrations During 2007 Exceedance Days Under Different Wind Regimes

Wind Regime	Average of Highest PM-10 Concentrations, µg/m^3	Annual Hours that Exceed the Standard	Percentage of Annual Hours that Exceed the Standard
Frontal	831.5	69	60.5%
Monsoon	2445.1	28	24.6%
Other[1]	355.5	17	14.9%

[1] Includes data from days with low and irregular winds.

Table V-19
Peak Hourly PM-10 Concentrations and Wind Speeds In the Maricopa Nonattainment Area During 2007

Site	Date	Hours Exceeding Standard	Highest PM	Max Wind Gust	High Wind Hours
Higley	6/6/2007	9	580.2	37.7	8
West 43rd	3/27/2007	11	794.4	44.6	11
West 43rd	4/12/2007	9	774.9	45.5	7
West 43rd	5/4/2007	11	570	35.2	10
West 43rd	6/6/2007	12	662.3	33.4	12
Coyote Lakes	10/21/2007	10	1569.2	NA	15
Higley	10/24/2007	7	869.8	33.2	4

Days on which the peak gust velocity were the highest may be flagged as exceptional events due to the capability of such winds to overcome BACM controls and the possible presence of transported PM-10 from sources both within and outside the nonattainment area. While the previous sections in this chapter describing the temporary monitoring insights and source weighting point to the importance of near-by sources during high wind events, long range transport can also occur on these days when wind speeds are unusually high. Evidence of such transport can be seen on days such as April 12, 2007, when the State Super Site monitor recorded hourly PM-10 concentrations as high as 337.9 µg/m^3 in the presence of minimal significant localized fugitive dust sources around the monitor. Such a designation as an exceptional event eliminates March 27 (one monitor exceeded) and April 12, 2007 (two monitors exceeded), because the exceedances on these days are associated with peak gust velocities that can easily generate PM-10 from controlled and natural surfaces. Several other monitors in nearby Arizona counties and eastern Californian desert counties also recorded exceedances on these days, suggesting the presence of regionally transported PM-10 along with the elevated wind speeds.

The exceedance recorded at Coyote Lakes on October 21, 2007, is also not considered in this analysis as this temporary installation was a special-purpose monitor that no longer operates and has since been replaced by the nearby (approximately 1.75 miles) Zuni Hills monitor in late 2009. No exceedances of the PM-10 standard were recorded at the Zuni Hills monitor in 2009 or 2010. As such, the Coyote lakes monitor is a poor candidate for the development of a design day.

Of the remaining days, June 6, 2007, is the only day on which more than one monitor exceeded the standard during the passage of a storm front. On this day, hourly average wind speeds began at moderate levels and rose during daylight hours to peak in the early afternoon. Wind speeds then dropped to the lowest levels of the day by midnight. Hourly PM-10 concentrations followed a similar trend with sharper increases when hourly wind speeds exceeded about 12 mph, with faster declines due to exhaustion of particulate entrainment from limited reservoir soils even as wind speeds remained steady for a few hours. Plots of hourly average wind speed and PM-10 concentrations for the West 43rd Avenue and Higley sites are presented in Figures V-9 and V-10, respectively.

The relationships between wind speeds and PM-10 concentrations at these two sites on June 6, 2007, suggest that local sources were primarily responsible for PM-10 impacting the monitors. As Figure V-9 indicates, elevated wind speeds above 12 mph (the speed at which wind entrainment of dust commences in the Maricopa area) were present at West 43rd Avenue for 12 hours, generating 73% of the 24-hour PM-10 concentration of 225.7 $\mu g/m^3$. The 24-hour concentration value at West 43rd Avenue is also the maximum concentration seen for an exceedance day that is not a clear candidate for an exceptional event. Elevated wind speeds above 12 mph were present for 8 hours on June 6 at the Higley site, accounting for 66% of the average 24-hour PM-10 concentration of 181.0 $\mu g/m^3$. In comparison to the Higley monitor, this day is also similar to the exceedance seen at the Higley monitor under frontal winds on October 24, 2007, implying that the controls that would bring attainment to Higley on June 6, 2007, would also provide attainment at Higley on October 24, 2007. On this basis, June 6, 2007, is the best design day for an attainment demonstration throughout the nonattainment area.

Figure V-9
Hourly Average Wind Speed and PM-10 Concentration at West 43rd Avenue Monitor on June 6, 2007

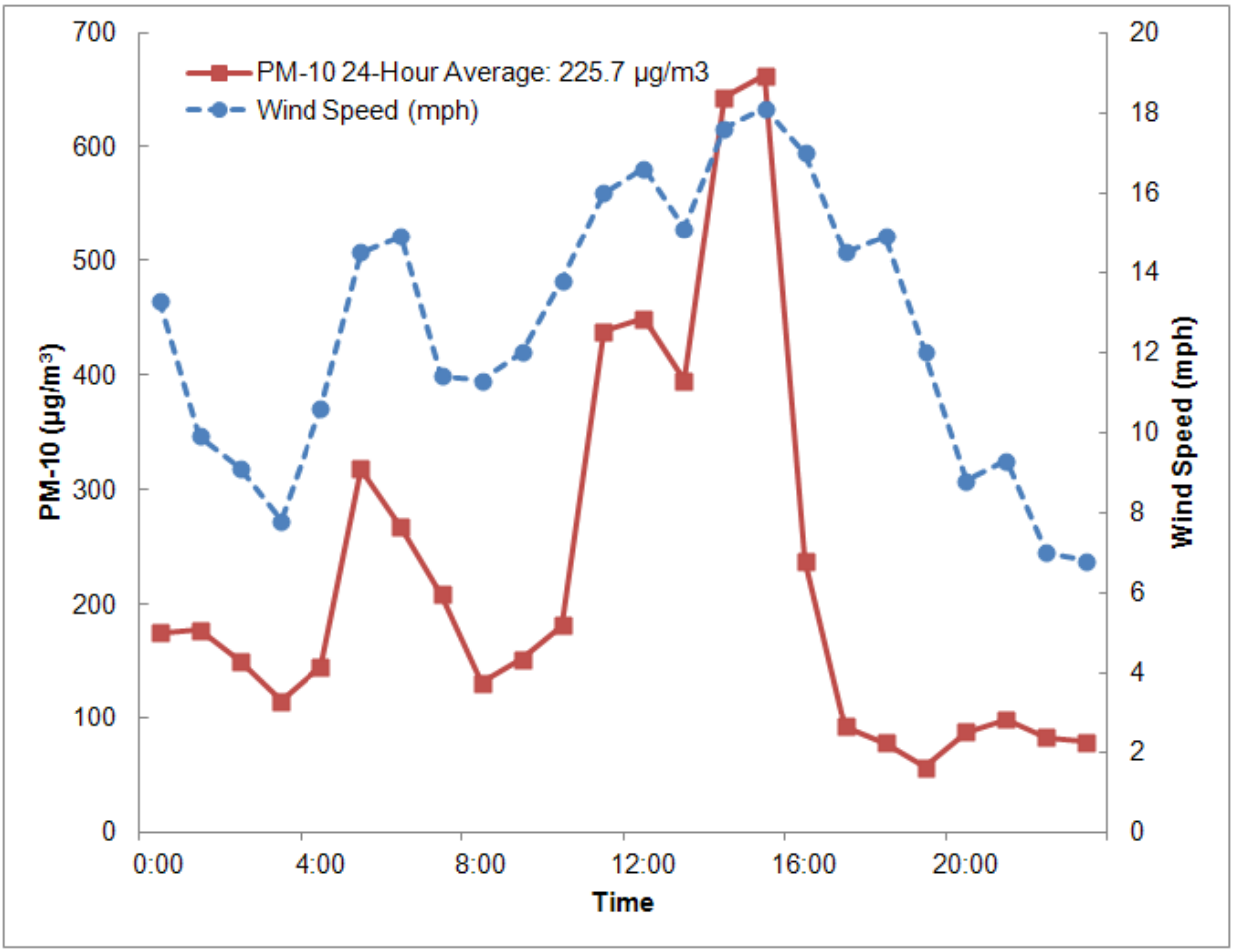
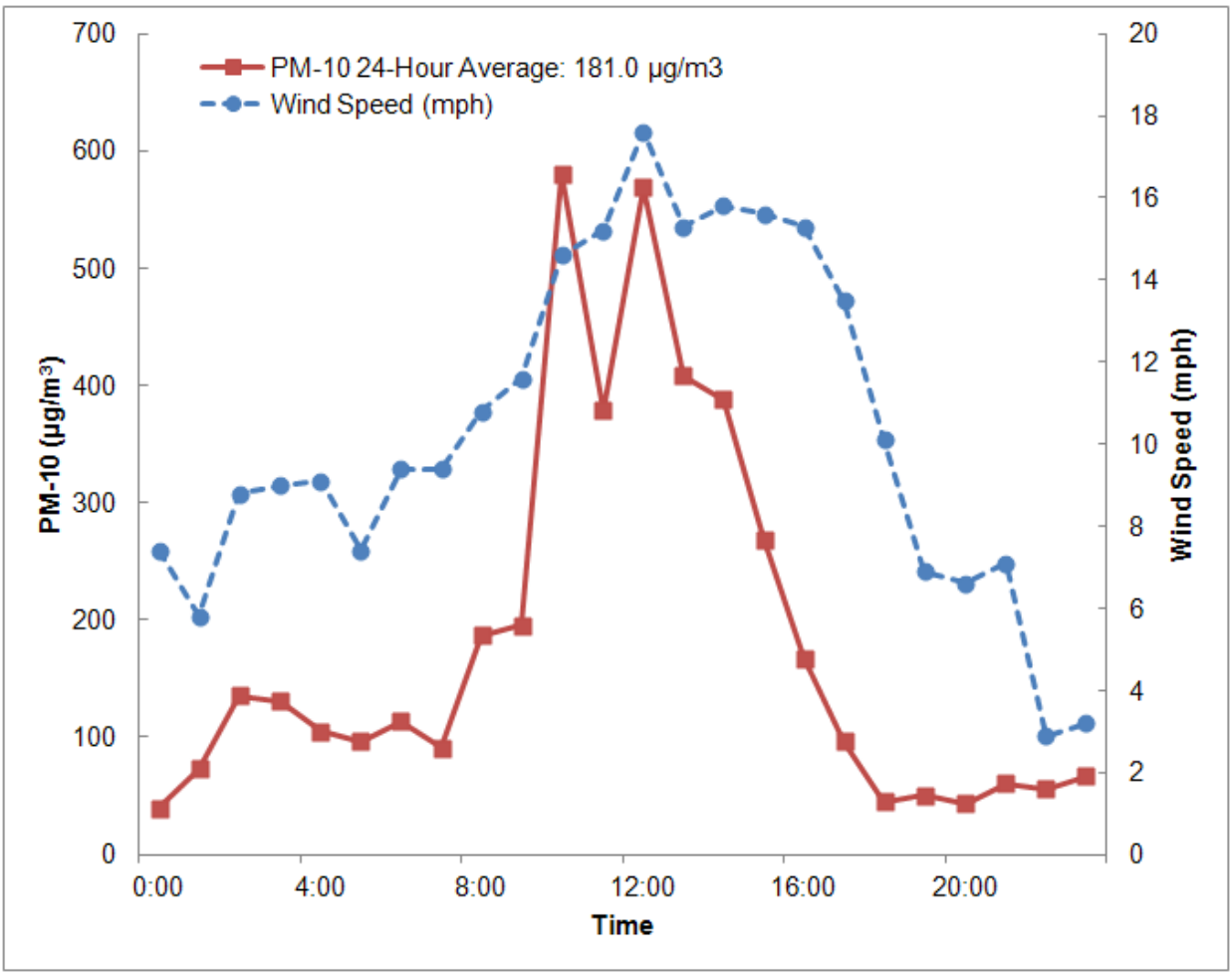
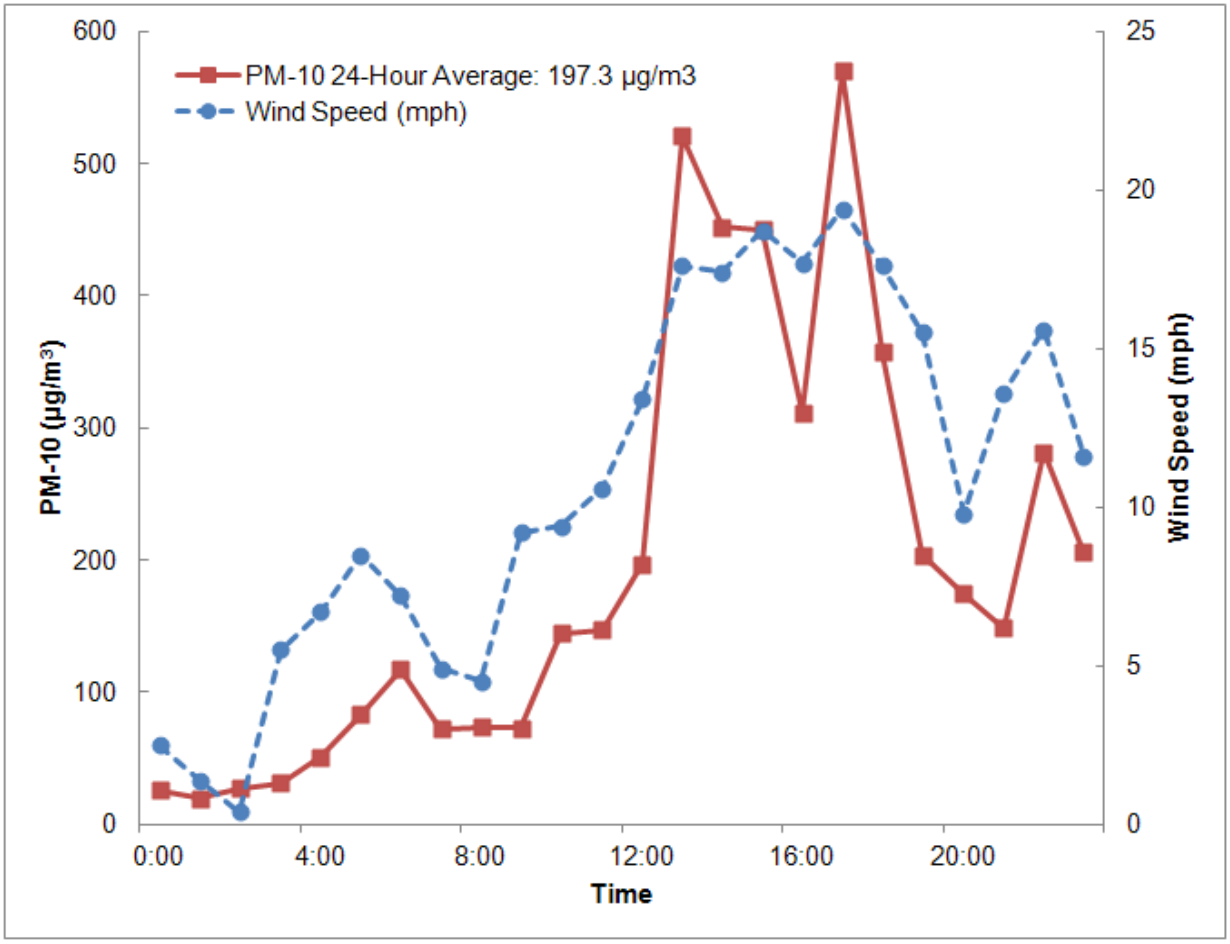


Figure V-10
Hourly Average Wind Speed and PM-10 Concentration
at Higley Monitor on June 6, 2007



Of the eight exceedance days that occurred in the Salt River area modeling domain (encompassing the Durango Complex, South Phoenix, and West 43rd Avenue monitors), only one exceedance day remains that has not been previously ruled out (November 15, 2007, at Durango) or modeled (June 6, 2007), or may be an exceptional event: May 4, 2007. A concentration of 197.3 µg/m^3 was measured at the West 43rd Avenue site on this day, which experienced 10 hours with average hourly wind speeds in excess of 12 mph. These high wind hours contributed 74% of the 24-hour average PM-10 concentration. The pattern of hourly wind speeds and PM-10 concentrations on this date suggests that local sources contributed the predominant fraction of PM-10 recorded at the West 43rd Avenue monitor, making this day the design day choice for the Salt River area modeling. A plot of hourly average wind speeds and PM-10 concentrations is included in Figure V-11.

Figure V-11
Hourly Average Wind Speed and PM-10 Concentration
at West 43rd Avenue Monitoring Station on May 4, 2007



Conclusions

In 2007, the 24-hour PM-10 standard was exceeded 19 times, on 11 unique days at the monitoring stations in the Maricopa County. Two of these exceedances were recorded at the Buckeye station, which is outside the PM-10 nonattainment area, and two were recorded at the Coyote Lakes site, which was a temporary special studies site no longer in operation. The Coyote Lakes monitor has since been replaced with the nearby Zuni Hills monitor in late 2009 which has not recorded an exceedance in 2009 or 2010. As such the Coyote Lakes monitor is a poor choice for development of a design day and these exceedances, along with those at the Buckeye monitor, have been excluded as candidates for design days within the nonattainment area. Of the remaining 15 exceedances, seven occurred on monsoon (thunderstorm outflow) days, which likely qualifies these exceedances for exceptional event status but not for consideration as design days. An additional three exceedances occurred during very strong synoptic frontal winds, which may also qualifies these exceedances for exceptional event status. Of the remaining five exceedances, two occurred on June 6, 2007, which is recommended to be the design day for the Maricopa nonattainment area. Of the further remaining three exceedances, one occurred at the Higley monitor (October 24, 2007) and is similar in nature to the modeled June 6, 2007 design day. The other two exceedances (May 4, 2007, and November 15, 2007) occurred within the Salt River modeling domain. November 15, 2007 was excluded as an outlier event and because its 24-hour value was barely over the standard (155.7 $\mu g/m^3$), leaving the exceedance of May 4, 2007 at the West 43rd Avenue monitor as the final choice to of a design day for the Salt River area domain.

MODELING DOMAINS

As explained earlier in the conceptual model section, separate modeling domains were developed for the high and low wind hours on each of the design days. Hourly high wind domains were developed using back trajectories calculated with wind speed and direction data from the modeled monitor. Domains for the low wind hours are represented by the sources and land uses surrounding each of the monitors. The basis for distinguishing between high and low wind hours is the 12 mph windblown dust threshold developed in the 2008 PM-10 Periodic Emissions Inventory (Appendix A, Exhibit 1). This section discusses in detail the development of the low and high wind domains. Table V-20 shows the breakout between high and low wind hours for each of the design day-modeled monitors.

Table V-20
Breakout of High and Low Wind Hours on Modeled Design Days at Each Monitor

	5/4/2007	6/6/2007						
	West 43rd	West 43rd	Central Phoenix	Durango	Greenwood	Higley	State SuperSite	West Phoenix
Hour	*(Hourly Average Wind Speed in mph)*							
0	2.5	***13.3***	***12.5***	8.9	8.1	7.4	7.6	7.1
1	1.4	9.9	***13.1***	6.3	5.7	5.8	6.3	7.8
2	0.4	9.1	8.6	5.0	4.9	8.8	5.4	8.4
3	5.5	7.8	8.0	1.0	2.9	9.0	5.4	4.2
4	6.7	10.6	10.9	2.6	2.1	9.1	6.7	5.1
5	8.5	***14.5***	10.3	7.3	5.4	7.4	7.2	6.1
6	7.2	***14.9***	***12.4***	9.1	6.7	9.4	7.2	8.5
7	4.9	11.4	***12.8***	8.7	7.7	9.4	6.5	10.3
8	4.5	11.3	11.1	10.5	8.3	10.8	7.2	8.7
9	9.2	12.0	11.3	11.2	10.0	11.6	6.7	8.6
10	9.4	***13.8***	***12.1***	11.9	11.0	***14.6***	6.9	8.8
11	10.6	***16.0***	***13.9***	***12.5***	10.8	***15.2***	9.4	***12.1***
12	***13.4***	***16.6***	***15.3***	***13.9***	***12.7***	***17.6***	8.9	***13.6***
13	***17.6***	***15.1***	***15.4***	***13.5***	***12.6***	***15.3***	9.8	***15.1***
14	***17.4***	***17.6***	***16.9***	***15.7***	***15.4***	***15.8***	10.5	***15.1***
15	***18.7***	***18.1***	***17.8***	***17.9***	***13.9***	***15.6***	11.4	***13.5***
16	***17.7***	***17.0***	***15.7***	***14.5***	11.9	***15.3***	10.1	12.0
17	***19.4***	***14.5***	***14.0***	***12.9***	11.7	***13.5***	9.2	11.7
18	***17.6***	***14.9***	***14.0***	10.3	11.4	10.1	11.2	10.0
19	***15.5***	12.0	11.9	8.9	8.7	6.9	9.6	9.3
20	9.8	8.8	11.1	6.4	7.4	6.6	7.8	9.1
21	***13.6***	9.3	11.7	7.5	7.0	7.1	6.3	6.8
22	***15.6***	7.0	8.8	6.3	5.1	2.9	3.8	5.3
23	11.6	6.8	8.5	5.2	4.0	3.2	3.6	4.8

Note: High wind hours are higlighted in bold italics.

High Wind Domains

High wind back trajectories are developed for any monitor-specific design-day hour with an average wind speed over 12 mph. When available, five-minute average wind speed and direction, as measured by the modeled monitor, was used to develop the back trajectories from which the modeling domains are developed. When five-minute data is unavailable, hourly wind speed and direction is used. The length of the back trajectory is

determined by the magnitude of the wind speed (e.g., an hourly average wind speed of 15 mph will produce a back trajectory 15 miles in length).

The back trajectory plots are generated based on either hourly or the five-minute surface wind speed (WS) and wind direction (WD) data. This back trajectory calculation only considers the horizontal air movement and ignores the vertical movement of the air. The trajectories are presented as a sequence of UTM coordinates for the endpoints of each specific time interval being simulated. Using five-minute data as an example, The X and Y of the UTM coordinates for each five minute interval are calculated as following:

X=X1+WS*0.447*60*5*SIN(WD*2*PI/360)
Y=Y1+WS*0.447*60*5*COS(WD*2*PI/360)

Where X and Y are the UTM coordinates of the current five minutes interval back trajectory endpoints; X1 and Y1 are the endpoints for the previous five minutes interval back trajectory; WS and WD are the wind speed (MPH) and Wind direction (degree) observation during the current five minutes. 0.447 ms^{-1}/mph is the WS unit conversion factor from MPH to m/s, 60 seconds/minute * 5 minute is the air traveling time (seconds) during the five minutes, and 2*PI/360 is the conversion factor from degrees to Radians. This process is completed and mapped for each high wind hour back trajectory in ArcGIS.

<u>Establishing the Boundaries of a High Wind Domain -</u> Once all of the back trajectories have been mapped, it is necessary to determine how far to extend the domain from either side of the back trajectory. This issue was explored in modeling efforts that focused on the West 43rd Avenue monitor in the Salt River area. A summary of those efforts are presented below and conclude that a one mile buffer on either side of the back trajectory is a conservative representation of the domain for high wind sources.

The analysis of emissions impacting the West 43rd Avenue monitoring station during high wind events included inventories of emissions in upwind areas. Defining the specific domain boundaries of upwind areas within which to focus emission data collection was both necessitated by the significance of source proximity to the monitor during high wind hours, and facilitated by the land use database maintained in GIS format by MAG.

Analysis of wind directions and speeds during hours when the West 43rd Avenue station exceeded 150 $\mu g/m^3$found that winds were primarily from the west-southwest along the Salt River, possibly influenced by orographic affects. Exceedance hours generally began when average hourly wind speeds exceeded 12 mph. At this speed, sources that may be located three hours upwind – a period of time during which the coarse fraction of wind-entrained dust will settle out of the air - would be located beyond the urban and agricultural boundaries to the west of the West 43rd Avenue station. Thus, the western boundary of each back-trajectory emission inventory domain was set at the edge of development (whether for agricultural or other use), typically just east of the Buckeye monitoring station. The eastern boundary was invariably set at the location of the West 43rd station.

Entrained dust plumes from disturbed lands spread horizontally and vertically as winds carry suspended particulate downwind. Analysis of in-plume concentrations predicted by a computer dispersion model (AERMOD) shows that the rate of spread decreases as wind speed increases. The modeling scenario used to determine the distance-related reduction factor to use in weighting emissions in a modified rollback analysis, as described in Source Weighting Analysis section, was also used to estimate the angular arc of a dust plume perpendicular to its centerline at different wind speeds.

Receptor sites lateral to the plume centerline were located at the same downwind distances from the hypothetical area source as those sited along the plume centerline. As in the weighting factor analysis, the AERMOD model was run at several different wind speeds ranging from 12 to 24 mph. The edge of each plume was identified in the output as the location of the lateral receptor closest downwind to the source that first registered a non-zero PM-10 concentration. A tabulation of the arcs subtended by plumes at increasing wind speeds, as reported by the modeling output data, is shown in Table V-21. At the minimum high wind speed of 12 mph, the arc subtended by a dust plume is estimated to be 34.2 degrees, or 17.1 degrees on each side of the downwind centerline.

Table V-21
Dust Plume Arc as a Function of Wind Speed

Hourly Average Wind Speed (mph)	Plume Arc (degrees)
12.0	34.2
15.0	33.1
18.0	28.8
21.0	25.9
24.0	22.7

The Estrella Mountains to the south of the Salt River have the potential to channelize high speed wind flows approaching from the west. This suggests that winds can be converging upwind of the West 43rd Avenue station in a manner that would not be detected by the wind instruments operating at the monitoring site. Such convergence would bring emissions from lands outside the 34.2 degree arc upwind of the station into the wind field bounded by the arc and impact the monitor. In order to account for this potential, and in an exercise of conservatism, the angle subtended by the modeled arc was doubled to assure that all upwind contributing sources were included within the high wind inventory domain. This assumption increased the upwind arc to a full angle of 68.4 degrees, or 34.2 degrees on each side of the back trajectory centerline.

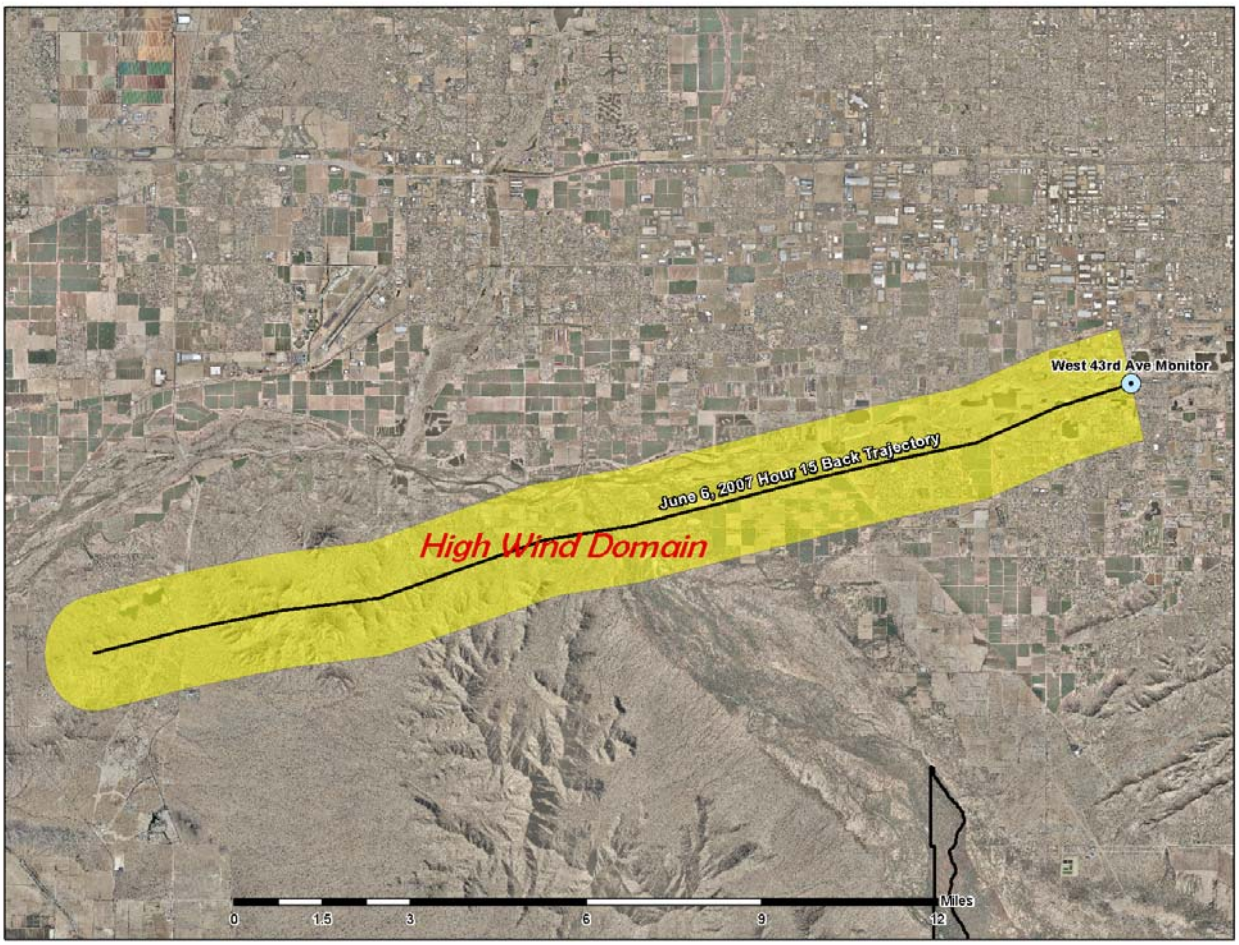
The emission weighting analysis demonstrated that PM10 concentrations drop dramatically with increasing distance downwind of an area source under high wind conditions. For example, under an hourly average wind speed of 12 mph, PM10 concentrations decline by two orders of magnitude, or 99%, between a fence line location

at the downwind edge of an area source and a plume centerline location 1.74 miles downwind. This reduction factor of 99% was considered to be significant and was used as a basis for the design of the emission inventory domain straddling the back trajectory centerline.

At a location 1.74 miles upwind of the West 43rd Avenue monitor, the width of a 68.4 degree arc would be 2.36 miles. Within this arc and downwind distance, sources contributing a significant majority of emissions impacting the monitor will be located – if the emission density of windblown PM10 is reasonably uniform within the upwind Salt River belt. A full arc width of 2.36 miles translates into an arc width on each side of the back trajectory centerline of 1.18 miles. This value was rounded downward to 1.0 miles to represent the width of the modeling domain on each side of the centerline.

In summary, all of the land uses within the resulting high wind domain that can generate windblown dust are included as emissions sources for the attainment modeling. Figure V-12 provides an example of a calculated high wind back trajectory and resulting domain.

Figure V-12
Example High Wind Back Trajectory and Resulting High Wind Domain
(Hour 15 from West 43rd Avenue Monitor on June 6, 2007)



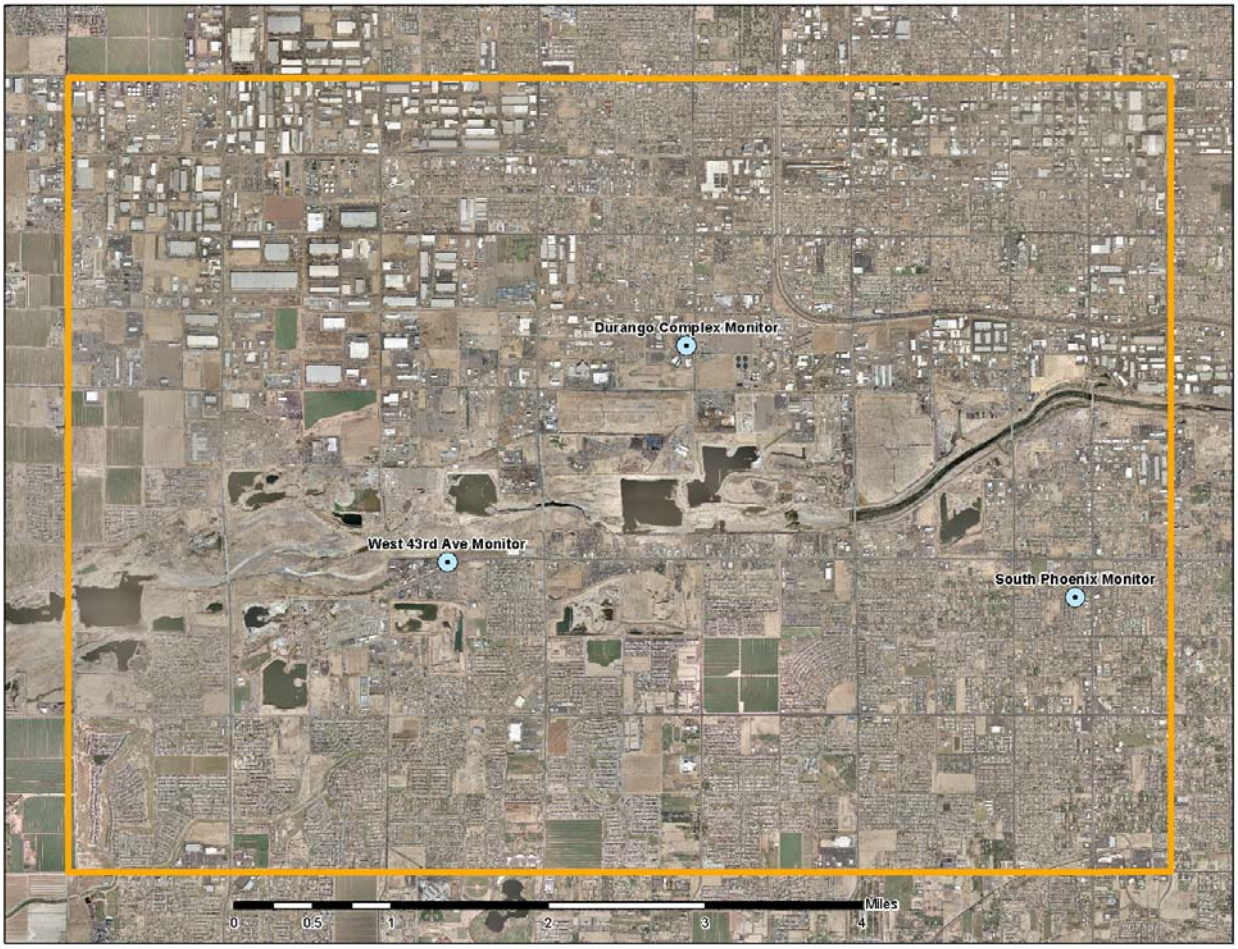
Low Wind Domains

Spatial domains for the low wind hours were developed based upon the predominant land uses surrounding each modeled monitor. The nonattainment area as a whole is too large to be representative of the PM-10 emissions around the modeled monitors. As such, smaller subsets of the nonattainment area are necessary in order to accurately represent the mix of sources around each modeled monitor. Three separate low wind modeling domains were developed as part of the attainment demonstration to aid in focusing on the low wind sources around each monitor.

Considerable effort has been expended in previous PM-10 air quality plans in developing the Salt River area domain. This area is modeled both on its own and as part of the

regional nonattainment area demonstration. This domain is considered to contain the worst-case representation of PM-10 sources in the nonattainment area and has the highest density of PM-10 emissions under low wind conditions. All major sources of PM-10 emissions, except unpaved roads, are represented in this area. These sources include light and heavy dust-generating industries, active agricultural land, active earthmoving sites, vacant lots and unpaved parking areas. There are three active PM-10 monitors that lie within the Salt River domain: West 43rd Avenue, South Phoenix and Durango Complex. This 36 square mile domain is bounded by Van Buren Street to the north, Baseline Road to the south, 59th Avenue to the west and 7th Street to the east. Figure V-13 displays the Salt River area low wind domain.

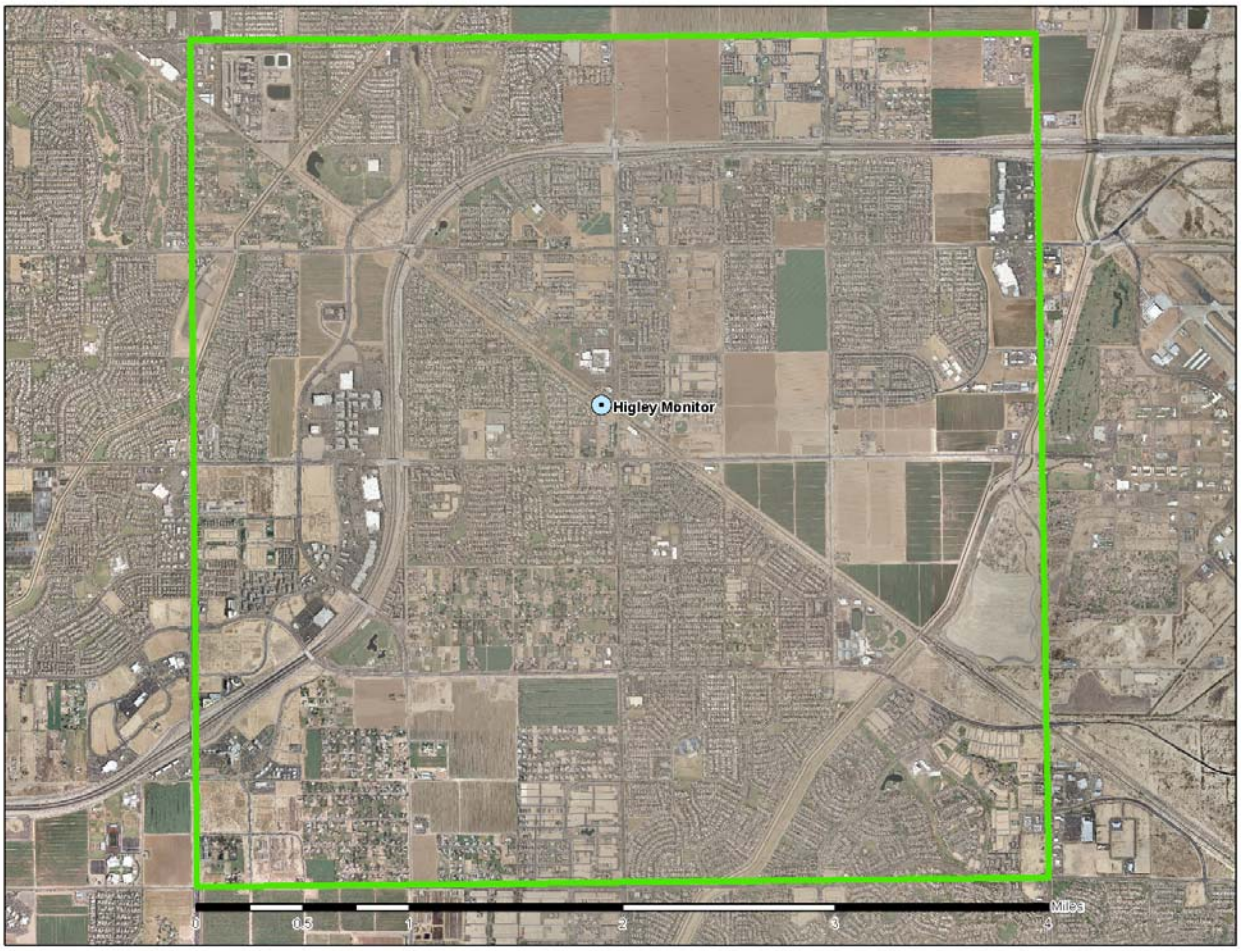
Figure V-13
Salt River Area Low Wind Domain



A second domain, located around the east valley Higley monitor was developed to represent the mix of sources in that area. This area is modeled as part of the regional attainment demonstration on June 6, 2007. Predominant PM-10 sources within the Higley domain include active agricultural fields, active earthmoving operations and a major

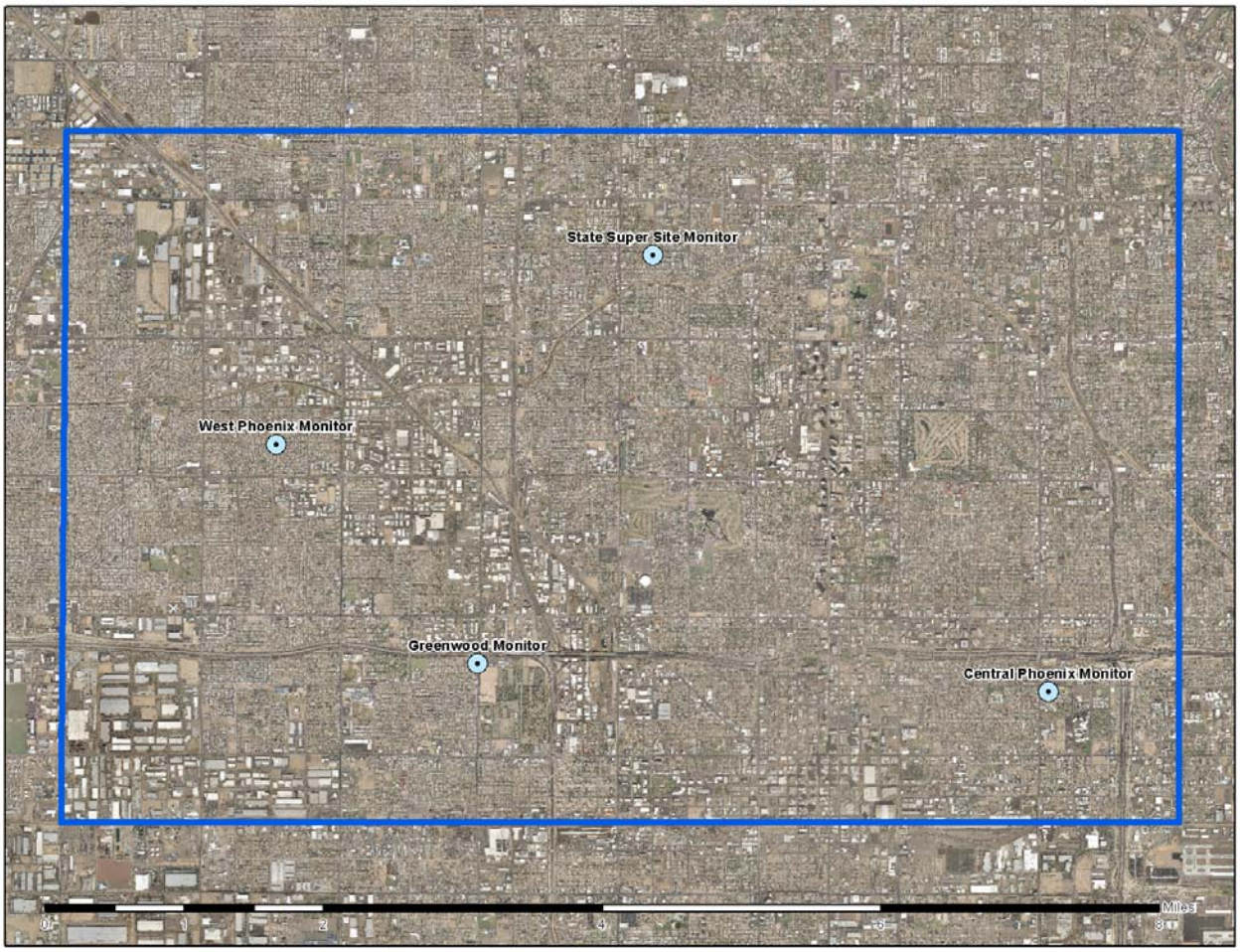
regional freeway. This 16 square mile domain is bounded by Warner Road to the north, Germann Road to the south, Val Vista Drive to the west and Power Road to the east. Figure V-14 displays the Higley low wind domain.

Figure V-14
Higley Low Wind Domain



The last low wind domain developed for the attainment demonstration contains four PM-10 monitors (modeled as part of the regional attainment demonstration) located in the center of the nonattainment area: Central Phoenix, Greenwood, State Super Site and West Phoenix. These monitors are all located in areas that have similar land uses of dense residential and light industrial/commercial/retail. In terms of PM-10 sources, the largest sources are light dust-generating industries, active earthmoving sites and major transportation corridors. This 40 square mile domain is bounded by Missouri Avenue to the north, Harrison Street to the south, 51st Avenue to the west and 24th Street to the east. Figure V-15 displays the Central City low wind domain.

Figure V-15
Central City Low Wind Domain



INVENTORY DEVELOPMENT

Under a rollback modeling scheme, reductions of emissions that impact the monitor are assumed to result in an equal reduction in monitor concentrations. As such, both base case (2007) low and high wind inventories must be developed along with control case (2012) low and high wind inventories. This following describes in detail how the 2007 base year and 2012 control/attainment year high and low wind inventories were developed. Details on how the base and attainment year inventories are developed for the entire nonattainment area are presented in Chapters II and III of this TSD.

High Wind Inventories

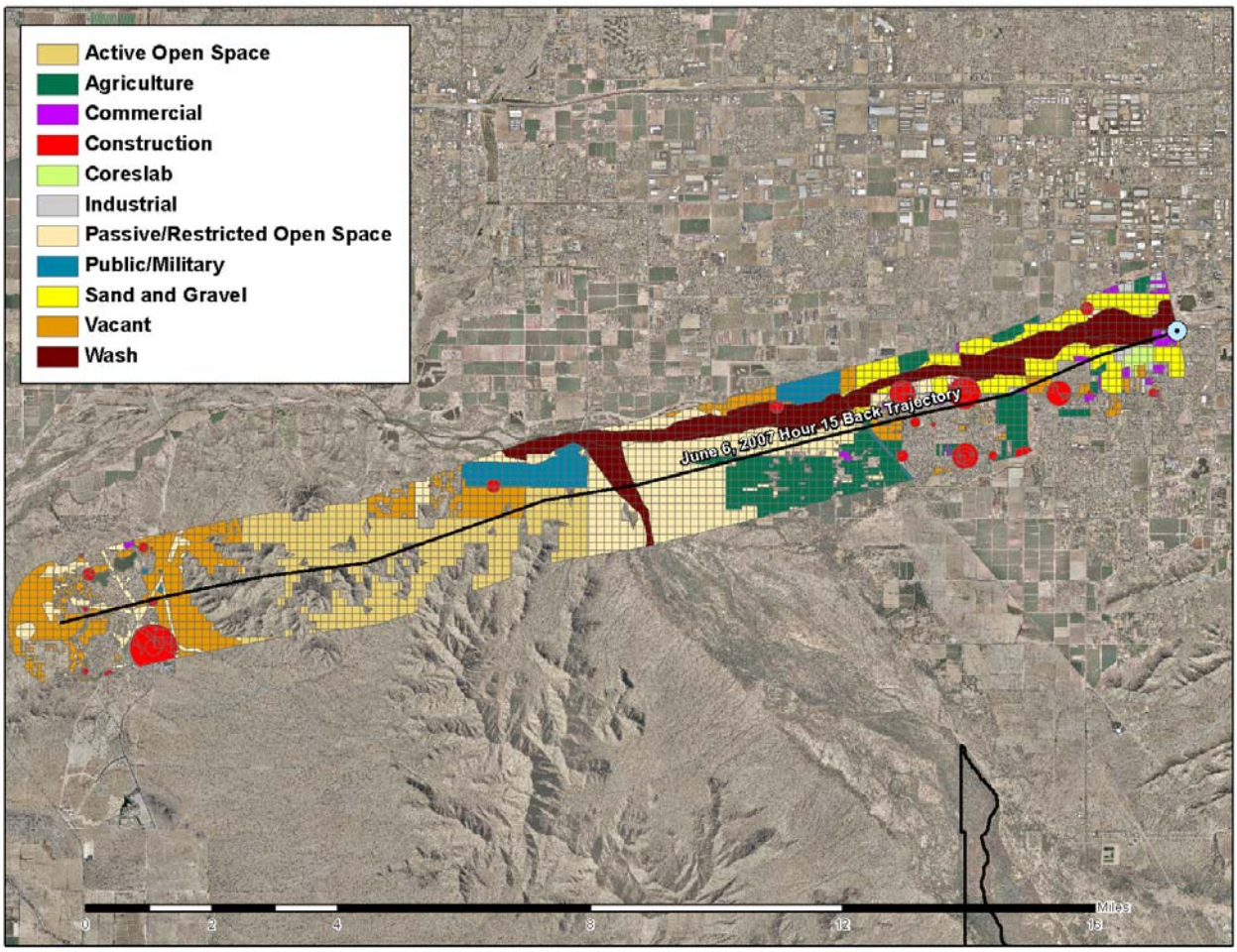
For the high wind hours, hourly windblown PM-10 emissions are calculated based upon the land uses that fall within each of the hourly high wind domains. Land use data, with the exception of construction data, comes from the MAG information services and represents land use patterns as of 2009. Land use is held constant between calculation of 2007 and 2012 year inventories. A detailed write-up of how the land use data is created is included in the 2008 PM-10 Periodic Emissions Inventory as an Appendix to the windblown dust section. Construction data was provided by the Maricopa County Air Quality Department for the year 2007. To be conservative this data is also held constant through 2012 even though there is substantially less construction occurring due to the economic recession. Windblown PM-10 emissions for the subject land uses are calculated per the methodology described in the 2008 PM-10 Periodic Emissions Inventory (Appendix A, Exhibit 1). As an example, emissions from the West 43rd Avenue monitor hour 15 high wind domain (June 6, 2007 design day) are explained below. All of the hourly high wind emissions are calculated in the same manner shown in this example.

Initially, through the use of ArcGIS, the land uses subject to windblown dust emissions within the high wind domain are identified. For the hour 15 example, 11 unique land uses within the high wind domain are subject to windblown dust as shown in Figure V-16. They include the land uses of Active Open Space (i.e., parks), Agriculture, Commercial, Construction, Coreslab (a large combination of sand and gravel and industrial facility), Industrial, Passive/Restricted Open Space (i.e., preserves), Public/Military Space (i.e., jails, bases), Sand and Gravel facilities, Vacant, and Dry Washes. These land uses are chosen because either all or some of their acreage is bare soil from which windblown dust can be generated. The steep slopes of mountain preserves are also as the surface roughness of the slope severely prohibits the production of windblown dust. Land uses such as residential or golf courses are not included as subject to windblown dust since none (or a very limited amount) of the acreage associated with these land uses is bare soil.

After the land uses are identified, a 10-acre fishnet grid is applied to the land uses, so that no individual land use parcel is larger than ten acres. This allows for calculating the distance from each parcel boundary to the modeled monitor; which is West 43rd Avenue in this example. The distance of the parcel to the monitor is necessary in order to apply

the distance weighting factor to the calculated emissions as discussed earlier in this chapter.

Figure V-16
Land Uses Capable of Producing Windblown Dust Within the Hour 15, West 43rd Avenue Monitor, High Wind Domain (June 6, 2007)



To be conservative, all but four of the land uses shown above are assumed to have 100% of their acreage capable of emitting windblown dust. The land uses of Commercial, Coreslab, Industrial and Public/Military are exempted from this assumption because these land uses are known to have a mix of large buildings and paved parking lots/access roads in addition to areas of bare soil. Over 2500 aerial photographs of these types of parcels in the Salt River area were evaluated to determine the average percentage of bare soil present on each of these land uses. The results of that analysis are listed in Table V-22. To be conservative, the mean value was chosen to represent the average percentage of bare soil on these land uses, as this value was higher than the median in all cases. Note that Coreslab is considered an industrial parcel, and as such is assigned the average of 24% for the amount of bare soil present.

Table V-22
Results of Aerial Photography Analysis of Percentage of Bare Soil on Land Uses with Both Bare and Covered Surfaces

Land Use	Mean	Median	Std. Deviation
Commercial	26%	20%	23%
Industrial	24%	17%	21%
Public/Military	35%	21%	35%

After the land uses within the high wind domain have been classified and selected, the process for calculating windblown emissions from these land uses can begin. The 2008 PM-10 Periodic Emissions Inventory developed emission factors for two classes of bare soil: disturbed and stable. Disturbed soils emit at a much higher rate than stabilized soils because there is more loose soil available to be entrained by the wind. As wind speeds increase, both disturbed and stable soils emit at higher rates, as the extra energy from the wind entrains more material from both surfaces. Thus, the main elements needed to calculate windblown PM-10 emissions are the number of acres of bare soil, the wind speeds over that soil, and the percentage of the acres that are disturbed or stable.

Table V-23 displays the emission factors by wind speed bins as developed in the 2008 Periodic Emissions Inventory. These emission factors were developed based upon local testing of Arizona soils. The units of the emission factors are tons per acre per five-minute, as the input wind speed data for most of the high wind domains is a five-minute average wind speed.

Table V-23
Windblown PM-10 Emission Factors (tons /acre-five-minute) by 10-Meter Wind Speed Bin and Soil Stabilization

Soil Stabilization	Wind Speed 12-15 mph	Wind Speed 15-20 mph	Wind Speed 20-25 mph	Wind Speed 25-30 mph	Wind Speed 30-35 mph
Disturbed	5.44E-05	1.69E-04	5.14E-04	1.24E-03	2.57E-03
Stable	1.10E-05	2.93E-05	7.68E-05	1.64E-04	3.10E-04

Continuing with the use of the hour 15, West 43rd Avenue, high wind domain example, the hourly average wind speed for that hour was 18.1 mph. An examination of the five-minute wind speed data for that hour reveals that ten of the five minute periods had wind speeds between 15-20 mph and two of the five minute periods had wind speeds between 20-25 mph. This means that the emissions factors from only two wind speed bins (15-20 and 20-25) will be used to calculate emissions for this hour.

At this point, the amount of acreage by land use and the five minute wind speeds have been determined for the example high wind domain. The one variable that is left to be

determined is how much of the land use acreage is disturbed or stable. A direct measurement of this variable is not possible, as stabilization rates change over time with meteorological and anthropogenic activities unique to each individual parcel. Therefore, a surrogate variable is needed to assume an average disturbance level for each land use subject to producing windblown dust. As discussed in Chapter Five of the main plan and the 2008 PM-10 Periodic Emissions Inventory, rule effectiveness has been chosen as the surrogate for the disturbance levels of bare soils. As an example, a rule effectiveness of 80% would assume that 80% of the acreage is stable and 20% is disturbed. Maricopa County Air Quality Department performed rule effectiveness studies for three fugitive dust rules: Rule 310, earthmoving activities, Rule 310.01, open and vacant areas, and Rule 316, sand and gravel sites. These studies were done on an annual basis and are shown in Table V-24. The values for calendar years 2007, 2008 and 2010 were all derived per the methodology listed in the 2008 PM-10 Periodic Emissions Inventory. The increases in rule effectiveness through time is a direct result of the implementation of the control measures in this plan. The value for 2012 is the assumed value achieved as a result of the control measures in this plan projected out through 2012 (See Chapter Five of main plan for more explanation).

Table V-24
Calendar Year Rule Effectiveness Rates as Surrogates for Soil Disturbance Rates

Rule	2007	2008	2010	2012
310	76%	90%	94%	94%
310.01	85%	95%	96%	97%
316	40%	65%	73%	73%

The 11 land uses identified earlier in Figure V-16 are thus assigned disturbance rates based upon the rule effectiveness rates in Table V-24. Rule 310 serves as a surrogate value for construction land uses, Rule 316 serves as a surrogate for sand and gravel land uses, and Rule 310.01 serves as a surrogate for all remaining land uses. Rule 310.01 directly regulates all open areas and industrial/commercial areas that are permitted or un-permitted. The only land use under which Rule 310.01 does not regulate is agriculture. However, because there are no quantitative rule effectiveness or disturbance rates studies available that are applicable to agricultural land, Rule 310.01 disturbance rates are assumed to apply, as was assumed in the 2008 PM-10 Periodic Emissions Inventory. It is important to point out however, that because there are no benefits for agricultural land taken as part of the attainment demonstration or the five percent reductions, the assumed 2007 rule 310.01 effectiveness rate of 85% is held constant through 2012, meaning windblown dust emissions from agricultural lands in 2012 are the same as in 2007. All other land uses besides agriculture experience a reduction in emissions between 2007 and 2012 as a result of the benefit of increased rule effectiveness; which is pragmatically translating as an assumption of less disturbed soil in the windblown dust inventory.

Now that all of the required elements (acreage, percent disturbed, and wind speeds) have been determined, the elements are simply multiplied in order to obtain PM-10 windblown dust emissions for each land use within the high wind domain. An example equation using data from the hour 15 example high wind domain is shown below to detail how high wind emissions are calculated:

Example for calculating base year (2007) windblown dust emissions from Commercial land uses:

(1) Land use * % acreage * 15-20 mph wind * % Stable * Stable 15-20 mph = Stable Emissions
Acreage of bare soil speed periods emission factor
(250.2) * (26%) * (10) * (85%) * (2.93E-05) = 1.62E-02 Tons

+

(2) Land use * % acreage * 20-25 mph wind * % Stable * Stable 20-25 mph = Stable Emissions
Acreage of bare soil speed periods emission factor
(250.2) * (26%) * (2) * (85%) * (7.68E-05) = 8.49E-03 Tons

+

(3) Land use * % acreage * 15-20 mph wind * % Disturbed * Disturbed 15-20 mph = Disturbed Emissions
Acreage of bare soil speed periods emission factor
(250.2) * (26%) * (10) * (15%) * (1.69E-04) = 1.65E-02 Tons

+

(4) Land use * % acreage * 20-25 mph wind * % Disturbed * Disturbed 20-25 mph = Disturbed Emissions
Acreage of bare soil speed periods emission factor
(250.2) * (26%) * (2) * (15%) * (5.14E-04) = 1.00E-02 Tons

Sum of above equations (1 through 4) = 5.12E-02 Tons of PM-10 emissions from Commercial land uses.

This process is repeated for all land uses and then summed to calculate total PM-10 emissions from all land uses within the high wind domain. The only difference between 2007 and 2012 year emissions is that the disturbance rates change based upon gains in rule effectiveness, thus the reductions in emissions between 2007 and 2012 are solely attributable to increases in rule effectiveness.

The emissions that are calculated per the steps above, represent maximum potential PM-10 emissions from windblown dust. As explained in the 2008 PM-10 Periodic Emissions Inventory, a whole host of other factors including supply limitations, surface roughness, soil moisture content, vegetative cover, soil texture, etc. and would likely limit the PM-10 emissions from windblown dust to levels below what is calculated in each of the high wind domains. The 2008 PM-10 Emissions Inventory corrects for these limiters by standardizing PM-10 emissions as compared to concentrations seen at the monitor under high wind conditions. This helps to ensure the scale of the emissions estimate is not too

large. However, this step is not necessary for high wind emission inventories prepared for use in an attainment demonstration, as what is important in this rollback modeling is the difference between 2007 and 2012 emissions, not the scale of those emissions as compared to low wind emission sources. Since both 2007 and 2012 high wind emissions are calculated in the same way, the difference between the two inventories provides the reductions needed to model attainment at the monitors. The unit and scale of the inventories thus do not matter, only that the methodology is the same between the base and controlled inventories in order to claim the benefits of the measures in this plan as applied to the modeled concentrations.

Once high wind PM-10 emissions have been calculated for the land uses, one final step is required to prepare the emissions for attainment modeling. The calculated emissions for each land use parcel are divided by the distance (feet) from the modeled monitor. As discussed in an earlier section in this chapter, distance weighting is applied to this emissions in order to account for their diminishing impact on monitor concentrations with distance. The best weighting function was determined to be a simple inverse distance ratio (1/d) through analysis of dispersion behavior provided by sample AERMOD model runs (see earlier sections on source weighting and temporary monitor insights).

Tables V-25 through V-31 provide the results of the high wind emissions inventories for the high wind domains of each modeled monitor, based upon the process outlined above. They list both the calculated emissions and the inverse-distance weighted emissions for the base and controlled year inventories.

Table V-25
Base Case 2007 and Controlled 2012 High Wind PM-10 Emissions Inventories for May 4, 2007 Design Day at the West 43rd Avenue Monitor

High Wind Hour	Un-weighted Emissions (tons)		Distance-Weighted Emissions (tons/feet from monitor)		% Reduction of Weighted Emissions
	2007	2012	2007	2012	
12	3.05	2.09	2.872E-04	1.900E-04	33.8%
13	9.49	6.36	6.529E-04	4.245E-04	35.0%
14	9.94	6.67	6.866E-04	4.454E-04	35.1%
15	13.94	9.19	8.721E-04	5.581E-04	36.0%
16	13.36	8.81	8.921E-04	5.699E-04	36.1%
17	19.01	12.39	1.190E-03	7.505E-04	36.9%
18	11.84	7.86	7.837E-04	5.033E-04	35.8%
19	6.58	4.44	5.158E-04	3.364E-04	34.8%
21	4.02	2.72	3.236E-04	2.129E-04	34.2%
22	6.63	4.48	5.104E-04	3.330E-04	34.8%
Total	97.86	65.02	6.714E-03	4.324E-03	35.6%

Table V-26
Base Case 2007 and Controlled 2012 High Wind PM-10 Emissions Inventories for June 6, 2007 Design Day at the Central Phoenix Monitor

High Wind Hour	Un-weighted Emissions (tons)		Distance-Weighted Emissions (tons/feet from monitor)		% Reduction of Weighted Emissions
	2007	2012	2007	2012	
0	1.90	1.32	7.549E-05	5.230E-05	30.7%
1	0.99	0.74	5.184E-05	3.687E-05	28.9%
6	1.69	1.18	6.873E-05	4.797E-05	30.2%
7	0.99	0.74	5.254E-05	3.730E-05	29.0%
10	0.88	0.64	4.939E-05	3.485E-05	29.4%
11	2.01	1.41	7.319E-05	5.123E-05	30.0%
12	4.01	2.91	1.706E-04	1.166E-04	31.7%
13	7.52	5.04	2.448E-04	1.625E-04	33.6%
14	7.28	4.96	2.265E-04	1.520E-04	32.9%
15	4.33	3.04	1.657E-04	1.121E-04	32.3%
16	4.27	3.13	1.737E-04	1.192E-04	31.4%
17	2.29	1.60	8.494E-05	5.855E-05	31.1%
18	2.21	1.55	7.971E-05	5.545E-05	30.4%
Total	40.39	28.25	1.517E-03	1.037E-03	31.7%

Table V-27
Base Case 2007 and Controlled 2012 High Wind PM-10 Emissions Inventories for June 6, 2007 Design Day at the Durango Complex Monitor

High Wind Hour	Un-weighted Emissions (tons)		Distance-Weighted Emissions (tons/feet from monitor)		% Reduction of Weighted Emissions
	2007	2012	2007	2012	
11	1.99	1.37	1.340E-04	9.011E-05	32.8%
12	3.69	2.55	2.267E-04	1.543E-04	31.9%
13	3.12	2.15	1.876E-04	1.281E-04	31.7%
14	8.02	5.49	4.672E-04	3.093E-04	33.8%
15	9.84	7.07	4.992E-04	3.379E-04	32.3%
16	5.62	3.79	3.247E-04	2.160E-04	33.5%
17	2.47	1.72	1.619E-04	1.110E-04	31.4%
Total	34.74	24.13	2.001E-03	1.347E-03	32.7%

Table V-28
Base Case 2007 and Controlled 2012 High Wind PM-10 Emissions Inventories for June 6, 2007 Design Day at the Greenwood Monitor

High Wind Hour	Un-weighted Emissions (tons)		Distance-Weighted Emissions (tons/feet from monitor)		% Reduction of Weighted Emissions
	2007	2012	2007	2012	
12	1.05	0.77	5.872E-05	4.191E-05	28.6%
13	1.03	0.80	6.482E-05	4.701E-05	27.5%
14	3.03	2.16	1.618E-04	1.110E-04	31.4%
15	2.34	1.75	1.266E-04	8.868E-05	30.0%
Total	7.45	5.49	4.119E-04	2.886E-04	29.9%

Table V-29
Base Case 2007 and Controlled 2012 High Wind PM-10 Emissions Inventories for June 6, 2007 Design Day at the Higley Monitor

High Wind Hour	Un-weighted Emissions (tons)		Distance-Weighted Emissions (tons/feet from monitor)		% Reduction of Weighted Emissions
	2007	2012	2007	2012	
10	0.74	0.55	6.103E-05	4.481E-05	26.6%
11	3.00	2.05	1.944E-04	1.330E-04	31.6%
12	2.15	1.54	1.805E-04	1.270E-04	29.6%
13	2.41	1.69	1.824E-04	1.268E-04	30.4%
14	5.61	3.83	2.282E-04	1.553E-04	31.9%
15	5.70	3.98	2.113E-04	1.442E-04	31.8%
16	5.65	3.90	2.065E-04	1.403E-04	32.1%
17	1.50	1.11	6.687E-05	4.791E-05	28.4%
Total	26.76	18.64	1.331E-03	9.195E-04	30.9%

Table V-30
Base Case 2007 and Controlled 2012 High Wind PM-10 Emissions Inventories for June 6, 2007 Design Day at the West Phoenix Monitor

High Wind Hour	Un-weighted Emissions (tons)		Distance-Weighted Emissions (tons/feet from monitor)		% Reduction of Weighted Emissions
	2007	2012	2007	2012	
11	0.65	0.53	2.164E-05	1.680E-05	22.4%
12	1.78	1.33	5.329E-05	3.930E-05	26.2%
13	3.35	2.45	8.177E-05	5.933E-05	27.4%
14	4.27	3.08	1.123E-04	8.105E-05	27.8%
15	1.63	1.21	4.623E-05	3.396E-05	26.5%
Total	11.67	8.60	3.152E-04	2.304E-04	26.9%

Table V-31
Base Case 2007 and Controlled 2012 High Wind PM-10 Emissions Inventories for June 6, 2007 Design Day at the West 43rd Avenue Monitor

High Wind Hour	Un-weighted Emissions (tons)		Distance-Weighted Emissions (tons/feet from monitor)		% Reduction of Weighted Emissions
	2007	2012	2007	2012	
0	2.29	1.59	2.064E-04	1.388E-04	32.8%
5	3.31	2.29	2.894E-04	1.924E-04	33.5%
6	5.05	3.43	4.359E-04	2.860E-04	34.4%
10	3.44	2.38	2.835E-04	1.898E-04	33.1%
11	6.67	4.51	4.937E-04	3.237E-04	34.4%
12	6.02	4.06	5.697E-04	3.704E-04	35.0%
13	5.66	3.82	4.721E-04	3.088E-04	34.6%
14	9.67	6.48	6.830E-04	4.425E-04	35.2%
15	13.99	9.12	9.717E-04	6.168E-04	36.5%
16	9.67	6.48	6.630E-04	4.304E-04	35.1%
17	5.10	3.45	4.285E-04	2.812E-04	34.4%
18	4.94	3.34	3.857E-04	2.526E-04	34.5%
Total	75.81	50.97	5.883E-03	3.833E-03	34.8%

Low Wind Inventories

Even though high wind design days are being modeled for this attainment demonstration, there are still several hours, if not the majority of hours, in the design day when winds are not high enough to produce windblown dust. Emissions from these hours contribute to the design day value and need to be accounted for. Significant reductions from the control measures in this plan have also occurred during low wind or stagnant conditions, so much so that a stagnant PM-10 exceedance has not been seen since 2007 in the nonattainment area.

The success of the low wind measures in this plan negates the need to develop complex design day-specific emission inventories. But rather, annual low wind emissions can simply be assigned to the land uses within each of the three low wind domains. The difference in 2007 and 2012 low wind inventories provide the benefits of the measures in this plan under low wind or stagnant conditions.

Initially, an investigation was made to see if the low wind inventory for the nonattainment area as a whole could be used instead of spatially unique low wind domains. However, because the nonattainment area is so large, substantial differences in the distribution of land uses within the nonattainment area provide for drastically different mix of PM-10 sources throughout sub-areas of the nonattainment area. As such, it became apparent that low wind emissions needed to be estimated for the areas immediately surrounding the modeled monitors in order to accurately reflect the benefits of the control measures at each monitor in the attainment demonstrations.

Low wind emissions are assigned to each of the three domains based upon land use distribution within each of the domains. The values for the low wind emissions are taken from Chapter Five of this Plan (the development of those emissions are explained in Chapters II through III of this TSD). As a first step, the 2007 base and 2012 controlled low wind inventories are assigned to the PM-10 nonattainment area as a whole. After the allocation is complete, the allocated emissions are divided by the number of acres in each land use to produce an annual tons/acre rate which can then be applied to the land uses in each of the three low wind domains to estimate the low wind emissions in each domain. Table V-32 lists the low wind emission categories and the land uses to which those emissions are allocated and Table V-33 lists the resulting tons/acre annual PM-10 emission rate for the PM-10 nonattainment area. Tables V-34 through V-36 display the resulting low wind emissions in each of the three low wind domains.

Table V-32
Annual Low Wind PM-10 Emission Inventory Allocated by Land Use Category

Source Category	2007 Emissions (tons)	2012 Emissions (tons)	Land Use Category
POINT	158.53	134.59	Industrial
AREA			
Residential Fuel Combustion	514.20	535.25	Residential
Commercial Fuel Combustion	283.26	294.85	Commercial
Industrial Fuel Combustion	478.48	498.06	Industrial
Commercial Cooking	974.17	1,014.05	Commercial
Construction	16,106.11	3,731.54	Construction
Tilling, Harvesting, Cotton Ginning	936.27	893.20	Agriculture
Travel on Unpaved Farm Roads	768.69	731.03	Agriculture
Livestock	260.95	260.95	Agriculture
Travel on Unpaved parking Lots	2,3750.50	2,472.74	Vacant/Open
Offroad Recreational Vehicles	2,138.74	2,226.28	Vacant/Open
Leaf Blowers	877.98	913.91	Residential
Fires	496.71	496.71	Vacant/Open
Mining/Quarrying	561.81	255.62	Industrial
Travel on Industrial Haul Roads	770.71	350.67	Industrial
Other Industrial Sources	1,032.62	876.65	Industrial
NONROAD			
Aircraft	193.54	145.50	Transportation
Airport Ground Support Equipment	28.64	19.90	Transportation
Locomotives	34.16	34.16	Transportation
Agricultural Equipment	15.37	13.60	Agriculture
Commercial Equipment	119.54	105.78	Commercial
Construction & Mining Equipment	1,269.88	1,123.64	Constr./Indust. 50/50
Industrial Equipment	103.04	91.18	Industrial
Lawn & Garden Equipment	185.95	164.53	Residential
Pleasure Craft	7.13	6.31	Vacant/Open
Railway Maintenance Equipment	1.15	1.02	Transportation
Recreation Vehicles	7.80	6.90	Vacant/Open
ONROAD			
Exhaust	2,943.36	1,407.06	Transportation
Tire Wear	245.80	261.41	Transportation
Brake Wear	727.66	787.25	Transportation
Paved Roads	7,749.01	8,421.72	Transportation
Unpaved Roads	10,217.66	10,312.22	See Note
TOTAL	52,584.31	38,588.59	N/A

Note: Unpaved roads are allocated based upon the land uses that they are nearest to: Residential 26%, Commercial 3%, Agriculture 13%, Vacant/Open 45%, Industrial 2% and Construction 11%.

Table V-33
Annual Low Wind PM-10 Tons per Acre Emission Rates in the Nonattainment Area

Land Use	Acres	2007 Tons	2012 Tons	2007 Tons/Acre	2012 Tons/Acre
Residential	435,720	4,235	4,295	9.72E-03	9.86E-03
Commercial	123,742	1,684	1,724	1.36E-02	1.39E-02
Agriculture	133,761	3,310	3,239	2.47E-02	2.42E-02
Vacant/Open	1,026,817	9,624	9,849	9.37E-03	9.59E-03
Transportation	28,856	11,923	11,078	4.13E-01	3.84E-01
Industrial	54,364	3,944	2,975	7.25E-02	5.47E-02
Construction*	43,795	17,865	5,428	4.08E-01	1.24E-01
TOTAL	1,847,054	52,584	38,588	2.86E-02	2.09E-02

*Construction acreage comes from Maricopa County Air Quality Department permit records for the year 2007. Only locations that were verifiable were included in the acreage total.

Table V-34
Annual Base Case 2007 and Controlled 2012 Low Wind PM-10 Emissions Inventories for the Salt River Area Low Wind Domain

Land Use	Acres	2007 Emissions (tons)	2012 Emissions (tons)	% Reduction
Residential	6,296	61.19	62.05	(1.4%)
Commercial	4,508	61.34	62.81	(2.4%)
Agriculture	1,180	29.19	28.57	2.1%
Vacant/Open	2,984	27.97	28.62	(2.3%)
Transportation	405	167.28	155.42	7.1%
Industrial	6,410	465.10	350.77	24.6%
Construction	1,073	437.70	132.98	69.6%
Total	22,856	1,249.76	821.23	34.3%

Table V-35
Annual Base Case 2007 and Controlled 2012 Low Wind PM-10 Emissions Inventories for the Central City Low Wind Domain

Land Use	Acres	2007 Emissions (tons)	2012 Emissions (tons)	% Reduction
Residential	12,161	118.19	119.87	(1.4%)
Commercial	6,419	87.33	89.43	(2.4%)
Agriculture	0	0.00	0.00	0.0%
Vacant/Open	2,745	25.73	26.33	(2.3%)
Transportation	244	100.82	93.67	7.1%
Industrial	3,619	262.58	198.03	24.6%
Construction	404	164.80	50.07	69.6%
Total	25,592	759.46	577.41	24.0%

Table V-36
Annual Base Case 2007 and Controlled 2012 Low Wind PM-10 Emissions Inventories for the Higley Low Wind Domain

Land Use	Acres	2007 Emissions (tons)	2012 Emissions (tons)	% Reduction
Residential	4,216	40.97	41.55	(1.4%)
Commercial	1,123	15.28	15.65	(2.4%)
Agriculture	1,865	46.15	45.17	2.1%
Vacant/Open	1,774	16.62	17.01	(2.3%)
Transportation	389	160.74	149.34	7.1%
Industrial	36	2.58	1.95	24.6%
Construction	765	312.06	94.81	69.6%
Total	10,167	594.41	365.49	38.5%

CONTROL MEASURE ANALYSIS

Under rollback modeling, the reductions achieved by the control measures are reflected as a comparison between the base case (2007) and controlled case (2012) inventories. Calculation of the emission reductions associated with these control measures for the entire nonattainment area are presented in Chapters II and III of this TSD, as part of the requirement to show five percent annual reductions in PM-10 emissions.

Since high wind days are being modeled for this attainment demonstration, both high wind and low wind inventories were developed to compare the effectiveness of the control measures in this plan. For the high wind hours, reductions between the 2007 and 2012 inventories is solely due to the benefits of the control measures in this plan (increased rule effectiveness), as land use is conservatively held constant between 2007 and 2012. No adjustment for economic growth or recession has been applied to the high wind inventories. These reductions have been shown as part of the high wind inventory tables presented earlier (Tables V-25 through V-31). Although no credit has been taken, in practice, land use conversion has also reduced PM-10 emissions within the high wind domains, as construction activity has been limited due to the economic recession and as agricultural land within the PM-10 area slowly converts to other uses.

The reductions seen during the low wind hours are a result of both the control measures and economic growth factors. Because of the large size of the nonattainment area, the reductions of PM-10 emissions between the base case 2007 and controlled case 2012 inventories were calculated for three low wind domains within the nonattainment area. These reductions have been shown in Tables V-34 through V-36 as part of the discussion of the creation of the low wind inventories.

DEMONSTRATION OF ATTAINMENT

As discussed earlier in the Chapter, May 4, 2007 was selected as the high wind design day to demonstrate attainment in the Salt River area, where the West 43rd Avenue monitor alone had exceeded the 24-hour PM-10 standard. June 6, 2007 was chosen as the high wind design day for the entire nonattainment area when two monitors in the nonattainment area exceeded on this date (West 43rd Avenue and Higley). The control measures in this plan are designed to reduce PM-10 emissions and their resulting concentrations to the point where the design days can be shown to attain the standard.

Rollback modeling assumes a linear relationship between PM-10 emissions sources and their contribution to observed ambient PM-10 concentrations. Hours where the wind speeds are low (< 12 mph), limit the emissions sources to those within the predetermined low wind domain. Because all of the low wind sources are within a few miles of the modeled monitor, all sources are weighted equally. During high wind hours, PM-10 emission sources follow the back trajectory of the prevailing winds at the monitor, forming a high wind domain whose distance from the monitor stretches back based upon the magnitude of the wind speeds. This creates high wind domains that can be over 20 miles in length. To account for the distance of the windblown PM-10 sources from the modeled monitor, these sources are weighted by their relative distance to the impacted monitor.

The reductions observed between the base case 2007 and controlled case 2012 low inventory and the high wind (distance-weighted) inventory provides the expected reductions of concentrations at the impacted monitor. Holding background values constant, the reductions seen in the inventories are applied to the low and high wind hourly concentrations of the design day to demonstrate that the control measures in the plan will achieve attainment. Attainment in 2012 has been shown for both the May 4, 2007 and June 6, 2007 design days. Results of the attainment demonstrations are presented in Tables V-37 through V-44.

Table V-37
2012 Attainment Demonstration
High Wind Design Day (May 4, 2007) at the West 43rd Avenue Monitor

Hour	Wind Speed (mph)	May 4, 2007 PM-10 Concentration ($\mu g/m^3$)	Background Concentration ($\mu g/m^3$)	2012 Controlled PM-10 Concentration ($\mu g/m^3$)
0	2.5	25.9	14.9	22.1
1	1.4	19.8	14.9	18.1
2	0.4	27.0	14.9	22.8
3	5.5	31.5	14.9	25.8
4	6.7	50.7	14.9	38.4
5	8.5	82.7	14.9	59.4
6	7.2	117.3	14.9	82.2
7	4.9	71.9	14.9	52.3
8	4.5	73.5	14.9	53.4
9	9.2	73.0	14.9	53.1
10	9.4	144.2	14.9	99.9
11	10.6	147.0	14.9	101.7
12	***13.4***	***196.6***	***21.9***	***137.5***
13	***17.6***	***521.0***	***21.9***	***346.4***
14	***17.4***	***451.6***	***21.9***	***300.6***
15	***18.7***	***449.9***	***21.9***	***295.8***
16	***17.7***	***311.2***	***21.9***	***206.7***
17	***19.4***	***570.0***	***21.9***	***367.7***
18	***17.6***	***357.2***	***21.9***	***237.2***
19	***15.5***	***204.0***	***21.9***	***140.7***
20	9.8	174.7	14.9	119.9
21	***13.6***	***148.8***	***21.9***	***105.4***
22	***15.6***	***281.1***	***21.9***	***191.0***
23	11.6	205.6	14.9	140.2
24-Hour Avg.		197.3		134.1

Note: High wind hours highlighted in bold italics.

Table V-38
2012 Attainment Demonstration
High Wind Design Day (June 6, 2007) at the Central Phoenix Monitor

Hour	Wind Speed (mph)	June 6, 2007 PM-10 Concentration ($\mu g/m^3$)	Background Concentration ($\mu g/m^3$)	2012 Controlled PM-10 Concentration ($\mu g/m^3$)
0	***12.5***	***138.5***	***21.9***	***102.7***
1	***13.1***	***176.2***	***21.9***	***131.6***
2	8.6	133.6	14.9	105.1
3	8.0	109.7	14.9	86.9
4	10.9	92.9	14.9	74.2
5	10.3	81.5	14.9	65.5
6	***12.4***	***99.6***	***21.9***	***76.1***
7	***12.8***	***104.0***	***21.9***	***80.2***
8	11.1	80.2	14.9	64.5
9	11.3	73.2	14.9	59.2
10	***12.1***	***69.6***	***21.9***	***55.6***
11	***13.9***	***96.1***	***21.9***	***73.8***
12	***15.3***	***106.2***	***21.9***	***79.5***
13	***15.4***	***150.5***	***21.9***	***107.3***
14	***16.9***	***211.2***	***21.9***	***148.9***
15	***17.8***	***255.7***	***21.9***	***180.1***
16	***15.7***	***111.7***	***21.9***	***83.5***
17	***14.0***	***71.0***	***21.9***	***55.7***
18	***14.0***	***74.4***	***21.9***	***58.4***
19	11.9	72.5	14.9	58.7
20	11.1	59.8	14.9	49.0
21	11.7	70.6	14.9	57.2
22	8.8	63.0	14.9	51.5
23	8.5	66.9	14.9	54.4
24-Hour Avg.		107.0		81.7

Note: High wind hours highlighted in bold italics.

Table V-39
2012 Attainment Demonstration
High Wind Design Day (June 6, 2007) at the Durango Complex Monitor

Hour	Wind Speed (mph)	June 6, 2007 PM-10 Concentration ($\mu g/m^3$)	Background Concentration ($\mu g/m^3$)	2012 Controlled PM-10 Concentration ($\mu g/m^3$)
0	8.9	132.6	14.9	92.2
1	6.3	166.4	14.9	114.4
2	5.0	133.6	14.9	92.9
3	1.0	112.7	14.9	79.2
4	2.6	124.4	14.9	86.8
5	7.3	101.4	14.9	71.7
6	9.1	164.5	14.9	113.2
7	8.7	113.4	14.9	79.6
8	10.5	93.6	14.9	66.6
9	11.2	86.3	14.9	61.8
10	11.9	83.3	14.9	59.8
11	***12.5***	***130.3***	***21.9***	***94.8***
12	***13.9***	***168.1***	***21.9***	***121.4***
13	***13.5***	***202.7***	***21.9***	***145.4***
14	***15.7***	***405.5***	***21.9***	***275.9***
15	***17.9***	***398.1***	***21.9***	***276.5***
16	***14.5***	***119.9***	***21.9***	***87.1***
17	***12.9***	***70.0***	***21.9***	***54.9***
18	10.3	53.9	14.9	40.5
19	8.9	57.0	14.9	42.6
20	6.4	61.1	14.9	45.3
21	7.5	83.0	14.9	59.6
22	6.3	67.8	14.9	49.7
23	5.2	79.6	14.9	57.4
24-Hour Avg.		133.7		94.6

Note: High wind hours highlighted in bold italics.

Table V-40
2012 Attainment Demonstration
High Wind Design Day (June 6, 2007) at the Greenwood Monitor

Hour	Wind Speed (mph)	June 6, 2007 PM-10 Concentration (µg/m^3)	Background Concentration (µg/m^3)	2012 Controlled PM-10 Concentration (µg/m^3)
0	8.1	138.4	14.9	108.8
1	5.7	159.9	14.9	125.1
2	4.9	123.4	14.9	97.4
3	2.9	105.2	14.9	83.5
4	2.1	105.6	14.9	83.8
5	5.4	86.5	14.9	69.3
6	6.7	112.6	14.9	89.2
7	7.7	103.8	14.9	82.5
8	8.3	77.9	14.9	62.8
9	10.0	79.0	14.9	63.6
10	11.0	74.7	14.9	60.3
11	10.8	103.2	14.9	82.0
12	***12.7***	***172.2***	***21.9***	***129.2***
13	***12.6***	***194.6***	***21.9***	***147.1***
14	***15.4***	***442.1***	***21.9***	***310.3***
15	***13.9***	***240.6***	***21.9***	***175.1***
16	11.9	93.5	14.9	74.6
17	11.7	96.9	14.9	77.2
18	11.4	82.5	14.9	66.3
19	8.7	68.3	14.9	55.5
20	7.4	61.3	14.9	50.2
21	7.0	67.9	14.9	55.2
22	5.1	63.5	14.9	51.8
23	4.0	68.3	14.9	55.5
24-Hour Avg.		121.7		94.0

Note: High wind hours highlighted in bold italics.

Table V-41
2012 Attainment Demonstration
High Wind Design Day (June 6, 2007) at the Higley Monitor

Hour	Wind Speed (mph)	June 6, 2007 PM-10 Concentration ($\mu g/m^3$)	Background Concentration ($\mu g/m^3$)	2012 Controlled PM-10 Concentration ($\mu g/m^3$)
0	7.4	39.6	14.9	30.1
1	5.8	72.9	14.9	50.6
2	8.8	135.2	14.9	88.9
3	9.0	130.9	14.9	86.2
4	9.1	104.9	14.9	70.3
5	7.4	96.4	14.9	65.0
6	9.4	113.4	14.9	75.5
7	9.4	90.9	14.9	61.6
8	10.8	187.2	14.9	120.9
9	11.6	195.1	14.9	125.7
10	***14.6***	***580.2***	***21.9***	***431.9***
11	***15.2***	***379.0***	***21.9***	***266.3***
12	***17.6***	***568.8***	***21.9***	***406.7***
13	***15.3***	***408.1***	***21.9***	***290.5***
14	***15.8***	***387.9***	***21.9***	***271.1***
15	***15.6***	***268.9***	***21.9***	***190.5***
16	***15.3***	***167.5***	***21.9***	***120.8***
17	***13.5***	***96.4***	***21.9***	***75.3***
18	10.1	45.2	14.9	33.5
19	6.9	50.7	14.9	36.9
20	6.6	43.1	14.9	32.2
21	7.1	60.5	14.9	42.9
22	2.9	55.7	14.9	40.0
23	3.2	66.9	14.9	46.9
24-Hour Avg.		181.1		127.5

Note: High wind hours highlighted in bold italics.

Table V-42
2012 Attainment Demonstration
High Wind Design Day (June 6, 2007) at the State Super Site Monitor

Hour	Wind Speed (mph)	June 6, 2007 PM-10 Concentration ($\mu g/m^3$)	Background Concentration ($\mu g/m^3$)	2012 Controlled PM-10 Concentration ($\mu g/m^3$)
0	7.6	99.3	14.9	79.0
1	6.3	149.6	14.9	117.3
2	5.4	112.2	14.9	88.8
3	5.4	95.8	14.9	76.4
4	6.7	92.4	14.9	73.8
5	7.2	80.6	14.9	64.8
6	7.2	80.2	14.9	64.5
7	6.5	82.7	14.9	66.4
8	7.2	63.5	14.9	51.8
9	6.7	60.8	14.9	49.8
10	6.9	53.6	14.9	44.3
11	9.4	65.5	14.9	53.4
12	8.9	77.8	14.9	62.7
13	9.8	107.8	14.9	85.5
14	10.5	142.1	14.9	111.6
15	11.4	109.4	14.9	86.7
16	10.1	62.3	14.9	50.9
17	9.2	54.4	14.9	44.9
18	11.2	57.5	14.9	47.3
19	9.6	53.9	14.9	44.5
20	7.8	60.9	14.9	49.9
21	6.3	62.5	14.9	51.1
22	3.8	55.1	14.9	45.5
23	3.6	54.8	14.9	45.2
24-Hour Avg.		80.6		64.8

Table V-43
2012 Attainment Demonstration
High Wind Design Day (June 6, 2007) at the West Phoenix Monitor

Hour	Wind Speed (mph)	June 6, 2007 PM-10 Concentration ($\mu g/m^3$)	Background Concentration ($\mu g/m^3$)	2012 Controlled PM-10 Concentration ($\mu g/m^3$)
0	7.1	134.4	14.9	105.7
1	7.8	164.9	14.9	128.9
2	8.4	123.8	14.9	97.7
3	4.2	106.1	14.9	84.2
4	5.1	99.1	14.9	78.9
5	6.1	84.4	14.9	67.7
6	8.5	94.4	14.9	75.3
7	10.3	102.9	14.9	81.8
8	8.7	75.2	14.9	60.7
9	8.6	70.3	14.9	57.0
10	8.8	62.1	14.9	50.8
11	***12.1***	***122.2***	***21.9***	***99.7***
12	***13.6***	***169.6***	***21.9***	***130.8***
13	***15.1***	***256.6***	***21.9***	***192.2***
14	***15.1***	***259.8***	***21.9***	***193.6***
15	***13.5***	***132.1***	***21.9***	***102.9***
16	12.0	88.2	14.9	70.6
17	11.7	71.9	14.9	58.2
18	10.0	66.7	14.9	54.3
19	9.3	65.1	14.9	53.1
20	9.1	66.7	14.9	54.3
21	6.8	67.3	14.9	54.7
22	5.3	62.6	14.9	51.2
23	4.8	63.7	14.9	52.0
24-Hour Avg.		108.8		85.7

Note: High wind hours highlighted in bold italics.

Table V-44
2012 Attainment Demonstration
High Wind Design Day (June 6, 2007) at the West 43rd Avenue Monitor

Hour	Wind Speed (mph)	June 6, 2007 PM-10 Concentration ($\mu g/m^3$)	Background Concentration ($\mu g/m^3$)	2012 Controlled PM-10 Concentration ($\mu g/m^3$)
0	***13.3***	***175.1***	***21.9***	***124.9***
1	9.9	177.0	14.9	121.4
2	9.1	150.0	14.9	103.7
3	7.8	115.5	14.9	81.0
4	10.6	145.0	14.9	100.4
5	***14.5***	***318.0***	***21.9***	***218.8***
6	***14.9***	***267.2***	***21.9***	***182.9***
7	11.4	208.1	14.9	141.8
8	11.3	131.4	14.9	91.4
9	12.0	152.0	14.9	105.0
10	***13.8***	***180.8***	***21.9***	***128.3***
11	***16.0***	***438.3***	***21.9***	***294.9***
12	***16.6***	***449.1***	***21.9***	***299.6***
13	***15.1***	***394.9***	***21.9***	***265.9***
14	***17.6***	***643.1***	***21.9***	***424.3***
15	***18.1***	***662.3***	***21.9***	***428.4***
16	***17.0***	***237.5***	***21.9***	***161.8***
17	***14.5***	***92.3***	***21.9***	***68.1***
18	***14.9***	***77.9***	***21.9***	***58.6***
19	12.0	56.1	14.9	42.0
20	8.8	87.3	14.9	62.5
21	9.3	98.1	14.9	69.6
22	7.0	82.6	14.9	59.4
23	6.8	78.3	14.9	56.6
24-Hour Avg.		225.7		153.8

Note: High wind hours highlighted in bold italics.

APPENDIX B

EXHIBIT 2:

Calculation of Benefits from PM-10 Certified Street Sweepers Purchased with CMAQ Funds in 2001-2009

CMAQ Funded PM-10 Certified Street Sweepers Purchased in 2001-2009							PM-10 Emission Reductions (kg/day)									
Sweeper		AADT Per	Lane	Lane	Cycle	Cycle					Total	Reduction	Benefit with	Month of	Age in	Usage
#	Agency Requesting Sweeper	Lane	MIles Old	Miles New	LenOld	LenNew	Replace	Expand	Incr Freq	Process	Reduction	by Unit	Usage Factor	Purchase	Dec-09	Factor
1	Apache Junction	832	98	118	45	30		0.41	1.20		1.61	1.61	1.28	Mar-04	5.8	0.795
4	Chandler	5,260	131	131	14	14	32.30			0.22	32.51	32.51	22.86	Nov-01	8.1	0.703
6	Chandler	8,313	165	165	7	7	118.53			0.54	119.08	119.08	94.67	Aug-04	5.3	0.795
8	El Mirage	1,469	129	108	30	15		-1.13	5.83		4.70	4.70	3.73	Jan-04	5.9	0.795
9	Fort McDowell	1,500	21	21	30	30	0.69			0.02	0.71	0.71	0.52	Dec-01	8.0	0.734
21	Litchfield Park	4,518	12	12	30	30	1.19			0.01	1.20	5.34	4.24	Jun-04	5.5	0.795
		2,259	23	28	14	14	2.44	0.89		0.05	3.37			Jun-04	5.5	0.795
		244	35	50	14	14	0.40	0.29		0.08	0.77			Jun-04	5.5	0.795
23	Mesa	229	342	342	38	38	1.35			0.21	1.56	1.56	1.34	Oct-06	3.2	0.857
24	Paradise Valley	10,000	20	20	90	30	1.46		4.90	0.02	6.37	15.41	10.83	Jul-01	8.4	0.703
		7,000	22.5	22.5	90	30	1.15		3.86	0.02	5.02			Jul-01	8.4	0.703
		3,000	18	18	90	45	0.39		0.66	0.01	1.06			Jul-01	8.4	0.703
		1,000	147	147	90	45	1.07		1.80	0.08	2.95			Jul-01	8.4	0.703
26	Peoria	4,500	53.4	53.4	25	25	6.31			0.05	6.36	7.88	6.02	Nov-03	6.1	0.764
		1,000	18	18	35	35	0.34			0.01	0.35			Nov-03	6.1	0.764
		500	116.8	116.8	35	35	1.09			0.08	1.17			Nov-03	6.1	0.764
27	Phoenix	4,205	302	302	21	14			33.33		33.33	33.33	23.43	Aug-01	8.3	0.703
28	Phoenix	4,205	302	302	21	14			33.33		33.33	33.33	23.43	Aug-01	8.3	0.703
29	Phoenix	4,205	302	302	21	14			33.33		33.33	33.33	23.43	Aug-01	8.3	0.703
30	Phoenix	4,205	302	302	21	14			33.33		33.33	33.33	23.43	Aug-01	8.3	0.703
31	Phoenix	4,205	302	302	14	14	59.52			0.50	60.02	60.02	47.72	Jun-04	5.5	0.795
32	Phoenix	4,205	302	302	14	14	59.52			0.50	60.02	60.02	47.72	Jun-04	5.5	0.795
33	Phoenix	4,205	302	302	14	14	59.52			0.50	60.02	60.02	45.86	Oct-03	6.2	0.764
34	Phoenix	4,205	302	302	14	14	59.52			0.50	60.02	60.02	45.86	Oct-03	6.2	0.764
35	Phoenix	4,205	302	302	14	14	59.52			0.50	60.02	60.02	45.86	Oct-03	6.2	0.764
36	Phoenix	4,205	302	302	14	14	59.52			0.50	60.02	60.02	45.86	Oct-03	6.2	0.764
37	Phoenix	4,205	302	302	14	14	59.52			0.50	60.02	60.02	45.86	Oct-03	6.2	0.764
38	Phoenix	4,205	302	302	14	14	59.52			0.50	60.02	60.02	45.86	Oct-03	6.2	0.764
39	Phoenix	4,205	302	302	14	14	59.52			0.50	60.02	60.02	45.86	Oct-03	6.2	0.764
40	Phoenix	4,205	302	302	14	14	59.52			0.50	60.02	60.02	45.86	Oct-03	6.2	0.764
41	Phoenix	4,205	302	302	14	14	59.52			0.50	60.02	60.02	45.86	Oct-03	6.2	0.764
42	Phoenix	4,205	302	302	14	14	59.52			0.50	60.02	60.02	45.86	Oct-03	6.2	0.764
43	Scottsdale	8,450	49	49	7	7	35.78			0.16	35.94	37.45	26.33	Oct-01	8.2	0.703
		150	310	310	25	25	1.22			0.29	1.51			Oct-01	8.2	0.703
44	Scottsdale	7,100	101	101	7	7	61.97			0.33	62.30	62.33	49.55	Sep-04	5.3	0.795
		350	4	4	42	42	0.02			0.00	0.02			Sep-04	5.3	0.795
45	Scottsdale	7,000	73	73	7	7	44.16			0.24	44.40	46.54	37.00	Sep-04	5.3	0.795
		2,000	11	11	21	21	0.69			0.01	0.70			Sep-04	5.3	0.795
		350	240	240	42	42	1.31			0.13	1.44			Sep-04	5.3	0.795
49	Tempe	6,600	111.75	111.75	21	5	23.05		94.15	0.51	117.71	133.09	97.69	Jul-02	7.4	0.734
		4,750	26.75	26.75	21	10	3.97		7.34	0.06	11.37			Jul-02	7.4	0.734
		800	153.75	153.75	21	21	3.84			0.17	4.01			Jul-02	7.4	0.734
50	Tempe	6,600	111.75	111.75	21	5	23.05		94.15	0.51	117.71	133.09	105.81	Feb-04	5.8	0.795
		4,750	26.75	26.75	21	10	3.97		7.34	0.06	11.37			Feb-04	5.8	0.795
		800	153.75	153.75	21	21	3.84			0.17	4.01			Feb-04	5.8	0.795
52	Youngtown	1,492	26	26	90	30	0.28		0.95	0.02	1.25	1.25	0.96	Oct-03	6.2	0.764
53	Queen Creek	1,365	20	20	30	15	0.60		1.00	0.03	1.63	2.21	1.76	Nov-04	5.1	0.795
		910	6	6	30	15	0.12		0.20	0.01	0.33			Nov-04	5.1	0.795
		68	46	46	30	15	0.07		0.12	0.07	0.25			Nov-04	5.1	0.795
54	Chandler	1,492	60	60	30	30	1.96			0.05	2.00	5.92	4.89	Jan-05	4.9	0.826
		291	548	548	30	30	3.49			0.42	3.91			Jan-05	4.9	0.826
55	Glendale	5,706	175	175	12	12	54.60			0.34	54.94	64.60	51.35	Sep-04	5.3	0.795
		910	110	110	15	15	4.38			0.17	4.55			Sep-04	5.3	0.795

CMAQ Funded PM-10 Certified Street Sweepers Purchased in 2001-2009							PM-10 Emission Reductions (kg/day)									
Sweeper		AADT Per	Lane	Lane	Cycle	Cycle					Total	Reduction	Benefit with	Month of	Age in	Usage
#	Agency Requesting Sweeper	Lane	MIles Old	Miles New	LenOld	LenNew	Replace	Expand	Incr Freq	Process	Reduction	by Unit	Usage Factor	Purchase	Dec-09	Factor
		228	445	445	15	15	4.43			0.68	5.11			Sep-04	5.3	0.795
56	Tempe	6,006	12	12	7	5	6.23		2.16	0.06	8.45	11.11	9.18	Apr-05	4.7	0.826
		4,323	6	6	10	10	1.70			0.01	1.72			Apr-05	4.7	0.826
		728	40	40	21	21	0.91			0.04	0.95			Apr-05	4.7	0.826
58	Surprise	6,066	6	17	28	15	0.85	2.63	3.52	0.03	7.02	8.08	6.43	Jul-04	5.4	0.795
		218	6	43	28	15	0.03	0.32	0.32	0.07	0.74			Jul-04	5.4	0.795
		67	46	103	42	28	0.05	0.10	0.09	0.08	0.32			Jul-04	5.4	0.795
59	Surprise	6,066	112	123	28	15		2.63	25.46		28.09	28.90	22.97	Jul-04	5.4	0.795
		218	7	44	28	15		0.32	0.33		0.65			Jul-04	5.4	0.795
		67	15	72	42	28		0.10	0.06		0.16			Jul-04	5.4	0.795
60	Peoria	4,095	242	248	25	25		1.08			1.08	3.96	3.27	Dec-04	5.0	0.826
		910	91	111	30	30		0.67			0.67			Dec-04	5.0	0.826
		601	576	676	30	30		2.21			2.21			Dec-04	5.0	0.826
61	Buckeye	3,640	6	6	7	7	1.89			0.02	1.91	3.04	2.42	Aug-04	5.3	0.795
		776	10	10	7	7	0.67			0.03	0.70			Aug-04	5.3	0.795
		194	40	40	14	14	0.36			0.07	0.43			Aug-04	5.3	0.795
62	Gila River IC	6,825	6	6	7	7	3.54			0.02	3.56	4.56	3.77	Aug-05	4.3	0.826
		444	24	24	7	7	0.92			0.08	1.00			Aug-05	4.3	0.826
63	Gila River IC	2,730	4	4	7	7	0.94			0.01	0.96	1.19	0.98	Aug-05	4.3	0.826
		228	10	10	7	7	0.20			0.03	0.23			Aug-05	4.3	0.826
64	Gila River IC	3,640	16	16	25	14			2.02		2.02	2.54	2.10	Aug-05	4.3	0.826
		375	40	40	25	14			0.52		0.52			Aug-05	4.3	0.826
65	Gila River IC	228	4	4	25	14			0.03		0.03	0.15	0.13	Aug-05	4.3	0.826
		118	30	30	25	14			0.12		0.12			Aug-05	4.3	0.826
66	El Mirage	3,550	4	11	30	10		0.91	2.87		3.78	6.42	5.30	Jan-05	4.9	0.826
		1,755	12	12	30	12			1.16		1.16			Jan-05	4.9	0.826
		910	44	44	30	15			1.47		1.47			Jan-05	4.9	0.826
67	Phoenix	4,205	302	302	21	14			33.33		33.33	66.66	55.06	Feb-05	4.8	0.826
		4,205	302	302	21	14			33.33		33.33			Feb-05	4.8	0.826
68	Phoenix	4,205	302	302	21	14			33.33		33.33	66.66	55.06	Feb-05	4.8	0.826
		4,205	302	302	21	14			33.33		33.33			Feb-05	4.8	0.826
69	Tempe - Arterials	6,006	12	12	12	12	3.94			0.02	3.96	6.63	5.69	Mar-06	3.8	0.857
	Tempe - Collectors	4,323	6	6	10	10	1.70			0.01	1.72			Mar-06	3.8	0.857
	Tempe - Res Streets	728	40	40	21	21	0.91			0.04	0.95			Mar-06	3.8	0.857
70	Chandler - Collectors	898	46	46	30	30	0.90			0.04	0.94	2.22	1.90	Mar-06	3.8	0.857
	Chandler - Res Streets	106	414	414	30	30	0.96			0.32	1.28			Mar-06	3.8	0.857
71	Chandler - Collectors	1,356	43	43	30	30	1.28			0.03	1.31	3.37	2.89	Mar-06	3.8	0.857
	Chandler - Res Streets	208	387	387	30	30	1.76			0.30	2.06			Mar-06	3.8	0.857
72	Apache Junction - Arterials	3,458	28.25	28.25	20	20	3.21			0.03	3.24	4.16	3.56	Mar-06	3.8	0.857
	Apache Junction - Collectors	496	10.75	10.75	20	20	0.17			0.01	0.19			Mar-06	3.8	0.857
	Apache Junction - Res Streets	137	61.5	61.5	20	20	0.28			0.07	0.35			Mar-06	3.8	0.857
	Apache Junction - Other mid sect	1,274	9	9	20	20	0.38			0.01	0.39			Mar-06	3.8	0.857
73	Queen Creek - Arterials	1,365	0	9.7	15	15		0.97			0.97	1.46	1.25	Jan-06	3.9	0.857
	Queen Creek - Collectors	455	0	6.8	15	15		0.23			0.23			Jan-06	3.9	0.857
	Queen Creek - Res Streets	228	0	31.3	30	30		0.26			0.26			Jan-06	3.9	0.857
74	Phoenix - Arterials	4,488	450	450	14	7			144.23		144.23	221.40	189.74	Mar-06	3.8	0.857
	Phoenix - Collector/Res Streets	2,401	450	450	14	7			77.17		77.17			Mar-06	3.8	0.857
75	Phoenix - Arterials	4,488	450	450	14	7			144.23		144.23	221.40	189.74	Mar-06	3.8	0.857
	Phoenix - Collector/Res Streets	2,401	450	450	14	7			77.17		77.17			Mar-06	3.8	0.857
76	Scottsdale - Arterials	3,185	0	260	30	30		30.43			30.43	30.43	27.02	Dec-06	3.0	0.888
77	Fountain Hills- Arterials	4,550	85	85	15	15	16.92			0.13	17.05	25.80	22.11	Dec-05	4.0	0.857
	Fountain Hills - Collectors	1,820	140	140	45	30	3.72		3.12	0.11	6.94			Dec-05	4.0	0.857
	Fountain Hills - Res Streets	273	350	350	60	45	1.05		0.59	0.18	1.81			Dec-05	4.0	0.857

CMAQ Funded PM-10 Certified Street Sweepers Purchased in 2001-2009							PM-10 Emission Reductions (kg/day)									
Sweeper		AADT Per	Lane	Lane	Cycle	Cycle					Total	Reduction	Benefit with	Month of	Age in	Usage
#	Agency Requesting Sweeper	Lane	MIles Old	Miles New	LenOld	LenNew	Replace	Expand	Incr Freq	Process	Reduction	by Unit	Usage Factor	Purchase	Dec-09	Factor
79	Gilbert - Arterials -	9,087	269	506	15	15		158.28			158.28	238.43	34.06	Feb-08	1.8	0.143
	Gilbert - Collector/Res Streets	2,730	0	799	30	30		80.15			80.15			Feb-08	1.8	0.143
80	Gilbert - Arterials	9,087	269	506	15	15		158.28			158.28	238.43	34.06	Feb-08	1.8	0.143
	Gilbert - Collector/Res Streets	2,730	0	799	30	30		80.15			80.15			Feb-08	1.8	0.143
81	Buckeye - Arterials	1,593	0	24	7	7		5.74			5.74	5.74	4.92	Mar-06	3.8	0.857
82	ADOT - Freeway	30,030	175	250	14	7		55.74	168.50		224.23	301.18	248.77	Jun-05	4.5	0.826
	ADOT - Other Frontage Roads	7,818	375	500	14	14		76.95			76.95			Jun-05	4.5	0.826
83	ADOT - Freeway	30,030	175	250	14	7		55.74	168.50		224.23	301.18	248.77	Jun-05	4.5	0.826
	ADOT - Other Frontage Roads	7,818	375	500	14	14		76.95			76.95			Jun-05	4.5	0.826
84	Surprise- Arterials	8,964	120	120	20	15			19.76		19.76	20.15	16.65	Oct-05	4.2	0.826
	Surprise- Collectors	198	16	40	28	20		0.19	0.12		0.31			Oct-05	4.2	0.826
	Surprise - Res Streets	61	36	67	120	45		0.02	0.06		0.08			Oct-05	4.2	0.826
85	Guadalupe - Collectors	5,678	5	5	1	1					0.00	0.52	0.44	Nov-06	3.1	0.857
	Guadalupe - Res Streets	578	25	25	4	2			0.52		0.52			Nov-06	3.1	0.857
86	Williams Gateway- Arterials	410	12	12	14	5			0.50		0.50	0.50	0.43	Apr-06	3.7	0.857
87	Mesa - Collectors	1,759	35	35	40	40	1.01			0.02	1.03	1.86	1.59	Oct-06	3.2	0.857
	Mesa - Res Streets	200	215	215	40	40	0.71			0.12	0.83			Oct-06	3.2	0.857
88	Mesa - Collectors	1,759	35	35	40	40	1.01			0.02	1.03	1.86	1.59	Oct-06	3.2	0.857
	Mesa - Res Streets	200	215	215	40	40	0.71			0.12	0.83			Oct-06	3.2	0.857
89	Avondale - Collectors	4,550	44	44	7	7	17.30			0.14	17.45	27.85	23.00	Aug-05	4.3	0.826
	Avondale - Res Streets	910	127	127	7	7	9.99			0.42	10.40			Aug-05	4.3	0.826
90	Chandler Airport - Arterials	523	4	4	5	5	0.20			0.02	0.21	2.61	2.24	Mar-06	3.8	0.857
	Chandler Airport - Collectors	91	1	1	5	5	0.01			0.00	0.01			Mar-06	3.8	0.857
	Chandler Airport - Other	683	35	35	5	5	2.23			0.16	2.39			Mar-06	3.8	0.857
91	Goodyear - Arterials	3,185	176	176	14	14	26.27			0.29	26.56	30.52	26.15	Dec-05	4.0	0.857
	Goodyear - Collectors	601	84	84	14	14	2.36			0.14	2.50			Dec-05	4.0	0.857
	Goodyear - Res Streets	218	122	122	14	14	1.25			0.20	1.45			Dec-05	4.0	0.857
92	Goodyear - Arterials - 2005	3,185	176	176	14	14	26.27			0.29	26.56	30.52	26.15	Dec-05	4.0	0.857
	Goodyear - Collectors	601	84	84	14	14	2.36			0.14	2.50			Dec-05	4.0	0.857
	Goodyear - Res Streets	218	122	122	14	14	1.25			0.20	1.45			Dec-05	4.0	0.857
93	Gilbert - Arterials	6,104	679	679	15	15	181.32			1.04	182.36	236.73	33.82	Oct-05	4.2	0.143
	Gilbert - Collectors	3,000	70	70	20	20	6.89			0.08	6.97			Oct-05	4.2	0.143
	Gilbert - Res Streets	3,000	714	714	30	30	46.85			0.55	47.40			Oct-05	4.2	0.143
94	Gilbert - Arterials	6,982	697	697	15	15	212.90			1.07	213.97	268.34	38.33	Oct-05	4.2	0.143
	Gilbert - Collectors	3,000	70	70	20	20	6.89			0.08	6.97			Oct-05	4.2	0.143
	Gilbert - Res Streets	3,000	714	714	30	30	46.85			0.55	47.40			Oct-05	4.2	0.143
95	Gilbert - Arterials	5,954	697	697	15	15	181.55			1.07	182.62	236.99	33.86	Oct-05	4.2	0.143
	Gilbert - Collectors	3,000	70	70	20	20	6.89			0.08	6.97			Oct-05	4.2	0.143
	Gilbert - Res Streets	3,000	714	714	30	30	46.85			0.55	47.40			Oct-05	4.2	0.143
96	Phoenix - Arterials	5,918	465	465	10	10	142.52				142.52	227.87	0.00	Jun-06	3.5	0.000
	Phoenix - Collector/Res Streets	3,167	460	460	14	14	85.36				85.36			Jun-06	3.5	0.000
97	Phoenix - Arterials	5,918	465	465	10	10	142.52				142.52	205.40	0.00	Sep-07	2.3	0.000
	Phoenix - Collector/Res Streets	3,167	460	460	7	7	62.89				62.89			Sep-07	2.3	0.000
100	Surprise - Arterials	10,000	54	54	20	3			85.52		85.52	85.52	73.29	Dec-05	4.0	0.857
101	Tempe - Arterials	6,600	48	48	12	6			23.11		23.11	33.73	32.05	Aug-09	0.3	0.950
	Tempe - Collectors	4,750	32	32	10	5			10.63		10.63			Aug-09	0.3	0.950
102	Goodyear - Arterials	3,750	234	234	30	14			36.85		36.85	36.85	32.72	Sep-07	2.3	0.888
	Goodyear - Collectors	675	114	114	14	14			0.00		0.00			Sep-07	2.3	0.888
	Goodyear - Res Streets	240	130	130	14	14			0.00		0.00			Sep-07	2.3	0.888
103	Tolleson - Collectors	1,500	26	26	14	7	1.83		2.79	0.09	4.70	5.55	4.93	May-07	2.6	0.888
	Tolleson - Res Streets	250	26	26	14	7	0.30		0.46	0.09	0.85			May-07	2.6	0.888
104	Mesa - Collectors	1,759	40	40	52	43			0.31		0.31	0.49	0.45	May-08	1.6	0.919
	Mesa - Res Streets	182	215	215	52	43			0.17		0.17			May-08	1.6	0.919

CMAQ Funded PM-10 Certified Street Sweepers Purchased in 2001-2009							PM-10 Emission Reductions (kg/day)									
Sweeper		AADT Per	Lane	Lane	Cycle	Cycle					Total	Reduction	Benefit with	Month of	Age in	Usage
#	Agency Requesting Sweeper	Lane	MIles Old	Miles New	LenOld	LenNew	Replace	Expand	Incr Freq	Process	Reduction	by Unit	Usage Factor	Purchase	Dec-09	Factor
	Mesa - Other (Alleys)	109	5	5	52	43			0.00		0.00			May-08	1.6	0.919
105	Mesa Falcon Field - Arterials	1,320	7	7	7	7	0.80			0.02	0.82	0.82	0.73	Nov-07	2.1	0.888
106	Litchfield Park - Arterials	4,111	12	16	30	21		0.60	1.04		1.64	4.07	3.62	Nov-07	2.1	0.888
	Litchfield Park - Collectors	2,056	23	25	14	10		0.32	1.62		1.94			Nov-07	2.1	0.888
	Litchfield Park - Res Streets	222	35	45	14	10		0.17	0.31		0.49			Nov-07	2.1	0.888
107	Buckeye - Arterials	546	0	62	7	7		5.08			5.08	5.57	4.95	Sep-07	2.3	0.888
	Buckeye - Collectors	273	0	4	7	7		0.16			0.16			Sep-07	2.3	0.888
	Buckeye - Res Streets	27	0	80	7	7		0.33			0.33			Sep-07	2.3	0.888
108	Surprise - Arterials	2,093	48	48	16	7			8.16		8.16	8.97	7.96	Aug-07	2.3	0.888
	Surprise - Collectors	1,638	24	24	5	5					0.00			Aug-07	2.3	0.888
	Surprise - Res Streets	455	0	48	30	30		0.80			0.80			Aug-07	2.3	0.888
109	Queen Creek - Arterials	4,550	15	51	15	7		12.04	17.79		29.83	31.88	28.31	May-07	2.6	0.888
	Queen Creek - Collectors	2,730	0	5	15	7		1.00	1.05		2.05			May-07	2.6	0.888
110	Gilbert - Arterials	4,572	256	256	15	15	51.20			0.39	51.59	85.82	12.26	Feb-08	1.8	0.143
	Gilbert - Collectors	2,275	300	300	15	15	29.86			0.46	30.32			Feb-08	1.8	0.143
	Gilbert - Res Streets	228	340	340	15	15	3.38			0.52	3.91			Feb-08	1.8	0.143
111	Gilbert - Arterials	4,576	256	256	15	15	51.25			0.39	51.65	85.87	12.27	Feb-08	1.8	0.143
	Gilbert - Collectors	2,275	300	300	15	15	29.86			0.46	30.32			Feb-08	1.8	0.143
	Gilbert - Res Streets	228	340	340	15	15	3.38			0.52	3.91			Feb-08	1.8	0.143
112	Chandler - Arterials	5,098	0	34.5	30	30		6.46			6.46	6.46	5.74	Jun-07	2.5	0.888
113	Cave Creek - Arterials	3,731	0	10	180	14		0.23	2.71		2.94	22.69	20.15	Jan-07	2.9	0.888
	Cave Creek - Collectors	1,593	0	20	180	30		0.20	0.98		1.17			Jan-07	2.9	0.888
	Cave Creek - Res Streets	228	0	25	180	60		0.03	0.07		0.10			Jan-07	2.9	0.888
	Cave Creek - Major Intersection	7,963	0	10	180	2		0.49	17.99		18.48			Jan-07	2.9	0.888
114	Goodyear - Collectors	655	65	65	21	14			1.12		1.12	1.73	1.59	Jan-08	1.9	0.919
	Goodyear - Res Streets	237	99	99	21	14			0.61		0.61			Jan-08	1.9	0.919
115	Fountain Hills - Arterials	4,550	85	85	15	15	16.92			0.13	17.05	31.59	28.06	Sep-07	2.3	0.888
	Fountain Hills - Collectors	1,820	140	140	45	30	3.72		3.12	0.11	6.94			Sep-07	2.3	0.888
	Fountain Hills - Res Streets	273	350	350	60	45	1.05		0.59	0.18	1.81			Sep-07	2.3	0.888
	Fountain Hills - Downtown	2,730	15	15	45	7	0.60		5.15	0.05	5.79			Sep-07	2.3	0.888
120	Chandler - Arterials	7,745	66	66	14	14	29.95				29.95	32.83	0.00	Jul-08	1.4	0.000
	Chandler - Collectors	1,201	15	15	30	30	1.22				1.22			Jul-08	1.4	0.000
	Chandler - Other	6,120	4	4	30	30	1.66				1.66			Jul-08	1.4	0.000
121	Surprise - Arterials	6,461	0	31	15	15		14.72			14.72	26.71	24.55	Mar-08	1.8	0.919
	Surprise - Collectors	3,185	0	37	15	15		8.66			8.66			Mar-08	1.8	0.919
	Surprise - Res Streets	546	0	166	30	30		3.33			3.33			Mar-08	1.8	0.919
122	Avondale - Arterials	8,190	91	97	7	7		7.38			7.38	9.10	8.36	Jul-08	1.4	0.919
	Avondale - Collectors	1,820	41	43	14	14		0.29			0.29			Jul-08	1.4	0.919
	Avondale - Res Streets	910	244	264	14	14		1.43			1.43			Jul-08	1.4	0.919
123	Queen Creek - Arterials	3,640	29	46	15	7		4.55	12.84		17.38	17.46	16.58	Dec-08	1.0	0.950
	Queen Creek - Res Streets	68	29	58	30	30		0.07			0.07			Dec-08	1.0	0.950
126	Mesa - Collectors	1,759	42	44	43	40		0.09	0.15		0.24	0.37	0.35	May-09	0.6	0.950
	Mesa - Res Streets	182	225	235	43	40		0.05	0.08		0.13			May-09	0.6	0.950
	Mesa - Other	109	5	5	43	40			0.00		0.00			May-09	0.6	0.950
127	Paradise Valley - Arterials	6,825	18	18	15	15			0.00		0.00	0.29	0.28	Feb-09	0.8	0.950
	Paradise Valley - Collectors	364	15	15	35	28			0.04		0.04			Feb-09	0.8	0.950
	Paradise Valley- Res Streets	319	100	100	35	28			0.25		0.25			Feb-09	0.8	0.950
131	Maricopa County - Arterials	364	0	534	14	14		15.31			15.31	24.51	23.28	Jun-09	0.5	0.950
	Maricopa County - Res Streets	364	0	367	16	16		9.20			9.20			Jun-09	0.5	0.950
132	Maricopa County - Arterials	364	0	534	14	14		15.31			15.31	24.51	23.28	Jun-09	0.5	0.950
	Maricopa County - Res Streets	364	0	367	16	16		9.20			9.20			Jun-09	0.5	0.950
133	ASU - Res Streets	2,527	17	29.32	1	1	4.76	7.86		0.67	13.29	21.25	20.19	Apr-09	0.7	0.950
	ASU - Pedestrian Paths	4,095	10.04	13.04	1	1	4.55	3.10		0.30	7.96			Apr-09	0.7	0.950

CMAQ Funded PM-10 Certified Street Sweepers Purchased in 2001-2009							PM-10 Emission Reductions (kg/day)									
Sweeper		AADT Per	Lane	Lane	Cycle	Cycle					Total	Reduction	Benefit with	Month of	Age in	Usage
#	Agency Requesting Sweeper	Lane	MIles Old	Miles New	LenOld	LenNew	Replace	Expand	Incr Freq	Process	Reduction	by Unit	Usage Factor	Purchase	Dec-09	Factor
145	Scottsdale - Arterials	5,897	44	44	7	7	20.84				20.84	41.47	0.00	Apr-09	0.7	0.000
	Scottsdale - Collectors	3,898	62	62	7	7	19.41				19.41			Apr-09	0.7	0.000
	Scottsdale - Res Streets	91	108	108	25	25	1.21				1.21			Apr-09	0.7	0.000
Total purchased through December 31, 2009							2,756.22	919.95	1,570.24	25.35	5,271.77	5,271.77	2,939.89	kg/day	1,182.83	tons/yr
									Sweepers purchased 1/1/01-12/31/06				2,559.12	kg/day	1,029.63	tons/yr
									Sweepers purchased 1/1/07-12/31/09				380.77	kg/day	153.20	tons/yr

Notes:

(1) Missing sweeper #s in column A represent units that were purchased with CMAQ funds, but were no longer in service as of December 31, 2009

(2) EFs are based on the Jan 2011 AP-42 Paved Road equation; EFs for Arterials <10,000 ADT (0.71 g/mi) and ≥10,000 ADT (0.23 g/mi) were weighted by 2008 VMT to obtain 0.35 g/mi for all arterials

(3) If Benefits with Usage Factor = 0.00, the sweeper is replacing an older PM-10 certified sweeper and no credit is taken

APPENDIX C

APPENDIX C

EXHIBIT 1:

Arizona Revised Statutes Listed in Table 4-1

ARIZONA REVISED STATUTES LISTED IN TABLE 4-1

9-500.04. Air quality control; definitions

A. The governing body of a city or town in area A or area B as defined in section 49-541 shall:

3. In area A, beginning on January 1, 2008, develop and implement plans to stabilize targeted unpaved roads, alleys and unpaved shoulders on targeted arterials. The plans shall address the performance goals, the criteria for targeting the roads, alleys and shoulders, a schedule for implementation, funding options and reporting requirements. priority shall be given to the following:

(a) Unpaved roads with more than one hundred average daily trips.

(b) Unpaved shoulders on arterial roads and other road segments where vehicle use on unpaved shoulders is evident or anticipated due to projected traffic volume.

5. In area A, in order to reduce particulate matter in ambient air:

(a) Beginning March 31, 2008, on any high pollution advisory day forecast by the department of environmental quality prohibit employees or contractors of that city or town from operating leaf blowers except while in vacuum mode and prohibit those employees or contractors from blowing landscape debris into public roadways at any time.

(b) No later than March 31, 2008, adopt, implement and enforce an ordinance that bans the blowing of landscape debris into public roadways at any time by any person.

6. In area A, no later than March 31, 2008, adopt or amend codes or ordinances and, no later than October 1, 2008, commence enforcement of those codes or ordinances as necessary to require that parking, maneuvering, ingress and egress areas at developments other than residential buildings with four or fewer units are maintained with one or more of the following dustproof paving methods:

(a) Asphaltic concrete.

(b) Cement concrete.

(c) Penetration treatment of bituminous material and seal coat of bituminous binder and a mineral aggregate.

(d) A stabilization method approved by the city or town.

7. In area A, no later than March 31, 2008, adopt or amend codes or ordinances and, no later than October 1, 2009, commence enforcement of those codes or ordinances as necessary to require that parking, maneuvering, ingress and egress areas that are three thousand square feet or more in size at residential buildings with four or fewer units are maintained with a paving or stabilization method authorized by the city or town by code, ordinance or permit.

8. In area A, no later than March 31, 2008, adopt or amend codes or ordinances as necessary to restrict vehicle parking and use on unpaved or unstabilized vacant lots.

9. In area A, no later than March 31, 2008, require that new or renewed contracts for street sweeping on city streets must be conducted with street sweepers that meet the south coast air quality management district rule 1186 street sweeper certification specifications for pick up efficiency and PM-10 emissions in effect on January 1, 2007.

H. Subsection A, paragraphs 5 through 8 of this section do not apply to any site that

has a permit issued by a control officer as defined in section 49-471 for the control of fugitive dust from dust generating operations.

9-500.27. Off-road vehicle ordinance; applicability; violation; classification

A. No later than March 31, 2008, in area A, as defined in section 49-541, a city or town shall adopt, implement and enforce an ordinance that prohibits the operation of any vehicle, including an off-highway vehicle, an all-terrain vehicle or an off-road recreational motor vehicle, on an unpaved surface that is not a public or private road, street or lawful easement and that is closed by the landowner by rule or regulation of a federal agency, this state, a county or a municipality or by proper posting if the land is private land.

B. This section does not apply to the operation of vehicles used in the normal course of business or the normal course of government operations.

C. This section does not prohibit or preempt the enforcement of any similar ordinance that is adopted by a city or town in area A, as defined in section 49-541, before March 31, 2008 for purposes of dust abatement.

D. A person who violates an ordinance adopted pursuant to subsection A of this section is guilty of a class 3 misdemeanor.

E. In addition to or in lieu of a fine pursuant to this section, a judge may order the person to perform at least eight but not more than twenty-four hours of community restitution or to complete an approved safety course related to the off-highway operation of motor vehicles, or both.

11-871. Emissions control; no burn; exemptions; penalty

A. A county that contains any part of area A, as defined in section 49-541, shall develop, implement, and enforce in area A, as defined in section 49-541, an ordinance relating to residential wood burning restrictions, including a no burn restriction when monitoring or forecasting by the department of environmental quality predicts the carbon monoxide standard is likely to be exceeded.

B. On or before October 31, 2007, a county that contains any part of area A, as defined in section 49-541, shall amend the ordinance prescribed by subsection A of this section to include a no burn restriction for any high pollution advisory day forecast by the department of environmental quality for particulate matter.

D. The ordinance shall provide that a person who violates an ordinance adopted pursuant to this section is subject to:

4. The imposition of a civil penalty of two hundred fifty dollars for the fourth or any subsequent violation.

11-877. Air quality control measures

A. In order to reduce particulate matter in ambient air, the board of supervisors of any county that contains any portion of area A, as defined in section 49-541, shall develop, implement and enforce in area A the following air quality control measures:

1. Beginning on the effective date of this section, prohibit employees or contractors of that county from operating leaf blowers on any high pollution advisory day forecast by the department of environmental quality except while in vacuum mode and prohibit those employees or contractors from blowing landscape debris into public roadways at any time.

2. No later than March 31, 2008, adopt, implement and enforce an ordinance that bans the blowing of landscape debris into public roadways at any time by any person.

3. No later than March 31, 2008, adopt, implement and enforce an ordinance that

prohibits the operation of leaf blowers except on surfaces that have been stabilized with asphaltic concrete, cement concrete, hardscape, penetration treatment of bituminous material and seal coat of bituminous binder and a mineral aggregate, decomposed granite cover, crushed granite cover, aggregate cover, gravel cover, or grass or other continuous vegetative cover, or any combination of those stabilizers.

B. This section does not apply to any site that has a permit issued by a control officer as defined in section 49-471 for the control of fugitive dust from dust generating operations.

28-1098. Vehicle loads; restrictions; civil penalties

A. For the purpose of highway safety or air pollution prevention, a person shall not drive or move a vehicle on a highway unless the vehicle is constructed or loaded in a manner to prevent any of its load from dropping, sifting, leaking or otherwise escaping from the vehicle, except the following are permitted:

1. Sufficient sand may be dropped for the purpose of securing traction.

2. Water or another substance may be sprinkled on a roadway in cleaning or maintaining the roadway.

3. Minor pieces of agricultural materials such as leaves and stems from agricultural loads.

C. If a person is found in violation of this section and the violation:

1. Does not cause any damage or injury and is the person's:

(a) First violation in a sixty month period, the person is subject to a civil penalty of not more than two hundred fifty dollars.

(b) Second or subsequent violation in a sixty month period, the person is subject to a civil penalty of not more than three hundred fifty dollars.

49-424. Duties of department

The department shall:

11. Develop and disseminate air quality dust forecasts for the Maricopa county PM-10 nonattainment area. Each forecast shall identify a low, moderate or high risk of dust generation for the next five consecutive days and shall be issued by noon on each day the forecast is generated. At a minimum, the forecasts shall be posted on the department's website and distributed electronically. When developing these forecasts, the department shall consider all of the following:

(a) Projected meteorological conditions for the Maricopa county area, including all of the following:

(i) Wind speed and direction.

(ii) Stagnation.

(iii) Recent precipitation.

(iv) Potential for precipitation.

(b) Existing concentrations of air pollution at the time of the forecast.

(c) Historic air pollution concentrations that have been observed during meteorological conditions similar to those that are predicted to occur in the forecast.

49-457.01. Leaf blower use restrictions and training; leaf blower equipment sellers; informational material; outreach; applicability

A. This section applies in a county with a population of two million or more persons or any portion of a county within an area designated by the environmental protection

agency as a serious PM-10 nonattainment area or a maintenance area that was designated as a serious PM-10 nonattainment area.

B. After March 31, 2008, no person may use a leaf blower to blow landscape debris into public roadways.

C. After March 31, 2008, no person may operate a leaf blower except on surfaces that have been stabilized with asphaltic concrete, cement concrete, hardscape, penetration treatment of bituminous material and seal coat of bituminous binder and a mineral aggregate, decomposed granite cover, crushed granite cover, aggregate cover, gravel cover, or grass or other continuous vegetative cover, or any combination of those stabilizers.

D. At least once every three years, any person operating a leaf blower for remuneration shall successfully complete training approved by the department on how to operate a leaf blower in a manner designed to minimize the generation of fugitive dust emissions. Any person who is required to be trained under this subsection shall complete initial training no later than December 31, 2008.

E. Any person who rents or sells in the normal course of business equipment that is used for blowing landscape debris shall provide to the buyer or renter of the equipment printed materials that are approved by the department pursuant to this section.

F. The department shall produce printed materials and distribute those materials to persons who sell or rent equipment used for blowing landscape debris. The printed materials shall be designed to educate and inform the user of the equipment on the safe and efficient use of the equipment, including methods for reducing the generation of dust, and shall include information regarding dust control ordinances and restrictions that may be applicable.

G. This section does not apply to any site that has a permit issued by a control officer as defined in section 49-471 for the control of fugitive dust from dust generating operations.

49-457.03. Off-road vehicles; pollution advisory days; applicability; penalties

A. In area A, as defined in section 49-541, a person shall not operate an off-highway vehicle, an all-terrain vehicle or an off-road recreational motor vehicle on an unpaved surface that is not a public or private road, street or lawful easement during any high pollution advisory day forecast for particulate matter by the department.

B. This section does not apply to:

1. An event that is intended for off-highway vehicles, all-terrain vehicles or off-road recreational motor vehicles and that is endorsed, authorized, permitted or sponsored by a public agency, that occurs on a designated route or area and that includes dust abatement measures at all staging areas, parking areas and entrances.

2. An event that occurs at a facility for which an admission or user fee is charged and that includes dust abatement measures.

3. A closed course that is maintained with dust abatement measures.

4. An off-highway vehicle, all-terrain vehicle or off-road recreational motor vehicle used in the normal course of business or the normal course of government operations.

5. Golf carts that are used as part of a private or public golf course operation.

C. A person who violates this section is subject to:

1. A warning for the first violation.

2. The imposition of a civil penalty of fifty dollars for the second violation.

3. The imposition of a civil penalty of one hundred dollars for the third violation.

4. The imposition of a civil penalty of two hundred fifty dollars for the fourth or any subsequent violation.

D. For violations of this section, the control officer or other enforcement officer shall use a uniform civil ticket and complaint substantially similar to a uniform traffic ticket and complaint prescribed by the rules of procedure in civil traffic cases adopted by the supreme court. The control officer or other enforcement officer may issue citations to persons in violation of this section.

49-457.04. Off-highway vehicle and all-terrain vehicle dealers; informational material; outreach; applicability

A. Any person who rents or sells in the normal course of business off-highway vehicles, all-terrain vehicles or off-road recreational motor vehicles, other than golf carts sold to public or private golf courses, shall provide to the buyer or renter of the vehicle printed materials that are approved by the department pursuant to this section.

B. The department shall produce printed materials and distribute those materials to persons who sell or rent off-highway vehicles, all-terrain vehicles or off-road recreational motor vehicles. The printed materials shall be designed to educate and inform the user of the vehicle on methods for reducing the generation of dust and shall include information regarding dust control ordinances and restrictions that may be applicable. The department shall make available on the department's website the printed materials in a format that is accessible to the public.

C. This section applies in a county with a population of two million or more persons or any portion of a county in an area designated by the environmental protection agency as a serious PM-10 nonattainment area or a maintenance area that was designated as a serious PM-10 nonattainment area.

49-457.05. Dust action general permit; best management practices; applicability; definitions

A. This section applies in a county with a population of two million or more persons or any portion of a county within an area designated by the environmental protection agency as a serious PM-10 nonattainment area or a maintenance area that was designated as a serious PM-10 nonattainment area.

B. The director shall issue a dust action general permit for regulated activities, which shall specify the best management practices necessary to reduce or to prevent PM-10 particulate emissions as soon as practicable before and during a day that is forecast to be at high risk of dust generation under a forecast issued by the department pursuant to section 49-424.

C. A person that has a permit issued by the director or a control officer for the control of fugitive dust from dust-generating operations is not required to obtain a dust action general permit under subsection D of this section, except that the person shall implement the control measures required in the permit issued by the director or control officer, including those measures related to wind, to reduce or to prevent PM-10 particulate emissions as soon as practicable before and during a day that is forecast to be at high risk of dust generation under a forecast issued by the department pursuant to section 49-424. Failure to implement a control measure under this subsection shall only be enforced by the

director or control officer that issued the permit. The director or control officer shall not recover penalties for violations of both this subsection and the permit based on the same act or omission.

D. A dust action general permit may be required for any person that owns or conducts a dust-generating operation that is found by the director to have failed to choose and implement an applicable best management practice listed in the dust action general permit as soon as practicable before and during a day that is forecast to be at high risk of dust generation.

I. For the purposes of this section:

1. "Applicable implementation plan" means that term as defined in 42 United States Code section 7602(q).

2. "Best management practices" means techniques that are verified by scientific research and that on a case-by-case basis are practical, economically feasible and effective in reducing PM-10 particulate emissions from a regulated activity.

3. "Control officer" has the same meaning prescribed in section 49-471.

4. "Disturbed surface area" means a portion of the earth's surface or material that is placed on the earth's surface that has been physically moved, uncovered, destabilized or otherwise modified from its undisturbed native condition if the potential for the emission of fugitive dust is increased by the movement, destabilization or modification.

5. "Dust-generating operation" means disturbed surface areas, including those of open areas or vacant lots that are not defined as agricultural land and are not used for agricultural purposes according to sections 42-12151 and 42-12152, or any other area or activity capable of generating fugitive dust, including the following:

(a) Land clearing, maintenance and land clean up using mechanized equipment.

(b) Earthmoving.

(c) Weed abatement by discing or blading.

(d) Excavating.

(e) Construction.

(f) Demolition.

(g) Bulk material handling, including hauling, transporting, stacking, loading and unloading operations.

(h) Storage or transporting operations, including storage piles.

(i) Operation of outdoor equipment.

(j) Operation of motorized machinery.

(k) Establishing or using staging areas, parking areas, material storage areas or access routes.

(l) Establishing or using unpaved haul or access roads.

(m) Installing initial landscapes using mechanized equipment.

6. "Fugitive dust" means particulate matter that could not reasonably pass through a stack, chimney, vent or other functionally equivalent opening, that can be entrained in the ambient air and that is caused by human or natural activities, including the movement of soil, vehicles, equipment, blasting and wind. Fugitive dust does not include particulate matter emitted directly from the exhaust of motor vehicles and other internal combustion engines, from portable brazing, soldering or welding equipment or from pile drivers.

7. "Regulated activity" means all dust-generating operations except for the following:

(a) Normal farm cultural practices as prescribed in section 49-504, paragraph 4 or section 49-457.

(b) Emergency activities that may disturb the soil and that are conducted by any utility or government agency in order to prevent public injury or to restore critical utilities to a functional status.

(c) Establishment of initial landscapes without the use of mechanized equipment, conducting landscape maintenance without the use of mechanized equipment and playing on or maintaining a field used for nonmotorized sports, except that these activities shall not include grading or trenching performed to establish initial landscapes or to redesign existing landscapes.

(d) Rooftop operations for cutting, drilling, grinding or coring roofing tile if that activity is occurring on a pitched roof.

49-474.01. Additional board duties in vehicle emissions control areas; definitions

A. The board of supervisors of a county which contains any portion of area A or area B as defined in section 49-541 shall:

4. In area A, beginning January 1, 2008, develop and implement plans to stabilize targeted unpaved roads, alleys and unpaved shoulders on targeted arterials. The plans shall address the performance goals, the criteria for targeting the roads, alleys and shoulders, a schedule for implementation, funding options and reporting requirements. Priority shall be given to the following:

(a) Unpaved roads with more than one hundred average daily trips.

(b) Unpaved shoulders on arterial roads and other road segments where vehicle use on unpaved shoulders is evident or anticipated due to projected traffic volume.

5. In a county with a population of two million or more persons or any portion of a county in an area designated by the environmental protection agency as a serious PM-10 nonattainment area or a maintenance area that was designated as a serious PM-10 nonattainment area, no later than March 31, 2008, adopt or amend codes or ordinances and, no later than October 1, 2008, commence enforcement of those codes or ordinances as necessary to require that parking, maneuvering, ingress and egress areas at developments other than residential buildings with four or fewer units are maintained with one or more of the following dustproof paving methods:

(a) Asphaltic concrete.

(b) Cement concrete.

(c) Penetration treatment of bituminous material and seal coat of bituminous binder and a mineral aggregate.

(d) A stabilization method approved by the county.

6. In a county with a population of two million or more persons or any portion of a county in an area designated by the environmental protection agency as a serious PM-10 nonattainment area or a maintenance area that was designated as a serious PM-10 nonattainment area, no later than March 31, 2008, adopt or amend codes or ordinances and, no later than October 1, 2009, commence enforcement of those codes or ordinances as necessary to require that parking, maneuvering, ingress and egress areas three thousand square feet or more in size at residential buildings with four or fewer units are maintained with a paving or stabilization method authorized by the county by code, ordinance or permit.

7. In area A, no later than March 31, 2008, adopt or amend codes or ordinances as necessary to restrict vehicle parking and use on unpaved or unstabilized vacant lots.

8. In area A, require that new or renewed contracts for street sweeping on city streets must be conducted with street sweepers that meet the south coast air quality management district rule 1186 street sweeper certification specifications for pick up efficiency and PM-10 emissions in effect on January 1, 2007.

11. In a county with a population of two million or more persons or any portion of a county within an area designated by the environmental protection agency as a serious PM-10 nonattainment area or a maintenance area that was designated as a serious PM-10 nonattainment area, no later than March 31, 2008, adopt rule provisions, and, no later than October 1, 2008, commence enforcement of those rule provisions regarding the stabilization of disturbed surfaces of vacant lots that include the following:

(a) Reasonable written notice to the owner or the owner's authorized agent or the owner's statutory agent that the unpaved disturbed surface of a vacant lot is required to be stabilized. The notice shall be given not less than thirty days before the day set for compliance and shall include a legal description of the property and the estimated cost to the county for the stabilization if the owner does not comply. The notice shall be either personally served or mailed by certified mail to the owner's statutory agent, to the owner at the owner's last known address or to the address to which the tax bill for the property was last mailed.

(b) Authority for the county to enter the lot to stabilize the disturbed surface at the expense of the owner if the vacant lot has not been stabilized by the day set for compliance.

(c) Methods for stabilization of the disturbed surface of the vacant lot, the actual cost of stabilization and the fine that may be imposed for a violation of this section.

B. For the purposes of subsection A, paragraph 11 of this section:

1. "Disturbed surface" means a portion of the earth's surface or material placed on the earth's surface that has been physically moved, uncovered, destabilized or otherwise modified from its undisturbed native condition if the potential for the emission of fugitive dust is increased by the movement, destabilization or modification.

2. Vacant lots do not include any site of disturbed surface area that is subject to a permit issued by a control officer that requires control of PM-10 emissions from dust generating operations.

H. Subsection A, paragraphs 5, 6 and 7 of this section do not apply to any site that has a permit issued by a control officer as defined in section 49-471 for the control of fugitive dust from dust generating operations.

49-474.05. <u>Dust control; training; site coordinators</u>

A. This section applies in a county with a population of two million or more persons or any portion of a county in an area designated by the environmental protection agency as a serious PM-10 nonattainment area or a maintenance area that was designated as a serious PM-10 nonattainment area.

B. No later than January 1, 2008, the control officer shall develop and implement basic and comprehensive training programs for the suppression of PM-10 emissions from sources of PM-10 that are subject to a permit issued by a control officer that requires control of PM-10 emissions from dust generating operations. The control officer may

approve training developed and provided by a third party and the board of supervisors may adopt rules prescribing standards for dust control training.

C. At least once every three years, the following persons are required to successfully complete basic dust control training:

1. The site superintendent or other designated on-site representative of the permit holder if present at a site that has more than one acre of disturbed surface area that is subject to a permit issued by a control officer requiring control of PM-10 emissions from dust generating operations.

2. Water truck and water pull drivers.

D. Persons who are required to be trained under this section shall complete the training no later than December 31, 2008. All persons who have successfully completed training during the 2006 and 2007 calendar years are deemed to have satisfied this requirement if the training program completed was conducted or approved by a county air pollution control officer. Completion of the training required under subsection G satisfies the requirements of this subsection.

E. No later than June 30, 2008, the permittee for any site of five acres or more of disturbed surface area subject to a permit issued by a control officer requiring control of PM-10 emissions from dust generating operations shall have on site at least one dust control coordinator trained in accordance with this section at all times during primary dust generating operations related to the purposes for which the dust control permit was obtained.

F. A dust control coordinator has full authority to ensure that dust control measures are implemented on site, including conducting inspections, deployment of dust suppression resources and modification or shutdown of activities as needed to control dust. The dust control coordinator shall be responsible for managing dust prevention and dust control on the site.

G. At least once every three years, the dust control coordinator shall successfully complete a comprehensive dust control class conducted or approved under subsection A by the county air pollution control officer with jurisdiction over the site. The dust control coordinator shall have a valid dust training certification identification card readily accessible on site while acting as a dust control coordinator. All persons having successfully completed training during the 2006 and 2007 calendar years are deemed to have satisfied this requirement if the training program completed was conducted or approved by a county air pollution control officer.

H. Subsections C and D do not apply when on-site dust generating operations are conducted by a permittee who is required to obtain a single permit for multiple noncontiguous sites that is issued by a control officer and that requires control of PM-10 emissions.

I. The requirements of subsections E and F lapse if all of the following apply:

1. The area of the disturbed surface area is less than five acres.

2. The previously disturbed areas are stabilized in accordance with the requirements of applicable rules.

3. The permittee provides notice of the acreage stabilized to the control officer.

J. Permittees who are required to obtain a single permit for multiple noncontiguous sites that is issued by a control officer and that requires control of PM-10 emissions from

dust generating operations shall have on sites with greater than one acre of disturbed surface area at least one individual who is designated by the permittee as a dust control coordinator trained in accordance with subsection C. The dust control coordinator shall be present on site at all times during primary dust generating activities that are related to the purposes for which the permit was obtained. This subsection does not apply to permittees subject to subsections B and C.

49-474.06. Dust control; subcontractor registration; fee

A. In an area designated by the environmental protection agency as a serious PM-10 nonattainment area or a maintenance area that was designated as a serious PM-10 nonattainment area, a subcontractor who is engaged in dust generating operations at a site that is subject to a permit that is issued by a control officer and that requires control of PM-10 emissions from dust generating operations shall register with the control officer by submitting information in the manner prescribed by the control officer. The control officer shall issue a registration number after payment of the fee authorized under subsection C.

B. The subcontractor shall have its registration number readily accessible on site while conducting any dust generating operations.

C. The control officer may establish and assess a fee for the registration required under subsection a based on the total cost of processing the registration and issuance of a registration number.

49-501. Unlawful open burning; exceptions; fine; definition

A. Notwithstanding the provisions of any other section of this article:

2. From May 1 through September 30 each year, it is unlawful for any person to ignite, cause to be ignited, permit to be ignited or suffer, allow or maintain any open outdoor fire in area A as defined in section 49-541.

B. The following fires are excepted from this section:

1. Fires used only for cooking of food or for providing warmth for human beings or the branding of animals or the use of orchard heaters for the purpose of frost protection in farming or nursery operations.

C. Permission for the setting of any fire given by a public officer in the performance of official duty under sebsection B, paragraph 2, 3 or 4 of this section shall be given in writing and a copy of the written permission shall be transmitted directly to the director of environmental quality and the control officer of the county, district or region in which such fire is allowed. The setting of any such fire shall be conducted in a manner and at such time as approved by the control officer or the director of environmental quality, unless doing so would defeat the purpose of the exemption.

F. Nothing in this section is intended to permit any practice which is a violation of any statute, ordinance, rule or regulation in a county with a population in excess of one million two hundred thousand persons. Notwithstanding any other law, such a county shall prohibit by ordinance the use of wood burning chimineas, outdoor fire pits and similar outdoor fires on those days for which the county has issued a no burn day restriction.

G. A person who violates any provision of this section may be served a notice of violation and be subject to the enforcement provisions of this article to the same extent as a person violating any rule or regulation adopted pursuant to this article, except that a violation that lasts no more than twenty-four hours and that is the first violation committed by that person is subject to a civil penalty of no more than five hundred dollars.

49-541. Definitions

In this article, unless the context otherwise requires:

1. "Area A" means the area delineated as follows:

(a) In Maricopa county:

Township 8 north, range 2 east and range 3 east
Township 7 north, range 2 west through range 5 east
Township 6 north, range 5 west through range 6 east
Township 5 north, range 5 west through range 7 east
Township 4 north, range 5 west through range 8 east
Township 3 north, range 5 west through range 8 east
Township 2 north, range 5 west through range 8 east
Township 1 north, range 5 west through range 7 east
Township 1 south, range 5 west through range 7 east
Township 2 south, range 5 west through range 7 east
Township 3 south, range 5 west through range 1 east
Township 4 south, range 5 west through range 1 east

(b) In Pinal county:

Township 1 north, range 8 east and range 9 east
Township 1 south, range 8 east and range 9 east
Township 2 south, range 8 east and range 9 east
Township 3 south, range 7 east through range 9 east

(c) In Yavapai county:

Township 7 north, range 1 east and range 1 west through range 2 west
Township 6 north, range 1 east and range 1 west

APPENDIX C

EXHIBIT 2:

Maricopa County Resolution to Evaluate Measures in the MAG 2012 Five Percent Plan for PM-10 for the Maricopa County Nonattainment Area

RESOLUTION TO EVALUATE MEASURES IN THE MAG 2012 FIVE PERCENT PLAN FOR PM_{10} FOR THE MARICOPA COUNTY NONATTAINMENT AREA

C·85·12·006·M·00

WHEREAS, Maricopa Association of Governments (MAG) has been designated by the Governor of Arizona, as the regional air quality planning agency in Maricopa County; and

WHEREAS, the Maricopa County nonattainment area is classified as a Serious Nonattainment Area for PM_{10} particulate matter according to the Clean Air Act; and

WHEREAS, the Clean Air Act required the Maricopa County nonattainment area to attain the PM_{10} particulate matter standard by December 31, 2006; and

WHEREAS, the Maricopa County nonattainment area failed to attain the PM_{10} particulate matter standard by December 31, 2006; and

WHEREAS, due to the Maricopa County nonattainment areas failure to meet the PM_{10} particulate matter standard MAG as the regional air quality planning agency is required to develop a plan to reduce PM_{10} emissions by five percent per year until the standard is met ("the Five Percent Plan"); and

WHEREAS, the Five Percent Plan contains innovative control measures implemented in 2011 and existing dust control rules to reduce PM_{10} particulate matter emissions which must be retrospectively assessed to evaluate the effectiveness of such measures; and

WHEREAS, Arizona Revised Statutes 49-406 G. requires that each agency that commits to implement a control measure describe that commitment in a resolution adopted by the governing body which specifies its authority for implementing the measures as provided in statute, ordinance, or rule; a program for enforcement of the measure; and the level of personnel and funding allocated to the implementation of the measure; and

WHEREAS, Maricopa County is responsible for tracking emissions from point, area and non-road mobile sources and for tracking implementation of control measures in the 1992 Memorandum of Agreement developed under Arizona Revised Statutes § 49-406 (F).

NOW, THEREFORE BE IT RESOLVED BY THE BOARD OF SUPERVISORS, MARICOPA COUNTY (BOARD) as follows:

SECTION 1. That the BOARD agrees to proceed with a good faith effort to implement the commitment identified in Exhibit A, which is part of this resolution.

SECTION 2. That the BOARD commits to implement the measures as scheduled and with the funding sources identified. Recognizing, however, that the availability of necessary funding may depend on the funding programs or processes of various state and federal agencies, Maricopa County agrees to consider modifications of the funding or schedules for implementation actions, if necessary. Maricopa County agrees to submit any modification to the commitments in Exhibit A to EPA for approval as a SIP revision.

PASSED AND ADOPTED by the Board of Supervisors of Maricopa County, Arizona, this 16th day of November 2011.

Andy Kunasek, Chairman

ATTEST:

Clerk of the Board

MARICOPA COUNTY COMMITMENT 1

Commitment Title: Evaluation of New Innovative Control Measures and Existing Maricopa County Control Measures

County Measure Description: Develop and assess the effectiveness of the innovative control program implemented through the dust generation forecast and dust action general permit on permitted and unpermitted sources of PM_{10} in Maricopa County on forecast high risk days. Perform a rule effectiveness study on the implementation of existing dust control rules.

Responsible Agency and Authority for Implementation: The Maricopa County Board of Supervisors is authorized by A.R.S. § 49-479 to adopt rules for air pollution control and by A.R.S. § 49-480 to establish, administer and enforce a program for air quality permits. The Board adopted rules establishing an air quality permit program and pursuant to A.R.S. § 49-473, designated the Air Quality Department to issue permits and administer and enforce the permit program. In the Memorandum of Agreement developed in 1992 under A.R.S. § 49-406 (F), Maricopa County is responsible for tracking emissions from point, area and non-road mobile sources and for tracking the implementation control measures. By operation of A.R.S. § 49-471, the executive head of the department designated under A.R.S. § 49-473 serves as the Air Pollution Control Officer. The Air Pollution Control Officer is specifically authorized to take the enforcement actions set forth in A.R.S. §§ 49-502, 49-511, 49-512 and 49-513. A.R.S. § 474.01 (A)(11) requires adoption of rule provisions by March 31, 2008, and enforcement of the provisions by October 1, 2008, regarding stabilization of disturbed surfaces of vacant lots.

Implementation Schedule: The Air Quality Department in consultation with the U. S. Environmental Protection Agency (EPA) completed a rule effectiveness study analyzing the impact of Rules 310, 310.01 and 316 for the 2008 PM_{10} Periodic Emissions Inventory contained in the appendix of the MAG 2012 Five Percent Plan for PM_{10} for the Maricopa County Nonattainment Area. The department in consultation with EPA will use a similar approach and process with an appropriate temporal period to evaluate the new innovative control measures such as the dust generation forecast and dust action general permit. The Air Quality Department will conduct the program evaluations as follows:

Initial Evaluation:

January 2013	Initiate evaluation process for new innovative control measures and existing rule effectiveness studies.
March 2013	Complete draft program evaluation reports.
April 2013	Complete final program evaluation reports.

Periodic Evaluation: The department will reevaluate the effectiveness of the new innovative control measures as part of the periodic emissions inventory required by EPA every three years.

Level of Personnel and Funding Allocated for Implementation: Level of Personnel and Funding Allocated for Implementation:

Program evaluations will be accommodated as part of the air quality compliance, enforcement and planning processes and will be coordinated by the Maricopa County Air Quality Department's existing Planning and Analysis Division.

The Maricopa County Air Quality Department administers the air quality program in Maricopa County. Currently the department has 140.6 employees. The Maricopa County Air Quality Department's FY 2010-11 revenue was approximately $15.3 million. No change in funding is anticipated for these program evaluations.

Enforcement Program:

The Air Quality Department's enforcement options for regulatory programs include orders of abatement, civil actions for injunctive relief or civil penalties, and filing a class 1 misdemeanor citation. Senate Bill 1552 authorizes the county to enter the lot to stabilize the disturbed surface, issue notices of violation, and collect monetary penalties that include the cost of stabilization.

Monitoring Program:

As noted above, the Air Quality Department will assess and evaluate the effectiveness of the new innovative measures as well as the complete rule effectiveness studies for the existing Rules 310, 310.01 and 316.

APPENDIX C

EXHIBIT 3:

Arizona Department of Environmental Quality Dust Action General Permit

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY
Air Quality Division
1110 West Washington Street • Phoenix, AZ 85007 • Phone: (602) 771-2308

DUST ACTION GENERAL PERMIT

(As required by Arizona Revised Statutes, Title 49, Chapter 3, Article 2, Section 49-457.05)

This air quality control permit does not relieve applicant of responsibility for meeting all air pollution regulations

THIS GENERAL PERMIT ISSUED SUBJECT TO THE FOLLOWING **Conditions contained in Attachments "A", "B" and "C"**

ADEQ GENERAL PERMIT NUMBER **NA** EXPIRATION DATE **December 30, 2016**

PERMIT ISSUED THIS **30th** DAY OF **December, 2011**

Eric C. Massey, Director, Air Quality Division

SIGNATURE TITLE

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DUST ACTION GENERAL PERMIT

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DUST ACTION GENERAL PERMIT

INTRODUCTION

Since the start of Calendar Year 2008, the majority of exceedances of the PM_{10} National Ambient Air Quality Standard (NAAQS) in the Maricopa County serious PM_{10} nonattainment area have been related to high wind events. High wind events, along with a number of other meteorological conditions that can lead to the generation of dust can be predicted through meteorological forecasts.

In accordance with A.R.S. § 49-424(11), ADEQ is developing and disseminating an air quality dust forecast for the Maricopa County serious PM_{10} nonattainment area. Based upon knowledge of historical and recent meteorological conditions, and the prediction of such factors as wind speed and wind direction, forecasts identify the potential risk of dust entrainment as "Low", "Moderate" or "High" for the next five consecutive days. ADEQ updates this five-day *Maricopa County Dust Control Forecast* every Sunday through Friday, and posts it on its website at http://www.azdeq.gov/environ/air/ozone/mcdust.pdf.

In accordance with A.R.S. § 49-457.05, this Dust Action General Permit identifies a series of Best Management Practices (BMPs) for specific dust generating operations. When ADEQ's Maricopa County Dust Control Forecast predicts that a day is at high risk for dust generation, those dust generating operations that are not already required to control dust through a permit issued by the Arizona Department of Environmental Quality (ADEQ) or the Maricopa County Air Quality Department (MCAQD) are expected to choose and implement at least one BMP to reduce or prevent PM_{10} emissions. Implementation of a BMP is expected to occur as soon as practicable before and during the high risk event. Although the BMPs in the Dust Action General Permit only apply to those sources that do not already have a permit, dust generating operations with an air quality permit are also expected to implement the dust controls in their permit at the same time.

According to statute, BMPs identified in the Dust Action General Permit are expected to be employed absent the requirement to obtain an air quality permit. If the owner or operator of a dust-generating operation is found by ADEQ's Director to have failed to choose and implement an applicable BMP as soon as practicable before and during a day that is forecast to be at high risk of dust generation, then the owner or operator can be required to obtain a Requirement to Operate (RTO) under the Dust Action General Permit. The process by which ADEQ's Director makes such a finding is identified within the Dust Action General Permit. Violations of the Dust Action General Permit are subject to the enforcement requirements of Arizona Revised Statutes Title 49, Chapter 3, Article 2, including civil penalties of up to ten thousand dollars per day, per violation, pursuant to Section 463.

In accordance with A.R.S. § 49-457.05(E) this Dust Action General Permit is subject to a 30-day public comment period and shall be effective for a period of five-years.

DUST ACTION GENERAL PERMIT

ATTACHMENT "A": GENERAL PROVISIONS

I. APPLICABILITY

A. This Dust Action General Permit is applicable to the owner or operator of a regulated activity within a county with a population of two million or more persons, or any portion of a county within areas designated by the environmental protection agency as a serious PM_{10} nonattainment area or a maintenance area that was previously designated as a serious PM_{10} nonattainment area who is required by the Director to obtain a general permit in accordance with Condition IV of this Attachment.

B. Each owner or operator of a regulated activity that is required by the Director to obtain this Dust Action General Permit shall obtain a Requirement to Operate that includes the following information:

1. The regulated activity;

2. The legal owner or operator of the regulated activity; and

3. The physical address, location, or parcel number where the regulated activity occurs.

C. Each Requirement to Operate (RTO) issued under this general permit shall only apply to those regulated activities that are identified pursuant to Section V of this attachment and in the RTO, are under the control of the same Permittee, and are located on one or more properties that are adjacent or contiguous to the location of the regulated activity.

II. DEFINITIONS

For the purposes of the Dust Action General Permit the following terms are defined as follows:

A. "Applicable implementation plan" means that term as defined in 42 United States Code section 7602(q).

B. "Best management practices" means techniques that are verified by scientific research and that on a case-by-case basis are practical, economically feasible and effective in reducing PM_{10} particulate emissions from a regulated activity.

C. "Control officer" has the same meaning prescribed in Arizona Revised Statutes § 49-471.

D. "Designated, managed or open trail system" means roads, highways, multiple use corridors, trails or routes that are part of a system of trails and routes that are designated, managed or opened to public motor vehicle travel by government land management agency by rule, order, travel management plan, sign, or map approved by such agency.

E. "Disturbed surface area" means a portion of the earth's surface or material that is placed on the earth's surface that has been physically moved, uncovered, destabilized or otherwise modified from its undisturbed native condition if the potential for the emission of fugitive dust is increased by the movement, destabilization or modification.

F. "Dust-generating operation" means disturbed surface areas, including those of open areas

or vacant lots that are not defined as agricultural land and are not used for agricultural purposes according to Arizona Revised Statutes §§ 42-12151 and 42-12152, or any other area or activity capable of generating fugitive dust, including the following:

1. Land clearing, maintenance and land clean-up using mechanized equipment.

2. Earthmoving.

3. Weed abatement by discing or blading.

4. Excavating.

5. Construction.

6. Demolition.

7. Bulk material handling, including hauling, transporting, stacking, loading and unloading operations.

8. Storage or transporting operations, including storage piles.

9. Operation of outdoor equipment.

10. Operation of motorized machinery.

11. Establishing or using staging areas, parking areas, material storage areas or access routes.

12. Establishing or using unpaved haul or access roads.

13. Installing initial landscapes using mechanized equipment.

G. “Dust Suppressant” means water, hygroscopic material, a solution of water and chemical surfactant, foam, non-toxic chemical stabilizer, or any other dust palliative, which is not prohibited for ground surface application by the Environmental Protection Agency (EPA) or the Arizona Department of Environmental Quality (ADEQ), or any applicable law, rule, or regulation, as a treatment material for reducing fugitive dust emissions.

H. "Fugitive dust" means particulate matter that could not reasonably pass through a stack, chimney, vent or other functionally equivalent opening, that can be entrained in the ambient air and that is caused by human or natural activities, including the movement of soil, vehicles, equipment, blasting and wind. Fugitive dust does not include particulate matter emitted directly from the exhaust of motor vehicles and other internal combustion engines, from portable brazing, soldering or welding equipment or from pile drivers.

I. “Livestock special event” means displaying, racing, training or exercising livestock during an event at which a fee is collected, or is open to 24 or more persons including staff, participants and spectators, and is conducted at a facility specifically designed for this purpose and is not already subject to A.R.S. § 49-457.”

J. “Owner or operator” means any person who owns, leases, operates, controls, or supervises a regulated activity subject to the requirements of this general permit.

K. "Regulated activity" means all dust-generating operations except for the following:

1. Normal farm cultural practices as prescribed in A.R.S. §§ 49-504(4) or 49-457.

2. Emergency activities that may disturb the soil and that are conducted by any utility or government agency in order to prevent public injury or to restore critical utilities to a functional status.

3. Establishment of initial landscapes without the use of mechanized equipment, conducting landscape maintenance without the use of mechanized equipment and playing on or maintaining a field used for nonmotorized sports, except that these activities shall not include grading or trenching performed to establish initial landscapes or to redesign existing landscapes.

4. Rooftop operations for cutting, drilling, grinding or coring roofing tile if that activity is occurring on a pitched roof.

III. GENERAL PERMIT EXPIRATION, RENEWAL AND RE-OPENING

A. This Dust Action General Permit is valid for a period of five years from the date of issuance. The Director of ADEQ (Director) shall review and may renew this General Permit every five years from its date of issuance. The Permittee's RTOs shall coincide with the term of this General Permit, regardless of when the RTO was issued during this five year period. The Director may require an existing RTO to be renewed at the time that this General Permit is renewed.

B. The Director may periodically reexamine, evaluate and modify the Dust Action General Permit as prescribed in A.R.S. Section 49-426(H)(2) through (6). After approval by the Director, any modifications to the Dust Action General Permit shall be provided to the Control Officer and shall be submitted to the United States Environmental Protection Agency as a revision to the applicable State Implementation Plan.

C. At the time that the public notice is required, pursuant to issuance of the proposed General Permit renewal, the Director shall notify in writing all Permittees with existing RTOs that have been renewed. The written notice shall describe the source's duty to comply with the conditions of the General Permit.

IV. COMPLIANCE WITH PERMIT CONDITIONS

A. The Permittee shall comply with all Conditions of this General Permit including all applicable requirements of Arizona air quality statutes and the air quality rules. Any permit noncompliance constitutes a violation of the Arizona Revised Statutes and is grounds for enforcement action, including, but not limited to civil penalties. In addition, non-compliance with any federally enforceable requirements constitutes a violation of the Clean Air Act.

B. It shall not be a defense for a Permittee in an enforcement action that it would have been necessary to halt or reduce the permitted activity in order to maintain compliance with the conditions of this General Permit.

V. ISSUANCE OF A DUST ACTION GENERAL PERMIT FOR CAUSE

A. The Director may require the owner or operator of a regulated activity to obtain a

Requirement to Operate under the Dust Action General Permit at any time if it can be demonstrated that:

1. The regulated activity is not otherwise subject to an air quality permit issued by the Director or the Maricopa County Air Quality Department Control Officer; and

2. The owner or operator of a regulated activity did not choose or implement a Best Management Practice as soon as practicable before and during a day forecast to be at high risk of dust generation.

B. A demonstration that the owner or operator of a regulated activity did not choose or implement a Best Management Practice shall include the following:

1. Documentation that includes a description of the regulated activity;

2. Documentation that clearly identifies the legal owner or operator of the regulated activity;

3. Documentation that clearly identifies the physical address(es), location(s), or parcel number(s) where the regulated activity occurred;

4. Documentation that includes records, field reports or photographic evidence that demonstrates that the owner or operator of the regulated activity was not implementing a Best Management Practice as soon as practicable before and during a day forecast to be at high risk of dust generation;

5. A description of the actions taken by the owner or operator of the regulated activity to comply with the required Best Management Practice(s) at the time of the inspection;

6. Documentation that identifies any previous inspections associated with the owner, operator, physical address(es), location(s), or parcel number(s) as well as results of those inspections; and

7. Documentation that demonstrates that the owner or operator of the regulated activity has been provided with a copy of the documentation identified in Condition III.B.1 through 6 above.

C. Upon receipt of a demonstration that the owner or operator of a regulated activity did not choose or implement a Best Management Practice, the Director shall:

1. Notify the owner or operator of the receipt of the demonstration; and

2. Provide the owner or operator with five (5) business days to demonstrate that a Best Management Practice was employed at the time of the inspection; or provide a document that identifies the Best Management Practice(s) that will be employed at the address(es), location(s), or parcel number(s) identified in the Director's letter.

D. If the Director determines that the owner or operator of a regulated activity was not in compliance with the required Best Management Practices as soon as practicable before and during a day forecast to be at high risk of dust generation, and has not adequately

identified the Best Management Practices that will be employed as soon as practicable before and during future days forecast to be at high risk of dust generation the Director shall issue a RTO under the Dust Action General Permit and shall require the owner or operator to choose and implement Best Management Practices within five (5) business days of the determination.

VI. TERMINATION FOR CAUSE

A. The Permittee may apply to the Director for termination of a RTO under the general permit if it can be demonstrated that:

1. The regulated activity is subject to an air quality permit issued by the Director or the Maricopa County Air Quality Department Control Officer;

2. The Permittee is no longer the legal owner or operator of the regulated activity by demonstrating one of the following;

   a. The regulated activity has been sold, transferred or otherwise been dispossessed by the Permittee; or

   b. The regulated activity is no longer capable of being operated at the physical address(es), location(s), or parcel number(s) where the regulated activity occurred; or

3. The Permittee provides documentation that a Best Management Practice has been chosen and implemented for each applicable regulated activity as soon as practicable before and during a day forecast to be at high risk of dust generation by submitting one of the following:

   a. Demonstrating that a Best Management Practice of a permanent nature has been applied to the regulated activity;

   b. Submitting a copy of the records required in Attachment "B" Conditions I.D and II.C for the two most recent consecutive years after the time that the Dust Action General Permit has been issued; or

   c. Submitting a copy of the records required in Attachment "B" Conditions I.D and II.C for a different time period than that prescribed in Condition VI.A.3.b above based upon a demonstration that:

      (1) A regulated activity was not owned or operated at the location during the two most recent consecutive years; or

      (2) There were no days forecast to be at high risk of dust generation during the two most recent consecutive years.

B. The Director may terminate a RTO under the general permit if the Director makes an independent finding that:

1. The regulated activity is subject to an air quality permit issued by the Director or the Maricopa County Air Quality Department Control Officer;

2. In accordance with Condition VI.A.2 above, the Permittee is no longer the legal

owner or operator of the regulated activity.

VII. COMPLIANCE CERTIFICATION

A. The Permittee shall submit to the Director a compliance certification once each year, which describes the compliance status of the source with respect to each General Permit condition and the methods used for determining the compliance status. This certification shall be submitted by January 31st and shall cover the previous calendar year.

The compliance certification shall include the following:

1. Identification of the dust-generating operation owner or operated by the Permittee.

2. Identification of the Best Management Practice(s) used by the Permittee to comply with the terms and conditions of this General Permit.

B. The Director may request additional information to support the compliance certification.

VIII. INSPECTION AND ENTRY

Upon presentation of credentials and other documents as may be required by law, the Permittee shall allow the Department, or an authorized representative (including an authorized contractor acting as a representative of the Department), to perform the following:

A. Enter upon the Permittee's premises where a regulated activity is located or conducted, or where records must be kept under the conditions of this General Permit;

B. Have access to and copy, at reasonable times, any records that are required to be kept under the conditions of this General Permit;

C. Inspect, at reasonable times, any facilities, equipment (including monitoring and air pollution control equipment), practices, or operations regulated or required under this General Permit;

D. Sample or monitor at reasonable times, substances or parameters for the purpose of assuring compliance with the General Permit or other applicable requirements; and

E. Record any inspection by use of written, electronic, magnetic and photographic media.

IX. RECORD KEEPING REQUIREMENTS

Until the RTO under the general permit is terminated pursuant to Section XIII of Attachment "A", the Permittee shall retain records of all required records and supporting information and shall make the records available to the Director upon request.

X. REPORTING REQUIREMENTS

The Permittee shall submit the following reports:

A. Compliance certifications in accordance with Section IV of Attachment "A".

B. Other reports required by any condition in Attachment "B".

XI. DUTY TO PROVIDE INFORMATION

A. The Permittee shall furnish to the Director, within a reasonable time, any information that the Director may request in writing to determine whether cause exists for revoking the General Permit coverage, or to determine compliance with this General Permit. Upon request, the Permittee shall also furnish to the Director copies of records that the Permittee is required to keep under the General Permit. For information claimed confidential, the Permittee shall furnish an additional copy of such records directly to the Director along with a claim of confidentiality.

B. If the Permittee has failed to submit any relevant facts or if the Permittee has submitted incorrect information in a General Permit coverage application, the Permittee shall, upon becoming aware of such failure or incorrect submittal, promptly submit such supplementary facts or corrected information.

XII. PROPERTY RIGHTS

This General Permit does not convey any property rights of any sort, or any exclusive privilege.

XIII. SEVERABILITY CLAUSE

The provisions of this General Permit are severable. In the event of a challenge to any portion of this General Permit, or if any portion of this permit is held invalid, the remaining permit conditions remain valid and in force.

XIV. RENTING OR LEASING A REGULATED ACTIVITY

In the case that a regulated activity covered under this general permit is rented or leased, a copy of this General Permit and relevant RTOs shall be provided by the owner to the renter or lessee, and the renter or lessee shall be bound by this permit's provisions. In the event a copy of this General Permit and relevant RTOs are not provided to the renter or lessee, both the owner and the renter or lessee shall be responsible for the implementation of a Best Management Practice in compliance with the General Permit conditions and any violations thereof.

DUST ACTION GENERAL PERMIT

ATTACHMENT "B": SPECIFIC CONDITIONS

I. GENERAL CONDITIONS

A. The Permittee shall obtain a copy of the *Maricopa County Dust Control Forecast* each day that it is updated by:

1. Accessing the forecast through ADEQ's website at: http://www.azdeq.gov/environ/air/ozone/mcdust.pdf; or

2. Signing up for ADEQ's electronic mailing system.

B. The Permittee shall register to receive all available electronic updates from all Maricopa County Air Quality Department air quality monitors within 4 miles of the regulated activity.

C. The Permittee shall notify employees who conduct or operate a regulated activity when the *Maricopa County Dust Control Forecast* identifies the following day as being at high risk of dust generation.

D. The Permittee shall keep a record of each *Maricopa County Dust Action Control Forecast* that identifies the next calendar day as being at high risk of dust generation and a log of the date, time and method used to notify employees.

II. BEST MANAGEMENT PRACTICES REQUIREMENT

A. As soon as practicable before, and during a day identified by the *Maricopa County Dust Control Forecast* as being at high risk of dust generation, the Permittee shall take reasonable precautions to reduce or prevent particulate matter from becoming airborne. Examples of Best Management Practices for specific source categories are included in Attachment "C" of this permit.

B. The Permittee shall choose and implement a Best Management Practice for each regulated activity owned or operated by the Permittee.

C. The Permittee shall keep records of the Best Management Practices that are employed in advance of and during a day identified by the *Maricopa County Dust Control Forecast* as being at high risk of dust generation.

III. ALTERNATIVE BEST MANAGEMENT PRACTICES NOT INCLUDED IN THE GENERAL PERMIT

A. The Permittee may choose and implement an alternative Best Management Practice that is not included in Attachment "C" of this permit provided that the Permittee maintains records of documentation demonstrating that the alternative Best Management Practice that was selected and implemented achieves an equivalent or greater control of PM_{10} particle emissions than an example included in Attachment "C";

B. Any person may petition the Director to make a determination that an alternative Best

Management Practice achieves an equivalent or greater control of PM_{10} emissions than the examples included in Attachment "C". These petitions shall include the following:

1. A description of the alternative Best Management Practice; and

2. A demonstration that the alternative Best Management Practice achieves an equivalent or greater control of PM_{10} emissions than an example included in Attachment "C".

C. Upon renewal or re-opening of this general permit, the Director shall add to the Best Management Practices examples in Attachment "C" any alternative Best Management Practices that were approved under Condition III.B above.

DUST ACTION GENERAL PERMIT

ATTACHMENT "C": BEST MANAGEMENT PRACTICE EXAMPLES

I. VEHICLE USE IN OPEN AREAS AND VACANT LOTS

A. This condition does not apply to designated, managed or opened trail systems.

B. As soon as practicable before and during a day forecast to be at high risk of dust generation, the Permittee shall:

1. Reduce or prevent motor vehicle access to the open area or vacant lots by:

a. Installing barriers, curbs, fences, gates, posts, shrubs, trees or other effective control measures; or

b. Installing no trespassing, no parking or no access signs that comply with local, County, State or Federal sign standards; or

2. Uniformly apply and maintain surface gravel or chemical or organic stabilizers to all areas disturbed by motor vehicles.

C. As soon as practicable before and during the day forecast to be at high risk of dust generation the Permittee shall inspect, maintain and repair as necessary the best management practice selected in Condition I.B. above.

II. OPEN AREAS AND VACANT LOTS

A. This condition does not apply to designated, managed or opened trail systems.

B. As soon as practicable before and during a day forecast to be at high risk of dust generation, the Permittee shall control PM_{10} emissions from open areas and vacant lots by:

1. Establishing vegetative ground cover on all disturbed surface area; or

2. Increasing the use of dust suppressants on the open area or vacant lot; or

3. Uniformly applying and maintaining surface gravel or chemical or organic stabilizers to all disturbed areas.

C. As soon as practicable before and during the day forecast to be at high risk of dust generation the Permittee shall inspect, maintain, and repair, as necessary, the best management practice selected in Condition II.B above.

III. UNPAVED PARKING LOTS

A. This condition does not apply to designated, managed or opened trail systems.

B. This condition applies to parking, maneuvering, ingress and egress areas at developments other than residential buildings with four or fewer units.

C. As soon as practicable before and during a day forecast to be at high risk of dust generation, the Permittee shall control PM_{10} emissions from unpaved parking lots by:

1. Increasing the use of dust suppressants other than water on the unpaved parking lot; or

2. Uniformly applying and maintaining surface gravel or chemical or organic stabilizers to all disturbed areas.

D. As soon as practicable before and during the day forecast to be at high risk of dust generation the Permittee shall inspect, maintain, and repair, as necessary, the best management practice selected in Condition III.C above.

IV. UNPAVED ROADWAYS, ALLEYWAYS AND ROAD SHOULDERS

A. This condition does not apply to designated, managed or opened trail systems.

B. This condition applies to unpaved roadways or alleyways that experience an average of 150 vehicle trips or more per day.

C. As soon as practicable before and during a day forecast to be at high risk of dust generation, the Permittee shall control PM_{10} emissions by:

1. Reducing or preventing motor vehicle access as prescribed in Condition I.B above;

2. Increasing the use of dust suppressants other than water on the unpaved roadway or alleyway; or

3. Uniformly applying and maintaining surface gravel or chemical or organic stabilizers to the unpaved roadway or alleyway.

D. As soon as practicable before and during the day forecast to be at high risk of dust generation the Permittee shall inspect, maintain, and repair, as necessary, the best management practice selected in Condition IV.C above.

V. LIVESTOCK SPECIAL EVENTS NOT COVERED UNDER A.R.S. § 49-457

A. This condition applies to livestock facilities at which special events that are not already covered under A.R.S. § 49-457 occur.

B. As soon as practicable before and during the day forecast to be at high risk of dust generation the Permittee shall control PM_{10} emissions by:

1. Increasing the use of dust suppressants, including water, on unpaved access connections and feed lane access areas at the livestock special event; or

2. Uniformly applying and maintaining surface gravel or chemical or organic stabilizers to all areas disturbed by motor vehicles other than areas where such application will create a documentable hazard for livestock activities; or.

3. Reducing or preventing motor vehicle access on unpaved access connections and feed lane access areas at the livestock special event by:

a. Installing barriers, curbs, fences, gates, posts, shrubs, trees or other effective control measures; or

b. Installing no trespassing, no parking or no access signs that comply with local, County, State or Federal sign standards; or

C. As soon as practicable before and during the day forecast to be at high risk of dust generation the Permittee shall inspect, maintain, and repair, as necessary, the best management practice selected in Condition V.B above.

VI. EASEMENTS, RIGHTS-OF-WAY, AND ACCESS ROADS FOR UTILITIES

A. This condition does not apply to designated, managed or opened trail systems.

B. This condition applies to easements, rights-of-way, and access roads for utilities (transmission of electricity, natural gas, oil, water, and gas) that experience an average of 150 vehicle trips or more per day.

C. As soon as practicable before and during a day forecast to be at high risk of dust generation, the Permittee shall control PM_{10} emissions by:

1. Reducing or preventing motor vehicle access as prescribed in Condition I.B above;

2. Increasing the use of dust suppressants other than water on the easement, right-of-way or access road; or

3. Uniformly applying and maintaining surface gravel or chemical or organic stabilizers to the easement, right-of-way or access road.

D. As soon as practicable before and during the day forecast to be at high risk of dust generation the Permittee shall inspect, maintain, and repair, as necessary, the best management practice selected in Condition VI.C above.

VII. TRACKOUT OR DEPOSITS OF BULK MATERIAL

As soon as practicable before and during a day forecast to be at high risk of dust generation, the Permittee shall clean-up loose material or remove deposits of bulk material from areas accessible to the public on day before and during high risk day.

VIII. DESIGNATED, MANAGED OR OPENED TRAIL SYSTEMS

A. During the course of each calendar year, the Permittee shall control PM_{10} emissions from designated, managed or opened trail systems by employing adaptive management techniques such as:

1. Posting public information to educate the riding public about at the impacts of air quality regulation on the use of off-highway vehicles,

including the restriction of operation during high pollution advisories, through methods similar to kiosks, distribution of material at major events and dealerships, and other Public Service Announcements; and

2. Conducting mechanized trail repair and maintenance at slow speeds that:

   a. Reduce the speed of water run-off on the designated, managed or opened trail system;
   b. Reduce the amount of silt that would otherwise accumulate on the designated, managed or open trail system;
   c. Add grade dip or water controls to the designated, managed or open trail system; or
   d. Add or repair silt traps on water drains; or

3. Re-routing an existing designated, managed or opened trail that causes traffic to avoid soils susceptible to dust generation; or constructing a new designated, managed or opened trails that allow for appropriate trail repair and maintenance and include speed limiting features such as turns and climbs; or

4. Rehabilitating open parking areas, mine sites, and old unpaved roads that are not designated, managed or opened trail systems. Rehabilitation includes re-contouring the areas, replanting trees and spreading native seed to hold soil together and reduce windblown dust; or

B. As soon as practicable before and during a day forecast to be at high risk of dust generation, the Permittee shall control PM_{10} emissions from disturbed areas along the designated, managed or opened trail system by employing adaptive management techniques such as:

1. Applying a proven dust surfactant;

2. Repairing roads and other unpaved surfaces to control the water run-off and silt;

3. Using soil binders and compaction to allow for light to moderate traffic flow; or

4. Installing an engineered road or surface that:

   a. Raises the road or surface bed above grade;
   b. Uses an ABC road mix and binder;
   c. Compacts the road or surface; and
   d. Crowns to drain water; or

C. As soon as practicable before and during the day forecast to be at high risk of dust generation the Permittee shall inspect, maintain, and repair, as necessary, the best management practice selected in Conditions VI.A or B above; or

D. When the *Maricopa County Dust Control Forecast* identifies the following day as being at high risk of dust the Permittee shall post information at kiosks or use equivalent methods to notify users of designated, managed or opened trail system.

APPENDIX C

EXHIBIT 4:

Arizona Department of Environmental Quality Commitment to Revise the MAG 2012 Five Percent Plan for PM-10 for the Maricopa County Nonattainment Area if Necessary for the Emerging and Voluntary Measure

Janice K. Brewer
Governor

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

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Henry R. Darwin
Director

Deborah Jordan, Director
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United States Environmental Protection Agency, Region IX
75 Hawthorne Street
San Francisco, CA 94105-3901

Re: Commitment to Revise the MAG 2012 Five Percent Plan for PM-10 for the Maricopa County Nonattainment Area if Necessary for the Emerging and Voluntary Measure

Dear Ms. Jordan:

EPA's September 2004 guidance entitled *Incorporating Emerging and Voluntary Measures in a State Implementation Plan (SIP)* allows air pollution planning organizations to take credit for emissions reductions associated with new and emerging measures. As part of the proposed *MAG 2012 Five Percent Plan for PM-10 for the Maricopa Nonattainment Area* (Five Percent Plan), the Arizona Department of Environmental Quality (ADEQ), the Maricopa County Air Quality Department (MCAQD) and the Maricopa Association of Governments (MAG) are taking emissions reductions credit for the implementation of Dust Action Forecasts and the Dust Action General Permit.

The Arizona Department of Environmental Quality is required by Arizona Revised Statute § 49-424(11) to develop and disseminate an air quality dust forecast for the Maricopa County PM-10 non-attainment area. These forecasts use projected meteorological conditions, wind speed and direction, recent precipitation and historical air pollution concentrations that have occurred under the predicted condition to identify days that are at low, moderate or high risk of dust generation.

A.R.S. § 49-457.05(B) requires ADEQ to develop a Dust Action General Permit that specifies the best management practices (BMPs) that are necessary to reduce or to prevent PM-10 particulate emissions and requires those BMPs to be implemented as soon as practicable before and during a day that ADEQ forecasts to be at high risk of dust generation. Individuals that are subject to BMPs under the Dust Action General Permit are already subject to the requirements of Maricopa County Air Quality Department Rule 310.01. If it can be demonstrated that these individuals did not choose and implement a BMP as soon as practicable before and during a day forecast to be at high risk of dust generation, the ADEQ Director can issue the Dust Action General Permit to that individual. The permit requires additional monitoring, record keeping and reporting requirements to ensure that BMPs are being applied as required.

Because these methods of air pollution control are new, the estimation of emissions reductions due to the use of forecasts and the Dust Action General Permit was completed using the best information and methods possible, specifically an increase in the effectiveness of MCAQD Rule 310.01. To ensure that the projected emissions reductions are achieved, Maricopa County has provided a commitment to evaluate the effectiveness of MCAQD Rule 310.01 in calendar year 2013. If the evaluation does not result in sufficient emissions reductions, a replacement SIP measure must be adopted as a replacement.

A.R.S. § 49-404 requires ADEQ to maintain a State Implementation Plan that provides for the implementation, maintenance and enforcement of national ambient air quality standards. Should it be demonstrated through Maricopa County's April 2013 final program evaluation reports that the emerging and voluntary measure contained within the Five Percent Plan did not achieve the necessary emissions reductions, the Arizona Department of Environmental Quality commits to submitting a SIP revision that contains replacement measures to reduce PM-10 emissions by an amount equal to or more than the total PM-10 emissions reductions that were not achieved by these measures. An implementation schedule for the submission of this revised plan is as follows:

May 2013	ADEQ will consult with MAG to determine if additional emissions reductions are necessary.
June 2013	If additional controls are required, ADEQ will work with MAG to identify potential replacement measures.
April 2014	If additional controls are required, ADEQ will submit a SIP revision that contains the necessary replacement measure(s).

ADEQ does not anticipate the need for additional personnel or funding to comply with this commitment as any required SIP revisions will be accommodated as part of its normal air quality planning process.

If you have any questions, please contact me at (602) 771-2288.

Sincerely,

Eric C. Massey, Director
Air Quality Division

cc. Bill Wiley, Maricopa County Air Quality Department
Lindy Bauer, Maricopa Association of Governments
Colleen McKaughan, U.S. EPA Region IX

APPENDIX D

APPENDIX D

EXHIBIT 1:

Agricultural Best Management Practices Program

AGRICULTURAL BEST MANAGEMENT PRACTICES PROGRAM

Throughout the course of the development of the *MAG 2012 Five Percent Plan for PM-10 for the Maricopa Nonattainment Area* (Five Percent Plan) the Governor's Agricultural Best Management Practices (BMP) Committee has worked to enhance its Best Management Practices program. On December 9, 2011, the Ag BMP Committee approved enhancements to the BMP program. On behalf of the Governor's Agricultural BMP Committee, the Arizona Department of Environmental Quality (ADEQ) sent a Notice of Exempt Rule Making to the Secretary of State's Office on December 29, 2011, making the enhanced BMP program effective on that same date.

The enhanced BMP program is enforceable as a matter of State law. ADEQ has determined that implementation of the program will result in a numerically quantifiable air quality benefit throughout the Maricopa nonattainment area. ADEQ has also determined that the program will result in reduced concentrations of PM-10 at the monitors throughout the same area.

The program will also have benefits outside of Maricopa County. According to the 2011 rule enhancements, the Agricultural BMP program automatically becomes effective in any area of the State that is designated as nonattainment for the PM-10 National Ambient Air Quality Standard (NAAQS) after June 1, 2009. For areas designated as moderate nonattainment, one BMP must be employed, whereas in areas that are designated as serious nonattainment, two BMPs must be employed.

ADEQ has determined that the revised Five Percent Plan already meets EPA's requirements for annual five percent reductions in PM-10 emissions and a demonstration that the plan will result in the area's attainment with the 24-hour PM-10 NAAQS without the inclusion of the enhanced Agricultural BMP program. As part of the public comment period, ADEQ is requesting comments about whether the Department should make a commitment to EPA to include the enhanced Agricultural BMP program as part of the Five Percent Plan or, given its statewide benefits, if the Department should include the enhanced Agricultural BMP program as a stand alone revision to the State Implementation Plan.

APPENDIX E

APPENDIX E

EXHIBIT 1:

Public Hearing Process Documentation

APPENDIX E

EXHIBIT 2:

Certification of Adoption